



# **GREEN GROWTH**

## **in motion:**

### **Sharing Korea's Experience**

# GREEN GROWTH

**in motion**

Sharing Korea's Experience



I. Institutional Foundations	II. Climate Policy	III. Green Energy	IV. Green Technology and Industry	V. Green City, Transportation and Building	VI. Green Life
<p>I - 1 Framework Act on Low Carbon, Green Growth <b>026</b>                      I - 2 Presidential Committee on Green Growth <b>032</b>                      I - 3 National Strategy for Green Growth and its Five-Year Plan <b>038</b>                      I - 4 Green Finance <b>047</b></p>	<p>II - 1 Greenhouse Gas Inventory <b>052</b>                      II - 2 Climate Change Adaptation <b>058</b>                      II - 3 Climate Change and Agriculture <b>063</b>                      II - 4 Climate Change and Health <b>069</b></p>	<p>III - 1 Energy Efficiency <b>074</b>                      III - 2 Smart Grid <b>079</b>                      III - 3 Fuel Cells <b>083</b>                      III - 4 Photovoltaics <b>088</b>                      III - 5 Wind Power <b>094</b></p>	<p>IV - 1 The 27 Core Technologies <b>098</b>                      IV - 2 Commercialization of Green Technologies <b>105</b>                      IV - 3 Green IT <b>111</b>                      IV - 4 Green Industry <b>117</b>                      IV - 5 Greening the Existing Industries <b>121</b>                      IV - 6 Green Certificates <b>132</b>                      IV - 7 Public Procurement of Green Products <b>136</b>                      IV - 8 Green Jobs <b>141</b>                      IV - 9 Green Talent <b>145</b></p>	<p>V - 1 Green City <b>152</b>                      V - 2 Building Energy Management Policy <b>156</b>                      V - 3 Green Buildings <b>162</b>                      V - 4 Fuel Efficiency and Greenhouse Gas Regulations <b>168</b>                      V - 5 Green Transportation <b>172</b>                      V - 6 Bicycle and Low Carbon Transportation <b>175</b></p>	<p>VI - 1 Resource Recycling Policy <b>184</b>                      VI - 2 Scrap Metal Recycling <b>189</b>                      VI - 3 Green Purchasing and Consumption <b>194</b>                      VI - 4 Green Education <b>200</b></p>
			<p><b>Supplement</b></p>	<p>Framework Act on Low Carbon, Green Growth <b>212</b>                      Enforcement Decree of the Framework Act on Low Carbon, Green Growth <b>233</b></p>	

I. Institutional Foundations

- Figure 1-1 Structure of Framework Act on Low Carbon, Green Growth 027
- Figure 1-2 The Five Civilian Caucus Related to Green Growth Policies (as of Oct. 2010) 035
- Figure 1-3 List of Reports to the President by PCGG 035
- Figure 1-4 The Policy Framework of Low Carbon Green Growth 041
- Figure 1-5 Ten Policy Agenda Supporting the Strategy 044
- Figure 1-6 Investment Plan for Green Growth 2009 – 2013 046
- Figure 1-7 Expected Economic Effects of Green Growth 046

II. Climate Policy

- Figure 2-1 Principles of GHG Inventory 053
- Figure 2-2 Flow Chart of GHG Inventory Development 054
- Figure 2-3 Scope of GHG Emission Sources 055
- Figure 2-4 Variation in Rice Yield due to the Combined Impact of CO<sub>2</sub> Concentration Level in the Atmosphere and the Temperature rise 067

III. Green Energy

- Figure 3-1 The Concept of Smart Grid 079
- Figure 3-2 The Fuel Cell System 083
- Figure 3-3 The Basic Structure and Power Generation Method of Solar Cells 088
- Figure 3-4 Basic Structure of Solar PV 089
- Figure 3-5 Korea's Investment in Renewable Energies (Unit, 100million KRW) 089
- Figure 3-6 Korea's Renewable Energy Export (Unit, million USD) 089

IV. Green Technology and Industry

- Figure 4-1 Selection Process of the 27 Core Technologies 099
- Figure 4-2 Green Technology Category 099
- Figure 4-3 27 Core Technologies, 17 New Growth Engines and 15 Green Energy Technologies- a Comparison 100
- Figure 4-4 The Share of Green Technology in National R&D, 2008 101
- Figure 4-5 Types of Investment and their Trends 102
- Figure 4-6 Process of Establishing Strategy for Commercialization of Green Technologies 107
- Figure 4-7 New Growth Industries 117
- Figure 4-8 The Strategy for Industrial Development Based on Knowledge and Innovation Driven Green Growth 122
- Figure 4-9 17 New Growth Engines in 3 Categories 123
- Figure 4-10 Major Tasks for Greening (by Sector) 123

IV. Green Technology and Industry

- Figure 4-11 Greening the Value Chain of the Automobile Industry 124
- Figure 4-12 Threats to Businesses Originating from Climate Change 126
- Figure 4-13 Green Business Management Model 126
- Figure 4-14 Green Business Management Standards and Detailed Indices 128
- Figure 4-15 Public-Private Information Channel for International Environmental Regulations 129
- Figure 4-16 Concept Diagram of Green Partnership 129
- Figure 4-17 Concept of Eco Industrial Park (EIP) 131
- Figure 4-18 The Status of Green Certificate (Number of Cases, as of 10 September, 2010) 133
- Figure 4-19 Technologies for Green Technology Certificates 133
- Figure 4-20 Korea's Eco Mark Products 137
- Figure 4-21 Green Jobs 142
- Figure 4-22 Major Green Technologies and Related Qualifications 147

V. Green City, Transportation and Building

- Figure 5-1 Characteristics of Four City Types 153
- Figure 5-2 Stream of City Paradigm 153
- Figure 5-3 Concept of Low Carbon Green City 154
- Figure 5-4 Korea's Climate Change Policies 154
- Figure 5-5 New Direction of Green Building Production Activities 162
- Figure 5-6 Examples of Technologies to Realize Sustainable Green Buildings 163
- Figure 5-7 Sustainable Building Index 165
- Figure 5-8 Plan on the Vitalization of Green Buildings 165
- Figure 5-9 Average Energy Consumption Efficiency of Passenger Vehicle 169
- Figure 5-10 Emissions Standards for Passenger Vehicles on Gasoline or Gas 169
- Figure 5-11 Bike Ride Population by Country 177

VI. Green Life

- Figure 6-1 Paradigm Shift of Waste Policy 185
- Figure 6-2 The Level of Scrap Metal Recycling Technology by Countries 191
- Figure 6-3 Classification of the Strategic Recycling Metals (an Example) 191
- Figure 6-4 Relations between ISO 14020 Series and Domestic System 194
- Figure 6-5 Current Situation of EDP Certification (Updated on August 31, 2009) 195
- Figure 6-6 Eco Mark of Korea 197
- Figure 6-7 Environment Grade Mark 197
- Figure 6-8 Carbon Footprint Mark 197
- Figure 6-9 Reinforcement of Policies on Green Growth Education 201
- Figure 6-10 High School Curriculum of 'Environment and Green Growth' 202



## Foreword

Human civilization has been shaped by several major transformations in its history. The industrial revolution that led to the advent of an era of quantity-oriented, expansionary growth heavily based on the extensive input of labor and capital has brought about widespread environmental degradation, rapid global population growth, unsustainable consumption habits and other pressures on Earth's limited natural resources. Global warming and the challenges of climate change derived from the heavy use of fossil fuels have laid bare the limits of this old development model and threaten the sustainability of the entire world.

The world desperately needs a new growth paradigm that can address the challenges of climate change and resource depletion. The solution lies in green growth. Green growth is the new revolutionary development paradigm that sustains economic growth while at the same time ensuring climatic and environmental sustainability. It focuses on addressing the root causes of these challenges while ensuring the creation of the necessary channels for resource distribution and access to basic commodities for the impoverished. Under this new paradigm, new ideas, transformational innovations and state-of-the-art technology will become the major drivers for growth.

Recognizing this new reality, various countries across the world are striving to implement sound policies for green growth, including the Republic of Korea, a country that overcame endemic poverty to emerge as one of the leading global economies. Having proclaimed green growth as the new national vision of Korea, the government has formulated various policies to put this vision into action and announced the Green New Deal in January 2009. The Five Year Green Growth Plan covering the years of 2009 to 2013 and the Framework Act on Low Carbon, Green Growth represent innovative and concrete measures towards realizing green growth.

I believe the sharing of Korea's practices for green growth will provide other countries with useful tools and ideas that can be utilized to address their own challenges and the global imperatives that threaten us all. The road ahead is likely to be more difficult than the road already travelled. However, with renewed resolution and cooperation among all nations and stakeholders from both developed and developing countries, I am confident that green growth can become a new global vision that will put us on the path towards a more sustainable and prosperous future.

I would like to express my gratitude to the Presidential Committee on Green Growth of Korea. In particular, the Founding Co-Chair of the Committee, Professor Kim Hyung Kook's knowledge and dedication enabled the compilation of the original book on Korea's green growth, *The Right Way to Know about Green Growth*, which we have relied on here. I am positive that this work can be further developed in the near future to provide a more complete explanation of green growth and Korea's experiences. Moreover, I hope that this work will further stimulate passions and generate valuable tips for the global dissemination of green growth paradigm that will contribute towards making a better world for mankind.

*Han Seung-soo*

*Chairman*

*Board of Directors*

*The Global Green Growth Institute*

## **Green Growth**

### **The Background of its Birth and the Way Forward**

There is a question that is often raised. Was the national vision of ‘Low Carbon Green Growth’ conceived out of chance or out of necessity? Many still ask the question: is green growth – a sort of one-time political slogan or a long-lasting commitment for next generations?

The answer is this – green growth was the product of the creative efforts of a nation’s leader who, through his foresight, was able to understand the needs of the present, and armed with his political determination, opened a new path towards the future. Moreover, as was the case in the past socioeconomic miracles of the Republic of Korea, the great citizens of our nation have become the driving force towards green growth.

### **The Encounter of the Climate Change Challenge and the 60<sup>th</sup> Anniversary of the Founding of Korea**

In December of 2007, the president-elect, Mr. Lee Myung-bak, ordered the establishment of a rather unusual committee within his Presidential Transition Office located in Tongui-dong, Seoul. This body was the Special Committee on Climate Change. The issue of climate change had not been brought up formally even once during the presidential campaign. This marked the official debut of climate change as an agenda item at a time when the new presidential leadership was preparing for the assumption of its new responsibilities and duties. However, under the burden of high priority agendas and marred by other political episodes, the Special Committee on Climate Change did not draw much attention from the society at large.

Then, in February of 2008, upon the official launch of the new administration, President Lee Myung-bak established a division with an unfamiliar sounding title, this time in the Blue House, the National Future and Vision Office. This marked the reincarnation of the national medium to long-term socio-economic planning function within the Blue House, which had disappeared with the dissolving of the Economic Planning Board and the

subsequent establishment of the Ministry of Finance and Economy in 1998.

Not unlike a chemical reaction, bringing the somewhat idle themes of climate change and national vision together and creating momentum towards this end required a special and catalytic moment. That came on August 15<sup>th</sup> of 2008. It almost appeared as though the 60<sup>th</sup> anniversary of the founding of the Republic of Korea falling on the first year of President Lee Myung-bak’s administration was destined. It is important to note the significance of the 60<sup>th</sup> anniversary. In Korea, the 60<sup>th</sup> anniversary of one’s birth is called “Hwan-gap.” Then, why do Koreans celebrate one’s 60<sup>th</sup> anniversary? We believe that it marks a point in life in which one reflects on the life he or she has lived so far, giving us the chance for introspection and an opportunity to make new pledges in life. If this is the case for mortal humans, it carries even more significance for a country founded upon the spirit of immortality. The year 2008, which marked the 60<sup>th</sup> anniversary of Korea as a nation, was a year to celebrate, and also a year that required Korea to reflect on the previous 60 years and to plan for the upcoming 60 years with a new vision. It can be stated that green growth was conceived at a time when the determined will of the nation’s leader responded to the needs of our times for a new direction.

### **Going from “The Great Korean People, a History of Miracles” to “The Great Korean People, a New Dream”**

Thus it was out of necessity that the 60<sup>th</sup> Anniversary Commemorative Services Committee, the Presidential Council for Future and Vision and the Global Advisory Group be established almost simultaneously in April of 2008.

In addition to these bodies, national and international think tanks and government officials identified the following as crucial questions that needed to be addressed at the watershed event of the 60<sup>th</sup> Anniversary of Korea:

- 1) *What is it that the Republic of Korea has achieved in the past 60 years?*
- 2) *Can Korea continue such achievements in the future?*
- 3) *If not, then what is the alternative?*

Setting aside the political and ideological lenses, there is no room for divergent views with regards to the answer for the first question. Pessimism abounded with respect to the future of Korea, having endured the plunder of the Japanese colonial rule and the calamity of the Korean War, with some suggesting that even a century would not be enough to get the country back on its feet. But in a mere 60 years, Korea has risen forward as a middle-income country as one of the world's top ten economies. And while some pointed out that the chances of a rose growing out of a trashcan was greater than that of Korea achieving democracy, the flower of democracy in Korea is in full bloom as we have witnessed a number of peaceful turnovers of governmental power. In addition, in the time span of a single generation, a nation that was once a recipient of international aid has now transformed itself into a donor of international aid. Korea has achieved a modernization revolution that no other newly independent country following World War II has.

Of course, there were bumps and distortions throughout Korea's modern history and Korea still has to endure the sufferings of a divided nation. On the whole, however, Korea's modern history of the last 60 years deserves the positive evaluation and the Korean citizens were the main driving force of that era. Thus, we can sum up our 60 year history in the phrase "the great Korean people, a history of miracles."

Answering the second question is the challenge. Could Korea continue to achieve such miracles in the future? On its next 60-year anniversary, would the Korean people still be confidently celebrating success as we had done in 2008? Having evaluated this question from a variety of viewpoints, the answer, unfortunately, is no.

The main reasons are as follows:

First, the almost mythical high growth rate which enabled the economic miracle on the Korean peninsula ended about a decade ago. As Paul Krugman has pointed out, quantitative growth driven by intensive use of labor and capital has reached its limits, and it fails to generate adequate job opportunities. There can be many reasons for this, but the main cause seems to be the failure of providing new engines for growth and of new development modalities.

Second, Korea has become ever more vulnerable in terms of energy security. The excessive energy-dependency of its industries, especially in fossil fuels, has reached its peak. Korea spends about a \$100 billion USD annually in energy imports, which account for nearly 100% of its energy demand (In the case of 2008, Korea spent \$140 billion USD for its energy imports due to the oil price shocks). These sums amount to a figure greater than that generated by the nation through its exports of automobiles, semiconductors and ships combined. And yet, Korea's energy efficiency falls short of the OECD member countries' average. Furthermore, it is a country which is vulnerable and sensitive to the fluctuation of international energy prices, leaving it without too many alternatives. Moreover, Korea's energy security is further threatened by the ever-increasing energy demand of newly emerging economies such as China and India.

Third, there is the "inconvenient truth" that is increasingly becoming impossible to ignore. In the past century, the average temperature of the world has risen by 0.74° Celsius. In comparison, the rise in the average temperature of Korea is more than two times that of the world. Similarly, the rise in sea-level of some regions in Korea is higher than the average rise in sea-level that the world has experienced. United States Ambassador Kathleen Stephens, who in her youth as a volunteer worker in Korea was fascinated by the country's then vivid four seasons, regrets the fact that the Korea of the present only offers the two seasons of summers and winters.

However, in reality, Koreans in general, until recently, were rather uninformed of these facts. In one region of Korea, torrential downpours could inundate the entire area in a matter of a single day, while residents of another region witnessed record droughts. Not too many appeared to give notice to the fact that the fruits and the type of fish that appeared on their dinner table had changed as well, while the temperate weather of the past had been replaced with the subtropical weather of the present. Our entire habitat is changing, yet few were keen on facing up to, and acknowledging this “inconvenient truth.”

In addition, emissions of greenhouse gases (GHGs), the root cause of climate change, had doubled in the past 15 years in Korea. Yet it was hard to find awareness, let alone a plan of action to address this issue. The problem of climate change was giving the developed countries of the world more room to exercise new regulatory controls. Meanwhile, they were also hungrily seeking new market opportunities arising from the need to address climate change. Unfortunately, Korea seemed to turn a blind eye to both these realities.

A fundamental and comprehensive change was necessary for Korea to successfully overcome the challenges arising from an economic standstill marked by growth without employment, energy-import dependency and climate change. This provided the backdrop to the pledge of embarking on an era of “the great Korean people, a new dream.” President Lee Myung-bak’s vision of ‘Low Carbon Green Growth’ was created with the goal of incorporating this new dream, and it is intended to signal the advent of a new era through the adoption of a new paradigm.

### **Creating a New Growth Engine and Transitioning into a Planet-Responsible Civilization**

To answer the third question, what exactly is ‘Low Carbon Green Growth’? I will present the strategy and the core pillars of Green Growth instead of dealing with the subject extensively.

- 1) Green growth is aimed at creating a new development paradigm in which the conflicting goals of economic growth and protection of the environment are no longer seen as such. It engenders a complementary relationship between the two ideals. Broadly defined, green growth seeks to advance the transition from quantitative growth to qualitative growth and the shift from the traditional, fossil-fuel dependent socioeconomic structure into a low carbon one.
- 2) Green growth identifies the measures that will allow us to mitigate climate change and its dependency on fossil fuel. In turn, these measures will also bring about new growth and create jobs. In order to achieve these goals, it will be necessary, above all, to concentrate on developing green technologies and the infrastructure required for green growth.
- 3) Green growth encompasses not only industrial sectors but the transportation and building sectors and more. Additionally, it seeks to revolutionize the lifestyle and culture of consumption across all areas.
- 4) Green growth necessitates the active participation of the government, the private sector and the general public. It requires both a solid partnership among the stakeholders mentioned and the institutional support that can enable such cooperation. Importantly, it should be developed as a national agenda pursued by society at large without being restricted by the boundaries of class, age, politics and ideologies.
- 5) Through the pursuit of green growth, Korea seeks to contribute to the international community based on its principle of working together in addressing the common challenges of our world. This, in turn, enhances Korea’s status in the international community. Ultimately, it seeks to create a planet-responsible civilization by engendering a “me first spirit” in which individuals make conscious, environmentally friendly choices to create a planet in which man and nature live in harmony.

### **Leadership, International Credibility and the Hosting of the G20 Summit**

Prior to the official declaration of the national vision of Green Growth, President Lee Myung-bak traveled to Hokkaido, Japan in July of 2008 to participate in the Toyako G8 Summit, which marked the first time the Republic of Korea had been invited to such an occasion reserved for the developed nations. In addition, the significance of the Summit was amplified by the fact that it was the first multilateral conference the President would attend following his inauguration.

At this summit, President Lee Myung-bak pledged to make Korea ‘an early mover’ in the efforts towards addressing climate change. Additionally, he announced his intention to create the East Asia Climate Partnership, while emphasizing Korea’s willingness to play a bridging role between the developed and developing countries. His words were well received and it served as an opportunity to confirm the fact that Korea had something unique to offer to the international community. In a sense, the Summit offered the chance of a preliminary evaluation of the concept of green growth by the leaders of the world, and President Lee’s leadership played an important role in ensuring a positive response. Specifically, the President’s committed attitude of respecting and observing the promises made with other nations in a consistent manner served to increase Korea’s credibility within the international community. This was an achievement made despite the heavy domestic criticism that was being leveled on him during the course of negotiations with the US regarding the import of American beef.

It is a truly remarkable fact that Korea was able to set an international agenda beyond the already familiar issue of North-South Korean relations when it was often thought that the privilege of global agenda setting belonged to the developed countries. Furthermore, the idea of Korea playing a ‘bridging role’ between the developed and developing countries expressed at the Toyako G8 summit drew much attention in

the London G20 Summit convened afterwards to address the global financial crisis. Moreover, this new initiative provided another good justification for Korea to host 2010’s G20 Summit in Seoul.

In fact, the agenda of developmental cooperation between the developed and developing countries was adopted for the Seoul G20 Summit based on the experience of Korea. Additionally, green growth was selected as a central agenda in the G20 Business Summit attended by major international firms and entrepreneurs across the globe.

### **Green New Deal and the Establishment of the Presidential Committee on Green Growth**

The National Energy Committee, in which the President serves as the Chairman, released the National Energy Plan a month after the declaration of green growth as a new national vision. In comprehensively revising the original plan and incorporating actions for the development of renewable energy sources and attaining energy independence, the Plan contained some groundbreaking measures. Having been announced at a time when a barrel of crude oil cost upwards of \$140 USD, it seemed the Plan provided further justification and support to the declared path of green growth.

However, an unprecedented global financial crisis marked by the bankruptcy of Lehman Brothers pummeled the world into chaos. Korea, a country deeply entrenched in the global financial markets, could not escape the effects of the crisis. As the year 2008 drew to a close, the scale of the global financial crisis became larger and its effects even more severe. Numerous government policies that had been designed for a scenario that precluded the possibility of such a crisis started to falter. Green growth policies, which require significant up-front investment, were particularly vulnerable. Many believed that due to the crisis, the new government’s vision of green growth had gone down the drain.

Despite these negative views, the President thought differently. President Lee Myung-

bak realized the need to implement an economic stimulus package in a swift and resolute manner in order to expedite the recovery process. Notably, though, the President identified the need to incorporate additional plans for the future such that it would not merely have a one-off effect, but so that it could provide direction for the post-recovery period. This led to the formation of the Green New Deal Policy, which was announced in January of 2009 amidst the presence of the prime minister and other relevant ministers.

Korea was soon under the spotlight of the international community, which was looking for their own economic recovery plans. The investment bank HSBC comprehensively analyzed Korea's Green New Deal and widely distributed its findings. The United Nations, and in particular the United Nations Environment Programme (UNEP), identified Korea's Green New Deal as an example to follow in the world's efforts to recover from the crisis. Numerous heads of state that met with the President in the G20 Summit held in London lauded the concept of a green new deal. Amongst them were President Barack Obama of the United States and President Hu Jintao of China.

What Korea needed now was an authoritative coordinating body that could effectively and coherently organize and direct Korea's efforts towards green growth, which had by now clearly become a priority agenda. Thus the Presidential Committee on Green Growth (PCGG), a single coordinating body directly under the control of the President was established with then Prime Minister Han Seung-soo and Professor Kim Hyung-gook, former Dean of Seoul National University's Graduate School of Environmental Studies as its co-chairmen. Furthermore, the National Energy Committee under the Ministry of Knowledge Economy, the Korean National Commission on Sustainable Development of the Ministry of Environment and the Task Force Team on Climate Change of the Prime Minister's Office was integrated into the PCGG.

### **Achievements and Work for the Future and the Path to a Greater Korea**

Along with the establishment of the PCGG, the government's preliminary efforts for green growth involved the systemization of a green growth framework. A five-year plan for green growth for 2009 to 2013 was formulated to clearly present the policy directions and strategies that would enable the nation to achieve its objectives in a systematic manner. Under this first five-year plan, the government would spend 2% of the nation's GDP for the greening of the current economic structure of Korea. In particular, 27 strategic green technologies were identified, among which ten priority technologies were further selected as those that Korea would seek to become a global leader in.

Another achievement worthy of mentioning was the formation of Korea's midterm greenhouse gas mitigation goal of reducing the level of GHG emissions by 30% relative to the business-as-usual (BAU) scenario by 2020. This target was set after extensive consultations involving the PCGG, other relevant government bodies, industries, the financial sector and other private sector stakeholders. National Assembly hearings and over 80 different public opinion surveys were conducted to set this ambitious target, which given Korea's status as a non-Annex I country represented the highest level recommended by the UN. Crucially, the widespread support from the Korean public at large made this possible.

Following the announcement of this voluntary reduction goal, developed country pressure to include Korea amongst the Annex I countries was now replaced with warm applause. Moreover, countries like China and India followed Korea's lead by setting their own GHG reduction targets. This case was illustrative of Korea leading by example in taking action against climate change according to the spirit of "common but differentiated responsibilities" and in line with its "respective capability." International media including the Financial Times described November 27, 2009, the day that Korea announced its GHG mitigation goal, as another birthday for green growth.

Shortly thereafter, in December of that year, President Lee Myung-bak travelled to Copenhagen for the 15th Conference of the Parties to the UNFCCC and gave a keynote speech on the subject of “Me First,” emphasizing the need to act first before telling others what to do. This, he said, was the key to solving the problem of climate change. The speech was received with calls of encore. It was clear that the international community was hungry for action instead of talk, and practice instead of lecturing.

The National Assembly responded to the President’s leadership through its own efforts. The Framework act on Low Carbon, Green Growth, which would provide the legal foundation for green growth, was passed with bipartisan support. Ulrich Beck once claimed that “poverty is a hierarchical concept, but smog is a democratic one.” The cross-party support in matters of counteraction against climate change seemed to demonstrate clearly that Korea understood his words well. To this end, the National Assembly’s Special Commission on Climate Change led by Chairman Lee In-kyi was instrumental in converging public opinion and resolving differences in views.

If 2009 was the year in which the institutional framework for green growth was established, 2010 was one in which the substantive issues surrounding green growth was addressed. Meanwhile, we also witnessed efforts to produce some actual progress towards green growth measures in the industrial sector. In the field of nuclear energy that is currently regarded as the most realistic form of clean energy, Korea succeeded in creating an overseas export market. This was followed by a quantum leap forward in the development of the renewable energy industry, particularly solar PV and wind energy. Additionally, Korea boasts world-class secondary battery production capacity, while it is a close second in its ability to mass produce electric-powered vehicles. A green transport sector is being created by linking the entire country through the high-speed railway system, and thereby engendering a modal shift from the road to the railway, resulting in a large reduction

of GHG emissions. A smart grid test bed has been completed in Jeju Island and operations for the largest tidal power plant in the world in Sihwa will soon begin. The bicycle industry, which had largely been outsourced, is now making a comeback, generating jobs.

Samsung, Hyundai, LG, SK, POSCO and other conglomerates are in fierce competition with each other to invest billions in the green industry sector. Small and medium enterprises are being created everyday with dreams of becoming the next global leader in the green industry. If stage one of green growth in Korea was led primarily by the government, stage two, market-driven green growth, is now unfolding.

The global dissemination of green growth is also rapidly accelerating. The OECD’s Declaration on Green Growth was followed by UNEP’s overview report on the Republic of Korea’s National Strategy for Green Growth. The World Economic Forum, better known as the Davos Forum, has identified the notion of green growth as providing a new world order in the age of the post-global financial crisis, and has made green growth part of its Global Redesign Initiative. China has outlined its objective of achieving a “green economy”, while Denmark, a leader in climate change efforts, hosted the Global Green Growth 2010 conference in Copenhagen.

This is proof that the world is starting to recognize that prudent climate change mitigation efforts through green growth can provide new and better opportunities. This also provided the climate for the establishment of the Global Green Growth Institute (GGGI) under the leadership of President Lee, which will make green growth a durable international asset. World renowned scholar in the climate change field, Sir Nicholas Stern, by way of offering his reasons for his participation in GGGI explained that “by not properly addressing climate change, economic damages amounting to 5 to 20% of GDP is expected, but given the right measures a second industrial revolution can be created and green growth precisely penetrates this possibility.”



But the road ahead of us is far and it is filled with difficulties. If green growth were a book, we have just written only the first chapter. Like an open-end program, we do not yet know what the end product of green growth will look like. We can currently only say that any life-changing green technology is in its infancy stage. Even if the rise of green industries has begun, for this to yield actual results in the form of GHG reduction and energy efficiency, a lot of time and effort will be needed.

Furthermore, if we fail to live a green lifestyle, green buildings and the infrastructure for green transport will not be of much use. Reducing energy prices, applying the principle of carbon pricing and taxing carbon emissions are not easy to realize in the real world. It might even be necessary to make drastic socio-economic changes that turn inside-out the practices and norms that we have held on to so far.

Even so, we cannot stop or retreat from our path. There is only one Earth and only one mankind. The countdown on climate change has already started. What we need is action and progress. Action leads to further action and progress will lead to further progress. As such, green growth will, in the end, bear fruit and create a planet-responsible civilization in which mankind and the environment coexist in harmony.

For a greater Republic of Korea, for a better world and for a more improved generation, we have to walk an unyielding path towards green growth.

*Kim Sang-hyup*

*Secretary to the President for Green Growth and Environment  
and GGGI Board Member*



# Institutional Foundations



- I-1. Framework Act on Low Carbon, Green Growth 026
- I-2. Presidential Committee on Green Growth 032
- I-3. National Strategy for Green Growth and its Five-Year Plan 038
- I-4. Green Finance 047

## I-1. Framework Act on Low Carbon, Green Growth

Roadmap for the Nation's Future Development

### Background and Milestones

On 15 August 2008, President Lee Myung-bak proclaimed 'Low Carbon Green Growth' as Korea's national vision. Yet, the legal grounds to support the vision were to be drafted. In particular, legislation on climate change issues, one of the core green growth policies, had not yet been enacted. Additionally, existing laws relevant to green growth issues, such as the Energy Act and the Sustainable Development Act, were not being implemented in a closely coordinated way.

At the end of 2008, some developed countries had enacted, or were in the process of amending laws to respond to climate change and to overcome energy crises. In December 2008, the European Union enacted the '20-20-20' EU Climate and Energy Package. It aimed at a 20% reduction in emissions of greenhouse gases, 20% improvement in energy efficiency, and 20% increase in renewable energy consumption by 2020 compared to year 1990 (*European Commission Climate Action*). In November 2009, the United Kingdom enacted the Climate Change Act 2008. For the first time in the world, this law stipulated the greenhouse gas (GHG) emissions reduction target (*Legislation.gov.co*). France was in the process of enacting *La Loi Grenelle Environnement*, which aimed to establish the most efficient low carbon economy in Europe by 2020 (*Le Grenelle Environnement*).

Considering national and global trends, the Korean government realized that it needed to outline a legal foundation to support a harmonized development of the economy and the environment in an effort to pursue green growth policies from the perspectives of climate change, energy and sustainable development. At the end of 2008, the Korean government, led by the Taskforce on the Establishment of Green Growth Committee drafted the Framework Act on Low Carbon, Green Growth (hereafter "the Framework Act" or "The Act"), which comprehensively interlinked policies and laws on low carbon green growth. The draft Framework Act was finalized as the government proposal at a cabinet meeting on 25 February 2009 after being discussed with relevant ministries, prior announcement of legislation, public hearings, and being reviewed by the Regulatory Reformation Committee.

After the government's draft was introduced in the National Assembly, it underwent in-depth consultation and review by the Committee on Response to Climate Change and the Legislative and Judicial Committee and the bill was passed with a bipartisan agreement on 29 December 2009. After that, the President approved it and the Act was officially announced on 13 January 2010. President Lee stated that the Framework Act was the result of public support for green growth as the new national vision. He also noted that it laid a strong legal and institutional foundation for Korea to become a world-leading nation in the field of green growth.

The enactment of the Framework Act was followed up by preparation of the Enforcement Decree for the Framework Act (hereafter "the Decree") by the government. The draft Decree was approved at a cabinet meeting on 6 April 2010. Upon the President's approval, the Framework Act and the Decree took effect on 14 April 2010.

### Structure of the Framework Act and Key Contents

The Framework Act is comprised of 7 chapters and 64 articles and the Decree is comprised of 7 chapters and 44 articles (*Figure 1-1*).

Figure 1-1: Structure of Framework Act on Low Carbon, Green Growth

Classification	Act (64 Articles)	Enforcement Decree (44 Articles)
Chapter 1 General Provisions	Purpose, Definitions, Basic Principles, Responsibilities of Entities	Purpose, Greenhouse Gases
Chapter 2 National Strategy for Low Carbon Green Growth	Establishment, Implementation, Monitoring and Evaluation of National Strategy and Action Plan for Green Growth,	Establishment of Five-Year Plan for National Strategy for Green Growth; Establishment, Amendment, Monitoring and Evaluation of Central and Local Green Growth Plans
Chapter 3 Presidential Committee on Green Growth, Etc.	Composition, Operation, Function, etc. of Presidential Committee on Green Growth	Composition, Operation, Meetings, Deliberation of Presidential Committee on Green Growth, Subcommittees, Secretariat, Local Committees on Green Growth; Distribution of Resources for Green Technology Development
Chapter 4 Promotion of Low Carbon, Green Growth	Fostering Green Economy and Green Industries, Resource Recycling, Green Technology, Green Finance, Eco-friendly Tax Reformation, Green Jobs	Establishment, Operation and Support of Green Industry Investment Companies; Standardization and Certification Procedure of Green Technologies and Green Industries; Green Cluster Development
Chapter 5 Realization of Low Carbon Society	Establishment of Basic Plans for Climate and Energy Policies, Target Management, Reporting of Greenhouse Gas Emissions and Energy Consumptions, Cap and Trade System	Principles of Management of Greenhouse Gases; Public Institutions Subject to Control of Greenhouse Gases and Energy Targets; Designation of Controlled Entities; Greenhouse Gases and Energy Target Management by Controlled Entities; Registrations and Statements; Management of National Greenhouse Gas Information System; Establishment of Greenhouse Gas Information Management Center; Measures for Climate Adaptation
Chapter 6 Realization of Green Life and Sustainable Development	Green Land, Water, Green Transportation, Construction, Agriculture, Green consumption and Life.	Plan for Green Land; Greenhouse Gas Emissions Reduction System in the Traffic Sector; Standards and Expansion for Green Buildings
Chapter 7 Supplementary Provisions	Enhancement of International Cooperation, Preparation of National Reports, Fines for Negligence	Imposition of Fines for Negligence

Some of the key contents of the Framework Act are:

- **(Plans)** It mandates the Korean government to lay out basic plans for climate change, energy and sustainable development in coordination with the National Strategy for Green Growth to systematically support national policies regarding low carbon green growth. This includes setting a Five-Year Action Plan for Green Growth that includes policy objectives, strategies for attaining targets, policies for prioritized items, and an estimated budget. It requires the central government ministries to prepare central enforcement plans to promote green growth in their respective sectors. Local governments are also required to prepare local plans.
- **(Institutions)** It establishes institutions to foster low carbon green growth. Under the Framework Act, the Presidential Committee on Green Growth (PCGG) is established in order to formulate major policies and plans for low carbon green growth and strategies. The Act also requires that each municipality or provincial government set up a local committee on green growth under the local government.
- **(New growth engines)** It promotes green technology and green industries as new engines for growth and green jobs. While institutionally supporting green technology and industries with high potential to grow, the Act strongly emphasizes market mechanisms so that such growth is led by the private sector. To achieve this objective, the Act supports transition to eco-friendly production system and promotes corporate green management. Moreover, the Act mandates the government to formulate policies to provide support necessary for R&D and commercialization of green technologies. The Act also requires the government to support the standardization of green technology and green industries already developed or under development in Korea to

meet international standards. The Act also supports small and medium-sized businesses in their green transition by offering training, supplying experts and fostering collaboration with large businesses. Furthermore, the Act promotes building of green technology and industry clusters, and expanding green information communications industries. To reduce the burden on business arising from both international and domestic regulations, the Act requires the government to remodel domestic regulatory system and provide measures to address international regulations.

- **(Finance)** It mandates the government to stimulate green investment through green finance. Through green certification and screening of green businesses, it allows the government to select promising green technologies, companies and industries to invest in. The Act also encourages new green financial products and expansion of financial support for green technology R&D and green companies. The Act promotes the creation of a 'green fund', where public agencies can contribute to setting up and the profit resulting from investment in green R&D would be redistributed to the investors. In addition, the Act promoted an eco-friendly tax system in order to minimize the nation's inefficiency in resource distribution.
- **(Energy)** It mandates the government to substantially increase energy independence and gradually reduce GHG emissions. To decrease imported fossil fuel dependency and to prepare for climate change negotiations for the post-2012 climate regime, the Act mandates the government to prepare medium and long term goals and to monitor the progress towards major objectives including: (1) GHG emissions reduction; (2) energy conservation and energy efficiency; (3) energy independence; (4) distribution of renewable energy. In particular, the Decree stipulates a concrete goal to reduce GHG emissions by 30 percent below business-as-usual by 2020.

The Ministry of Environment (ME) manages the general scheme for GHG emissions reduction, while each ministry is in charge of the reduction in its respective sector. The Ministry of Knowledge and Economy (MKE) manages the commerce and power sectors; the Ministry of Land, Transport and Maritime Affairs (MLTM) manages the building and transportation sectors; the Ministry of Food, Agriculture, Forestry and Fisheries (MFAFF) manages the agriculture and livestock industry sectors; and the ME manages the waste sector. Large GHG emitters and energy consuming companies are required to regularly report to the government independently reviewed data on GHG emissions, energy production and consumption. For the purpose of gathering and managing such information, the Act mandates reporting of GHG emissions by businesses and establishes a central information center on GHG information. Furthermore, the government helps such large GHG emitters and energy consuming companies to meet the target by providing financial, tax, managerial, and technical support.

The Act also lays legal grounds for the establishment of an emission trading system

#### Declaration of Framework Act & Green Growth Honorary Ambassadors

Left: Held at Seoul Press Center on 14 April 2010. The Framework Act was passed by the National Assembly on 29 December 2009, and promulgated after the approval by the President on 13 January 2010. Right: Celebrity LEE, Da Hae and Artist Rain attended the 7th Green Growth Committee Meeting (held at the Blue House) as Green Growth Honorary Ambassadors on 3 February 2010.





to prepare for the expansion of the global carbon market and to provide a cost-effective GHG reduction scheme. While the MKE and the ME would each set a standard for fuel efficiency and GHG allowance, the ME will be in charge of regulatory work such as application and management. Additionally, the Act mandates financial support, tax benefits, R&D and policy revisions to promote low carbon, highly efficient, eco-friendly vehicles such as hybrid, hydrogen fuel and electric cars.

- **(Lifestyles)** It mandates the government to promote green lands, green lifestyle, and sustainable development. Primarily to reduce GHG emissions in the transportation sector, the Act mandates the expansion of green transport such as train, bus, light rail transit, and bicycles. The Act also introduces a green building rating system to promote low energy and eco-friendly buildings. The Act mandates the ME to develop plans to minimize climate change impacts and respond to disasters. The Act promotes eco-friendly and organic agricultural products whose production may serve as carbon sinks. Furthermore, the Act mandates collaboration among local governments, businesses and the public to foster green lifestyle in every sector.
- **(International cooperation)** It mandates strengthening environmental diplomacy to tackle climate change and to increase international cooperation as a world leader in the field of green growth. It promotes information sharing and networking with international organizations and foreign governments to jointly pursue global green growth.

### Policy and Legal Implications of the Framework Act

Followings are policy and legal implications of the Framework Act.

- **(Growth)** The Act is about the nation's future development strategy. While developed countries have emphasized transition to a low carbon society, Korea differs in that it highlighted *growth* in a low carbon society, which is created by developing new growth engines. Green growth is a more attractive concept to emerging economies and developing countries, whose desire for growth is very high. If sustainable development is balanced development of economy, environment and society, then green growth is a strategy or pathway to achieve the goal of sustainable development.
- **(Comprehensiveness)** The Framework Act is a comprehensive law whose scope goes beyond short-term responses to climate change, energy and environment and provides the legal and institutional ground for a systematic transition of the entire society and economy to green growth. It is also a law to support the economy by fostering green technologies and industries as new growth engines, developing green towns or green industry clusters, and offering economic incentives such as green financing and a carbon market and a green fund.

- **(Fundamental)** The Framework Act is a fundamental law with precedence over other relevant laws. For example, the Framework Act has priority over energy or sustainable development related laws. Other existing and future laws must conform with the objectives and principles of the Act. Furthermore, policies and measures taken under other laws must be in harmony with the National Strategy for Low Carbon Green Growth.
- **(Results-based)** It is a result-based law, which focuses on the management, monitoring and evaluation of specified targets and policy goals. The Act combines related energy and climate change objectives which have been previously divided among separate laws. More precisely, the Act mandates concrete targets for key areas including GHG emissions reduction, energy efficiency and conservation, renewable energy use, and the transport share of train. The Act mandates regular monitoring and evaluation mechanisms to meet the targets in the most efficient manner.
- **(International Standards)** The Act considers international standards. The regulation of GHGs to reduce global warming is burdensome to businesses in the short term. However, it can be beneficial for businesses in the medium and long term because it will eliminate potential disruptions in markets and facilitate new industries and technologies. Policies including mandatory GHG reporting, creation of a GHG inventory, and a cap-and-trade for emissions are crafted with regard to international standards.
- **(Practicality)** The Act considers practicality and flexibility. The Act does not see GHG regulation merely as a regulatory scheme, but considers it as a new growth engine. As such, in order to cope with possible water scarcity problems due to climate change, the Act mandates sustainable water management. In addition, the Act also provides some safety measures for industries that are particularly vulnerable to international competition.
- **(Market Mechanism)** The Act sends signals to businesses and consumers in order to promote change. By introducing eco-friendly tax reform, disclosing of green management performance, requiring a fuel efficiency standard and enhancing green labeling policies, it will promote business's productivity and the public consumption patterns to become highly efficient and resource conservative.

## I-2. Presidential Committee on Green Growth

Overall Administrative Body of the Korean Government's Green Growth Plan

### Realizing the Vision of *Green* as an Engine for New Growth

The Presidential Committee on Green Growth (PCGG) is an advisory body that was established on 16 February 2009 under the direct supervision of President Lee Myung-bak. The PCGG has the overall responsibility of implementing and managing the government's efforts to participate in the international endeavor to reduce greenhouse gas emissions, as well as reducing reliance on fossil fuels and using *green* as a new engine for growth. The implementation of green growth policies requires strong leadership from the government. A clear vision that is shared with the public needs to clearly identify the step-by-step strategies and measures for the required regulatory reforms. The basis for the founding of the PCGG was embodied in the Presidential Directive enacted on 5 January 2009 regarding the establishment and management of the Committee.

President Lee declared "low carbon green growth" as the new national vision in the 60<sup>th</sup> anniversary of the founding of the Republic of Korea on 15 August 2008. Thereafter, the government decided on 3 November of the same year to establish the PCGG, which combined three separate bodies: the Committee on Climate Change Response, the National Energy Committee and the National Commission on Sustainable Development. As one entity, they could pursue the goal of green growth in a more systematic and concerted manner. Consistent with this organizational shift, the Comprehensive Plan on Combatting Climate Change, the National Energy Plan and the Sustainable Development Act were incorporated into the Framework Act on Low Carbon, Green Growth.

The enactment of the Framework Act on Low Carbon, Green Growth confirmed the PCGG's legal status as a strong institution. The related legal stipulation in Article 14 of the Framework Act, which is entitled the Presidential Committee on Green Growth Organization and Management. It states, "The PCGG shall be instituted under the control of the President in order for the Committee to deliberate on the State's major policies and plans related to low carbon green growth and matters concerning the performance of such policies and plans." The National Energy Committee and the

National Commission on Sustainable Development were reintegrated into the Ministry of Knowledge Economy (MKE) and the Ministry of Environment (ME), respectively.

### Formulating the Green Growth Plan and Strategy

Under Article 15 of the Framework Act, the PCGG has responsibility for deliberating on matters concerning Korea's green growth policy:

- 1 Basic policy direction on low carbon green growth;
- 2 Establishment, revision and enforcement of the National Strategy for Green Growth;
- 3 Basic plan for coping with climate change, energy and sustainable development;
- 4 Management of targets on the promotion of low carbon green growth; review and evaluation of the actual state;
- 5 Adjustment of, and support for, policies of appropriate central administrative agencies and local governments with respect to low carbon green growth;
- 6 Legal system related to low carbon green growth;
- 7 Direction on the distribution of resources for low carbon green growth and the efficient use of such resources;
- 8 International negotiations and cooperation, education and public relations activities, training of human resources, and the establishment of the foundation for low carbon green growth;
- 9 Survey on, and resolution of, problems of enterprises and other sectors related to low carbon green growth, and recommendations for corrective measures of, or expression of opinions on such problems;
- 10 Any other act required to be brought before the Committee for deliberation; and
- 11 Other matters considered necessary in connection with low carbon green growth.

Meanwhile, the Committee designated two co-chairpersons, one each from the government and the private sector. The co-Chairperson from the government is the *ex officio* Prime Minister, whereas the first non-governmental Chairperson of the Committee was Kim Hyung Kook (*terms of office: February 2009–June 2010*), Emeritus Professor at Seoul National University who was chosen to bring about expert input and facilitate communication with the private sector. After June 2010, the second non-governmental Chairperson is Young Soogil, former Ambassador to the Organization for Economic Cooperation and Development (OECD).

The Committee is composed of no more than 50 members, including the two co-chairpersons. As of 16 February 2009, the Committee had 33 non-governmental members. In its second year, the number rose to 36 non-governmental members. The committee

members from the government consisted of ministers from various government ministries including: the Ministry of Strategy and Finance (MOSF), the Ministry of Education, Science and Technology (MEST), the Ministry of Knowledge Economy (MKE), the Ministry of Environment (ME), the Ministry of Land, Transport and Maritime Affairs (MLTM), the Ministry of Gender Equality and Family (MOGEF). Also represented were directors of various government research institutes including the Korea Development Institute (KDI), Korea Energy Management Corporation (KEMCO) and the Korea Environment Institute (KEI). In total, the Committee had 18 non-governmental members in its first year and 14 governmental members in its second year.

Under the Committee, three Councils were installed: the Green Growth & Industry Council; Climate Change & Energy Council; and the Green Life & Sustainable Development Council. The Green Financial System Council was added in the second year.

Additionally, a Secretariat was formed to provide practical support to the activities of the Committee and the various councils mentioned above. The Secretariat consists of six teams: Policy Planning & Coordination Team, Energy Policy Team, Climate Change Policy Team, Green Technology & Industry Team, Green Life & Sustainable Development Team and International Cooperation Team. Delegates from various government ministries such as MOSF, MKE, ME and MEST formed the core of the six teams of the Secretariat. From the Blue House, the Secretary to the President for Green Growth and Environment handles the administrative liaison role between the Blue House and the Committee.

### Establishing the Network for Private-Public Green Growth Cooperation

With the Committee serving a pivotal role, an all-inclusive private-public cooperative network for green growth was established for the comprehensive pursuit of green growth policies. Furthermore, within the departments of the central and local governments, certain director-level government workers were designated as *green growth officers* in order to facilitate the coordination of policies and communication between the central, regional and local governments. Finally, Sixteen Regional Green Growth Committees composed of various green growth experts from the industrial and education sectors were established to provide overall administration and deliberation of regional green growth policies.

Concerted efforts were also made to gather public opinion and communicate with the private sector. Five consultative groups on green industries, green finance, green technologies, green life and green IT were established, each composed of experts from the industrial, financial and science sectors. This was done in order to provide an open environment for communication and to promote inputs from the civil society towards the formulation of green growth policies.

Figure 1-2: The Five Civilian Caucus Related to Green Growth Policies (as of Oct. 2010)

Council (Established Month)	Head	Organization	Number of Meetings (2009)	Frequency of Meetings (2010)
Industry (Mar. 2009)	Hur Dong Soo (KBCSD Chair)	Around 50 people from business and industry groups	3	Quarterly
Technology (Apr. 2009)	Park Chan-Mo (Former Special Advisor for Science and Technology)	40 people from science and industrial technology groups	3	Quarterly
Lifestyle (Oct. 2009)	Not designated	20 people from civil society groups	1	Quarterly
Finance (Apr. 2009)	Shin Dong-Kyu (Korean Federation of Banks)	55 people from financial companies, etc.	2	Twice a year
Green IT (Nov. 2009)	Lee Suk-Chae (CEO, Korea Telecommunications)	32 people from IT association, business, research institutes	1	Twice a year

Figure 1-3: List of Reports to the President by the PCGG

Item	Report	Date
Climate Change and Energy Independence	Formulating and Executing Measures for Energy Supply and Demand Management	2009.06
	Establishing a Management System for Automobile Fuel Economy and Greenhouse Gases	2009.07
	Waste and Biomass to Energy	2009.07
	Strengthening the Foundations for the Commercialization of Renewable Energies	2009.08
	Establishing the National Midterm Greenhouse Gas Emissions Reduction Target	2009.11
	Installing Smart Grids	2010.01
	Strategy for the Development of Renewable Energy Markets	2010.10
	Strategy for Future Water Resources Management in Relation to Climate Change	2010.10
Creating New Engines for Growth	Reducing Emissions of Greenhouse Gases from Small & Medium Enterprises	2010.10
	Strategy for the Development and Commercialization of Core Green Technologies	2009.05
	National Strategy for Green IT	2009.05
	Establishing the System for Funds Inflow to Promote Green Investments	2009.07
	Creating Green Jobs and Developing Appropriate Human Resources	2009.11
	Increasing the Supply of Nuclear Power and Enhancing Export Potential	2010.01
	Introducing Green Certification	2010.04
	Enhancing Green Finance and Investment	2010.07
	Strengthening Financial Support to Enhance Competitiveness of Green Measures	2010.07
	Expanding Public Green Markets	2010.07
Supporting the Creation and Expansion of Green Small and Medium Enterprises	2010.07	
Enhancing Quality of Life and Korea's International Standing	Strengthening the Competitiveness of Secondary Batteries	2010.07
	Developing Technologies for National CO <sub>2</sub> Capture and Storage	2010.07
	Promoting Water Industries and their Overseas Expansion	2010.10
	Promoting the Use of Bicycles	2009.02
	Enhancing Educational Measures for Green Growth	2009.08
	Promoting the Practice of "Low Carbon Green Lifestyles"	2009.08
	Creating the Foundations for Green National Territory, Buildings and Transport	2009.11



## Creating the Legal and Regulatory System for Green Growth

Following its launch in February 2009, the PCGG has worked to establish the legal and regulatory foundation for green growth through the formulation of the National Strategy for Green Growth and its Five Year Green Growth Plan in July 2009. This included setting the medium-term greenhouse gas emissions reduction goal in November 2009; and the legislation of the Framework Act on Low Carbon, Green Growth in December 2009 which took effect in April, 2010. At the international stage, Korea proposed the Nationally Appropriate Mitigation Action (NAMA) registry where developing countries register their respective mitigation actions on a voluntary basis for international recognition during the 15th Conference of the Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC) held in Copenhagen in December 2009.

Amongst the above measures, the Framework Act on Low Carbon, Green Growth has been highly rated in the international community as the first of its kind that comprehensively lays out legal measures regarding climate change, energy and sustainable development across the economy, industry, environment and everyday life of Korean citizens. Meanwhile, the Five-Year Green Growth Plan incorporates policy measures for the reduction of greenhouse gas emissions, development and production of renewable energy sources, climate change adaptation, as well as measures relating to green buildings, green cities, green transportation, green lifestyle, international climate cooperation and more. Under the Plan, the Korean government will invest KRW 107 trillion (USD 97 billion), equivalent to 2% of the GDP annually, over the five-year period from 2009 to 2013, which is twice the UN-recommended level of investment (*United Nations Environment Programme 2009*). This ambitious investment plan provides a stable source of funding for the implementation of green growth policies and is symbolic of the government's strong dedication for green growth.

As of December 2010, the Committee had already conducted ten separate meetings for the formulation of policies across all areas. In particular, during the Seventh Meeting held in February 2010, seven tasks for completion during 2010 were identified:

- 1 Plan for the achievement of the national medium-term greenhouse gas emissions reduction goal;
- 2 Facilitate development of ten crucial green technologies and promote development of green technologies in general;
- 3 Make major industries more efficient and green;
- 4 Promote green finance, and expand the scope of green buildings and transport;
- 5 Enhance energy conservation measures;

- 6 Reduce food waste; and
- 7 Establish a "Me-first" culture and expand international cooperation.

Through these measures, the main focus in the year 2010 was to move into the actual activity phase where realistic results would be achieved based on the preparatory measures undertaken during the past few years.

### I-3. National Strategy for Green Growth and its Five-Year Plan

New National Development Paradigm with Positive Cycle between the Economy and the Environment

#### The Korean Government's Administrative Approach to Manage National Development Goal

Much of the credit for Korea's success in achieving condensed economic growth in its modern history is due to the preparation and implementation of national long-term development plans. Before the 1960s, the government prepared only one-year development plan due to lack of budget stability. Only in 1962 did the government start to implement the first five-year development plan to modernize the Korean industry. This policy approach with using a central planning became popular throughout the society. It is now common that most businesses and even relatively conservative universities to formulate five- or ten-year development plans.

The government-led five-year development planning has often been used by authoritative regimes as a tool to centrally control economic activities. Other democratic nations have used this administrative tactic to nationalize key industries. In Korea's case, the original five-year economic development plan was a way to mobilize the break out of absolute poverty and jumpstart the economic growth. Later, five-year plans acted as locomotives to accelerate Korea's transformation from a traditional agriculture-based economy to an industrial society.

This five-year planning has brought about drastic change in the Korean society. Rapid economic growth gained momentum and this success grew confidence within and outside the government. The government also gained confidence that it could rely more on growth led by Korea's sizable private sector. Gone are the days of the heavily controlled and authoritarian economic planning in the new era of Korean democracy.

However, globalization also helped change Korea's five-year planning practice. The administration of President Kim Young-sam (1993-1998) focused heavily on how to respond to the surge of globalization. While its focus remained in globalization issues, the policy practice, institutions and action plans involving five-year plan gradually faded out.

#### Korea's Vision of Green Growth for the Next Sixty Years

With the country's strong economic growth, Korea has fully industrialized and its

major manufacturing industries have gained global competitiveness in semi-conductor, shipbuilding, steel and petrochemical products. However, Korea was confronted with development challenges at the peak of its industrial modernization. Korea's challenges include environmental risk from climate change, the risks of energy and resource scarcity and the dire need for a new growth engine as the economy enters an era of lower growth.

On 15 August 2008, in commemoration of the 60<sup>th</sup> anniversary of the founding of the Republic of Korea, President Lee Myung-bak proclaimed 'Low Carbon Green Growth' as the national vision for the next 60 years. His announcement confirmed that an era of green modernization will follow as a historical necessity the era of industrialization and information technology. It also reflects his administration's new strategy to lead in the era of the green economy and to lay a strong foundation for further advancement of the national economy.

*"Admittedly, Korea has lagged behind in the carbon era, but the country should move a step ahead in the coming hydrogen era. The road ahead of us will be bumpy and will sometimes come to rivers with rapid currents and valleys that are deep and rough. There will also be difficult periods of suffering and undue inconveniences. If Korea makes an audacious and swift move just as it did to advance its information capabilities to make up for belated industrialization, the country will undoubtedly be reborn as a green power."*

President Lee's speech on the 60th anniversary of the founding of the Republic of Korea

#### Three Main Objectives of the Vision

Green growth as Korea's path to socio-economic development is a truly unprecedented challenge. It is evident that the current generation should prepare for the future with an



#### Committee on Climate Change Responses:

In this meeting chaired by Han Seung-soo, then the Prime Minister of the Republic of Korea on 19 September 2008, President Lee determined specific follow-up measures for green growth vision and measures for greenhouse gases reduction and new growth engines.

open perspective and make utmost efforts to execute real actions. From the national level to the individual level, collective actions to materialize new social consciousness are urgently needed. Against this backdrop, the Korean government revived the practice of formulating the five-year plan, an effective policy tool during the early development of the Korean economy. As an old Korean saying goes, “Past makes future.” In other words, the green growth five-year plan is the government’s attempt to renew an administrative tool that was proven effective during the era of industrialization.

As concern over climate energy risk has spread over the world, industrialized countries started to emphasize the role of government as a catalyst, a facilitator, a guarantor or an enabler in carrying out green policies and measures. Therefore, the long-term national planning has once again gained favor. British sociologist Anthony Giddens, in his book *The Politics of Climate Change*, emphasized the active role of government in creating a model for a low carbon future, overcoming challenges and transforming them into opportunities. In the same line, he argued for the need to formulate plans regarding climate change and energy security from a long-term perspective.

To formulate five-year plans, one must plan with a long term perspective. One reason that government’s role in planning is so critical in the era of climate and energy lies in that human history contains no clear, obvious model to follow. In contrast, Korea rushed to modernize its industry decades ago. Success was guaranteed only if Korea closely followed the industrialized countries’ economic policies. With the model clear established, the government’s role was limited to shaping policies to achieve similar results.

Today, ecological modernization remains merely a concept. There is no precedent to follow that guarantees success. Some argue for social justice in addition to economic development. Others argue for increase of environmental value. When aiming for too many objectives, more often than not diverse values offset one another rather than create synergy. The difficult challenge is to discern how much offsetting impact the society can afford due to conflicting values between the economy and the environment.

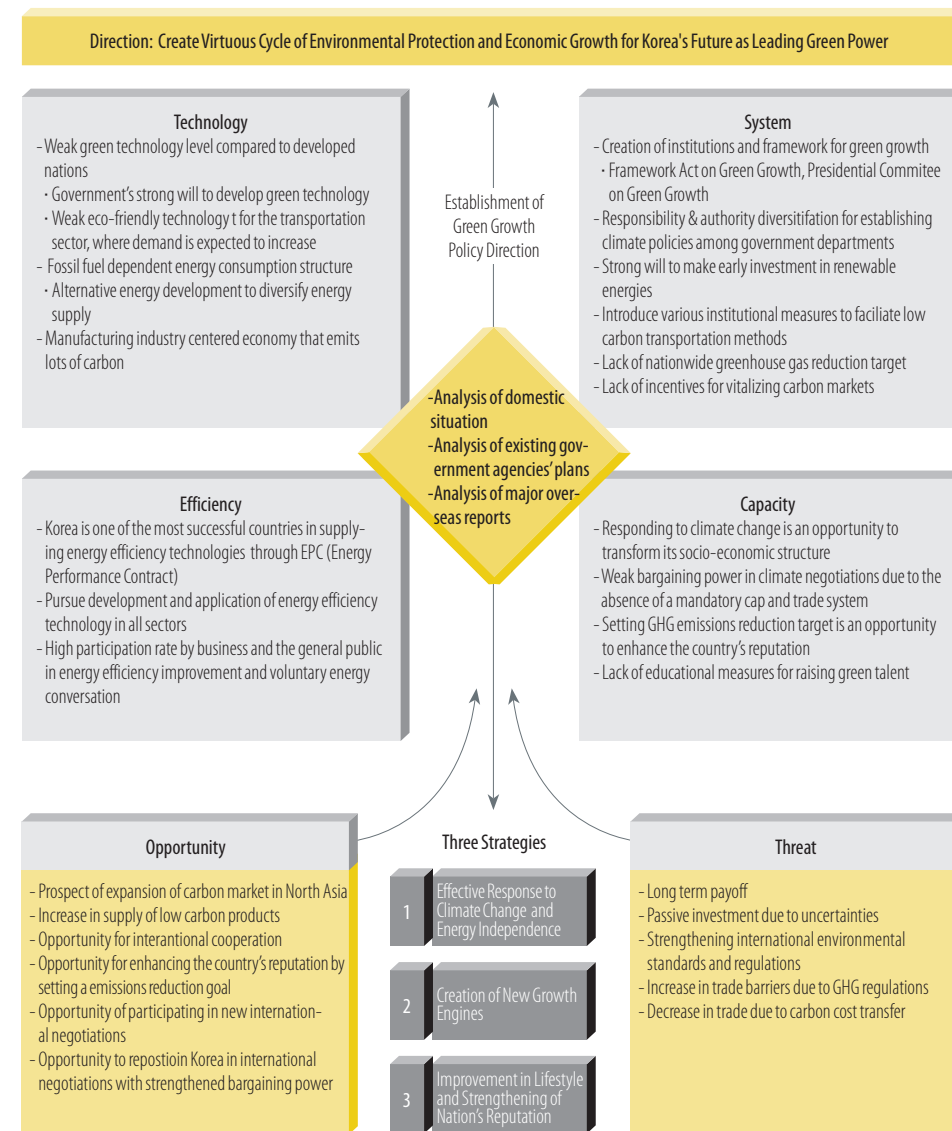
A modern society highly regards diversity of values. When the Presidential Committee on Green Growth (PCGG) prepared the Five-Year Plan, it first laid out the values underlying the plan. After considering domestic and international trends, previous or existing implementation plans, and international analysis reports, the Committee designated a national goal for Korea to become one of the global top seven powers by 2020, and global top five powers by 2050 in the field of green growth.

The National Strategy for Green Growth envisages three main objectives: (i) to effectively deal with climate change and attain energy independence; (ii) to create new growth engines on multiple fronts; and (iii) to raise the overall quality of life for the

people and to enhance Korea’s contributions to the international community through strong advocacy for green growth (Figure 1-4).

In pursuing these objectives, the Korean government decided to actively engage with the issue from the perspective of ‘active value’ and to view today’s challenges as opportunities.

Figure 1-4: The Policy Framework of Low Carbon Green Growth



Meanwhile, many industrialized countries have been exposed to the issue for a longer time but engaged rather passively. Moreover, Korea's National Strategy takes a humanitarian approach by directly linking the tangible benefit of attaining the objectives related to climate policies and development policies with the quality of life of individual citizens.

The Strategy coordinated various basic plans, existing targets, and investment plans in the areas of climate change, energy, green industry, and green society. Moreover, the Strategy evaluated green growth related projects proposed by different government ministries and eliminated duplicative projects. With broad participation of expert groups from both governmental and private agencies and with review of relevant research results, the government incorporated comments and advice and finalized the National Strategy. The National Strategy mandated the provision of expected benefits out of green investment, rather than simply listing future investment plans. Since it takes long time to reap tangible benefits from green investment, the National Strategy requires periodic evaluation starting in 2013 of the future outlook in 2020, 2030, and 2050. To achieve the main three objectives, the government selected ten policy directions (Figure 1-5).

### Action Plan to Achieve Green Growth for the Next Five Years

The Five-Year Green Growth Plan (2009-2013) is a detailed implementation plan for the next five years based upon the National Strategy. It is a detailed action plan to implement the National Strategy. Also, it is an indicative planning for the green behavior of each member of the society because the participation of all industries and citizens is necessary for green growth. Consistent with this, the plan identified core tasks for five years after having considered their investment potential, significance of subject projects, and relevance to the National Strategy. Along with the core tasks, the Plan also clarified the ministries in charge, the yearly investment plan, and the expected benefit. This presented systematic mechanisms for policy implementation.

Pursuant to Article 9 of the Framework on Low Carbon Green Growth, the Five-Year Plan coordinated and reviewed the relevant existing plans, particularly their respective objectives, and the financial support of each government ministry involved. The existing plans included the National Basic Plan on Energy, the Green New Deal, and the New Growth Engine Project.

### Key Content of the Five-Year Green Growth Plan

The Five-Year Plan specified policy targets for each category. Those targets were calculated by using methodologies called forecasting based on business-as-usual data in the past, and back-casting, based on future expected data. The Plan also indicated investment plans for the next five years and identified specific executing agencies.

Followings are Ten Policy Directions of the Five-Year Plan:

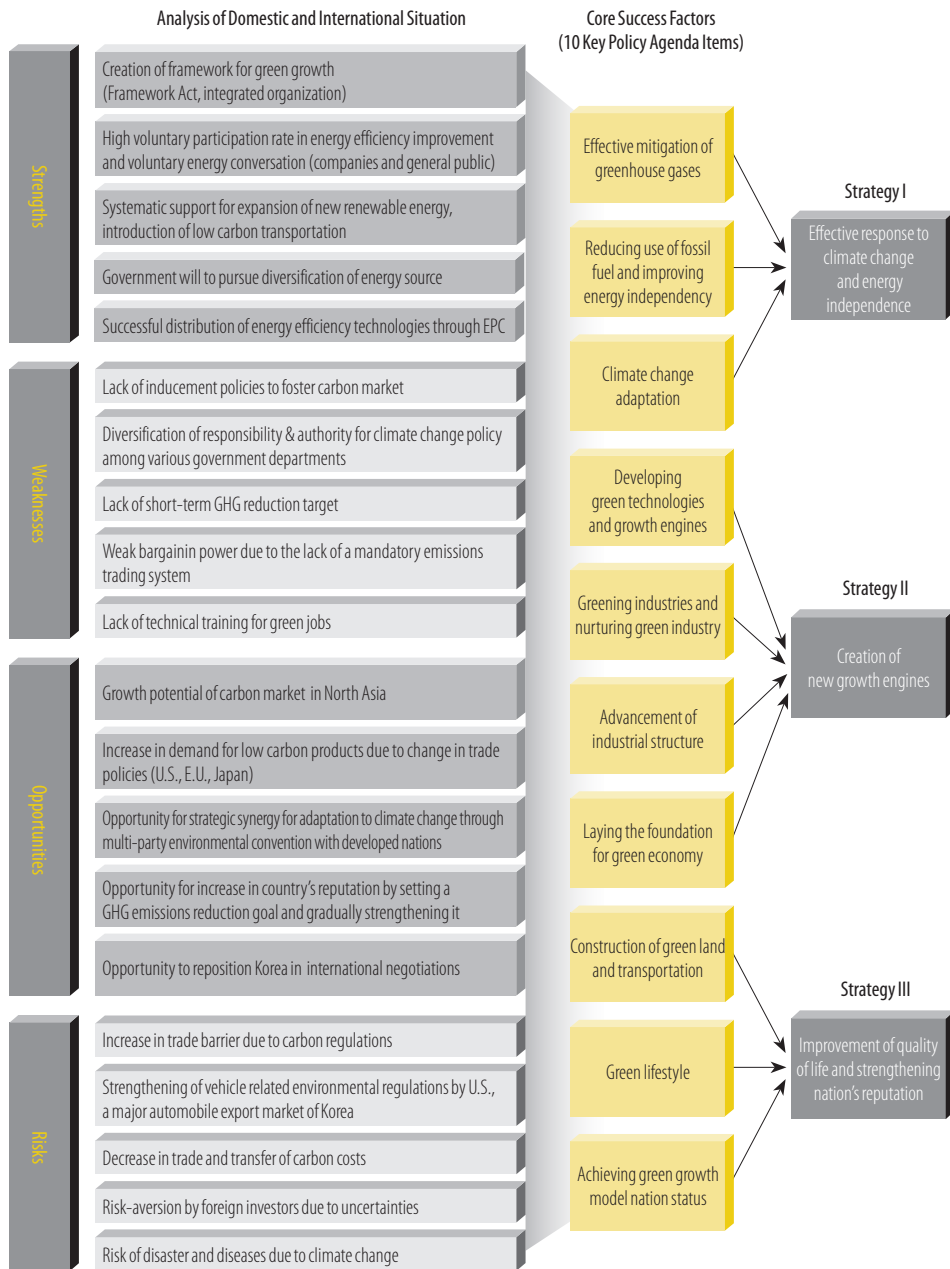
- 1 Set a national target for reduction of greenhouse gas emissions and to carry out step-by-step strategies in each sector for effective mitigation of greenhouse gas emissions;
- 2 Enhance energy efficiency and increase the use and supply of clean, renewable energy to reduce the use of fossil fuels and advance energy independence;
- 3 Establish and implement adaptation policies to minimize the damages from the adverse impacts of climate change to strengthen the capacity to adapt to climate change, such as water management policy including the Four Major Rivers Restoration Project, climate-friendly marine system management; precautionary disaster and emergency response strategy, and forest management;
- 4 Increase R&D investment in new technologies, such as LED, solar cells, green cars, and green IT, to the extent that such technologies can be commercialized by 2012, thereby creating new growth engines and gaining a competitive edge in the global market;
- 5 Pursue industry-side low carbon efficiency through the greening of Korea's key industries and small and medium business, disseminating green business models, and forming 'zero-emission' green industrial complexes;
- 6 Advance industrial structure through the cutting-edge fusion of existing industries, including fusion between broadcasting and telecommunications, information and communications technology, robotics, and nanotics, and the development of high value-added industry, where energy per unit value is much lower;
- 7 Engineer a structural basis for the green economy by introducing a emissions trading system, developing green stock index and new financial products, and reforming the tax system to be more environment-friendly;
- 8 Promote green homes, ecological urban planning and green transportation infrastructure that are closely linked to the daily life and convenience of the public;
- 9 Bring the green revolution into our daily lives through green growth education, green citizen training, and a carbon labeling system; and
- 10 Strive to become a green growth role model through active cooperation on the global stage where Korea takes a bridging role between developed and developing countries in international climate negotiations and expanding the size of green Official Development Assistance (ODA) to developing countries.

### Policies to Realize the Five-Year Plan

The role the government plays in addressing the climate change is very important. Government intervention in cases of market failure such as climate change is crucial.



Figure 1-5: Ten Policy Agenda Supporting the Strategy



There are five policy methods to realize green growth:

- 1 Government's investment in R&D shall be selective and concentrated. Green technology R&D as a percentage of all R&D will increase from 16% as of 2009 to 20% by 2013;
- 2 Regulatory policy will be coordinated with inducement policy in order to maximize the combined;
- 3 Inducement policies such as subsidy will be utilized at the minimum stimulus level. Anti-inducement methods such as environmental taxes shall utilize market mechanisms to the fullest extent;
- 4 Positive externality and negative externality will be internalized;
- 5 Moral suasion can be expected from strengthening education of the citizens and through leading by example by the prominent in society. However, considering the difficulty in achieving long-term change through moral suasion, Korea should consider market inducements, such as carbon mileage.

**Investment to Support Five-Year Plan**

In order to support the Five-Year Plan, the government earmarked KRW 107 trillion (USD 97 billion) of public investment for supporting green growth from 2009 to 2013 which is about 2% of the country's annual GDP. This is more than twice the figure recommended by UNEP.

The UNEP report on *A Global Green New Deal* (February 2009) recommended that at least 1% of GDP must be invested in green growth. According to this report, in order to overcome economic crisis at the end of 2008, China has established a plan of investment worth USD 205 billion in improving energy efficiency, protecting the environment, constructing a railroad system and building a power grid. The US and the EU each planned to invest 100 billion USD in green economy recovery such as improving building energy efficiency and expanding renewable energy distribution. The world's large-scale investment in supporting green growth is comparable to Korea's plan. However, as this report does not contain information on all investments in green growth by nation, it is difficult to compare the investment level by country. It could be that, unlike Korea, no other country has announced systematic and collective green growth plans.

Through such large scale investment, the Korean government plans to support 'effective response to climate change and securing energy independence,' 'creation of new growth engines,' and 'improving quality of life and strengthening the status of the country' (Figure 1-5). For the next five years, from the strength of the Five-year Plan, one can expect KRW 182-206 trillion (USD 165-187 billion) production inducement effect. One can also expect

a hiring effect of 11.8-14.7 million workers (Figure 1-6). Furthermore, in order to support the vulnerable, the government will strengthen green society safety net through measures such as improving the cooling and heating efficiency of the residences of the low income citizens. Furthermore, through afforestation, green jobs will increase for the citizens and public transportation will be more convenient.

Figure 1-6: Investment Plan for Green Growth 2009 – 2013

	Total	2009	2010	2011	2012	2013	Increase Rate
Total	107.4 (969)	17.4 (157)	24.2 (218)	25.7 (232)	20.6 (186)	19.4 (175)	10.5
Adaptation to Climate Change and Energy Independency	57.5 (519)	8.5 (77)	15.5 (140)	16.0 (144)	9.8 (88)	7.7 (69)	15.0
Creation of New Growth Engines	29.0 (262)	4.8 (43)	5.2 (47)	5.8 (52)	6.4 (58)	6.8 (61)	9.4
Improvement in Life and Strengthening Nation's Reputation	27.2 (245)	5.2 (47)	4.8 (43)	5.2 (47)	5.7 (51)	6.3 (57)	2.2

Unit: KRW trillion (USD billion), % \*November 3, 2011 Exchange Rate (USD1 = KRW1,108.5)  
Source: PCGG (2009)

Figure 1-7: Expected Economic Effects of Green Growth

		Production	Value Added	Job Creation
Scenario I	Total	181.7	75.0	156.1
	Yearly Average	36.3	15.0	31.2
		Compared to GDP 3.5%	Compared to GDP 1.5%	Compared to Unemployed 34.4%
Scenario II	Total	206.0	94.9	180.5
	Yearly Average	41.2	19.0	36.1
		Compare to GDP 4.0%	Compared to GDP 1.8%	Compared to Unemployed 39.8%

Scenario I: Assuming the current technology and productivity

Scenario II: Assuming productivity increase due to investment in green technology (secondary battery, green car, improved water reactor, LED, green PC, fuel cell, solar battery, CCS, etc.)

1) Estimated GDP in 2009: 1,029.5 trillion; 2) Number of unemployed as of 2009 1Q: 9,080,000 (Statistics Korea)

Source: PCGG (2009)

## I-4. Green Finance

Fundamental Element for Green Industry Growth

### Korean Government Policy for Facilitation of Domestic Green Finance

Green finance refers to channeling necessary funds to green business and industry through brokerage by financial institutions. Korea's most proactive policies to promote green finance are specified in the Five-Year Green Growth Plan and the Plans for Facilitating Financial Flow to Stimulate Green Investment announced in July 2009.

The Five-Year Plan introduced measures to facilitate policy lending for green technology and industry, establish green finance infrastructure, and nurture carbon market.

Among them, the policy lending for green technology and industry is executed through Korea Development Bank, Industrial Bank of Korea, Fund of fund, Korea Credit Guarantee Fund and Korea Technology Finance Corporation. Also, the Five-Year Plan introduced a carbon emission trading system to nurture the carbon market.

There are two programs for the establishment of green finance infrastructure are:

- 1 Reflection of a financial institution's performance in providing advantages for green loans into the institution's management evaluation; and alignment of green financial laws and regulations on green responsibility of trustees;
- 2 Establishment of technology infrastructure including development of a stock index related to the envi-

### The Future of Green Industry Growth

The government is interested in expanding green finance to prop green industry growth. July 2009 Monthly Debate on "Future Industry Strategy: the Future of Green Industry Growth" by Korea Forum For Progress.



ronment, society and corporate governing structure and a green industry stock index; enhancement of analysis and rating systems for green companies; establishment of an environmental information database; development of green experts training programs.

As a benchmark, a socially responsible investment (SRI) index can be used, which is composed of leading companies based on the evaluation of non-financial factors such as sustainability, environmental and social governance (ESG). Also, SRI can be stimulated by utilizing exchange-traded funds (ETF) or index funds.

In other countries, the Dow Jones Sustainability Index (DJSI) is the most representative SRI. This index has been recognized as the global standard for sustainable management and evaluation, as it comprehensively evaluates a company's environmental and social aspects in addition to its economic performance. In Korea, the Korea Exchange (KRX) developed its own SRI in September 2009. Also, Korea is planning to develop a green industry stock index, an investable index composed of leading green companies selected from listed domestic companies. Once the index is developed, a new form of stock investment will become possible by investing in an index fund based on the index.

The Plans for Facilitating Financial Flows to Promote Green Investment provides further detailed policy measures than the Five-Year Green Growth Plans. The Plan introduces Green Certificates to reduce uncertainties surrounding *what is green* by providing reliable standards to identify green technologies and projects. In addition, the Plan provides measures to acknowledge green firms who hold green technologies or pursue green projects. These Green Certificates serve to invigorate green finance by drawing investment funds towards green technology R&D and green projects. Certified green projects will benefit from lower tax rates and low interest rate bonds and loans.

Furthermore, the government decided to expand the target facilities and public financing of a type of company called Energy Service Company (ESCO). ESCO provides energy efficient, energy conservation retrofit services on outdated facilities and retrieves its investment from the saved energy bills. In addition, for small and medium sized ESCO, the government plans to provide increased tax credits and reduced rates on the deposits.

On the other hand, the government prepared plans to facilitate investment money throughout the different phases of technology development: R&D, commercialization, growing-up, and maturity. For the R&D phase, public lending will be prioritized. For the commercialization phase, fund of fund will be the main tool for facilitating investment, especially for the small and medium sized companies. For the growing-up phase, public equity funds, and long-term loans and bonds with preferred tax rates will be the major instrument for facilitating financial flow to the green companies. Finally, at the

maturity stage, a variety of tools including carbon based financial instruments, green SRI, green industry index, and green insurance will be utilized.

### Korean Example of Green Finance

Korea's representative green financial instruments are found in bank loan programs for green business and green projects. For instance, there has been introduced loan programs that offer preferred interest rates for photovoltaics and LED projects. As of December 2009, the scale of domestic bank loans for green business and projects are estimated as KRW 5.1 trillion (USD 4.7 billion), which amounts to 0.53% of the total bank loan (Korea Institute of Finance 2010).

In addition, banks offer preferred rates for savings accounts of customers who practice eco-living. Korean Banks also announced that they will make donations to green projects and environmental groups in proportion to their record of hosting green savings accounts. As of December 2009, the total amount of green savings is estimated as KRW 10 trillion (USD 9 billion), which amounts 1.29% of the total savings (Korea Institute of Finance 2010).

As for investment instruments specializing in green industry investment, there is an SRI fund specializing in companies promoting social responsibilities. The total scale of green investment funds, which are named as green, renewable, solar, alternative SRI and etc, is estimated as around KRW 1.7 trillion (USD 1.6 billion), which is 0.45% of the total domestic investment amount.





# Climate Policy



II-1. Greenhouse Gas Inventory	052
II-2. Climate Change Adaptation	058
II-3. Climate Change and Agriculture	063
II-4. Climate Change and Health	069

## II-1. Greenhouse Gas Inventory

Principles of Transparency, Accuracy, Completeness and Consistency

### Developing Greenhouse Gas Inventories: Basis for Mitigation

The primary cause of climate change has been identified as the negative impacts resulting from human activities (IPCC 2007). This fact has fostered a common understanding on the urgent need to mitigate the main source of global warming, the greenhouse gas (GHG) emissions. Based on the mutual recognition of the problem between countries in the global community, the United Nations Framework Convention on Climate Change (UNFCCC) was established in 1992. This Convention was followed by the adoption of the Kyoto Protocol in 1997, which legally obligates Annex I countries to reduce GHG emissions. As such, the international community has actively taken action to respond to climate change for the last twenty years.

To reduce GHG emissions, first of all, there must be an accurate understanding of the amount of GHG emissions from various sources. In other words, establishing GHG inventories is the basis for, and the first step toward reducing GHG emissions. Erroneous inventories can lead to misguided mitigation policies, which in turn can incur enormous socio-economic loss. Therefore, developing accurate and transparent inventories will result in appropriate and adequate GHG mitigation policies in each country.

### GHG Inventory: Definition and Purpose

A GHG inventory compiles aggregate quantitative estimations of GHG emissions and removals. The aim of the inventory is to accurately estimate and account for GHG emissions by sources and removals by sinks. The inventory provides the most basic and significant data that can be used in assessing mitigation potential of emission sources, setting a mitigation target, and establishing and executing mitigation implementation plans.

### Types of GHG Inventories

GHG inventories are categorized according to the following: (i) scope of emitters; (ii) emission source activities; and (iii) estimation method of the inventory. GHG emitters include

the states, local governments, and corporations. Each of them prepares an inventory report which is applicable to himself. The national inventory provides information on the country's aggregate GHG emissions, which include direct emissions or removals within the physical territorial boundaries of the country. The local government and corporate inventories include CO<sub>2</sub> from indirect emissions, which are originated outside their boundaries but then transferred inside, in addition to direct emissions and removals. An example of this is the indirect emissions released by Korea Electronic Power Corporation (KEPCO).

As illustrated by the UNFCCC's National GHG Inventories Requirements, GHG inventories are estimated by categorizing different emissions sources: energy, industrial processes, agriculture (including livestock), land-use change and forestry and waste. However, to achieve effective mitigation policies, a customized categorization system uniquely adapted to different characteristics of an emissions source can be developed and applied. The inventory estimation method for GHG emissions can follow either a top-down or bottom-up approach. The top-down approach uses available inventories for an emission area and then breaks the overall emissions down to sub-units using actual data or, if not available, surrogate data from similar types of sources and sinks. Most of the national and local government inventories follow the top-down approach. The bottom-up approach estimates emissions by using activity data on emission sources and process units, then aggregating the data for each emitter. The strength of the bottom-up approach is that it produces more accurate data reflecting characteristics of process units or emission sources in inventory estimation. Yet there is difficulty in the actual application of this practice when preparing national or local government inventories because the latter approach requires inspection and analysis for all emission sources and sinks.

### Principles of GHG Inventory

The principles of estimating GHG emissions for inventory compilation are similar across diverse emitting entities. Generally, the principles of transparency, accuracy, completeness, and consistency are applied (IPCC 2006, ICLEI 2010 & WRI/WBCSD 2004).

1. **Transparency:** the assumptions, processes and methodologies used for GHG inventory estimation must be transparent and clearly presented to make replication and assessment

Figure 2-1: Principles of GHG Inventory

National Inventory	Local Government Inventory	Corporate Inventory
Transparency, Accuracy, Completeness, Consistency, Comparability	Transparency, Accuracy, Completeness, Consistency, Relevance, Conservativeness	Transparency, Accuracy, Completeness, Consistency, Relevance

Source: 1. IPCC (2006), IPCC Guidelines for National GHG Inventories; 2. ICLEI (2010), Local Government Operations Protocol for the Quantification and Reporting of GHG Emissions; 3. WRI/WBCSD (2004), A Corporate Accounting and Reporting Standard (Revised Edition)

by a third party possible.

- 2 **Accuracy:** the inventory data must be exactly and accurately estimated within the capacity of the estimating entity.
- 3 **Completeness:** the inventory must report all GHG emissions and removals by sources and sinks within the boundaries of the entity preparing an inventory.
- 4 **Consistency:** the estimation methodologies and activity data must be consistent throughout the reporting period <sup>(Figure 2-1)</sup>.

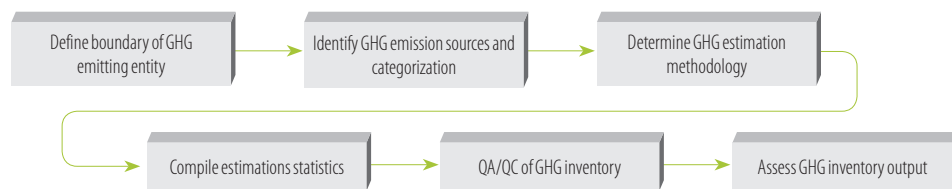
The UNFCCC emphasizes the principle of comparability and suggests standardized estimation processes and methodologies. This principle allows for cross-checking and comparisons between different national inventories. On the other hand, local governments and corporate inventories underscore the principle of relevance wherein they reflect the specific characteristics and conditions of the emitting entity. Moreover, local government inventories also take into account the principle of conservativeness, which stresses the conservative procedures in order not to overestimate GHG mitigation emissions in the inventory compilation process.

### GHG Inventory Development

The GHG inventory is prepared through a six-phase process according to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

- Phase 1 The boundary of the emitting entity is defined;
- Phase 2 The GHG emission sources are identified and categorized, then organized into data tables or worksheets;
- Phase 3 The emission estimation methodology is determined, based on the availability and level of relevant data on GHG emissions by source;
- Phase 4 The emissions are estimated using the chosen methodology. The resulting emissions from each sector are aggregated to compile an inventory for the emitter;
- Phase 5 The inventory outcome is verified through quality control (QC) and quality

Figure 2-2: Flow Chart of GHG Inventory Development



assurance (QA) phases to make qualitative improvements before finalizing the inventory; and

- Phase 6 The credibility of the inventory results is assessed, then directions for improvements and further developments are suggested <sup>(Figure 2-2)</sup>.

### Phase 1: Definition of GHG Emitting Entity's Boundary

The boundary of a GHG emitting entity must be first defined. The entity's boundary refers to the physical scope of the entity. To determine the boundary, the entity can consider the use of two methods, the control approach and the share allocation approach.

The control approach grants all responsibilities relevant to emissions to the controller of the entity. The controller can be decided either by focusing on financial control or operational control aspects. If the controller is selected from the financial side, the main consideration is given to those who are mostly responsible for the risk of, and compensation for, asset ownership. If the controller is determined from an operational perspective, the actor who holds the most rights and responsibilities related to emissions is selected.

The share allocation approach distributes the GHG emissions according to the proportion of economic risk and compensation from emission source management and operation activities. The national and local government inventories follow the control approach. Corporations can apply both approaches. Usually for corporations, the relevant stakeholders and the inventory-managing organizations consult with each other to decide which approach to take. More frequently the companies are applying the share allocation approach.

### Phase 2: Identification of GHG Emission Sources and Classification

The next step is to identify the GHG emission sources within the defined boundary of the entity. After the sources are identified and listed, they are categorized and organized

Figure 2-3: Scope of GHG Emissions Sources

Scope	Description	
Direct Emission Sources (Scope 1)	Stationary Combustion	GHG emissions released during the energy consumption process from a stationary combustion facility within the boundaries.
	Mobile Combustion	GHG emissions released from transport activities and vehicles within the boundaries.
	Industrial Emissions	GHG emissions discharged from a chemical reaction as products or by-products.
	Fugitive Emissions	GHG emissions released from raw materials (fuel), storage of in-process materials, transfer, and industrial processes.
Indirect Emission Sources (Scope 2)	GHG emissions indirectly released from the purchase of electricity, steam, etc., which come from routine activities outside the boundary (e.g. power generation).	
Indirect Emission Sources (Scope 3)	GHG emissions indirectly released from the raw material production, product use and product disposal processes, which do not belong to Scope 2.	

WRI/WBCSD (2004), A Corporate Accounting and Reporting Standard (Revised Edition)



into data tables or worksheets. Emission sources can be sorted according to the operational boundaries, into direct and indirect sources.

Indirect emission sources are again divided into two scopes, Scope 2 and Scope 3. National inventories mainly cover direct emission sources, but the local government and corporate inventories also include indirect emission sources. In most cases, indirect emission source estimations are required up to Scope 2 and only in a small number of cases, they are required for the Scope 3. Thus, the scope of both the direct and indirect emission sources must be determined at the inventory planning stage through consultation between the emitting entity and inventory management organization (Figure 2-3).

### Phase 3: Determination of GHG Estimation Methodology

To make a decision on the appropriate GHG estimation methodology, one must first identify the activity data, emission factors and relevant variables required for GHG emissions estimation. After examining and analyzing the level of available data, the estimation methodology which is most adequate for the entity developing a GHG inventory can be determined. Hence, a sound decision-making process must be in place to assist and select the appropriate emission estimation methodology.

The current reporting system of Korea suggests estimation tiers to the emitters, which will be applied according to their amount of emissions. ‘Tiers’ represent the complexity of the estimation methodology, and generally there are three types of tiers. Higher tiers produce more accurate emissions estimation results, as well as better reflect the characteristics of emission sources. Thus the entities must secure the relevant data and information which is required for estimating emissions for the specific tier where they belong.

### Phase 4: Compilation of GHG Inventory

By applying the chosen methodology for estimation by source, the emissions are estimated and compiled. The compilation follows the estimation principles enlisted by each national, local government and corporate inventories.

### Phase 5: Quality Control and Quality Assurance (QC and QA) of GHG Inventory

Quality Control (QC) and Quality Assurance (QA) of GHG inventories should be established as a structural system and be strictly followed. QC refers to the assessment and management of the inventory by the compilers. It includes the quantitative review of the estimations, assessment of the suitability of defining the boundary of the organizational structure and operations, and assessment of the estimation methodology determination process. The QC process also checks the source of the data, emission factors and relevant

variables used in estimation. It also verifies the output’s accuracy and credibility. QA, on the other hand, is the review process conducted by a third party who was not directly involved in the inventory compilation and development process. QA assesses whether the purpose of inventory estimation was satisfactory and whether the best, optimized method was applied.

### Phase 6: Assessment of GHG Inventory

To ensure the accuracy and credibility of the produced GHG inventory, the estimation process should be measurable and assessable. Accordingly, quantitative and qualitative indicators should be formulated. The accuracy of the inventory should be measured, followed by the application of assessment indicators throughout the inventory estimation phases. Through the process, problematic areas can be identified, based on which recommendations for improvements can be suggested.

### Korea’s GHG Inventory

Under Korea’s Framework Act on Low Carbon, Green Growth, a comprehensive national GHG information management system to systematically build and manage GHG inventories was established. The initial GHG inventory was prepared by the principal institutions designated for each sector. The Greenhouse Gas Inventory & Research Center of Korea (GIR) then reviews the inventory to ensure its credibility and impartiality.

In addition, Korea finalized and published the “GHG-Energy Target Management System Operating Guidelines” on 16 March 2011 (Notification No. 2911-29 of the Ministry of Environment). Under these guidelines 468 entities are obligated to report their GHG emissions and develop GHG inventories of their own. These GHG inventories will be later verified by a third party certified by the government. Such an inventory measurement, reporting, and verification (MRV) system is the first of its kind to be established by a Non-Annex I Party of the UNFCCC. The enforcement of these guidelines will help ensure the consistency, credibility, and transparency of national and corporate GHG inventories of Korea.

## II-2. Climate Change Adaptation

### Current Status and Challenges

#### Understanding Climate Change Adaptation

There are two main ways to address climate change issues. First is mitigation, actions to decrease the intensity of green house gas (GHG) emissions that are direct causes of the global warming. Second is adaptation, which is defined by the Intergovernmental Panel on Climate Change (IPCC) in 2007 as “*adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.*”

Although much less recognized by the public, adaptation is as important as mitigation because of the inertia that GHG emissions have. This means that the GHG emitted in the past will remain in the atmosphere for 50-200 years and thus cause global temperature to continue rising in the future. In this respect, the Stern Review identified adaptation as “*the only response available for the impacts that will occur over the next several decades before mitigation measures can have an effect* (Stern 2006).”

Two concepts, *vulnerability* and *adaptive capacity*, are central to understanding adaptation. Vulnerability refers to the extent to which an object is exposed to and sensitive to the risk of climate change. Adaptive capacity is an ability to respond successfully to climate change in order to reduce and overcome the potential adverse impact. In making an adaptation policy, both concepts should be taken into account. The vulnerability of each major sector should be evaluated by using forecasting data. Then, based on the outcome of evaluation, detailed adaptive capacity-building programs should be devised to minimize the projected risk.

#### Adaptation at the International Climate Change Agenda

So far major international discussions on responses to climate change have focused on mitigation, which has fostered conflicts rather than cooperation among states. It is only recently that adaptation has started to gain international attention. Previously adaptation was initiated mostly at local level such as the Thames Estuary 2100 Project in London in

2002 ([www.environment-agency.gov.uk](http://www.environment-agency.gov.uk)), the Room for the River in Netherlands ([www.ruimtevoorderivier.nl](http://www.ruimtevoorderivier.nl)) and the Halifax Climate SMART in Canada in 2006 ([www.halifax.ca/climate](http://www.halifax.ca/climate)).

In the 12<sup>th</sup> Conference of Parties to the UNFCCC (COP 12) held in Nairobi, Kenya in 2006, the Nairobi Work Program on Impacts, Vulnerability and Adaptation to Climate Change was announced. This is a five-year plan to support climate change adaptation for developing countries. This triggered a spill-over effect on many countries to develop subsequent adaptation policies. Reflecting such growing concern for adaptation, the IPCC 2007 report contained the research on the impact, adaptation and vulnerability aspects of climate change. The Bali Road Map adopted in COP 13 in 2007 also designated adaptation as one of the main pillars for climate change responses along with mitigation, technology and finance.

#### Economic Analysis of Korea's Vulnerability to Climate Change

Korea's vulnerability to the impact of climate change is considerable and therefore adequate actions and policies are required at both central and local government levels. In 2009, the Korea Environment Institute (KEI) released the first result of the Economic Analysis of Climate Change in Korea. The analysis estimated the scope of economic damage in the fields of agriculture, coastal environment and health by the year 2100 based on a climate change forecast for the Korean peninsula. The result predicted that the increase in the average temperature by 4°C in Korea will bring about economic damage worth more than USD 45.5 billion. The scale of damage will be apparent particularly in coastal, urban and rural areas. For instance, if the sea level rises by 80cm, then 605 km<sup>2</sup> of area will be affected by flood, an area larger than Seoul. In such a case, the number of flood victims from eleven



#### 350 Campaign

The Korea Green Foundation held the 350 Campaign in Myoengdong, Seoul, on 18 November 2010, as part of the international campaign to reduce the CO<sub>2</sub> rate from 339ppm to 350ppm.

coastal cities will exceed 370,000 people <sup>(KEI 2009)</sup>.

The direct impact of climate change on human survival is crucial. In Seoul, there will be 11 additional mortalities per day if the daily average temperature reaches 28.1°C or above. In rural areas, temperature increase of 4°C will reduce rice yield by 15%.

### Korea's National Climate Change Adaptation Master Plan

In May 2007 the third committee meeting of the Climate Change Response chaired by the Prime Minister made a resolution that the government should develop a National Climate Change Adaptation Master Plan. In December 2008, the Ministry of Environment (ME) jointly with other ministries, developed the Basic Plan on National Climate Change Adaptation, integrating the existing policies carried out by different ministries and agencies and presenting a long-term direction for the nation's adaptation policy.

Furthermore, Korea Adaptation Centre for Climate Change (KACCC) was established by the Korean Environment Institute (KEI) in July 2009. It aims to assess Korea's vulnerability to climate change, develop adaptation tools and construct a domestic and international climate change network.

### Korea's National Strategy for Green Growth and the Five-Year Action Plan

In July 2009, the Presidential Committee on Green Growth (PCGG) adopted the National Strategy for Green Growth and the Five Year Action Plan. The National Strategy declared 'strengthened capacity to adapt to climate change' as one of its ten policy directions and also suggested detailed adaptation strategies for public health, disaster reduction, agriculture, forestry, coast/fishery, water resources and ecosystem. The National Strategy also incorporates local adaptation programs which include: (i) detailed and accurate climate change forecasting information; (ii) analysis of the impact of climate change on health, food, water resources, ocean, disasters and forests; and (iii) establishment of related legal framework, development of adaptation policies and research projects.

### Adaptation Policy Directions for Six Main Sectors

The National Strategy for Green Growth identifies as the main targets of adaptation strategies health management, food security, stable water supply, coastal and marine management, disaster prevention and forest management.

- 1 **Health Management :** The Ministry of Health and Welfare (MW) is primarily responsible for making policies in consultation with the Ministry of Environment (ME) and the Korea Meteorological Administration (KMA) to protect people from diseases caused by heat

waves, viruses, air pollution, food and typhoons. Policy measures to deal with these issues include reinforced monitoring of infectious diseases, an improved air pollution alert system, equipping prevention mechanism and construction of an emergency medical system.

- 2 **Food Security :** The Ministry of Food, Agriculture, Forestry and Fisheries (MIFAFF) plays the leading role in consolidating a climate-friendly food security system while the Rural Development Administration (RDA) is assigned to develop agricultural technologies. Major countermeasures include developing new breeds that are adaptable to climate change, distributing relevant technologies, finding measures to minimize the adverse impact of climate change and enhancing international cooperation for a stable food supply.
- 3 **Water Management :** The Ministry of Land, Transport and Maritime Affairs (MLTM) and the Ministry of Environment (ME) are in charge of ensuring the availability and accessibility of fresh water in terms of quantity and quality. Specifically, an emergency fresh water supply system should be established in case of drought, along with other alternative water supplies such as desalination and the utilization of rain water. Likewise, a control system must be put in place to determine the cause of water contamination and therefore, strengthen the purification system. The Four Major River Restoration Project is the flagship project of Korea's water management.
- 4 **Coastal and Marine Management :** The Ministry of Land, Transportation and Maritime Affairs (MLTM), the Ministry of Environment (ME) and the Ministry of Food, Agriculture, Forestry and Fisheries (MIFAFF) lead the construction of an integrated management and adaptation system for coastal areas. Short-term action plans include preparations for potential flood damages caused by typhoons, storms and tsunamis. Long-term action plans include preventative measures for coastal erosion and ecosystem disruption. Availability of climate change vulnerability maps and development of early warning or alert systems are also among the technologies that need to be prioritized to avert damages to both human and physical infrastructure.
- 5 **Climate Disaster Prevention :** The National Emergency Management Agency (NEMA) has the primary role to devise specific measures for each sector to deal with different types of disasters, as well as a comprehensive national emergency response system. In addition, prevention, counteractions and rehabilitation plans are also drawn up to diminish the frequency and the extent of damages. Regulations for buildings and facilities will be revised to strengthen its preventative capability; facilitate natural disaster insurance services; and to set up efficient post-disaster actions.
- 6 **Forest Management :** The Korea Forest Service takes the lead in establishing an impact assessment mechanism, an effective response system and infrastructure to prevent

forest disasters. Aside from being one of the major sources for GHG mitigation, forest is also closely associated with adaptation in terms of the occurrences of forest fire, landslide and pest. Related policies include the expansion of green areas in cities to prevent urban heat island effect.

### Sectoral Adaptation Strategies Since 2010

Due to the complex and wide-ranging nature of climate change, adaptation policies and practices should be approached in a comprehensive manner with strong partnership between the central and local governments.

In 2010, the ME established the National Strategies for Adaptation for 2011-2015 based on the National Strategy for Green Growth and the Five Year Action Plan. The local governments subsequently indicated their plans of making detailed supporting policies to the said national strategies.

Meanwhile, the PCGG is continuing its effort to embrace adaptation into a major national agenda. In particular, it gave its full support in the drafting of the sectoral adaptation policies by each Ministry. For local authorities, different adaptation models will be set up according to its location type, for instance, mountain areas and coastal areas. The ME, the Korea Environment Institute (KEI) and the Seoul City Council will provide the required support and assistance in making the models as well as technical guidelines for local authorities.

## II-3. Climate Change and Agriculture

Preparations for Global Warming and Ways to Make Use of Changing Conditions

### Climate Change: a Major Variable for Agricultural Productivity

Agriculture refers to the industry of producing crops and raising livestock. It involves wide-ranging activities such as production, processing, distribution and marketing. Agriculture is heavily influenced by land and weather conditions, especially changes in the existing conditions. Factors such as temperature, precipitation and duration of sunshine determine the overall process of cultivation from seed selection, to sowing to harvest.

Climate change has both positive and negative effects on agriculture. Positive effects include: (i) increased crop productivity caused by the rising CO<sub>2</sub>; (ii) expansion of double-cropping due to the increase in cultivation period; (iii) reduction of damage on overwintering crops caused by low temperatures; (iv) reduction of heating costs for protected cultivation; and (v) expansion of cultivatable areas for tropical crops such as mango and kiwi fruit. On the other hand, negative effects include: (i) decrease in yield quantity and quality due to shortened cultivation period by temperature rise; (ii) pests and weeds proliferation; (iii) intensified soil erosion due to increased precipitation; and (iv) declined soil fertility as a result of the accelerated organic decomposition. Therefore, measures must be taken to make use of the positive effects while minimizing the negative effects. In order to do so, a fundamental change in the agriculture system is in order.

### Northing Cultivation Boundary Line

When the climate gets warmer, cultivation boundary lines move northwards in Korea. For example, a major apple producer that moved northwards from Kyungbuk to Chungbuk province. Peach production likewise expanded nationwide, which used to be possible only in Kyungnam and the west coast regions<sup>(Lee and Shim 2011)</sup>.

### Increasing Agricultural Meteorological Disasters

During the Discussion Forum of Agriculture and Fishery Industries and Communities for Climate Change Adaptation held in June 2010, organized by the Korea Metrological



Administration (KMA) and the Korea Rural Community Corporation (KRC), an official of the US Department of Agriculture said that “in the past 10 years, frequency of natural disasters in the world has quadrupled and the socio-economic loss in consequence have increased by 14 times in the second half of the century compared to the first half (Choi 2010).”

Korea is not an exception. In recent years, more days with extraordinary temperature, heavy rainfall, pests, and metrological disasters have been observed in Korea. For instance, frequent heat waves and floods in the summer together with the prolonged warm weather and droughts in winter have resulted in pest proliferation. In agriculture, Rice Stripe Tenuivirus (RST) has spread all over the west coast region, and damage by brown grasshoppers and fulgoridae is also increasing nationwide (Kim 2011). The outbreak of soya bean blight has increased by 23 times from 2009 due to the propagation of plant lice. The annual cost of metrological disasters on agriculture is estimated to be approximately USD 90 billion.

The extreme weather events are not the only factor making future forecasting more difficult. Around the world, the scale of destructive natural disasters is becoming severe. For example, Hurricane Katrina hit New Orleans in August 2005 killed more than 10,000

#### Palm Trees along the Seaside of Jeju Island

As a result of global warming, it became possible to grow palm trees in Jeju Island. Although their usage is only limited to decorative purpose at the moment, there is possibility to expand to palm-tree industry.



people and caused total damage estimated at USD 200 billion (CBC News Online 2005). Other deadly disasters include Cyclone Nargis in Myanmar in April 2008 which resulted in 140,000 deaths (BBC News 2009). Closer to home, Korea was hit by Typhoon Rusa in 2002 and Typhoon Maemi in 2003.

#### Forewarnings of Chronic Food Shortage

Self-sufficiency of major grains in Korea was 28% as of 2008. Korea is heavily dependent on imports for grain supplies except for rice (Jung 2011). However, rice yield is expected to decrease by 1.1%-1.7% by 2020 if the average temperature rises by 2-3% and the concentration of CO<sub>2</sub> in the atmosphere rises to 510-680 ppm.

#### Vulnerability of Food Quality

The pattern of food consumption is also subject to climate change. For instance, Korean consumers may have to shift their preference for sticky rice (Japonica rice) to long-grain rice (Indica rice) if the average temperature in the Korean peninsula continues to rise creating a more favorable condition for growing long-grain rice.

On the other hand, imported tropical fruits will become more affordable in the Korean domestic market. Some Korean traditional crops such as sticky rice, apples, pears, cabbage and radishes will gradually become scarce and expensive.

#### Challenges of Climate Change Adaptation for Agricultural Sector

To date, agricultural production relied on the use of machinery and chemical fertilizers to achieve the economies of scale. The international food trade system is grounded in the principle of comparative advantage, and assumes cheap oil. With these combined factors, excessive use of fossil fuels in agriculture has been an important cause of climate change. There is a need for new farming methods that use less energy and generate minimal GHG emissions. In addition, achieving national food sovereignty to ensure the survival of the nation and its people has emerged as a foremost concern of many countries due to growing uncertainty in agricultural production. In order to achieve this, it is necessary for governments to understand the agricultural vulnerability of their countries and find ways to enhance adaptability accordingly.

#### Ways to Reduce GHG emissions in Agriculture

The following are the ways to reduce GHG emission actively:

- 1 **Promotion of an environment-friendly farming and livestock industry:** The majority

of the agricultural products that we eat today are produced using chemical fertilizers, which generates methane and nitrous oxide during the process. If the use of chemical fertilizers is replaced by other environment-friendly alternatives, it will have a double gain of reducing GHG emissions while maintaining productivity. Currently new cultivation methods and water management systems for rice farming are being developed to reduce methane emissions. For dry-farming, careful studies on the use of different fertilizers are underway to reduce nitrous oxide.

- 2 **Animal excretion resource:** Animal excretion, which is traditionally perceived as causing water pollution and odor, can become useful when converted into biogas and liquid fertilizers. There are indeed instances where liquid fertilizers are utilized in rice farming and contribute to reducing the likelihood of weeds.
- 3 **Proliferation of energy efficient agricultural machinery and facilities:** In 2008 the amount of energy used by agricultural facilities and machinery was 1,975 thousand TOE (Lee et al. 2011). Energy conservation or efficiency is achievable by making use of geothermal or solar heat, or the pallet of agricultural by-products.
- 4 **Revitalization of local food campaign:** Korea's dependency on food ingredients from foreign countries is very high. Korea's food sufficiency including the animal feed was only 26% in 2006 while its grain imports amounted to about 14 million tons annually. This generates food miles and unnecessary energy consumption (Jung 2011). In order to minimize this problem, more food should be consumed close to where it is produced. The first step towards revitalizing the local food campaign is to increase domestic food sufficiency like the 'chi-san-chi-sho (地産地消)' movement in Japan.
- 5 **Development of bioenergy:** One ton of biodiesel has the effect of reducing 2.2 tons of CO<sub>2</sub>. Research is underway to develop optimum oilseed rape with high-yield ability, cellulose crops for methanol production such as flame grass, and improvement in the bio-energy production process.

### Crop Adaptation Policies by the Korea Rural Development Administration (RDA)

The basic principle of climate change adaptation policies for crops is to take advantage of the positives while minimizing the negatives. For this purpose, adaptation policies implemented by the RDA are as follows (Lee and Shim, 2011).

- 1 **Right crop for right land:** This method refers to boosting agricultural productivity by making the best use of the natural environment and local conditions. For example, traditional categorization of major producing regions should be revised based on the changing climate, reflecting the most suitable producing conditions for each crop as well as delaying

or advancing sowing or cultivating time.

- 2 **Climate-change-resistant breed:** It is necessary to develop new breeds that are resistant to high or low temperatures and droughts at the same time maintaining the traditional taste. Food crops, vegetables and fruits with high adaptability to unusual weather events should also be developed and supplied.
- 3 **Development of new cultivation technology** in preparation for extreme weather events: Specific examples include crop cultivation technology that is adaptable to climate change, water-conserving rice farming technology, and customized irrigation methods for different regions, crops, time periods and water capacities for the most efficient use of agricultural water resources.
- 4 **Precision farming:** Recently, the RDA invented a portable soil electrical conductivity sensor, which measures the extent of soil salinity accumulation in just 5 seconds without digging the land. Soil salinity accumulation occurs when an excessive amount of fertilizers is retained in the soil for a long time, especially in facilities blocked from rainfall, which leads to declines in yield and quality. Aside from the sensor, more sophisticated devices will be developed in the future such as a weeding robot for rice farming, electrically controlled rice-planting machine, and devices based on geographic information systems.
- 5 **Introduction and supply of tropical crops:** In Korea, it has been accepted that tropical fruits such as mango and papaya are only available by import or growing in greenhouses. As the weather has become warmer in Korea, they are now produced in many southern regions including Jeju Island. As such, it is necessary to actively embrace innovations and new measures to positively react to climate change.

### RDA's Food and Agricultural Technology Support in Asia

- 1 **Pest and weed response system:** An integrated system of monitoring, information sharing, and control should be in place to prepare for unexpected attacks from pests and weeds resulting from climate change.

■ Figure 2-4: Variation in Rice Yield due to the Combined Impact of CO<sub>2</sub> Concentration Level in the Atmosphere and the Temperature rise

Temperature rise	Variation in rice yield		
	340ppm	510ppm	680ppm
Current level	0	10.2	14.2
+1%	-7.5	1.1	4.9
+2%	-12.1	-4.4	-1.1
+3%	-14.5	-7.7	-4.3

(Figures are based on the data of five-year (2001-2005) average rice yield in 19 units of National Agricultural Cooperation.)

- 2 **A new livestock breeding system in case of heat waves:** Effective livestock management system for heat waves should be suggested along with individual guidelines for each type of livestock such as chickens, cows, pigs, etc. In addition, change in meadows should be monitored constantly and provide the basis for adaptation measures.
- 3 **Crop production forecasting mechanism:** A forecasting mechanism should be devised to prepare for price changes in the global grain market. The mechanism should include specific information such as: current production level by area, soil and water resources; weather and climate information of major production areas; yield estimation based on geographic information systems and crop modeling; integrated forecasting systems using satellites, models, and statistics; and food policy-making support mechanisms.
- 4 **International cooperation for stable food supply:** The RDA has invited 3,275 people from 116 countries to its training programs and sent 455 experts to 72 countries between 1972 and 2008. Since 2009, Korea Project on International Agriculture (KOPIA) centers have been operating in various countries including Vietnam, Uzbekistan, Kenya, Brazil, Myanmar and Paraguay. The Asian Food and Agriculture Cooperation Initiative (AFACI) was established in 2010, a regional cooperation to improve agricultural productivity. Such activities to transfer Korean agricultural skills to developing countries can be seen as a way to repay the assistance Korea received in the past such as the development of unification rice by the International Rice Research Institute (IRRI).

## II-4. Climate Change and Health

Weak Social Groups Exposed to More Risks

### Spread of Diseases Due to Climate Change

The Intergovernmental Panel on Climate Change (IPCC) report in 2007 pointed out that the major harms from rising temperatures are lack of water, ecosystem change, food shortages, coastal flooding, and health risks. Heat exhaustion, stress due to heat cramps, infectious diseases, and air pollution damage are included among the health risks.

There are also many cases of death and injury due to weather disasters such as floods, tsunamis, droughts and other extreme weather events aggravated by climate change. Between 1991 and 2002, a total of 1,591 people died from weather disasters in Korea. Meanwhile between 1992 and 2003, the death toll due to summer heat stress in four cities was estimated to be 2,100 (Korea Environment Institute 2005).

Waterborne diseases such as bacillary dysentery, cholera and typhoid along with food borne diseases seem to have a close correlation with ambient temperatures and global warming. Animal-mediated diseases are also affected by climate change. Both the host and pathogens are sensitive to temperature, humidity, and precipitation.

Malaria is a typical animal borne disease with climate sensitivity. According to the World Health Organization (WHO) every year, 3-5 million people are infected and of these, one million people died from this disease. Between 2005 and 2007, in cases where temperatures rose by 1 degree Celsius, the average incidence of tsutsugamushi, malaria, shigellosis, Leptospiral and Vibrio parahaemolyticus increased by 4.27% in Korea (Korea Institute of Health and Social Affairs 2008).

Due to the growing demand for energy, fossil fuel use continues to rise thereby increasing fine particles, nitrogen oxides, sulfur oxides and air pollutants including ozone. Ozone increases as the temperature rises. Therefore, the incidence of respiratory diseases is climbing due to air pollution. In addition, studies indicate that cardiovascular diseases can increase due to the same causes. Air pollution does not only increase respiratory diseases and other illnesses, but also increases the mortality rate.

Moreover, allergens like pollen are also increasing. Pollen in plants multiplies with the

rise in temperature. There are also changes in the flow of distribution and density of plants, bacteria and fungi due to heightened temperatures. As a result, the incidence and prevalence of respiratory diseases such as asthma and atopic dermatitis becomes severe.

### The Elderly Are Vulnerable to High Temperatures and Water Borne Diseases

The elderly suffers the most health effects from these high temperatures. When exposed to high temperatures, the body normally increases cardiac output and undergoes vasodilation. It also increases the amount of ejected ventricular blood to dissipate the high temperatures. However, the elderly (over 65 years old) have a very weak capacity to respond to this kind of change.

The elderly lack cognitive recognition of sudden temperature changes. When moving from the indoors to the outdoors where the temperature is high, their bodies may not respond adequately so that they experience heat stress. Elderly persons having chronic illness or neuroleptic, anticholinergic medications may run a higher risk of heat stress. People with heart diseases may be especially vulnerable to related death.

The ratio of the elderly infected with waterborne, food borne or animal diseases is not as high as other age groups. However, once an elderly person is infected, such infection can lead to a high mortality rate. In addition, elderly persons with respiratory diseases can die if exposed to air pollution and heat stress.

### Child Health More Sensitive to Environmental Conditions

Children, including young infants suffer greater impact from environmental conditions because they are physically, psychologically and cognitively immature. Children with many outdoor activities are at high risk for heat stroke. In addition, there are higher risks of skin diseases caused by ultraviolet light. The second leading cause of child deaths worldwide is infectious diarrhea. Infectious diarrhea usually result from contaminated water and waterborne gastroenteritis, which are usually high in countries that have poor water facilities. Of course, water supply contamination from flooding also occurs even in developed countries.

For children the infection and mortality risks of malaria and animal-borne disease are relatively high. They are also vulnerable to diseases such as atopic dermatitis due to the increase of allergens caused by rising temperatures. Moreover, children also experience greater risk of respiratory disease due to atmospheric pollutants because of immature respiratory tracts.

### The Health of Vulnerable Communities Exposed to Risks

The regions suffering the worst damage from global warming is Asia and the Pacific

Islands. Even in Korea, the effects of climate change vary depending by regions and socio-economic differences. There have been warnings in the past of rising sea levels due to global warming. Coastal communities could experience erosion damage due to rising sea levels. In cities, the impact of climate change are greater on the lower socio-economic class. The disabled, solitary elders and groups with limited mobility such as patients with chronic illnesses are subject to quick isolation from natural disasters. They may experience difficulty in adapting to extreme weather changes such as heat waves. People who work outdoors are at a high risk for extreme heat and heat stress.

The Korean government is taking measures to manage vulnerable groups by dividing the management into three categories: (i) epidemic prevention; (ii) protecting groups vulnerable to heat waves; and (iii) air pollution. The followings are the detailed policies measures for the three categories.

#### (i) Epidemic prevention:

- a. Strengthen early detection by operating waterborne (Vibrio-Net) and food borne disease surveillance (EnterNet-Korea) and vector surveillance systems (Vector-Net).
- b. Strengthen projects of prediction of climate change induced endemic diseases and combat medium-spread infectious diseases.
- c. Conduct surveillance in coast and airport quarantine to prevent foreign inflow of infectious diseases.

#### (ii) Protecting groups vulnerable to heat waves:

- a. Publicize, train, and disseminate a health care manual in preparation for extreme heat targeting the chronically ill and elderly, who are vulnerable to heat waves.
- b. Expand public health service assistantship who visit health screening facilities and vulnerable groups, hold health diagnosis and check up calls or text messages.

#### (iii) Protecting groups vulnerable to air pollution:

- a. Build surveillance system to track respiratory and allergic diseases due to air pollution.
- b. Strengthen preventive measures against asthma and allergic diseases led by public health centers with the surrounding community and residents as target groups.





# Green Energy



III-1. Energy Efficiency 074

III-2. Smart Grid 079

III-3. Fuel Cells 083

III-4. Photovoltaics 088

III-5. Wind Power 094

## III-1. Energy Efficiency

### Saving Energy and Raising Efficiency

#### Energy Efficiency and Energy Intensity

The indicator universally used to measure energy efficiency is 'energy intensity'. There are two types of energy intensity. One is an *added value of energy intensity* that indicates the amount of energy used to create a certain amount of added value (usually USD 1,000 or KRW 1 million), and the other is *the energy intensity of production* that is based on the physical amount of production.

*Energy intensity of production* more accurately measures the essential energy efficiency of particular production processes, equipments and facilities. However, because *energy intensity of production* is different per unit of product, it is difficult to compare efficiency per se. For this reason, *added value of energy intensity* is more widely used. Lower intensity means higher efficiency, and therefore an increase in GDP or decrease in total energy consumption.

#### Importance of Energy efficiency

Many countries seek to improve their energy efficiency. The International Energy Agency (IEA) proposed the '25 Energy Efficiency Policy Recommendations' for them and publishing progress reports. Korea seeks to improve its energy efficiency through policies such as tax breaks and loans for investments in facilities that save energy. In July 2009, the government established the Energy Efficiency Bureau within the Ministry of Knowledge Economy (MKE). The MKE is in charge of reducing and improving efficiency in Korea.

Korea's focus on energy efficiency was motivated by the challenges of energy security, climate change and economic competition. With the respect to energy security, Korea has limited energy supply and therefore must emphasize energy conservation, the so-called *the fifth fuel*. In addition, climate change concerns were important issues and 85% of all GHG emissions in Korea occur from energy combustion in Korea <sup>(Korea Energy Statistics Information System, www.kes-is.net)</sup>. The government announced a national GHG emissions goal at the end of 2009 of 30% of GHG emissions compared to its business as usual (BAU). Half of the reduction goal will be accomplished through improvement in energy efficiency.

Lastly, energy efficiency is a powerful factor in the economy, since energy cost is reflected in the cost of the product. Energy cost has direct effect on Korea's trade balance, representing a high proportion of imports. Korea imports 96% of all its energy. For example, Korea imported USD 91.2 billion of energy in 2009, which is equivalent to the amount of exports for ships, semiconductors and cellphones the three major exports of Korea <sup>(Ministry of Knowledge and Economy 2010)</sup>. According to the Korea Development Institute (KDI), an increase of world's oil price by 10% would impact negatively on Korea's GDP by 0.2%, investment by 1% and consumption by 0.1-0.2%.

#### The Fifth Fuel: Saving Energy and Raising Efficiency

Traditionally, sources of energy were classified as fire (the first fuel), oil (the second fuel), nuclear power (the third fuel), and renewable energy (the fourth fuel). In the special report published on 31 December 2008 issue of US's Time magazine, it included energy efficiency improvement as a new source of energy, calling it as *the fifth fuel*.

*"There is something more important than green technology. It is green living. It takes long time and much money to develop green technology, but green living can be done right away by anyone. According to the International Energy Agency, GHG emissions can be reduced to a level one third lower than the current level through energy saving and efficiency. This is why energy saving is called the fifth fuel. Korea, in reality, imports almost all its energy, so if Korea saves 10% of its energy, Korea can earn more than KRW 10 trillion (USD 9 billion) every year. However, the type of energy saving that I perceive is not such. Saving is the most humanistic action of caring and considering others. Each four person household emits 700kg of carbon dioxide, 400kg from heating or cooking and 300kg from use of private vehicles. Scholars argue that each household needs to plant more than 3,000 pine trees to offset the carbon dioxide emitted by them. If a family takes its own vehicle from Seoul to Pusan, it produces 200kg of carbon dioxide. This is why we campaign to make use of public transportation such as trains for this reason."*

"Good Morning, this is the President" President Lee Myung-bak on Radio and Internet broadcast on 10 August 2009

As the President emphasized in his speech, *the fifth fuel* refers to the improvement in energy efficiency. It does not simply mean saving energy, but it encompasses the concept of delivering the same or more result while reducing the energy inputs. Therefore, the key is to reduce the energy consumed in producing a unit of product or utility.

#### Reduce Energy Demand by 20% with Current Level of Technology

Improvement in energy efficiency can yield major benefits quickly. If one saved all the

energy wasted in the power plants of United States, it would be enough to power Japan for one year. Imagine the amount of energy wasted worldwide.

Moreover, energy efficiency is an immediate way to respond to the GHG emissions problem we face today. Without additional technology development, one could reduce more than 20% of energy demand worldwide.

Therefore, energy efficiency needs as much attention as developing renewable energy sources. In fact, there is a limit to expanding the renewables supply due to high production costs and technological challenges. Energy efficiency is the most cost-effective source of energy. It allows countries to buy time until the commercialization of renewable energy occurs. Moreover, instead of building a megawatt power plant, saving energy in “negawatts” not only creates more jobs with the equivalent cost but also is a more efficient way to deal with rapidly increasing energy consumption. “Negawatt” is a term newly created by Amory Lovins, the legendary energy efficiency specialist. It refers to the amount of energy saved from an hour of 1MW of energy consumption.

### National Policy for Development of the Fifth Fuel

There are many ways to improve energy efficiency. Many countries now operate energy efficiency regulations for equipment, facilities, and buildings, and support the technology development to improve efficiency.

Korea has three energy efficiency programs: (i) an energy efficiency rating system; (ii) a high-efficiency equipment certification program; and (iii) a standby power reduction program. A building energy rating system and energy conservation design criteria for buildings already exist for the building sector. To improve the efficiency of vehicles, Korea applies the Fuel Efficiency Grade Indication System to all types of vehicles.

The energy efficiency rating system indicates mandatory energy efficiency grades from 1st to 5<sup>th</sup> grade for 24 products<sup>i)</sup> that consume a lot of energy and are widely used by people. Production and sales of products that fall below the 5th grade is prohibited. The high-efficiency equipment certification program is a regulation that certifies products that are above specified standards for 41 products including various types of motors, ventilators, gas heaters, windows, and electric transformers. The standby power reduction program disseminates energy conserving products that reduces standby electricity. It indicates an

i) refrigerator, deep freezer, kimchi refrigerator, cooler, washing machine, cylinder type washing machine, dish washer, dish dreyer, water heater/cooler, rice cooker, vaccum cleaner, fan, air fresher, incandescent lamp, fluorescent lamp, ballast stabilizer, ballast stabilizer lamp, three-phase induction motor, home gas boiler, adapter, charger, heater/cooler, commercial refrigerator, gas water heater, car

energy savings e-standby standard for 20 products<sup>ii)</sup>. If a product falls below the standard, that product must be marked *below-standard*.

### Building Energy Rating System

The Building Energy Rating System that was originally applied to apartments is now expanded to office buildings. This rating system qualitatively evaluates the amount of heat energy produced and carbon dioxide emitted, giving grades based on the evaluation. In addition, when new construction is approved, all co-ops must deliver a plan and evaluation of energy efficiency. In comparison with developed countries, Korean standards have similar insulation standard for the outer wall, roof and floor, but have lower standards for windows and doors. The Korean government planned to raise the standards for windows and doors to double, and 50% higher for outer walls, roofs and floors by 2010.

### Fuel Efficiency Grade Indication System

For the transportation sector, Korea has the Fuel Efficiency Grade Indication System. The average fuel efficiency of a manufacturer’s fleet of passenger cars produced in a year is required to be at a specified level. In Korea, the fuel efficiency of a vehicle with an engine less than 1,600cc must be 12.4km/L. Engines above 1,600cc must be 9.6km/L. This standard is currently lower than that of developed countries. It will be raised to 17km/L by 2015.

### Development of Technology that Improves Energy Efficiency

In addition to improve energy efficiency, the Korean government plans to invest KRW 1.65 trillion (USD 15 billion) in technology development by 2014. Boilers, motors, furnaces, dryers, lighting, HVAC and home appliances were selected as the top seven types of equipment that consume the most energy. Also, the government plans to support the development of technology to improve power generation efficiency.

### Challenge and Tasks for Successful Production of the Fifth Fuel

To improve energy efficiency, actions must be taken on both energy demand and supply.

- 1 **Energy Demand:** Currently, power companies have no incentives to improve their efficiency. They make more profit as more electric power is sold. The government needs to implement an incentive structure to motivate electric power companies to pursue energy

ii) computer, monitor, printer, fax, copy, scanner, automatic power saving controller, TV, video, audio, DVD player, microwave, set-top box, door phone, wired/wireless phones, radio cassette, bidet, modem, home gateway



efficiency.

- 2 **Energy Supply:** Tremendous initial cost can be incurred to improve energy efficiency. For example, in constructing new apartments, better insulating products or highly energy efficient appliances increase the construction cost of those apartments. Conflicts can arise in this situation between construction companies and residents because the former has to bear the additional cost now while the latter will benefit from the reduced energy bill over the time. Policies needs resolve the temporal discordance between costs and benefits and conflicts between stakeholders. For example, the LED Light Lease Program promoted by the Korean government is a policy designed to resolve such discordance.

## III-2. Smart Grid

Electric Grid for the Next Generation

### The Appearance of Smart Grid

Smart grid refers to an intelligent electric grid that raises energy efficiency throughout the existing electric grid. Taking advantage of rapidly developing information and communication technology (ICT), the smart grid becomes the next generation electric grid that optimizes the electric system through the exchange of real-time information from sensors attached to equipment and products that produce and consume electricity.

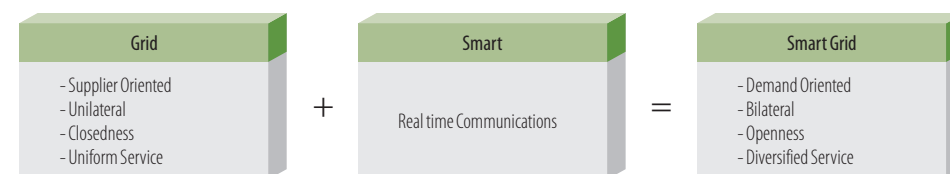
The smart grid gained attention at the end of 1990s. The idea was formalized in the *Grid 2030* published in 2003, which contained the future vision for the electric grid in the United States. Later, the smart grid was formally known through the dissertation published in the *Power and Energy Magazine* in 2005 by S. Amin and B. Wollenberg, titled “Toward a Smart Grid.”

The background for introducing a smart grid into countries varies depending on the country’s situation. It can be classified in two categories: One is modernization of the old electric grid. In order to modernize the run-down electric grid that lacked equipment investment since the privatization of the electric power industry, the United States proposed the smart grid as a solution. Second approach is that EU countries which are promoting it to increase energy efficiency and propagate renewable energy such as solar power.

### Innovation of a 120-year-old Traditional Electric Grid

The introduction of the idea of smart grid brought innovation to the 120-year-old traditional electric grid. The traditional electric grid is limited to mere electric power systems.

■ Figure 3-1: The Concept of Smart Grid



Controlling electric grid is one way from the centralized and large-scale generation equipment. However, the smart grid develops the electric power sector into a converging industry. It connects electric vehicle and distributed energy resources such as photovoltaics to charging facilities. It connects even household appliances to the grid so that they become intelligent and networked. As telephones that were invented 130 years ago have evolved to 4th generation smart phones, the smart grid is the major evolution of the traditional electric grid.

In addition, the smart grid is gaining attention worldwide as necessary infrastructure for green growth. In the age of energy depletion and climate change, expanding the dissemination of clean energy and improving energy efficiency is a must. In July 2009 at the Major Economies Forum on Energy and Climate, the smart grid was chosen as a technology for reduction of GHG emissions.

### Characteristics and Major Technologies

The major characteristics of the smart grid are the following:

- 1 Improve energy efficiency by deciding the optimal electricity generation level through real-time monitoring of electricity usage information;
- 2 Induce energy conservation by distributing energy demand and supply through application of different pricing based on electric power demand and supply;
- 3 Connect to a stable electric power system for irregular electricity produced from distributed energy resources such as wind energy;
- 4 Reduce power blackouts by equipping with self-assessment and recovery functions; and
- 5 Provide infrastructure for propagating electric vehicles.

The smart grid needs various technologies, as it is a system operating through complex connections between various equipments and systems. Following are some of the important technologies: they include automation technologies for distribution and generation, two-way communication technologies, AMI, power quality compensation equipment technologies, generation of renewables and connection technologies, electric power storage technologies, real-time power control and energy management system (EMS), smart appliances and electric vehicle charging and management technologies.

### Korea Favorable to Implementation of the Smart Grid

Korea's information technology and electricity technologies are world-class and the high population density makes efficiency of infrastructure very high. This makes Korea

favorable place for implementing the smart grid compared to any other country.

The Korean government announced the plans to promote the smart grid in the first committee meeting of Presidential Committee for Green Growth (PCGG) in February 2009. Since then, the groundwork of the smart grid has begun. In 2009, the Korea Smart Grid Association was founded, the Korea Smart Grid Institute was formed, the Jeju Test-bed site began its construction and the Smart Grid International Roadmap was written. In 2010, Korea announced its own Smart Grid Roadmap, and it is promoting the legislation called "Law on Construction and Accelerated Use of Smart Grid." Some of the detailed work that has been done is as follows:

- **Korea's Smart Grid Roadmap:** A detailed implementation plan for five sectors (Smart Power Grid, Smart Consumer, Smart Transportation, Smart Renewables, Smart Electric Service) has been drawn up. Korea will construct and operate a world-class test-bed city of smart grid in 2012, expand into metropolitan areas centered around consumers, and complete the nationwide smart grid for the first time in the world by 2030. For this, Korea will invest a total of KRW 27.5 trillion (USD 25 billion), KRW 7 trillion (USD 6.4 billion) for technology development and KRW 20.5 trillion on for infrastructure development.
- **Jeju Test-Bed Site:** The Korean government constructed a test-bed site in Gujwa-eup, Jeju Island for 6,000 households. It will connect electricity, communications, vehicles and household appliances to world-class smart grid technologies for testing purposes. For this site, 168 private companies that own technologies related to the smart grid formed 12 consortiums. The Jeju test-bed site began construction at the end of 2009. It plans to invest KRW 239.5 billion (USD 217.7 million) by 2013, of this KRW 68.5 billion (USD 62.3 million) is from the government, and KRW 1.71 billion (USD 1.6 billion) is from the private sector. There are five testing sectors: smart electric grid, consumer, transportation, renewables and electric services. In addition, the Jeju test-bed site constructed a public relations center for effective education to build domestic and international social consensus on implementation of the smart grid. The education center opened in November 2010 for the Korea Smart Grid Week event that coincided with the G20 Meeting.
- **International Cooperation:** In July 2009 during the G8 Summit, the smart grid was selected as one of the technologies that will reduce GHG emissions. Korea was chosen as a leader in the smart grid, along with Italy, and co-published Technology Action Plan for Smart Grid at the Copenhagen Climate Conference in December 2009. In January 2010, Korea's Minister of Knowledge Economy and Illinois' Director for the Department of Commerce and Economic Opportunity (DCEO) signed an MOU for collaboration on the smart grid. This MOU laid groundwork to build specific activities that the two parties can collaborate on, and culminated in

the signing of seven MOUs at a ceremony in Chicago in July 2010.

- **Enactment of Appropriate Laws:** In effectively promoting the smart grid, Korea plans to legislate a Law on Construction and Accelerated Use of Smart Grid in order to procure resources and give incentives for long-term investment. Also, Korea expects to deliver a basis for construction of electric vehicle charging stations by legislating parking spaces and household related laws.

### The Effect of Smart Grid

Korea's small to medium sized enterprises will find opportunities for expanding their exports through the smart grid and taking off as global companies. Between 2010 and 2030 when the nationwide smart grid is complete, Korea expects to reduce 230 million tons of GHG emissions, create a yearly average of 50,000 new jobs and increase to KRW 74 trillion (USD 67.3 billion) home consumption. At the same time, through efficient energy use, Korea expects to reduce KRW 47 trillion (USD 42.7 billion) in energy imports and KRW 3.2 trillion (USD 2.9 billion) in construction of new power plants. Korea also expects to gain KRW 49 trillion (USD 44.5 billion) of economic boost through increase of exports from reinforced international competitiveness.

However, many tasks lie ahead that needs to be resolved in order to achieve these synergies. Law and institutions to adopt real-time pricing need to be in place, as well as integration of existing electric grids and new technologies, and technology standardization for the convergence of heterogeneous technologies. Likewise, security of personal information and measures to counter hacking into electric grids need to be thoroughly examined.

Smart grid is a symbolic icon of green growth. However, since it is an area of unprecedented convergence in various technology and industries, Korea expects numerous impediments on the way. Therefore, for successful implementation, strong collaboration and cooperation among the people, the government, the private sector and scholars is important.

## III-3. Fuel Cells

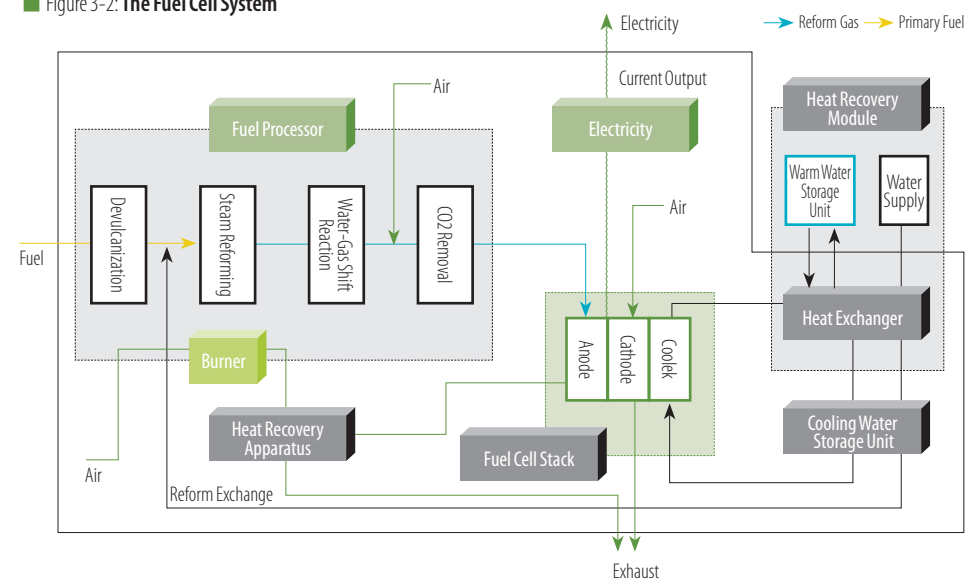
From Cellular Phones to Large Power Plants

### A Power Generating Mechanism that Converts Chemical Energy into Electrical Energy

A fuel cell is a device that generates electrical energy by converting the chemical energy of hydrogen and oxygen by means of an electrochemical reaction. It is composed of a fuel cell stack, a fuel processor and a balance of plant (BOP).

Fuel cells are highly efficient, environment-friendly devices compared to traditional thermal power plants. They create 45% less emissions of carbon dioxide and requires 31% less energy to operate <sup>(Lee 2009)</sup>. Moreover, fuel cell plants have the ability to utilize not only fossil fuel energy sources such as natural gas, oil or coal gas, but also non-fossil fuel sources including hydrogen, biogas and landfill gas. In addition, fuel cells have the added advantages

■ Figure 3-2: The Fuel Cell System



of being able to operate under custom, distributed power generation and are equipped with a backup generator. Meanwhile, fuel cells can maintain operation at over 95% of capacity.

The fuel cell stack is the part that generates electricity by creating an electrochemical reaction. That is, a series of connected single cells generate the required volume of electricity through the contact of hydrogen and oxygen. The fuel processor refers to the part that processes and converts fuel sources of the hydrocarbon family (not hydrogen, as is the case for city gas systems) into hydrogen. Furthermore, an inverter that converts the direct current created by fuel cells into alternating current is necessary, as well as a ventilator and pump for the supply of air and water, respectively. Finally, a heat exchanger is required for temperature control (Figure 3-2).

Fuel cells can be used for a variety of purposes. They can be employed as large-scale power plants that can replace traditional thermal power plants in providing electricity and heating for factories, buildings and residential homes. Fuel cell technology is also used in batteries that power portable IT devices such as notebook computers and cellular phones. It can also be utilized in power supply mechanisms in electric cars.

There are various different types of fuel cells, including: the Phosphoric Acid Fuel Cell (PAFC), Molten Carbonate Fuel Cell (MCFC), Proton Exchange Membrane Fuel Cell (PEMFC), Direct Methanol Fuel Cell (DMFC) and Solid Oxide Fuel Cell (SOFC). Of these, in consideration of domestic technological capacity and market competitiveness, particular attention is being given to MCFC for the purposes of distributed power generation; PEMFC for buildings and transportation; and SOFC for both buildings and distributed power generation.

Fuel cell power plants vary in size and capacity according to their purpose. For example, there are small (less than 10kW) plants for use in a single residential home or building. Medium-scale (10-250kW) plants are used in multi-household residential buildings or for the purpose of creating a small distributed power generation network. There also exist large-scale (250kW-1MW) plants connected to greater distributed power generation systems. Co-generation, or combined heat and power (CHP) generation, for buildings refers to a highly efficient (80%) system in which fuel cell plants installed directly in residential complexes or commercial buildings, and connected to the well-developed city gas pipeline system. Such systems can provide both electricity and heat to the occupants.

Fuel cells for vehicles can be utilized not only in automobiles and buses but also in industrial equipment such as forklifts or in small electric carts. Fuel cells can also be used in ships. Fuel cell vehicles, in addition to hybrid vehicles, will soon emerge as the next-generation means of transport to replace the existing fossil-fuel powered ones.

### Advancing Energy Security and Promoting Environmental and Economic Benefits

Of the existing various alternative energy methods, fuel cells are highlighted because they can be applied and used for numerous different purposes. Fuel cell technology represents the primary motor behind what President Lee Myung-bak, during the 60<sup>th</sup> anniversary of the founding of the Republic of Korea, described as the “hydrogen age” (Office of President, 2009). He said that fuel cells will allow Korea to turn the existing environmental and energy related challenges into opportunities. In other words, he pointed out that the development of fuel cells, in conjunction with the development of other renewable energy sources, could create a synergistic effect that will propel Korea into the position of a global “green” leader.

The importance of fuel cells can be summed up in the three E’s:

- 1 **Energy security benefit:** Hydrogen can be extracted from various types of fuels and renewable energy sources. As such, the diversification of energy supply will allow decreased reliance on fossil fuels.
- 2 **Environmental benefit:** Environment-friendly, non-fossil fuel sources of energy reduce our consumption of fossil fuels and consequently reduce emissions of CO<sub>2</sub>.
- 3 **Economic benefit:** Developing fuel cells and other renewable energy technologies requires the mobilizing of labor and capital across various industries and a wide range of technological innovations. Thus, new industries, markets and job opportunities arise, leading to economic benefits. As such, fuel cells are considered as the pioneering technology for green growth.

### Competition amongst Nations for Early Market Share

In order to successfully develop the fuel cell industry, it is necessary to localize production of materials and parts, decrease initial costs, develop high value-added products and enhance credibility of product performance and durability. In particular, PEMFC for buildings and vehicles, MCFC and SOFC for electricity generation – areas in which domestic investments are increasing and the global markets are expanding – are priority technologies requiring further advancements. For example, the price competitiveness of fuel cells for buildings, in which Korea is currently at a relatively high level of technical advancement, needs to be strengthened by enhancing the durability of the products as well as localizing the production of parts and materials.

In addition, investment towards general facilities and mass production capabilities needs to be promoted by expanding the initial diffusion of fuel cell technologies. In terms of fuel cell vehicles, continued technological innovation needs to occur in conjunction with

sample diffusion measures. In terms of MCFC fuel cell power plants, efforts are currently underway to transfer technology for localization while at the same time independently develop related technologies and production capacities. Meanwhile, it is necessary also to develop high value-added products for early market development and expansion in order to secure economic viability. For this, it will be necessary to expand the market through the development of applied technologies such as plant-connected MCFC, hybrid, co-generation, fuel cells for ships and more. At the same time, in order to improve efficient growth, turbine-connectedness (hybrid) and enlargement of the system need to be pursued to decrease cost of production and secure export competitiveness.

Looking at the stage-by-stage development strategy, the first stage lasting until 2012 will involve establishing the groundwork for the commercialization of fuel cell technologies. The details of this stage would include the standardization of parts and materials and the reduction of production costs through creating mass production capacity. Diffusion of household PEMFC and distributed power generation MCFC needs to occur for early development of the fuel cell market. Additionally, production of household SOFC and MCFC should become localized, while wrapping-up the technological development of commercial PEMFC. Moreover, technology development for secondary markets in uninterrupted power supply (UPS), backup-power PEMFC and MCFC for ships need to occur as well.

In the medium term second stage <sup>(2013-2020)</sup>, economic feasibility needs to be secured through the development of an export industry by means of system enlargement and optimization of mass production technologies. Full-scale overseas market expansion and the development of the export industry, in addition to the completion of distributed power generation SOFC technology, also need to be achieved.

The third stage <sup>(2021-2030)</sup> envisions the advent of the hydrogen age. Specifically this stage include establishing a hydrogen infrastructure by creating technologies for coal gasification and integrated coal gasification fuel cells (IGFC), which will pave the way towards replacing traditional thermal power plants and full-scale production of hydrogen fuel cell vehicles.

It is highly probable that the nation that can achieve the early establishment of a fuel cell market will likely evolve into the leading economic power in the said industry. Thus, above all else, it is important to develop a strategy for the domestic production of core technologies and parts that can enable Korea to establish itself in the market. In addition, it will be necessary to create the foundations for early market establishment through the development and dissemination of technologies that can facilitate early commercialization of fuel cell products. This will promote the self-sufficiency of domestic production companies. Korea will also need to look at the institutional framework that can facilitate the nurture of human capital, bring about the necessary regulatory systems and create other support mechanisms.

### High Hopes for Commercialization of Exports and Job Creation

The production of fuel cells for buildings began with around 200 test units being installed in 2010 and the installation of 10,000 units for residential homes. In 2010, in order to compete against developed nations, Korea will need to finish upgrading its technology so that domestic production can be fully commercialized and so that the unit price of fuel cells for buildings can be decreased. If these goals are achieved, it will be possible to supply about 100,000 units of fuel cells by 2020 <sup>(Korea Institute of Energy Technology Evaluation and Planning 2011)</sup>.

In terms of production of fuel cell vehicles, it is envisaged that around 1,000 will be supplied by 2012, after which we will reach the target of 10,000 units by 2015. By 2020, Korea hopes to begin mass production of fuel cell vehicles. With fuel cell power plants, Korea hopes to begin by producing about 50MW of electricity through fuel cell technology by the end of 2011. After this, it is envisioned that the production of fuel cells will be increased through the Renewable Portfolio Standard (RPS) policy <sup>(Lee 2009)</sup>.

The industry for fuel cells has a comprehensive portfolio that includes distributed power generation systems, fuel cell vehicles, co-generation plants for residential homes and portable batteries that use fuel cell technology. As such, there is a big ripple effect from the commercialization of fuel cell systems and production of parts. For this reason, the prospects for the creation of new engines of growth and job creation through fuel cell technology are bright. Nevertheless, unlike the developed countries that are equipped with well-organized supply chain systems for materials and parts for fuel cell technologies, this is not the case in Korea as of yet. To address these concerns, there are currently ongoing investment initiatives directed at domestic production of parts, systems and technologies.

To sum up, fuel cells represent a new technology with massive potential to be a new growth engine as they are an environment-friendly new energy source that can replace traditional sources. Reflecting this reality, there are worldwide efforts to commercialize fuel cell technology through government support and private sector involvement to encourage technology development and domestic production, particularly in Japan, the United States, EU and China.

The global trend in power generation technologies is shifting from the old idea of large, centralized power plants to smaller-scale, distributed power generation plants. When comparing the myriad different types of distributed power generation methods, in terms of price, it is true that power generation utilizing traditional gas turbines or engines is cheaper. However, when evaluating efficiency and environmental effects, fuel cells hold a comparative advantage. Moreover, given the speed of technological advancements in the fuel cells industry, combined with the bold investment schemes of businesses, the price of fuel cells will soon reach competitive levels.



### III-4. Photovoltaics

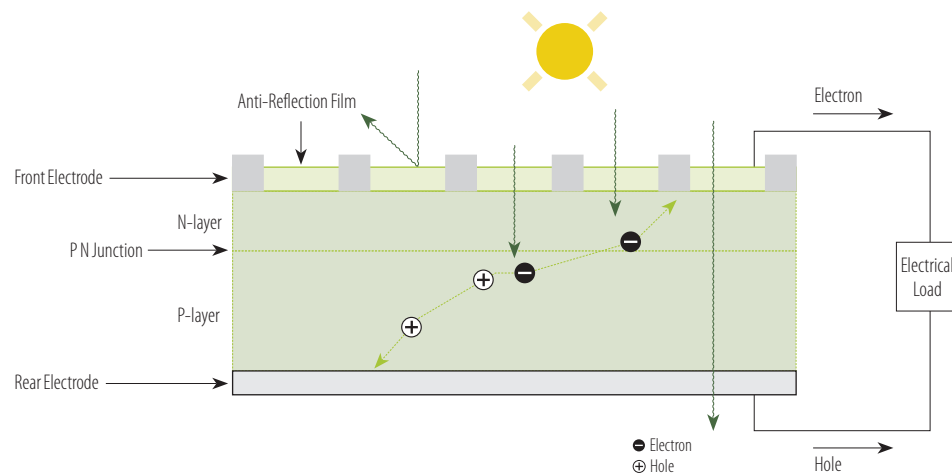
The Centerpiece of the Green New Deal

#### The Technology Behind Converting Solar Energy into Electricity

Photovoltaics (PVs) represent the solar cell power generation technology that can directly convert solar energy into energy. Unlike the older technology of solar power generation in which the radiation energy of solar rays is absorbed then converted into thermal energy, solar PV uses a semiconductor or dye-polymer solar cells to create electricity directly from solar rays.

Solar PVs are composed of the following: a solar cell, a module, a power conditioning system and an electricity storage device. The solar cell is created by a junction between the p-type semiconductor and n-type semiconductor (p-n junction), which is then coated with metal electrodes on both ends. Once sunlight enters and is absorbed through the cell, an electron and hole is produced. Then, the magnetic pull of the p-n junction electric field sends the electron to the n-side whereas the hole shifts towards the p-side, which creates

■ Figure 3-3: The Basic Structure and Power Generation Method of Solar Cells

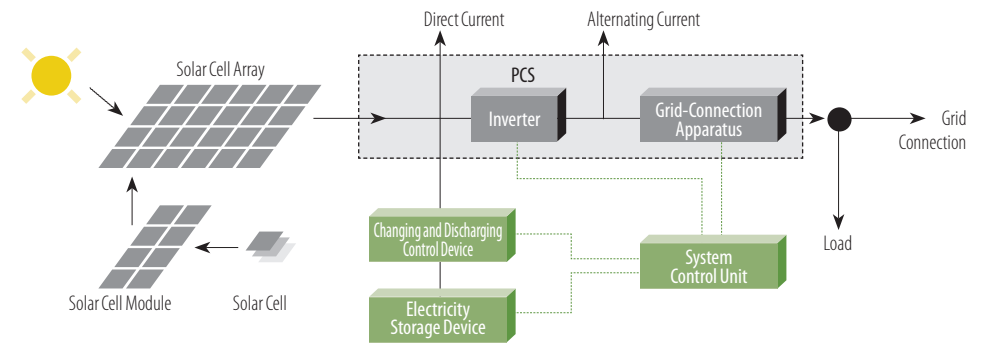


a new current, thereby reducing the difference of potential between the two sides of the junction. In short, solar PVs use the photovoltaic effect whereby electricity occurs once the semiconductor absorbs sunlight. Once sunlight enters the junction between the semiconductors, electrons are produced, creating a flow of electricity at the external circuit (Figure 3-3).

In order to reach an effective level of energy conversion, it is necessary that; (1) ample amounts of solar energy can be absorbed by the semiconductor; (2) the electrons created from sunlight are not easily destroyed and can be delivered to the external circuit; (3) materials are designed and used such that a large electric field can be created at the p-n junction; and (4) the design of the module and array should be optimized by using a direct parallel circuit structure such that the loss of electricity generated can be minimized.

The solar cell is designed in various ways depending on what sort of matter or substance it is produced with. If it is made with silicon, manufactured products would have about 16-19% efficiency while modularized products would show around 14-16% efficiency levels.

■ Figure 3-4: Basic Structure of Solar PV



■ Figure 3-5: Korea's Investment in Renewable Energies (Unit, 100million KRW)

Year	PV	Wind	Fuel Cell	Others	Total
2009	18,575	4,936	355	692	24,558
2010	30,337	6,130	1,053	1,271	38,791
Change	63.3%	24.1%	196.6%	83.6%	57.9%

■ Figure 3-6: Korea's Renewable Energy Export (Unit, million USD)

Year	PV	Wind	Others	Total
2009	1,656	762	10	2,428
2010	3,111	1,462	47	4,620
Change	87.8%	91.8%	370%	90.2%

That is, if the level of solar radiation from sunlight is  $1\text{kW}/\text{m}^2$ , through solar PV,  $0.15\text{kW}/\text{m}^2$  of electricity is generated (Ahn 2009).

The module of the solar PV system receives sunlight and converts it into electricity while the power condition system (PCS) converts the electricity from a direct current into an alternating current and transfers the current into the electric grid (Figure 4-4). There are two types of solar cells, the crystalline silicon solar cell and the thin film solar cell. Within thin film solar cells, they are further distinguished into the silicon thin film solar cell, the copper-indium-gallium-selenide (CIGS) solar cell, the dye-sensitized solar cell, the organic solar cell and the concentrating photovoltaics solar cell.

### 2012 – The Great Turning Point

The supply and demand imbalances in the Korean market for solar PVs caused disorder during the year 2009. However, in 2010, progress was made to turn the solar PV industry into an export-oriented market. At the same time, it is envisioned that the advent of the solar PV market will continue in the global market despite widespread economic stagnation, financial crises and the sluggish semiconductor market. In particular, the green new deals being pursued in Europe, the United States and Japan place solar PVs as the centerpiece of their policies.

Therefore, it is expected that the new business activities and the betterment of the business environment in solar PVs currently ongoing will lead to a great turning point in 2012. In other words, 2010 was the preparation period. Thus, from this year, it is expected that the solar PV industry will rebound and expand at a rapid rate. Specifically, it is worth noting the large-scale participation of Korean conglomerates such as Samsung Electronics, LG Electronics and Hyundai Heavy Industries.

The size of the domestic solar PV market is rated at KRW 2.25 trillion (USD 2 billion). This is which is a 650% increase from 2007 levels. However, this figure includes the subsidies for technological development, thus it might be over-inflated. If controlling government policy actions, with an assumption of a 20% expansion of the market in 2015 and 2020, the value of the market would be KRW 1.4 trillion (USD 1.3 billion) and KRW 2.7 trillion (USD 2.5 billion) respectively (Lee 2008).

Nevertheless, these figures are subject to change due to changes in the market circumstances or government policies. The numbers for the domestic export market for solar PVs during 2008 to 2009 is a bit nebulous due to the factors relating to importing countries' policies, but the export market has found balance starting in 2010. Currently, Korea is keeping pace with the global market in terms of technological development and investment.

### Strategies and Support Mechanisms for Securing International Competitiveness

Currently, the domestic solar PV industry has the capacity to manufacture the full array of materials from basic parts to the actual, final unit. In addition, due to the participation of major companies equipped with assembly-line manufacturing capabilities, the price of solar PVs is relatively low. However, as a latecomer into the industry, Korea's technological capacity in manufacturing crucial parts, new materials, PCS and the general manufacturing system stands at about 85% of that of developed nations (Lee 2008). In addition, due to a failure to effectively link R&D efforts with actual production, most parts are currently being imported from overseas.

In these circumstances, the following measures need to be implemented to develop the Korean solar PV industry.

- 1 **Technology:** Low cost, highly efficient, long-lasting technologies need to be developed to create new growth; develop technologies to enlarge the surface area of modules for export; secure technologies and raw materials that will enable production of durable and highly efficient next-generation solar cells; achieve early grid parity (the point at which renewable electricity is equal to or cheaper than grid power that uses oil due to limited supply of fossil fuels and decreasing production costs of renewable energy technology); analysis on patenting practices; and the securing of intellectual property rights through early innovation.
- 2 **Making solar PVs practical:** Attain price competitiveness through technological innovation that will allow domestic mass production; reduce costs through domestic production of crucial parts; decreasing unit production cost through development of highly efficient manufacturing processes; and cost-reducing technologies through use of domestic equipment and highly-efficient production mechanisms are all priorities.
- 3 **Marketability:** Specialization in different spheres of technology to create a polycentric market; making crystalline silicon solar cells highly efficient and strengthening price competitiveness; increasing confidence in thin film solar cell technology and establishing the technology for mass production; developing building integrated photovoltaic system (BIPV) for dye-sensitized and organic solar cells; and the establishing new markets in areas such as solar cell portable batteries are priorities.

In 2010, the Korean government's strategy in solar PVs prioritized the production of smaller solar PVs and increasing the share of domestic products in the market. In addition, it concentrated on securing crucial technologies for next-generation products such as thin film and dye-sensitized solar cells. Concentrated support was provided in the technology development of competitive single-multi crystalline silicon solar cell modules, and long-

lasting and pliable substrate binding amorphous silicon (a-Si) thin film solar cell modules. It also developed basic raw materials for the commercialization of next-generation dye-sensitized and organic solar cells, technology for long-lasting modules, BIPV, power conditioning systems for use in smart grids, low-cost single-multi crystalline silicon wafer production technology and technology for recycling of used materials.

Furthermore, in order to ensure domestic advancements in technology, Korea is in the process of developing low-cost and highly efficient crystalline silicon solar cells. To achieve this, it needs a strategy that will allow itself to be on a level playing field with the level of technology in developed nations while creating the technology for mass production of low-cost, highly efficient crystalline silicon solar cell modules. At the same time, Korea needs to look at strategies to: reduce manufacturing costs; secure technology for developing highly efficient, large surface area cells and modules; and create the market for these products. It is also critical to attain mass production capability for modules with more than 19% durability and highly efficient (more than 21%) solar batteries. Furthermore, it is necessary to commercialize and make economically viable the technology for high surface area silicon thin film technology in order to create opportunities for exports.

Although some amount of progress was made in 2010, Korea will need to pursue a new project to firmly establish itself in the global solar cell market by developing the technology for next-generation Si (silicon) thin film solar cells and dual-banded solar cells. With respect to CIGS thin film solar cells; Korea urgently needs the technology for a new module that can guarantee high efficiency and enhanced durability through use of multi-layer thin cell, multi-banded structure. Additionally, Korea needs to develop a new and cheaper non-vacuum manufacturing process that replaces the original vacuum process, a low cost print CIGS thin film manufacturing process, increased efficiency and long-lasting flexible substrates.

The transparency and color of dyes, the crucial element in dye-sensitized solar cells, needs to be optimized and the production shifted towards domestic producers in order that dye-sensitized solar cells can be fostered into a BIPV system. Materials and elements need to be diversified in order that the output from the module can be increased. Organic solar cells are one of the next-generation technologies that have the highest potential for development. But in order to realize this potential, it is crucial to develop reliable parts and the module that can ensure durability. Finally, it will be necessary to pursue cost reduction mechanisms by means of restructuring the production methods and securing basic raw materials.

In the year 2010, the solar PV industry attempted to find its place as an export industry through a strategic investment plan based on silicon technology and the strength-

ening of R&D measures. However, because of the nature of solar PV technology, concerted R&D efforts by industry, academies and research institutes will continue to be necessary to increase efficiency and reduce costs by realizing economies of scale. Already, numerous nations have recognized this fact and are undertaking massive public investment schemes. As a result of the Ninth Meeting of the Presidential Committee on Green Growth (PCGG) held in October 13, 2010, Korea is now firmly committed to making solar PV along with wind technology into new drivers of growth for the future, with a total of KRW 40 trillion (USD 3.6 billion) in combined public and private investments ([www.greengrowth.go.kr](http://www.greengrowth.go.kr)).

## III-5. Wind Power

The Item of the Future

### Onshore Wind Power: the Most Economically Viable Renewable Energy Source

The need for environment-friendly and non-exhaustive energy sources are two factors that have recently made alternative energy sources important. Wind power, solar PV, solar energy, geothermal energy, tidal power, wave energy and biomass are some of the major sources of alternative energy. Amongst these, there is significant interest in wind power.

The technology for wind power was actually introduced in ancient Persia at around the 7th century in windmills that were used to grind grains and pump water <sup>(Hassan et al. 1986)</sup>. The first person to discover the use of windmills as a wind power plant for the generation of electricity was the Danish meteorologist Poul La Cour in 1891 <sup>(Cleveland 2004)</sup>.

There are many advantages to wind power. Most of all it is the most economical of the renewable energy sources. In comparing the unit cost of production of renewable energy sources in 2008, solar PV's figure is 716 KRW/kWh (0.6 USD/kWh) whereas that of onshore wind power is 107 KRW/kWh (0.09 USD/kWh). Moreover, the current domestic system marginal price (SMP) is in excess of the compensation price of 107.29 KRW (0.1 USD). Even when including external costs, on shore wind power is still cheaper than coal or liquefied natural gas (LNG) <sup>(Small & Medium Business Administration 2009)</sup>.

The power of the wind rotates the rotor blades of wind power plants, thereby generating electricity. Theoretically, the maximum amount of energy that can be generated through wind power stands at 59.3% <sup>(Betz 1966)</sup>. In practice, however, when taking into account various factors such as the shape of the rotor blades that determine efficiency and the frictional force of the unit itself that needs to be overcome, efficiency stands at around 20% to 50%.

The wind power plant is composed of the rotor blade that converts wind into rotatory force, the tower that supports the rotor and the mainframe, the generator which converts the rotatory force into electricity and the gear box that speeds up the rotation speed of the blades and transfers that energy into the generator. A standard wind power plant model such as the MM92 manufactured by Repower has over 8,000 separate parts. In terms of the production costs of the three main parts: including the tower represents 26.3%; the rotor blade 22.2%; and the gearbox 12.9% of the total costs <sup>(Jung 2004)</sup>.

### The Geographical Advantage of Korean Offshore Wind Power

The domestic potential for offshore wind plants is high given Korea's geographical features. Of the total surface area covered by Korea's sea, 17.5% has a depth of 30m or less, meaning the amount of energy that can be generated annually reaches 20.1TWh. Specifically, the areas around Jeju Island and the South Sea are prime locations.

The government has drafted a wind power roadmap to exploit the ample potential of domestic offshore wind energy. The roadmap is largely divided into short-term and long-term priority areas for technological development. In the short-term, the focus will be on high capacity offshore systems and items that can be used for exports. In the long-term, the focus will be on creating next-generation, large-scale wind plants and futuristic floating offshore wind plants. The roadmap envisions that in the beginning stages, government initiatives and investment will be crucial in driving progress. The roadmap seeks to induce private sector involvement at each successive stage.

Domestic players in the wind power market include Unison <sup>(www.unison.co.kr)</sup>, which offers 750kW gearless wind turbines and Hyosung Power & Industrial Systems <sup>(www.hyosungpi.co.kr)</sup> which offers 750kW wind turbines equipped with a gearbox. These two products are currently in the commercialization stage. Additionally, Doosan Heavy Industries & Construction <sup>(www.doosanheavy.com)</sup> has successfully developed a 3MW wind turbine.

Current R&D projects underway include the 5MW offshore wind turbine, the 2MW direct drive wind turbine as well as individual parts such as the gearbox, the yaw and pitch drive and the yaw bearing. Research is also ongoing for the optimal design for onshore wind farms. Research also continues on the feasibility of offshore wind power plant farms, as well as the on-site test operation of offshore wind plants <sup>(Ministry of Knowledge and Economy 2010)</sup>.

According to plans for the establishment of offshore wind farms <sup>(MKE 2010)</sup>, Korea will need to evaluate the most geographically favorable location while also analyzing the ease of connecting such a farm to the central electricity grid and the possibility for expansion. Given these requirements it is envisioned that around five or six wind power plants will be installed preliminarily. In addition, research is ongoing to connect such a farm to a high voltage direct current (HVDC) grid.

About 80% of the technology for Korea's wind power industry stems from heavy industries. Meanwhile, about 80% of the main bearing has been localized. Korea forms up to 98% of the global market when it comes to floating structures <sup>(Korea Institute of Energy Technology and Planning 2010)</sup>. Thus if this technology is applied to wind power, the possibilities for floating offshore plants are immense. For this reason, offshore wind plants are seen as the next big export opportunity following on from Korea's successful shipbuilding experience.





# Green Technology and Industry



IV-1. The 27 Core Technologies	098
IV-2. Commercialization of Green Technologies	105
IV-3. Green IT	011
IV-4. Green Industry	117
IV-5. Greening the Existing Industries	121
IV-6. Green Certificates	132
IV-7. Public Procurement of Green Products	136
IV-8. Green Jobs	141
IV-9. Green Talent	145



## IV-1. The 27 Core Technologies

Korea's Path towards the Age of Green Competition

### Green Technologies: Two Birds with One Stone

Green growth incorporates two core ideas. It seeks to achieve the dual goals of environmental sustainability and economic growth. Green technologies represent the foundation upon which both of these ideals can be achieved.

Korea's Framework Act on Low Carbon, Green Growth illustrates green technologies in detail. Green technologies help minimize emissions of greenhouse gases (GHG) and other pollutants through the development of GHG reducing technology, increasing energy efficiency, developing clean manufacturing processes, clean energy and promoting comprehensive, socio-economic efficient use of energy and resources (refer to paragraph 2, article 3 of the Framework Act). The crucial point behind Korea's green growth policy is to conserve energy and resources while utilizing them in an efficient manner, in addition to realizing a low carbon society and identifying new factors for economic growth and job creation through green technologies such as clean, renewable energy, green cars and resource recycling technologies.

### The Age of Fusion Green Technologies

Traditionally, green technology was defined as renewable or clean energy sources that were environmentally friendly. In recent years green technology has also come to include emerging fields such as information technology (IT), biotechnology (BT) and nanotechnology (NT) that embody new technologies or are fused with existing ones.

In January 2009, the Korean government drew up a Comprehensive Plan for the Research and Development of Green Technologies (Ministry of Education, Science and Technology 2009). The Plan embodies the central idea that in order for Korea to compete and emerge as a green leader, it needs to successfully develop green technologies and link them to economic growth. The Plan further identifies 75 potential technologies, of which 27 were designated as core technologies (Figure 4-1). In May 2009, a Strategy for the Development and Commercialization of Major Green Technologies was drawn up by the Presidential Committee on Green

Growth. It categorizes the 27 core technologies into (1) energy source technologies; (2) energy efficiency enhancing technologies; (3) industrial and atmospheric greening technologies; (4) environmental protection and resource recycling technologies; and (5) pollution-free commercial technologies. The plan further identifies strategies and measures that cover the full spectrum of developing such technologies from research to commercialization. This includes market analysis and strategies, measures to establish a market foundation and regulatory measures (Figure 4-2).

Figure 4-1: Selection Process of the 27 Core Technologies



Figure 4-2: Green Technology Category

Category	Item	Sub-item
Technology for Energy Source	Renewable Energy	PV, Wind, Bioenergy, Ocean Energy, Geothermal, Solar, Hydro, Mixed Energy
	Nuclear/ Nuclear Fusion	Nuclear, Nuclear Fusion
	Hydrogen, Fuel Cell	Hydrogen Creation, Storage, Fuel Cell
Technology for Energy Efficiency	Enhancing Efficiency and Application of Fossil Fuels	CTL and Gasification, GTL, New Fossil Fuels
	Increasing Electricity Efficiency	LED, IT Machinery, Super-Conduction / Power IT, Enhancing Power Generation Efficiency, Energy Storage
Technology for Greening of Industries and Spaces	Enhancing Transportation Sector Efficiency	Vehicles, Railways, Ships, Space Aeronautics, Transport
	Green Territory	Green City, Home/ Building
	Ecofriendly Manufacturing Process	Ecofriendly Manufacturing Process
Technology for Environmental Protection and Resource Recycling	Climate Change Prediction and Assessment of Effects	Climate Change Prediction, Assessing Global Changes in Environment, Climate Change Adaptation
	Monitoring and Control of Air Pollution	CCS, non-CO <sub>2</sub> Pollutants Monitoring and Reduction
	Water Quality	Water Treatment, Securing Water Resources
	Environment Rehabilitation	Ecosystem Rehabilitation, Ground Water Restoration, Eco-friendly Agriculture
Technology for Pollution Free Economic Activity	Waste Treatment and Environment Preservation	Recycling Wastes for Resources and Energy, Waste Treatment, Environmental Risk Assessment, Cleansing the Environment
	CT, Soft-based IT, Knowledge Service, etc.	Virtual Reality

Source: PCGG (2009)

■ Figure 4-3: 27 Core Technologies, 17 New Growth Engines and 15 Green Energy Technologies- a Comparison

New Growth Engines(17)	Green Technologies(27)	Green Energy(15)
IT Fusion System	Power IT and Technology for Enhancing Efficiency of Appliances	Power IT, Superconduction
LED Appliances	LED lighting, Green IT Technology	LED
Renewable Energy	- High Efficiency, Cost Saving Technologies of Silicon-based Solar Cell - Non Silicon Solar Cell Production and its Crucial Original Technologies - Bioenergy Production Related Technologies: Component-wise and System-wise - High Efficiency Hydrogen Creation and Storage Technology - Next Generation, High Efficiency Fuel Cell Technology - High Efficiency Secondary Battery Technology	- PV - Wind - Fuel Cell - Clean Fuel - Energy Storage
Low Carbon Resource Industry(CO <sub>2</sub> Capture)	- CCS Technologies - Non CO <sub>2</sub> Processing	CCS
Green Transportation	High Efficiency, Low Pollution Vehicle Technologies	Green Car
Low Carbon Resource Industry(Nuclear Energy)	- Technologies for Advanced Light Water Reactor Construction and Design - Technologies for Eco-friendly Non Proliferating Fast Reactor - Technologies for Design and Construction of Nuclear Fusion	Nuclear Energy
- Cultural Contents & Software - Global Education Service	Virtual Reality Technology	
Cutting Edge Green City	Ecosystem and Green Rehabilitation	
Advanced Water Treatment	- Technology for Water Quality Management and Assessment - Technology for Alternative Water Resources - Monitoring of Harmful Substances/ Environmental Cleansing	
- Technology for Water Quality Management and Assessment - Technology for Alternative Water Resources - Monitoring of Harmful Substances/ Environmental Cleansing		Superconduction
	Technology for Eco-friendly, Low Energy Buildings	Building Energy
	Technology for CTG	IGCC
- High Value-added Food Industry - High Value-added Medical Service - Broadcast, Communications Fusion Industry - Robot Applications - New Materials, Nano Fusion - Green Finance - MICE Fusion Tourism		
	- Climate Change Prediction and Modeling - Climate Change Effects Assessment and Adaptation - Waste Reduction, Reuse - Green Process - Eco-friendly Plants - Intelligent, Transport System	
		Small Cogeneration, Heat Pump

Source: PCGG (2009)

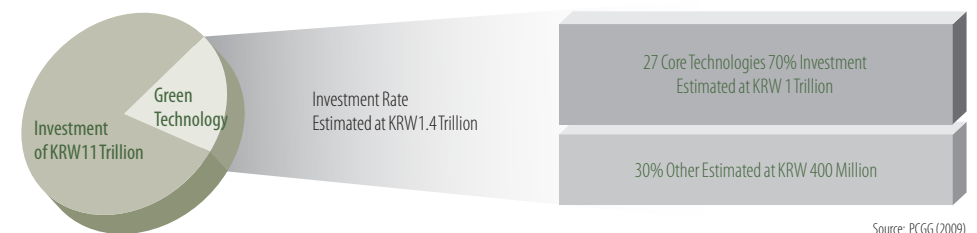
The 27 core technologies are as follows:

- Energy source technology:** Technology that allows replacing fossil fuel energy sources in limited supply with renewable energy and low carbon energy sources.
- Technology that enhances energy efficiency:** Enhancing efficiency of existing fossil fuel energy and promoting efficient use of electricity to reduce pollutants.
- Technology for greening industry and the atmosphere:** Restructuring the manufacturing process and increasing efficiency in order to reduce resource use and provide greener spaces.
- Technology for environmental protection and resource recycling:** Predicting environmental changes, assessing the effect of environmental impacts, controlling the emissions of environmental pollutants, rehabilitating ecosystems that have been affected by pollutants, etc.
- Technology for pollution-free economic activity:** Changing the manufacturing process into low carbon and other green methods.

The 27 core technologies incorporate measures for the 17 new growth industries and 15 green energy technologies. However, these technologies also include other measures (Figure 4-3).

The new growth industries span many sectors. In a way, the renewable energies, LEDs and green transportation systems under the 27 core technologies also appear in the program for new growth industries. However, the policy for new growth industries is distinct in that it also incorporates non-green measures such as the high value-added food industry, high value-added medical services, robotics and tourism. Furthermore, the 27 core technologies include most of the 15 green energy technologies. But the former have a broader spectrum that includes environmental protection, resource recycling and technologies that support pollution-free economic activity.

■ Figure 4-4: The Share of Green Technology in National R&D, 2008



Source: PCGG (2009)

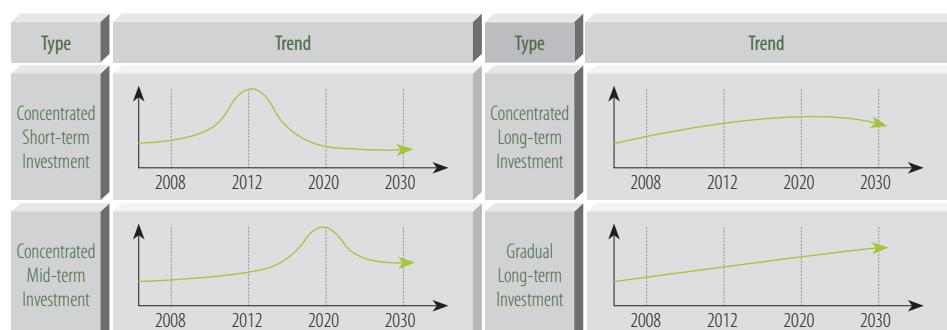
## Investment Direction of Green Technologies

The Korean government plans a large increase in investment for the research and development of green technologies (PCGG 2009). Having invested KRW 1 trillion (USD 0.9 billion) in 2008, it is planning to more than double that figure by 2012 in order to secure original technology and ease market entry (Figure 4-4).

The Korean government has further identified short, medium and long-term investment plans that take into account current investment priorities, levels of technology and prospects for commercialization of green technologies.

- 1 In the short-term, investment will focus on projects to allow for testing and production in a short period of time such as silicon solar cells, advanced water reactors and LED.
- 2 In the medium-term, investment will focus on economically feasible projects that help secure early market advantage, such as: highly efficient, low emission vehicles; green process; secondary batteries; non-CO<sub>2</sub> processing; management of water systems and water quality; securing alternative water sources, reducing wastes and virtual reality.
- 3 In the long-term, investment will focus on projects that can evolve into the pioneering technologies of the global future. These might include prediction of climate change; assessment and adaptation measures for climate change; fast reactor; nuclear fusion reactor; hydrogen energy; fuel cells; environmentally friendly vegetation growth; Integrated Gasification Combined Cycle (IGCC); urban regeneration; ecofriendly buildings; smart grids; carbon capture and storage (CCS) and hazardous substances.
- 4 In the grand scheme, original technologies need to be developed by Korea for areas that need long-term investment such as non-silicon solar cells, bioenergy and intelligent transport systems (Figure 4-5).

■ Figure 4-5: Types of Investment and their Trends



Source: PCGG (2009)

## Green Technology Central Information System

In December 2009, the Korean government established the Green Technology Network (GT NET, [gt.net.go.kr](http://gt.net.go.kr)) as an onestop portal that systematically stores and provides information that is crucial to the development of green technologies. Previously, this information was available from various sources including the Korea Institute of Science and Technology Evaluation and Planning (KISTEP), the Korea Institute of Science and Technology Information (KISTI), the Korea Institute of Energy Research (KIER), the Korea Institute of Energy Technology Evaluation and Planning (KETEP), the Korea Environmental Industry and Technology Institute (KEITI), the Korea Environment Institute (KEI), the Korea Trade-Investment Promotion Agency (KOTRA) and the Korea Energy Management Corporation (KEMCO). The GT NET provides information relating to the 27 core technologies. The information includes basic technical information, industry and market analysis, policy actions, research and development progress, roadmap, information from external sources and more.

Not only does the GT NET compile information relating to green technologies, it also provides a search mechanism. Furthermore, it offers information on the trend in a certain technology or industry. GT NET allows for specific searches on green technologies from the database of the National Science and Technology Information Service (NSTIS). Progress reports on research done so far can also be easily accessed. It has also structured an open architecture for technology development as it provides a strategic roadmap for green technologies while creating a green technology expert community network.

The National Green Technology Awards to reward pioneering green technologies on a sector-by-sector basis have also been co-developed by the Ministry of Education, Science and Technology (MEST), the Ministry of Food, Agriculture, Forestry and Fisheries (MFAFF), the Ministry of Knowledge Economy (MKE), Ministry of Environment (ME) and the Ministry of Land, Transport and Maritime Affairs (MLTM). In considering candidates for these awards, ministries evaluate the performance, economic feasibility, commercial value and practical applicability of green technologies developed by corporations, universities and research institutes. Different tiers of awards include: a Presidential Award; Prime Minister's Award, the Education, Science and Technology Minister's Award; the Food, Agriculture, Forestry and Fisheries Minister's Award; the Knowledge Economy Minister's Award; the Environment Minister's Award and the Land, Transport and Maritime Affairs Minister's Award. The first Presidential Award was awarded to LG Chemicals for its High Output, High Energy Lithium-Polymer Battery Technology in February 2010.

## Expected Outcomes

It is expected that through the development of the 27 core technologies, Korea's green technology capacity will reach 80% of the capacity of the developed nations' in 2012, and 90% by 2020. The scope of exports and domestic demand will reach USD 15 billion in 2012 and USD 41 billion in 2020. It is expected that 481,000 new jobs will be created in 2012 and 1.18 million by 2020. Total potential CO<sub>2</sub> reductions 47 million tons by 2012. Assuming a scenario in which there is 100% practical application of newly developed green technologies, CO<sub>2</sub> reduction will total 130 million tons by 2020 <sup>(PCGG 2009)</sup>.

According to the National Strategy for Green Growth, the government plans to allocate 25% of total government R&D investments into green technologies. In addition, the government is making further efforts towards establishing a system that facilitates green technology development, disseminates and commercialize green technologies, establishes the foundations for green technology industries and promotes active international cooperation.

## IV-2. Commercialization of Green Technologies

Creating KRW 117 Trillion in Value-Added in 2020

### Commercialization Strategy for the 27 Core Technologies

In 2008, the Korean government announced that it would use clean energy and green technologies as the new drivers for economic growth and job creation. The emphasis on concentrated investment in these fields spurred full-fledged discussions on green growth. In January 2009, the government proposed the Comprehensive Plan for the Research and Development of Green Technologies and identified the 27 core technologies to support the national agenda of low carbon green growth <sup>(Ministry of Education, Science and Technology 2009)</sup>.

Following these steps, detailed discussions then began between the government and 22 research institution<sup>i)</sup> on creating a commercialization strategy for the 27 core technologies, i.e. Comprehensive Strategy for Development and Commercialization of Core Green Technologies <sup>(PCGG 2009)</sup>. During this process, four workshops were held. Each began by evaluating market forecasts and market competitiveness. At the end, the workshop analyzed measures for technology development and detailed commercialization strategies.

The major aspects of the Comprehensive Strategy are as follows. First, it outlines practical measures to secure the necessary technology from external sources. It also identifies ways to increase domestic production of core technologies. Second, it provides incentives towards reforming the entire process from technology development, to testing to full-scale production. Third, it provides strategies to expand domestic and export markets, job creation, CO<sub>2</sub> emission reductions and more in a systematic manner.

i) Science and Technology Policy Institute (STPI); Korea Research Institute for Human Settlements (KRIHS); Korea Institute for International Economic Policy (KIEP); Korea Institute for Industrial Economics and Trade (KIET); Korea Energy Economics Institute (KEEI); Korea Information Strategy Development Institute (KISDI); Korea Institute for National Unification (KINU); Korea Development Institute (KDI); Korean Educational Development Institute (KEDI); Korea Institute of Curriculum and Evaluation (KICE); The Korea Transport Institute (KOTI); Korea Labor Institute (KL); Korea Rural Economic Institute (KREI); Korea Legislation Research Institute (KLRI); Korea Institute for Health and Social Affairs (KIHASA); Korean Women's Development Institute (KWDI); Korea Institute of Public Finance (KIPF); Korea Research Institute for Vocational Education and Training (KRIVET); National Youth Policy Institute (NYPI); Korea Maritime Institute (KMI); The Korea Institute of Public Administration (KIPA); Korean Institute of Criminology (KIC); Korea Environment Institute (KEI); Architecture & Urban Research Institute (AURI); Center for Rural Information & Culture (CRIC); Korea Institute of Child Care and Education (KICCE) and; KDI School of Public Policy and Management (KDI SCHOOL)

## Identifying Changes in the Market Environment, Evaluating Market Outlook and Competitiveness

The first step in establishing the commercialization strategy was to evaluate existing conditions and possible strategies (Figure 4-1). As the market is constantly changing, the evaluation of existing conditions provided clear direction for later steps. Specifically, identifying changes in the market, evaluating market outlook and gauging competitiveness were early priorities. Later, detailed strategic directions and roadmaps were drawn up.

Market analysis seeks to identify possible future societal changes and identify major issues relating to technology development. Just as any business, small or large, first studies on existing data, demographics and its competitors, it was necessary to first assess which issues would prove to have an impact on future technologies in drawing up the commercialization strategy.

The STEEPV method was utilized to conduct a macro-analysis of existing conditions. STEEPV incorporates issues relating to society (e.g. population), technology (e.g. fusion technology), economy (e.g. sustainable economic development), ecology (e.g. environmental problems), politics (e.g. balancing economic and environmental policies) and value & norms (e.g. individualization).

The macro-analysis of the basic market environment was crucial in providing an accurate and objective assessment of conditions to the decision-makers. It was found that the 27 core technologies would provide useful solutions to environmental and energy challenges, ease adaptation to ecological changes and help transitioning to low carbon, green industries (PCGG 2009).

Assessing market forecasts allows for the identification of potential risks and dangers prior to the commercialization of a new technology. In conducting the analysis, the global market forecast, domestic market forecasts, global market share and the activities of major industries both domestic and foreign were examined. Specifically, when calculating the market forecasts, the current price was used for the first year, whereas later forecasts used constant prices. Current price is calculated by including macroeconomic inflation into actual growth. It excludes the macroeconomic inflation effect and therefore is the opposite of the real price. As the subject of the market analyses, major parent industries in each of the major technologies were chosen. A parent industry can be defined as the industry that is directly responsible for the advent of a new technology. For example, the automobile industry would be the parent industry of next-generation automobile technologies.

Following market forecast analysis, it was estimated that the total value of the market for the 27 core technologies stood at USD 1.5 trillion. Growing at an annual rate of 10.2%, it

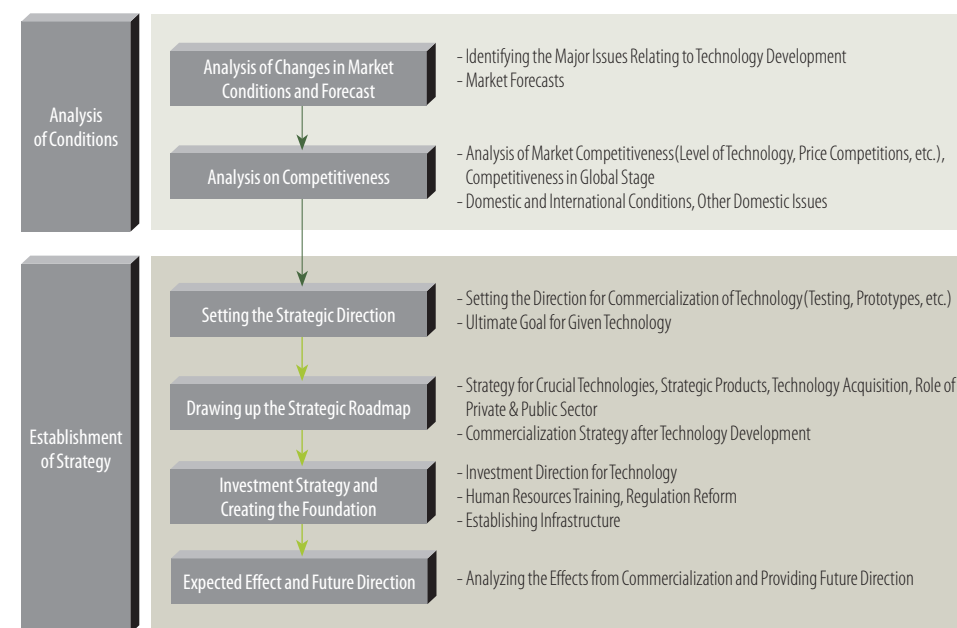
was estimated that the value would rise to USD 5.7 trillion by 2020. The size of the domestic market was USD 37 billion. Growing at 13.2%, it was expected to reach USD 230 billion.

It was expected that the market for the 27 core technologies will expand exponentially, with parent industries making up much of that expansion. Consequently, the process of greening industry will be significantly expedited. For example, high efficiency, low polluting vehicles only made up 0.7% of the entire market for automobiles in 2007. However, that figure is expected to rise to 30% by 2020 (MEST 2010).

The level of technology and the percentage of domestic technology were measured to assess the competitiveness of green technologies and industries. The level of technology was measured as a percentage, with 100% representing top-of-the-line technology available in the most advanced nation. Domestic technology was measured as a percentage reflecting the ratio of price to the amount of domestic technology used.

The results of the above assessment show that on average, the level of technology available was about 44-65% of the best technology available. In terms of the localization of the technology production, which is a factor that can determine how competitive Korea can be in the industry, the average was found to be 40-68%. The area in which Korea had the highest level of technological development was found to be in virtual reality, which falls

■ Figure 4-6: Process of Establishing Strategy for Commercialization of Green Technologies





under the category of pollution-free economic activity. Energy efficiency technology was found to have achieved the highest level of localization in its production. On the other hand, technologies such as those for environmental protection and resource recycling were only 50% compared to the best available technology. That figure was even lower at below 30% for technology for climate change prediction, management of water resources and quality and monitoring of hazardous substances (MEST 2010).

For the analysis of market conditions, issues were identified on a category basis. For energy technology, the priority was commercialization to establish a market share in renewable energy. For energy efficiency, Korea needs further testing, actual production and the development of raw materials. For the greening of industries and spaces, Korea needs to work on making green technologies competitive and user-friendly. Finally, in terms of technology for environmental protection and resource recycling, Korea needs to develop abilities for climate change adaptation and resource recycling suited to its specific conditions.

In the next stage, the detailed strategic direction was set. Then the roadmap and the investment strategy were established, followed by measures for establishing the basic foundation and assessing the expected effects. Specifically, strategic directions were divided into the following: development of basic technology, strengthening testing and production, facilitating short term growth, establishing infrastructure and strengthening international cooperation.

The development of source technology focuses on enhancing the competitiveness of green technologies and turning them into viable products and services. In terms of strengthening testing and production, Korea needs to establish test beds for new technology and facilitate the commercialization of technologies through systematic testing. Facilitating short-term growth refers to the domestication of technology and reaching price competitiveness to promote export of new green technologies. In order to attain technology for the establishment of infrastructure, Korea needs to establish the hardware infrastructure while securing economically viable raw materials to create a platform for future growth and achieve energy security. In terms of strengthening international cooperation, Korea will need to look at joint research ventures and international standardization of technology for nuclear fusion, climate change prediction, ecofriendly buildings, intelligent transport systems, smart grids and hydrogen energy.

The roadmap for strategic direction incorporates all of the existing major national strategies while offering insight on technology acquisition, practicability, and commercialization strategies for each product. In addition, the roadmap integrates measures for R&D, testing, prototype enterprise and full-cycle commercialization. The major national strategies

included in this roadmap are: the Comprehensive Plan for the Research and Development of Green Technologies (National Science and Technology Council, January 2009); Master Plan for the Long Term Research and Development for Climate Change Mitigation (Climate Change Adaptation Committee, December 2008); and the First National Energy Plan (August 2008).

### Roadmap for the 27 Core Technologies

The strategic roadmap included a categorical roadmap and a roadmap for each of the major technologies. The categorical roadmap includes the followings: technology for energy sources; energy efficiency; technology for the commercialization and greening of spaces; environmental protection; and resource recycling technology. Then there are roadmaps for each of the 27 core technologies.

The roadmap for energy sources technology stipulates that early government-led action for R&D and infrastructure development is important (Figure 4-6). In particular, with respect to advanced pressurized water reactors, the objective is to develop domestic capacity to manufacture crucial technologies and then commercialize the product after having finished the development of the Advanced Power Reactor+ (APR+).

The roadmap for each of the major technologies was drawn up keeping in mind the following major themes: analysis of strategic products, development of crucial technologies for the products, securing necessary technology on a stage-by-stage basis and distributing the work between private and public sector. First, having developed the required technology, several strategic products were selected that had the most market potential. This was done in order to facilitate the necessary support mechanisms. Furthermore, having selected the strategic products, three to four crucial technologies were identified for which an R&D time table and step-by-step goal setting were established. Using the results of the analysis of crucial technologies, further steps were taken to identify measures for the development of original technologies, technology cooperation and facilitation of investments.

For the investment strategy, four different kinds of investments were identified: concentrated short-term investment, concentrated medium term investment, concentrated long-term investment; and gradual long-term investments. Considerations include a combination of factors including current size of investments, the level of technology and the target commercialization period.

Concentrated short-term investment focused on silicon-based solar cells, advanced light water reactors and LED lighting. There are three technologies that need to be tested, produced and commercialized quickly. For concentrated medium term investment, the focus was on the following: high efficiency, low-pollution vehicles; green process; secondary batteries; non-CO<sub>2</sub> processing; management of water supply and quality;

securing of alternative water sources; reducing wastes and virtual reality. These technologies require first mover advantage in the market. For concentrated long-term investment, the focus was on: climate change prediction; climate change effects evaluation and adaptation; fast reactors; fusion reactors; hydrogen energy; fuel cells; ecofriendly plant growth; coal gasification plants; urban renaissance; eco-friendly buildings; smart grids; CO<sub>2</sub> capture, storage; and processing and management of hazardous substances. For gradual long-term investments, the focus was on non-silicon based solar cells, bioenergy and intelligent transport systems.

Crucial to developing green technologies in Korea is the human resources supply for R&D efforts. The demand for R&D human resources for the major green technologies was 20,000 in 2008. It is expected that figure will rise to 34,000 by 2012. The human resources will come from various sources with 7,000 coming from currently unemployed, 9,000 from the retraining of existing human resources, 14,000 newly hired and 27,000 foreign staff (MEST 2010).

The expected effects of stemming from commercializing new green technologies, including creation of value-added, jobs and the reduction of CO<sub>2</sub> were analyzed. The calculation of value-added involved using existing data from bodies such as the Bureau of Statistics as well as scientific estimation work when such data did not exist.

The results of the expected effects analysis showed value-added of KRW 17 trillion (USD 15 billion) in 2007, rising about seven-folds to KRW 117 trillion (USD 106 billion) by 2020. In terms of job creation, 220,000 jobs were created in 2007 while that figure is expected to rise five-fold to 1.18 million jobs by 2020. Through the introduction of eco-friendly, low-carbon manufacturing processes, GHGs were reduced by 1 million tons in 2007. It is expected that figure will rise to 1.29 million tons by 2020 (PCGG 2009).

### IV-3. Green IT

#### Energy Efficiency in the Information Technology Sector

#### Green Information Technology

Green IT is a compound word that combines *green* and *information technology*. It encompasses both the *greening of Information Technology* and *greening by Information Technology*. *Greening of IT* includes greening the lifecycles of IT products and services and promoting them as a new growth engine. *Greening by IT* promotes maximizing the efficient use of energy and resources through IT convergence.

The definitions of Green IT vary among countries. OECD defines Green IT as “*information communication technology that is used as a catalyst for mitigating the environmental influence on society with information communication technology that has low environmental burden.*” Japan’s Ministry of Economy, Trade and Industry (METI) defines Green IT as “*energy savings through the use of IT, and energy saving in the IT areas for building a society where environmental conservation and economic development coexist.*” These definitions are similar in role and scope to the Green IT concept set by the Korean government.

With advances in computerization and the expansion of IT equipment, increasing GHG emissions in the IT sector appeared as a new environmental problem. IT generates 2% of the world’s entire carbon dioxide emissions. This is equivalent to the emissions from all of the world’s passenger airplanes. Korea’s proportion of GHG emissions from the IT sector is 2.8% in 2008, which is higher than the world average of 2%. This proportion is expected to increase to 3.1% in 2012 (National Information Agency 2008).

Furthermore, swift advances in information technology globally are predicted to result in IT generating about 10-15% of all GHG emissions (Global Action Plan 2007). Information Data Centers (IDC) are notorious for their large energy consumption. Data shows such consumption expands 20% yearly. Hence, CO<sub>2</sub> emissions from electricity consumption is expected to increase to 259 million tons in 2020 from 76 million tons in 2002 (The Climate Group 2008).

This situation is the same for Korea. More than 60 domestic data centers own 110,000 servers, which consumed 12.7 billion kWh of electricity in 2006. The number of servers is expected to increase to 150,000 in 2011. Increase in standby electricity

consumption is a serious problem stemming from wider use of home appliances and home networks. Standby electricity consumption of IT equipment makes up 11% of all households' electricity consumption in Korea (NIA 2008). Although this number is lower than the estimated 25% by International Energy Agency (IEA), it is still an evident that much electricity is consumed without actually being used.

### Green IT Strategy of Korean Government

On 15 January 2009, the Ministry of Knowledge Economy (MKE) announced the IT Industry Strategy for Green Growth comprised of 37 detailed tasks in three different areas: (i) greening of IT; (ii) construction of the foundations for green growth based on IT; and (iii) creating a base for Green IT. In addition, on 16 January 2009, the Ministry of Public Administration and Security (MOPAS) announced the New Green ICT Korea. This is a green informationization promotion plan consisting of twelve main tasks and four major strategies: (i) greening of information resources; (ii) realizing green government; (iii) promoting the transformation to green society; and (iv) formulating supportive policies to transform to green society. Following this, Korea Communication Commission (KCC) announced the Comprehensive Plan for Promoting Green Broadcasting & Communications. It is made up of nineteen detailed tasks in six major areas to realize green growth on 8 April 2009.

The efforts by each ministry are highly commendable, but it was pointed out that these efforts produced no synergy at all since some of the ministries' work was overlapping. In order to resolve this problem, the government announced the National Strategy on Green IT that encompasses all ministries. It will produce synergies and link green growth with the IT value chain through technology development, fostering industries, promoting active use and strengthening infrastructure.

### Green IT Strategies of Korean Companies

The activities of IT companies were amazing. Samsung Electronics expanded its product line to develop eco-friendly products such as low power LED laptops and cell phones that use photovoltaics. In addition, Samsung introduced Eco Design to conform with global environmental regulations and Eco Partnership Plan to build an eco-friendly supply chain. Furthermore, Samsung developed an environment security system, comprehensive disaster recovery system, eco-friendly product development system and pollutant management system to manage the environment of its facilities.

Samsung SDS<sup>i)</sup> supported employees with remote workplaces and remote collaboration and video conferences through its on-site work system called Open Place. Samsung realized reductions in building maintenance costs by applying building energy management systems like IBS/BEMS in its Seocho Samsung Town buildings. It also developed nineteen green IT technologies such as direct current power, virtualization and cloud computing, among others, and continuously expanded the construction of green Internet Data Centers (IDC) utilizing these technologies.

LG CNS<sup>ii)</sup> is promoting LED electric banners, IP intelligent street lights, online completion services, united communications and environmental sensors as its new business areas of growth. In addition, LG has greened its IDC in Sangam district utilizing virtualization technology and cooling water. It has also adopted high green IDC technologies in the IDC in Gasan district that is under construction.

Korea Telecom<sup>iii)</sup> is promoting its KT Green Project which aims at reducing 20% of GHG emissions by 2013 compared to the level in 2005 through efficient use of energy based on IT. Moreover, KT is building an all-IP network and spreading out its bureau offices. Data centers will see the introduction of virtualization and direct current power type technologies. Furthermore, KT plans to expand its business to areas of remote work, video conferences, and environment and energy monitoring based on high technology infrastructure such as BcN, IPTV and WiBro.

SK Telecom<sup>iv)</sup> is making an effort to reduce electric power consumption of base stations by developing an eco-friendly wireless base standard model and expanding the use of common base stations. Through the use of natural HVAC and expanding the use of email and mobile billing, remote control of cellphones and standardization of surrounding equipment of cellphones, SK Telecom was able to avoid productions of 6,000 tons of carbon dioxide in 2007.

NHN, one of the emerging IT companies in Korea, does not own its own data center, but is promoting reductions in electric power consumption through collaboration with residential data centers. Also, it improved electric power efficiency by 30% through the

i) Samsung SDS is a subsidiary of Samsung Group and is one of the leading IT services & consulting companies in Korea. In 2007, SDS ranked No.1 in domestic IT service market share ([www.sds.samsung.com](http://www.sds.samsung.com)).

ii) LG CNS is a subsidiary of LG group and Korea's largest IT service provider and has implemented a number of large-scale public IT infrastructure projects and played a major role in the Korean government's e-Korea initiative ([www.lgcns.com/about-lgcns/company-overview/overview.aspx](http://www.lgcns.com/about-lgcns/company-overview/overview.aspx)).

iii) KT is a prominent Korean integrated wired/wireless telecommunication service provider. It has the largest portion of the domestic telephone and high-speed Internet business in Korea ([www.kt.com/eng/index.jsp](http://www.kt.com/eng/index.jsp)).

iv) SK Telecom is a Korean mobile telecommunications operator, controlled by the SK Group, one of the country's largest chaebol. Its Korean market share as of 2008 is 50.5% ([www.sktelecom.com](http://www.sktelecom.com)).

introduction of equipment heat management, air-conditioning, heat inhaling machines and an energy management system which uses low-power server, virtualization.

### Greening of IT

- 1 *Greening of IT* aims at reducing carbon dioxide emissions significantly by growing IT market. It will involve utilization of green IT equipment, expanding the green IT standard and developing the core technologies of low-power, high-efficiency IT equipment that considers overall marketability, GHG emissions level, and technology level for each item of IT equipment. Seventy-five percent of carbon dioxide emissions from IT is generated during the use of the IT equipment. Only twenty-five percent is generated during the process of producing the IT equipment. In addition, it is important to promote technology development for sectors whose Korea has technological priority in the world market as well as those where Korea can gain advantage by greening IT equipment such as PCs, monitors, D-TV and servers. On the other hand, Korea's domestic IT equipment technology development is highly focused on developing system operations or technology for eco-friendly materials. It therefore lacks technology development in the core of green IT equipment. In order to disseminate low-powered high-efficiency equipment, it is important to get support from the government in the form of incentives and mandates to use this equipment. For this reason, in order to boost initial demand, it is important to promote pilot projects in the public and private sector. Furthermore, it is important to set policies such as incentives and mandatory use of the equipment. Moreover, these policies should cover the entire cycle of production logistics by introducing an environmental labeling system for CO<sub>2</sub> reduction. In the case of standardization, standards related to GHG management and reduction are provided under ISO 14064 and 14040. However, there are no standards to quantify, reduce or manage GHG emissions that are applicable to areas specific to IT sector. Hence, it is important to prepare a guideline for the green standard.
- 2 Promotion of greening of IT services: This expedites the green business of IT industry by greening the IT resources and data centers, and promotes the building of low carbon green cloud service supply system that is used throughout various industries in Korea. Expansion of cloud computing services is occurring worldwide and replacing the existing IT services such as ISP, ASP and SI. As a result, concerns regarding the monopoly of a global company are rising. In order solve this problem, development and standardizations of open platform that guarantee compatibility is being pursued.
- 3 Build a safe network that is ten times faster: The backbone network must be wireless

to build a high-speed and highly intelligent green network base that solves energy and environment problems by connecting people and objects remotely. However, Korea still relies highly on Japan and the United States for core communications equipment, and imports most of it. Currently, Korea is promoting development of technology for localization of exchange and transfer equipment.

The promotion of wired infrastructure should be enhanced to prepare for IPTVs, realistic videophone and virtual reality that minimizes the physical movement between people and goods. In addition, broadband users must continuously increase through the promotion and expansion to regions where Wireless Broadband (WiBro) works and through the enhancement of the third generation communication networks. For this to happen, advancement into the fourth generation communication networks to expand mobile services is needed. The fourth generation communication networks are a foundation for using network of sensors effectively utilizing the already built broadcasting communication infrastructure. Also, an early response system should be built to predict network invasion scenarios.

### Greening by IT

- 1 In order to transform to a low carbon working environment utilizing IT, a new energy management system needs to be introduced. Specifically, remote work and remote collaboration needs to be widely introduced. Smart work centers must be constructed throughout Korea to reduce carbon dioxide emissions. Paperless work environments need to be introduced widely by transforming all work processes to online. Furthermore, building energy management systems needs to be expanded to improve the energy efficiency in the buildings sector. Laws and policies such as certification laws and policies to support active use must be promoted.
- 2 The realization of green living refers to the greening of overall living in education, medical care, culture and residences by maximizing the use of IT. For example, active use of remote education and dissemination of digital textbooks can reduce private education expenses and raise the quality of education services. The number of visits to hospitals by the elderly's and the chronically ill can be reduced through telemedicine and health monitoring. The amount of food waste can be reduced through the use of Radio Frequency Identification Devices (RFID). Energy efficiency of newly built houses can be improved through Home Energy Management Systems (HEMS).
- 3 Greening of manufacturing refers to converging ubiquitous IT (u-IT) with manufacturing industries and industrial estates central to Korean economy. The management

of product production based on u-IT raises energy efficiency. Monitoring of current level of pollutants emitted and the resource recycling rate using u-IT technologies can prevent environmental pollution and raises resource circulation rates. For example, in the petrochemical industry, the derived gases produced during the production process can be recollected and utilized as a source of heating energy for surrounding villages as well as for internal power generation. Waste water and water quality can be monitored comprehensively by improving the green management processes and policies using u-IT. Likewise, infrastructure that is potentially usable for common purposes at industry estates, similar to that of u-Biz conference systems, needs to be in place.

- 4 Smart green transportation and logistics system requires a transportation system that is becoming intelligent. Specifically, public transportation can be actively promoted through the use of bicycles and minimization of idle vehicles.
- 5 Smart electric grid construction allows introducing energy prosumers (customers who feed energy back into the grid) through construction of infrastructure embodying IT.
- 6 Overall and systematic real-time monitoring of the environment can be done through a smart real-time environment monitoring and disaster recovery system. This can help prevent disasters that produce carbon dioxide, and provide a safe and pleasant living environment through early response systems. Strengthening overall real-time environment monitoring and response systems can help maintain an ecological river and a safe environment. By constructing a quick and accurate system to cope with disasters, damages can be minimized and forest resources can be protected and maintained from wildfires.

### Green IT Committee and National Green IT Portal

On 25 November 2009, a green IT Committee was formed that encompasses the public and private sectors to promote green IT domestically and internationally. This committee is comprised of central administrative institutes, research institutes, universities, private companies and other groups. Policy direction, promoting structure and best practices were discussed at the committee's general assembly. The committee will shed a new light on green IT industries, as well as standardize the domestic green IT certification system. Further, it will operate the Green IT Forum and hold the Green IT International Conference to foster a base for green IT development by inducing investment and creating demand for high-efficiency and eco-friendly IT products and policies. The committee also operates the National Green IT Portal that shares green IT information through green IT statistics, trends, white papers, regular publications and a guidebook. Case studies of Green IT will be distributed based on the experiences of the government and public institutes.

## IV-4. Green Industry

Strategy for Climate Change and Energy Security

### Developing New Growth Industries and Resource Recycling Industries

Like many other nations Korea is developing green industries to address climate change and promote energy security. Korea is focusing on the development of new growth industries (industries that can provide engines for new economic growth) and resource recycling industries.

New growth industries are a comprehensive term that incorporates (1) green technologies industry; (2) high-tech fusion industry; and (3) high value-added industry (Figure 4-7). Green technologies industry provides the foundation for future growth as well as measures for addressing climate change and resource scarcity. High-tech fusion industry seeks to develop and promote new, fusion industries. High value-added industry refers to service industries that focus on high-value added services.

Meanwhile, resource recycling industries refer to measures for treatment of atmospheric pollutants, water supply, reusing of resources, renewable energies, heat energy conservation and management, sustainable agriculture and fisheries, sustainable forestry, natural disaster management, ecotourism, environmental protection and securing ecological diversity.

The government's efforts to develop of green industries are based on the green industries strategy outlined within the Framework Act on Low Carbon, Green Growth.

■ Figure 4-7: New Growth Industries

Category	High Potential New Growth Industries(17)
Green Technology Industry	Renewable Energy, Carbon Reducing Energy, Advanced Water Treatment, LED Applications, Green Transportation System, High-tech Green City(6)
High-tech Fusion Industry	Broadcast-Communications Fusion Industry, IT Fusion System, Robot Applications, New Materials - Nano Fusion, Bio Medicine(Resource) - Medical Equipment, High Value-Added Food Industry(6)
High Value-Added Service Industry	Global Health Care, Global Education Service, Green Finance, Contents - Software, MICE(Meeting, Incentives, Convention, Exhibition), Tourism

Source: Presidential Council for Future and Vision (2009)



The strategy for major green industries is subdivided into a support strategy and a regulation strategy. The support strategy focuses on support for R&D and commercialization, human resources development, financial support and tax system support, creation of green industrial parks, priority support for cooperative ventures between large corporations and small and medium enterprises, and the creation of a favorable business environment. The regulation strategy focuses on reducing emissions of GHGs, conserving energy, energy efficiency, limiting total electric power generation and a carbon emissions trading scheme.

Under the new growth industries strategy, customized measures are being developed appropriate to the type of industry, while spotlighting exemplary brands. Targets for the industries also vary according to how mature a given industry is.

First, depending on the maturity of the industry, there are three types of targets: short-term (3-5 years), medium-term (5-8 years) and long-term (within 10 years). The industries belonging in the short-term category are the ones that are considered most mature. Therefore can generate new jobs and high value-added goods and services. In the medium-term category are the industries equipped with crucial baseline technologies and capacity, which have the potential to create new business models and markets. In the long-term category are the industries which are in the early stages of development but have potential to become future, green engines of growth if the baseline technologies are secured.

Second, exemplary or *star brands* are nominated based on the growth potential of new industries. The selection of these industries will be conducted through the sharing between business and the government information of policy priorities, promising technologies and potential for the early commercialization of crucial technologies.

Third, customized measures are developed appropriate to the different types of new growth industries. With respect to the green technologies industry, the policies focus on early market development and technology development. With respect to the high-tech fusion industries the focus is on the product and technology. For the value-added industries the focus will be on the reform of legal and regulatory measures to facilitate government and private sector investment.

Fourth, it will be important to develop the appropriate human resources, international standards, infrastructure and certification systems. In particular, financial and capacity-building support will be provided to small and medium enterprises within the new growth industries for technology development and commercialization.

Fifth, in 2010 the government outlined ten crucial green technologies in order to prevent overlaps in investment and in general to facilitate better and more efficient investments opportunities. The ten crucial green technologies are:

- 1 Next-generation secondary batteries;
- 2 LED lighting and display;
- 3 Green PC;
- 4 Highly efficient solar cells;
- 5 Green cars;
- 6 Smart grids;
- 7 Future nuclear energy;
- 8 Fuel cells;
- 9 Carbon capture and storage technology; and
- 10 Advanced water treatment.

### The Fast Developing Global Green Market and Korea's Tasks

Korea has achieved significant progress in the field of enhancing energy efficiency, nuclear energy and renewable energy sources. In terms of enhancing energy efficiency, Korea has built a Di Methyl Ether (DME) production plant. DME is a substitute for LPG. Korea is only the fourth nation in the world to commercialize DME. Additionally, Korea has successfully commercialized eco-friendly hybrid vehicles and is developing better technologies for plug-in electric vehicles.

In terms of nuclear energy, Korea has successfully developed domestic capacity for a man-machine interface system. In terms of the renewable energies sector, Korea has developed the capacity for domestic production of technology and materials for polysilicon required in solar cells and is in the process of creating an export market. Moreover, domestic technology for sea wind power has also been developed.

The market for green industries is gradually expanding. Korea only accounts for 2% of the global market in 2009. This figure is expected to rise to 8% by 2013. The share of renewable energy in Korea's energy mix is also projected to rise from 2.7% in 2009 to 3.8% by 2013. Furthermore, upon completion of the Five Year Strategy for Green Growth in 2013, Korea is expected to become one of four leading nations in green cars, along with Japan, the United States and Germany ([www.greengrowth.go.kr](http://www.greengrowth.go.kr)).

Korea's green industries are expected to keep pace with the rapid growth of global green markets. According to data from the World Bank, it is expected that the global carbon emissions market will expand in size from USD 64 billion in 2007 to USD 150 billion in 2010. The renewable energy market, including wind energy, solar PV, biomass, hydrogen fuel cells amongst others, is expected to more than triple in size from USD 77.3 billion in 2007 to USD 254.5 billion by 2017 (Capoor & Ambrosi, 2009). Reflecting these figures, the global environment market is projected to double in size from KRW 1 trillion (USD 0.9 billion) in

2007 to KRW 2 trillion (USD 1.8 billion) by 2020 <sup>(UNEP 2008)</sup>.

### Customized Policies Specific to Green Industries

Given the economic, environmental and social importance of green industries and the trends in the global markets, the Korean government has pronounced its intention of actively supporting their development. However, it is important to take into account the specific characteristics of the green industries in order to devise successful policies.

First, as green industries are a relatively recent phenomenon, the government needs to consider the characteristics of an infant industry. Although green industries have great commercial and technological potential, they are also subject to market failures. In 2010, the OECD declared that existing economic theories and policy toolkits were not sufficient in tackling the complex challenges accruing from the pursuit of green growth <sup>(OECD 2010)</sup>. In this sense, the role of the government is important.

Third, an appropriate innovation system applicable to green industries needs to be developed. In order to reform the current industrial structure under which GHG emissions are inevitable, innovation is necessary to facilitate the expansion and commercialization of green industries as well as to the structure of such industry and the society as a whole.

## IV-5. Greening the Existing Industries

Green Business, the Path of a New Era

### The Incandescent Bulb of the 20<sup>th</sup> Century is now an Artifact

The incandescent bulb was born in 1879 as one of Thomas Edison's leading inventions. However, the incandescent bulb that lit up the 20<sup>th</sup> century is highly energy-inefficient and has a very short lifespan <sup>(Israel 1998)</sup>. As such, it is now being replaced by highly efficient fluorescent lights and LEDs. The incandescent light bulb will most likely be completely phased out by 2013 in many countries of Europe, the United States and Korea.

Paul Müller of Switzerland received the Nobel Prize in Physiology or Medicine in 1948 for his invention of DDT, which was aimed at increasing agricultural productivity and contributing to the health of the general public. However, in 2004, the international community banned the use of DDT except in some cases due to its harmfulness to human health and the environment <sup>(Reason Magazine 2002)</sup>.

Thus, what can be gathered from the above two examples is that products that fail to take into account environmental and energy efficiency concerns are no longer marketable today. Korea as a nation has achieved remarkable growth in the past through massive input of capital and labor. However, it is now unlikely that Korea will achieve further growth without comprehensive reform and restructuring of existing industries that are highly energy dependent.

Following the enactment of the Framework Act on Low Carbon, Green Growth in April 2010, legal measures have been imposed on businesses in order to effectively address climate change and volatile oil prices. This is the measure termed Reporting on Quantity of Greenhouse Gases Emitted and Quantity of Energy Consumed. Following negotiations between businesses and the government, targets are set for the quantity of GHG emissions, amount of energy use and energy efficiency of a certain business. Then, the business is provided with various incentives to reach those targets or on the other hand is penalized for failing to meet its targets. In order to turn the challenge of climate change into new opportunities, it is necessary to develop new green energy industries while greening the existing industries and businesses.

### Korean Government Declares Plan for Greening the Existing Industries

The industrial sector's share of total national GHG emissions amount to 37%. When taking into account the sector's electricity use, that number rises to over 50% according to the 2007 figure. It is imperative that Korea develops a green strategy that can lead to both economic growth and reductions in emissions of GHGs.

In December 2008, the Ministry of Knowledge Economy (MKE) announced the Knowledge and Innovation-driven Strategy for the Development of Low Carbon, Green Growth Industries to overcome internal and external difficulties being faced by the Korean economy and to introduce a new paradigm. The major point of the document is to create new engines for growth based on knowledge and technology that can facilitate the transition of the existing industrial sector into a low carbon era and thereby establish a structure allowing for continued development of industries while addressing environmental concerns. Some of the more detailed plans include: (i) Greening the main industries; (ii) Restructuring for a low carbon industrial sector; and (iii) Greening the entire value chain that includes production, distribution, marketing, service and resource

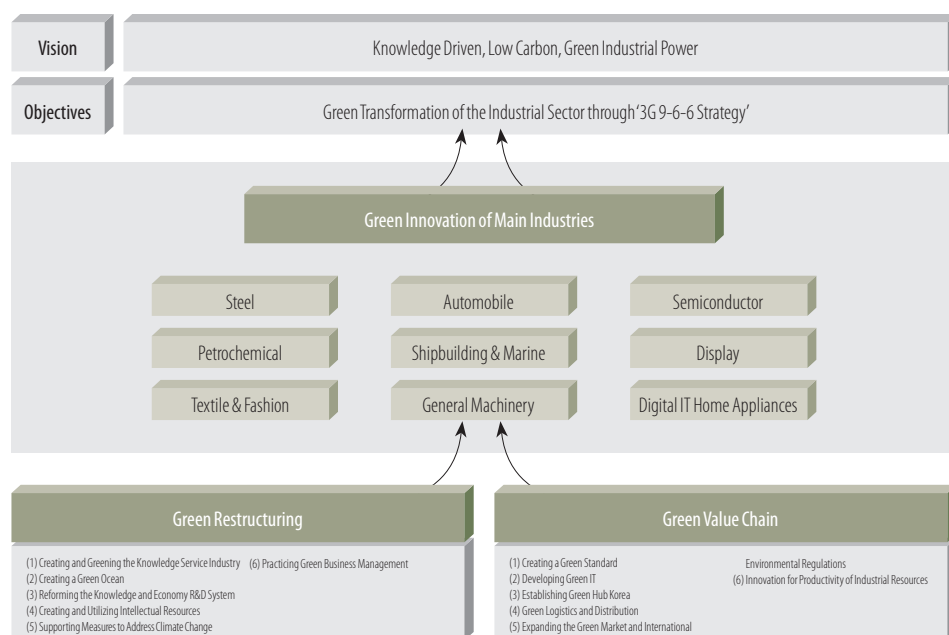
recycling. In other words, it provides an overall design for detailed policy actions and measures necessary for the green transformation of the industrial sector.

Furthermore, the MKE is in the process of formulating the Strategy for the Greening of Major Industries that includes policy measures for ecofriendly, highly efficient technology development and the greening of the production process for eleven industrial sectors including the cement and paper manufacturing industry. The detailed areas for work may vary according to different sectors of the industry, but overall, the focus is on renovating production process to increase resource and energy efficiency, creating the system for resource recycling and developing new products that consume less energy (Figure 4-8).

### Restructuring for a Low Carbon Industrial Sector

At the outset, it is necessary to realize that in order to renovate the industrial sector into a low carbon approach, comprehensive participation involving all the stakeholders in the socioeconomic system is necessary. The government is currently trying to engender the creation of a leading green market by concentrating investment in 17 new engines of

Figure 4-8: The Strategy for Industrial Development Based on Knowledge and Innovation Driven Green Growth



\*\*3G 9-6-6 Strategy\*\* refers to creating a system to support green growth by comprehensively applying a "green prism" to R&D efforts, exports, standards, IT and more. There are 3 overall strategies of Green Innovation, Green Restructuring and Green Value Chain with 9 sub-categories and two sets of 6 sub-strategies.

Figure 4-9: 17 New Growth Engines in 3 Categories

3 Categories	17 New Engines of Growth
Green Technologies	Renewable Energy, Carbon Reducing Energy, Advanced Water Treatment*, LED Applications, Green Transportation System, High-tech Green City
High-tech Fusion Industry	Broadcast-Communications Fusion Industry, IT Fusion System, Robot Applications, New Materials - Nano Fusion, Bio Medicine(Resource) - Medical Equipment, High Value-Added Food Industry
High Value-Added Service Industry	Global Health Care, Global Education Service, Green Finance, Contents - Software, MICE**, Tourism

\*Advanced Water Treatment: Technology relating to the securing, production, supply and treatment of water to effectively address the challenges of water shortage and pollution

\*\*MICE Industry: Meetings, Incentive Tours, Conventions and Exhibitions

Figure 4-10: Major Tasks for Greening (by Sector)

Item	Sector	Tasks
Heavy Energy-Consuming Sector	Steel	Expanding less energy-consuming manufacturing process
	Petrochemicals	Creating an integrated energy management network within petrochemical plants
	Cement	Cogeneration through heat wastes
	Paper Production	Integrated manufacturing process for pulp, reusing wastes as energy
Main Manufacturing Sector	Automobiles	Developing the green car and early commercialization
	Shipbuilding	Developing ecofriendly, highly efficient, IT-fused ships
	Textiles	Creating recycled, ecofriendly textiles
	Machinery	Developing low energy-consuming, hybrid excavators and applying hybrid engines
High-tech IT Sector	Semiconductors	Developing highly efficient memory semiconductors
	Display	Developing LED BLU(back light unit), LED TV, Big-screen AM OLED(active matrix organic light emitting diode), green display, etc.
	Home Appliances	Developing next-generation power saving PCs, monitors, TVs, etc.

growth that can bring about a green lifestyle transformation in the near future (Figure 4-9). For this, it will be important to concentrate on reforming the support system for research and development, securing and protecting intellectual property rights and developing the related human resources. Furthermore, businesses and companies need to develop an ecofriendly image that can help enhance their green competitiveness (Figure 4-10).

A reorganization of the industrial sector is necessary. A low energy-consuming intellectual service industry needs to be developed. For example, Coway, a Korean company which specializes in water filters, has recorded over a 500% increase in sales in the past nine years by transforming itself from a production-based company into a rental service-based one. It had realized that consumers no longer wanted to own water filters but rather were fully satisfied with renting them as long as they could have access to clean drinking water. In particular, through its after-sales service it has successfully created 12,000 new jobs. In short, Coway has successfully reformed its business model to create more value-added, higher profits and new jobs while reducing resource use at the same time.

■ Figure 4-11: Greening the Value Chain of the Automobile Industry

Phase		Before Green		Plus Green
Upstream	Competition	- Price - Performance - Look/Design	+	- Fuel (energy) efficiency - Eco-friendliness (free of CO2 emissions and harmful substances) - Innovative technologies (hybrid, fuel cells)
	Production Plan	- Cost accounting (profit) - Input-oriented (input cost) - ERP (optimize factors of production)	+	- Environmental accounting (decrease raw material cost and environmental pollution) - Output-oriented (minimize over-consumed resources and waste) - Green SW (heighten energy efficiency, reduce CO2)
	Design	- Shape, color, air resistance	+	- Green design (reduce weight, consider life cycle of product, develop virtual reality prototype)
	Component Material	- Supply unit cost reduction - Stock minimization	+	- Green purchasing (Large/small and medium sized green partnership) - Joint development of eco-friendly components and materials
Manufacture	Manufacture	- Quality control  - Compact vehicles - Full-sized vehicles - SUVs - Commercial vehicles	+	- Cleaner production  - Hybrid electric vehicles (HEV) - Fuel cell electric vehicles (FCEV)
Downstream	Distribution/Logistics	- Dealership management - Financial support (monthly-installment plan)	+	- Distribution efficiencies and joint logistics - Green marketing
	Use	- Individual ownership	→	- Rental, car sharing
	A/S	- Personal maintenance & repair	→	- Management by a contracted company specializing in maintenance
	Disposal	- Pick-up by scrap dealers - Material recovery (scrap metal)	+	- RFID-applied reverse logistics efficiencies - Remanufacture, urban mining (high value resources recovery)

### Greening the Entire Value Chain

In Japan, there is a company called Dowa Holdings that was established 130 years ago as a mining company that refined and sold raw materials. As the mining industry as a whole declined, however, so did the company's fortunes. Thus, the company transformed its business model by recovering rare metals from discarded cellular phones, batteries, electric appliances and catalyzers of scrapped vehicles, which the company then refined and resold them on the market. As a result, it has now become one of the world's leading urban mining companies. By rethinking its business concept it was able to create new engines for growth.

The automobile industry is the industry in which the greening of the entire value chain is most visible. Figure 4-11 shows the automobile industry's entire value chain that encompasses production, distribution, market, service and resource recycling. Whereas the focus in the past was on performance or outward appearance, the focus has now shifted to fuel efficiency and the ecofriendly nature of the product.

Another important factor in the new automobile industry is the securing of low carbon, ecofriendly parts. Production is now shifting from vehicles powered by fossil fuels to those that are now fueled by hybrid engines, fuel cells, electricity and other green energy forms. Meanwhile, at the downstream, a low-carbon structure is being emphasized across the logistics, distribution and marketing methods. In the case of electric cars, a government supported rental or car-sharing model can be considered as these vehicles are, in most cases, still too expensive for the market.

### Greening the Value Chain Equals Green Business

There is a strong global trend towards strengthening environmental regulations and expanding a green consumption culture given the pervasive challenges of climate change and unstable supply of energy and resources. In particular, regulatory measures for energy use and reduction of GHG emissions are too important to ignore for even the biggest of businesses in the coming post-2012 age (when the Kyoto Protocol expires). Furthermore, the world is racing to develop new, alternative energy sources that can mitigate dependence on fossil fuels. There is fierce competition for the securing of rare minerals and resources, the so-called "industrial vitamins" that include nickel, cobalt, chrome, manganese and titanium.

Moreover, due to numerous EU-led environmental regulations on products such as the End of Life Vehicles Directive (ELV), Waste Electrical and Electronic Equipment (WEEE), Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) and the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH), countries like Korea, China, Japan and others are following suit by

implementing similar regulatory measures.

Jonathan Lash of the World Resources Institute (WRI) identifies six threats to business management emanating from climate change. These are the (i) regulation; (ii) managing the supply chain; (iii) product technology; (iv) litigation; (v) reputation; and (vi) physical threats. He firmly believes that a transition towards a green business system is necessary to overcome these threats and develop new markets (Figure 4-12).

Green business refers to a system in which businesses fulfill their social and moral responsibilities by engaging in business activities that allow for the conservation of resources and energy while reducing emissions of GHGs and environmental pollution. Thus, it seeks to restructure the business system by developing a low carbon, highly efficient value chain, which includes products, service development, the business organization, the manufacturing process, marketing, etc.

### Green Business Management

Undoubtedly, leading businesses were the first to introduce green business management

Figure 4-12: Threats to Businesses Originating from Climate Change

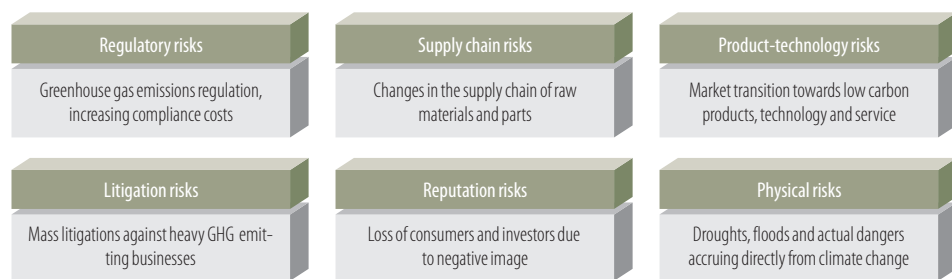
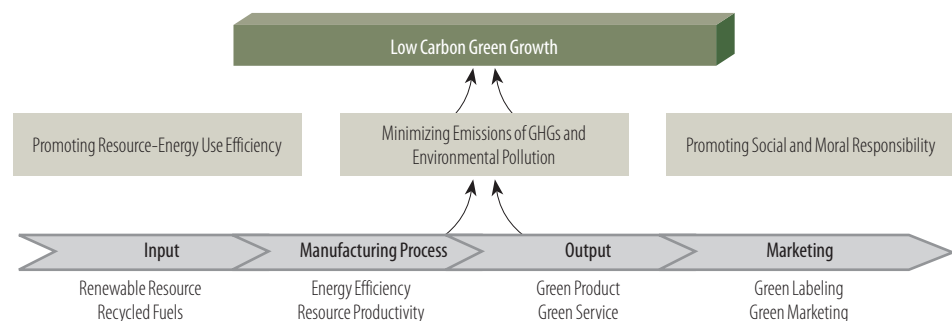


Figure 4-13: Green Business Management Model



into their operations, including Samsung Electronics, Hyundai Automobiles, Toyota, GE and other domestic and international multinational corporations.

Amongst these, General Electrics (GE) is often mentioned as the pioneer in green business management. In October of 2005, GE adopted a new business model called “ecomagination,” which incorporates ideas for ecology and imagination. This change was born out of the GE CEO’s idea that “green means money” (www.ecoimagination.com).

Under this new green business management direction, GE had originally aimed to create USD 20 billion in sales by 2010. However, GE achieved this goal by 2008. This example shows how businesses can successfully pursue green business management, achieving the dual goals of making profits while also being environmentally conscious. Such innovative ideas are creating a fierce green race towards green business management models.

This new trend towards green business management is accompanied by consumers’ preference for green products. Cheil, a Korean company conducted a survey in April 2010 in which they found that within the sample group of 300 consumers living in the Seoul metropolitan region, 77.3% would prefer to buy green products over regular products given that all other conditions are the same (Cheil2010). This shows that the general public’s recognition of green products is already high. Financial investment institutions already consider the open availability of information on GHG emissions reductions schemes and green technology development plans as two important conditions for evaluating the investment environment of a given business.

### The Government’s Plan to Expand the Green Business Management Model

On 27 November 2009, the Presidential Committee on Green Growth, the Ministry of Knowledge Economy, the Ministry of Environment and the Small and Medium Business Administration jointly developed a plan to expand the green business management model across the Korean commercial sector. This plan reformed the various green business policies of the different ministries and related organizations to: (i) establish the foundation for green businesses; (ii) strengthen the green business management potential of small and medium businesses; (iii) expand the green business partnership between different companies; and (iv) identify various detailed policy measures for the strengthening the management base of green businesses.

Moreover, within this plan is a green business management standard and index. The latter identifies 39 detailed indices that can be categorized into five larger themes which all aim for the goal of creating a green business organization. Businesses are recommended to follow these indices as they see fit, in order that a transition towards green business manage-



Figure 4-14: Green Business Management Standards and Detailed Indices

Classification	Category	Sub-category and Details
Strategy	Vision	01. Creating the strategy and policy for green business management 1) Creating green business management vision 2) Formulating green business management strategy and detailed goals
	Full Process Management	02. Green manufacturing process, green products and service development 1) Creating and reforming the green production process 2) Green products, service and marketing 3) Green products service proportion 03. Green purchase and cooperation amongst businesses 1) Creating internal regulations for green purchase 2) Green purchase ration 3) cooperation amongst businesses for green purchase
System	Establishing the Enforcement System	04. Cooperation system between organizations and divisions for green business management 1) Responsibilities and rights of an organization pursuing green business management 2) Training and education programs for dissemination of green business management model 3) Establishing an effective inter-division communication system
	Target Management	05. Internal assessment and output evaluation of green business management model 1) Creating a process of monitoring, maintenance, execution and measures 2) Executing internal assessments 3) Review by manager
Resource / Energy	Conserving Raw Materials and Water Resources	06. Reducing water use intensity 1) Reducing water use 2) Reduce water use intensity
		07. Reducing use of, and finding alternative raw and subsidiary materials 1) Measures for reducing use of, and finding alternative raw and subsidiary materials 2) Reducing raw and subsidiary materials use intensity
	Promoting Recycling	08. Enhancing resource efficiency 1) Reducing wastes 2) Reducing waste intensity 3) Reusing wastes
	Energy Use Reduction	09. Reducing energy intensity 1) Reducing energy use 2) Reducing energy intensity
10. Using renewable energy 1) Encouraging places of business to use renewable energies 2) Increasing use of renewable energies		
GHG / Environmental Pollution	Reducing Emissions of GHGs	11. Addressing and reducing GHG emissions 1) Reducing GHG emissions 2) Increasing rate of emissions reduction 3) Reducing emissions intensity
	Minimizing Environmental Pollution	12. Reducing environmental pollutants(atmosphere, water quality) 1) Establishing permanent monitoring system for environmental pollution 2) Reducing major atmospheric pollutants(SOx, NOx, dust, etc.) emissions intensity
		13. Management of harmful chemical substances 1) Activities on reducing harmful chemical substances 2) Improvement rate of harmful chemical substances consumption intensity
Social / Moral Responsibility	Open Information	14. Open information on management, e.g., Sustainable Report, etc. 1) Open information on green management 2) Publishing sustainable report(report on environment)
	Compliance to Laws and Regulations	15. Compliance to laws and regulations 1) Complying to environmental regulations 2) Complying to relevant regulations on product service supply and use 3) Regulating non-compliance and addressing complaints of related stakeholders

ment models can be made (Figure 4-13).

**The Green Business Management Headquarters of the Chamber of Commerce and Industry**

The Green Business Management Headquarters was created on 26 March 2010 in the Korean Chamber of Commerce and Industry to facilitate a private sector-based transition and expansion towards green business management. The aim of this new body is to disseminate knowledge of green business management idea and measures. It is also in the process of developing a new Green Business Management System Certification. Furthermore, it is seeking to develop a comprehensive national standard for green business management with the aim of expanding it into an international ISO standard in

Figure 4-15: Public-Private Information Channel for International Environmental Regulations

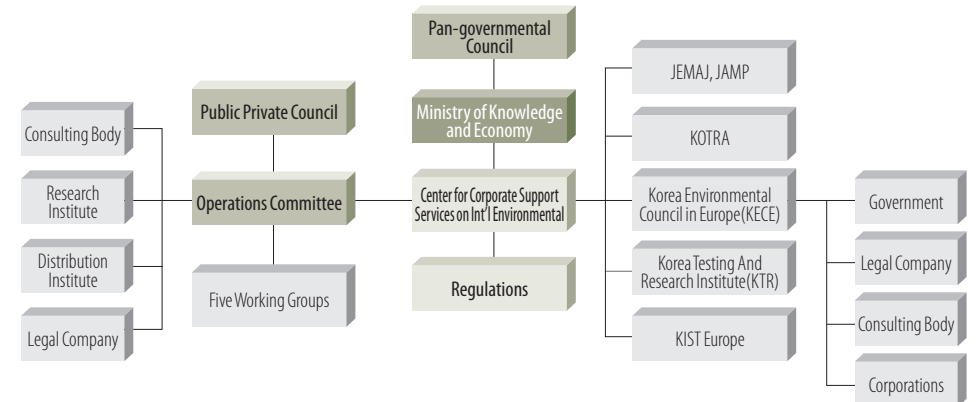
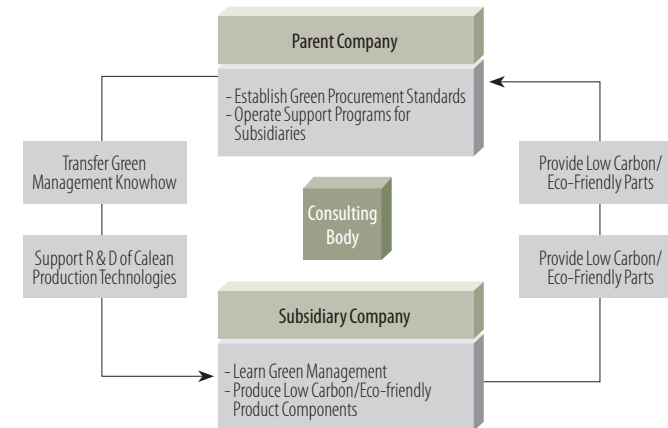


Figure 4-16: Concept Diagram of Green Partnership



the long-term future. Plans to facilitate the development of green business management human resources capacity and to transform the existing idea of environmentally-friendly businesses into green businesses, a new business brand, are being pursued.

### Strengthening the Green Management Capacity of Small and Medium Enterprises

Understanding the differences between SMEs and large corporations, the Korean government is in the process of implementing a green management capacity building program which outlines various levels of greenness. This provides better and more specialized support for SMEs that are at different stages of its business development. Moreover, the government is planning to create a Small and Medium Enterprises Green Management Support Group composed of both civilian and government experts to provide technical support to SME's adoption of green management practices. Within this plan is an idea of creating a Green Service Mall where SME's can receive online training programs or consulting services for green management.

Regional eco-revolution projects under the joint exercise of consulting firms and regional governments are also being expanded in which services for the promotion of clean production methods and assessment of energy use and measures for the reduction of wastes will be provided. Furthermore, a joint civilian-government central information body will collect and disseminate knowledge on green management with a view to providing awareness of international environmental regulations (Figure 4-14).

### Expanding the Green Business Management Partnership

Utilizing the supply chain existing between businesses and their partners, the government is currently planning a project to expand the green business management partnership that provides support towards the development of green business management knowhow and low carbon, clean production technology. This would facilitate efforts to address environment and resource challenges. The Ministry of Knowledge Economy has been playing a central role in the development of a green partnership project, which is currently becoming a topic of interest especially for corporations specializing in carbon partnerships (Figure 4-15).

This partnership concept will be expanded to include cooperative ventures between businesses involved in production, logistics and distribution of goods. In particular, the original plan to develop five eco-industrial parks has been expanded to create eight of such parks. The major underlying concept of eco-industrial parks is to increase resource efficiency and minimize wastes and pollution by reusing wastes resulting from one type of industry as resource for another type of industry. The long-term goal would be the

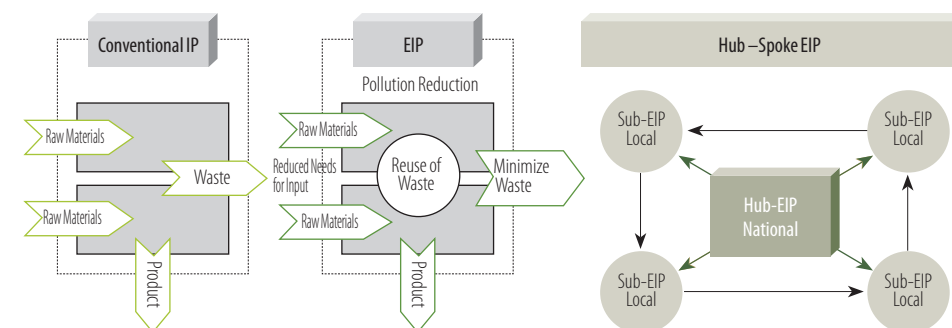
comprehensive expansion of such parks into hub-spokes, under which would be three to four sub eco-industrial parks (Figure 4-16).

### Green Factories

In promoting the modal shift towards green business management, on top of other support initiatives the government is planning to introduce a system of prizes whereby measures for green manufacturing and product design would be rewarded.

Moreover, a green factory movement is being pursued to facilitate the shift to a green manufacturing process. Finally, a green business management standard will be provided to the social service sector that includes public institutions, hospitals and universities.

Figure 4-17: Concept of Eco Industrial Park (EIP)



## IV-6. Green Certificate

### Improving the Global Competitiveness of Green Industry

Green industry is a promising area that provides solutions for the complex challenges of energy and climate change crises. However, one of the main challenges for green industry is its inability to draw sufficient financial inflow due to the high uncertainties and the prolonged payback period of green technology development. Despite the increase in preferred loans for green business and financial instruments, the overall scale of financial investment in green technologies has not distinctively expanded. As such, there has been strong demand for government intervention to provide trustworthy information for green investment opportunities.

### Green Certificate as a Support System for Investment in Green Technologies

The Korean government has introduced the Green Certificate to reduce uncertainties in green technology investment. The program certifies the greenness of a certain technology and business project and affirms green enterprise (Figure 4-18). The Green Certificate is considered to be a demand oriented policy measure allowing those individuals and businesses who are developing green technologies and making business out of them to get easier access to funding in financial markets. At the same time, the Green Certificate incorporates various support measures throughout the stages of green technology development and deployment including public financing, R&D, marketing, commercialization and distribution.

### Promoting the Green Certificate System

The Korean government revised the Restriction of Special Taxation Act (RSTA) to provide tax breaks for green finance as stipulated by the Framework Act on Low Carbon, Green Growth. The tax breaks for green finance took effect on 1 January 2010.

On 11 August 2010, the government in joint efforts of relevant ministries announced measures for promoting green certificates. According to the government, green certified firms will be prioritized for having access to public R&D programs, policy loans, public

procurement markets, getting support in finding markets for their products and product promotion. In addition, they will rank high on the list of companies chosen by the Military Manpower Administration (MMA) as an alternative to the mandatory service in the military for Korean men, which has been a support mechanism for the listed companies to secure labor at low cost.

### Selection of Green Technologies

The government systemized candidates for green technologies certificates across 10 categories and 61 areas under the categories after taking into account technology level, marketability, strategic importance and greenness. These categories and areas incorporate technologies that were already identified as *green* in the Green Energy (February 2009), Green

Figure 4-18: The Status of Green Certificate (Number of Cases, as of 10 September, 2010)

Category	Applications	1 <sup>st</sup> Phase (Documentation)	2 <sup>nd</sup> Phase (Review)	Review Results	
				Qualified	Not-Qualified
Green Technology Certificate	331(244)**	108(92)	99(88)	78(51)	46(41)
Green Business Certificate	40(36)	22(21)	7(6)	1(1)	10(10)
Green Certified Firms	23(23)	4(4)	12(12)	6(6)	1(1)
Total	394(267)	134(113)	118(103)	85(51)	57(49)

\*\* ( ) # of firms

Figure 4-19: Technologies for Green Technology Certificates

Category(10)	Areas(61)
1. Renewable Energy	(1) Photovoltaic (2) Fuel Cell (3) Energy Storage (4) Wind Power (5) IGCC (6) Clean Fuel (7) Ocean Energy
2. Carbon Reduction	(1) CCS (2) Non CO <sub>2</sub> Processing (3) Nuclear Power
3. Advanced Water Resources	(1) Heat Pump (2) Eco-friendly River Management (3) Desalination Plant (4) Natural Disaster Defense System (5) Integrated Water Resource Management (6) Assessment/ Management of Water System and Quality (7) Seawater Processing (8) High Efficiency Water for Agricultural Use (9) Advanced Water Treatment
4. Green IT	(1) LED (2) System Semiconductor (3) Next Generation Display (4) Green SW & Solution (5) Green Computing (6) Green Embedded SW (7) Next Generation Sensor Network (8) Digital Ship (9) Electric Power IT
5. Green Cars	(1) Green Car (2) Low Pollution, High Efficiency Vehicle (3) Green Agricultural Machinery (4) Wise Ship (5) High-tech Railways (6) Green Bicycle
6. High-tech Green Residential Homes, Cities	(1) U-city (2) ITS (3) GIS (4) Low Energy, Eco-friendly City
7. New Materials	(1) Superlight Magnesium Material (2) Ionic Liquid Material (3) Nano Carbon Fusion Material (4) Functional Nano Film (5) Natural Material Derived from Agricultural Product (6) Eco-friendly Agricultural Materials
8. Clean Production	(1) Solutions for International Environmental Regulations (2) Non-pollution Production (3) Resource Recycling
9. Eco-Friendly Agriculture, Foods	(1) Solutions for Change in Ecological Environment (2) Bioresources (3) Low Input Production (4) High-tech Automated System (5) Food Production (6) Safe Distribution
10. Environmental Protection, Preservation	(1) Climate Change Prediction and Modeling (2) Climate Change Impact Assessment & Adaptation (3) Waste and Resource Recovery from Waste (4) Use of Organic Byproduct for Resource (5) Eco-friendly Products (6) Eco-system Preservation and Restoration (7) Monitoring of Harmful Substances & Environmental Remediation

Technologies <sup>(May 2009)</sup> and New Growth Engines <sup>(May 2009)</sup> (Figure 4-19).

The ten categories are: renewable energy, carbon reduction, alternative water resources, green IT, green cars, high tech green residential city, new material, clean production, eco-friendly agriculture and food, and environmental protection and preservation. The criteria for award of certificates is the ability to demonstrate that the technology has reached 70% of the most advanced level in the same line of technologies, if they are being introduced or in an early stage. The list of candidates will be renewed every year to reflect related technological advancement and social change.

### Green Technology Certificates

Green technologies are finally selected by the Green Certificate Review Committee among the candidates who scored higher than 70 points out of 100 based on the evaluation of their technological level, marketability and greenness by the designated evaluation institutes.

### Green Business Certificates

Green business is defined as business that minimizes GHG emissions and pollution by using green technologies and green products. The candidates for Green Business Certificates are chosen among the same green technology categories. The exception is the new material category, where there is no demand for commercialization at the moment. There are about 95 business areas under the 9 green technology categories. The evaluation to issue green business certificates will focus on aspects of applicability of green technologies, environmental impacts, feasibility and marketability.

### Green Certified Firms

The standard for award of Green Certificates to firms is to select those which demonstrate that they made 30% of total output from green technology uses at the time of application, amongst the firms who have been running their business over a year.

### Application Process

Applications for Green Technology Certificates, Green Business Certificates, and Green Certified Firms can be submitted throughout the year online <sup>([www.greencertif.or.kr](http://www.greencertif.or.kr))</sup>. When an applicant submits required information including company name, type of business, main product, capital, sales, verification of registered corporate body and the designated contact point, the firm will get a reference number and identification code. The certificate decision will be made within 45 days from the date of acceptance.

### Certificate Issue

Once the decision is made on Green Certificates, relevant ministries will issue the certificates. The certificates will be effective for two years from the date of issue and renewable by application. The fees for issuing Green Certificates are KRW 1 million (USD 909) for technologies and KRW 1.5 million (USD 1,363) for firms.

### Expected Effects

Consumers and investors will be better equipped with more accurate information about green technologies and business with the introduction of Green Certificates. It is expected that producers will get more incentives to make their products greener, that researchers will be motivated to develop green technologies, that financiers will be more inclined to invest in green business. Green Certificates will provide an impetus for the economy to accelerate its transition to green economy.

## IV-7. Public Procurement of Green Products

Realizing Government Desire to Enhance Environmental Value

### Government as a Big Spender: Product Procurement Standard

The government is a 'big spender' that makes large purchases or procurements of products and/or services. As a 'good implementer', the government frames even the process of product and service procurement as an important measure for realizing national policy goals.

Government procurement or public purchasing contributes to the supplier's entry into the market as well as the expansion of the market (Office of Fair Trading 2004). Once the government has identified an innovative product as having social value, it can take on the role of an early adopter and test the product prior to market release. The government can also become an advocator, publicizing the worth and benefits of the product. Through this process, the government confirms public confidence in the relevant business and as a result creates brand value and vitalizes the market. For example, in Korea, traditional products which the royal family used in the past gained great popularity among the general public in recent years, as these products are still being promoted as the king's goods.

### Korean Government's Procurement System for Invigorating Green Public Market

The Korean government is operating the Purchasing System for Public Procurement of Minimum Green Standard Products (hereinafter, Minimum Green Standard) in order to provide incentives for green products in the market. The Public Procurement Service (PPS) has officially announced the Minimum Green Standard whereby environmental elements such as standby electricity, energy consumption efficiency, and recycling must be built-in to the products to be sold. Only the products that satisfy these requirements are able to transact business on the Korea On-line E-Procurement System (KONEPS) website (<http://shopping/g2b.go.kr>). This scheme naturally facilitates procurement of green products by government agencies.

Standards for 17 products, including computers, were announced on 1 February 2010. Standards for an additional 14 products, including cars, were announced on 1 September 2010,

for a total of 31 products. The Minimum Green Standard demonstrates a higher level of restriction compared to the general product certification standard in Korea. This is in order to expedite green technology development by corporations and strengthen competitiveness. The introduction of 31 product standards is expected to reduce approximately KRW 10.8 billion (USD 9.8 million) of energy costs, mitigate 14,000 tons of CO<sub>2</sub>, and create resource-recycling effect of over KRW 200 billion (USD 182 million) (Public Procurement Service 2010). To boost public expenditure on green products, the Korean government plans to further expand the number of products subject to the Minimum Green Standards to 100 products by 2013.

### Korea's Mandatory Policy on Green Product Public Procurement

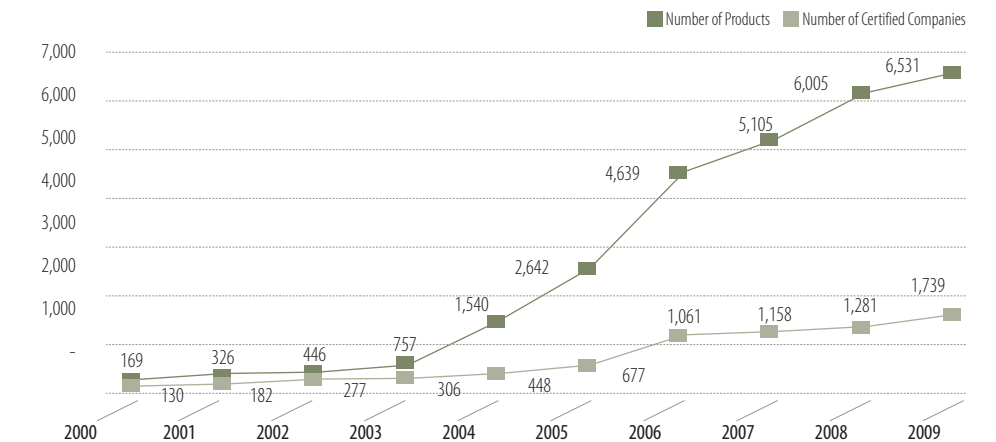
The origin of Korea's mandatory policy on green product public procurement is the

#### Eco-friendly Solar Lighting System.

The Public Procurement Service selected 63 best procurement products, including this eco-friendly solar lighting system on 18 February 2010. The government is supporting the development of green industries through mandatory measures on green products and public purchasing.



Figure 4-20: Korea's Eco Mark Products





Eco-labeling System introduced in 1994, based on the Development of and Support for Environmental Technology Act (Eco-labeling was changed to Environmental Declaration of Products, in line with the amendment of the act on 4 August 2000). When the act was first presented, the public procurement of green products remained at about 13.2 billion KRW (USD 12 million), which rose to reach approximately 255 billion KRW (USD 232 million) in 2004, 10 years into implementation <sup>(Construction Daily News 2008)</sup>. This figure jumped to roughly 690 billion KRW (USD 627 million) in 2009 <sup>(ECOI 2011)</sup>. However, a stronger policy measure to link the producers and consumers was called for.

To resolve this matter, the Korean government introduced a mandatory eco-friendly product procurement scheme to public institutions. A total of 821 institutions are subject to the Act on Encouragement of Purchasing of Environment-friendly Products (Enacted on 31 December 2004, enforced on 1 July 2005 and amended as the Act on Encouragement of Purchasing of Green Products on 5 April 2011, hereinafter, Environment-friendly Product Act), including state organizations, local governments, public enterprises, local public enterprises, local research institutes, etc. If the number of organizations affiliated with the above institutions is included, the total number reaches approximately 26,400.

The selected products based on the Environment-friendly Product Act are in line with the green products enlisted in Article 2, Paragraph 5 of the Framework Act on Low Carbon, Green Growth. The Act regulates Environmental Declaration Products, or those that meet the certification standards according to Article 17 of the Development of and Support for Environmental Technology Act. This Act also regulates the Good Recycle (GR) Certified Products, or those that meet the certification standards under Article 33 of the Act on the Promotion of Saving and Recycling of Resources.

To be applicable for the Environmental Declaration Products, the following criteria were assessed.

- 1 Percentage of harmful substances contained in the product
- 2 Energy power consumption and standby power
- 3 Recycling in manufacturing process or product reusability in discarding phase
- 4 Chemical use in manufacturing process
- 5 Considerations for resource and energy conservation to reduce environmental burden, pollutants discharge and harmful substance use reduction, reusability enhancement, product life extension in all phases of product lifecycle

The Ministry of Environment (ME) established the Integrated Environment-friendly Product Network <sup>(www.ecoi.go.kr)</sup> in 2005 in order to facilitate procurement of green

products. Every year, trainings are offered periodically for procurement officers in public institutions. Moreover, the central government, local governments and public enterprises are evaluated on the percentage of green product procurement as part of their performance appraisal. As of April 2010, approximately 140 local governments, including metropolitan city governments, enacted an ordinance on green purchasing.

Together with the increase in demand for eco-friendly products in public institutions, the number of eco-labeled products is on the rise, reaching 6,531 products from 1,739 companies as of 2009. The production scale of eco-labeled products was KRW 1.6 trillion (USD 1.5 billion) in 2004, which increased to KRW 18.9 trillion (USD 17 billion) in 2009, growing 13 times in size <sup>(GRI 2010)</sup>. According to Korea Environmental Industry & Technology Institute (KEITI), the total number of eco-labeled products has reached 8,042 as of January 2011 <sup>(KEITI 2011)</sup>.

The green product procurement policy of the public sector fosters environmental competition between corporations for market entry. This brings about three key impacts: first, environmental aspects of products are strengthened; second, the overall price and quality of products are improved; and third, related green technology development is stimulated.

Green product procurement by public institutions creates considerable CO<sub>2</sub> mitigation impacts. In Korea's case, the products public institutions purchased through the Public Procurement Service from 2004 to 2009 were found to have reduced approximately 2 million tons of CO<sub>2</sub>. This is equal to what a 181.5 million ten-year-old pine trees can absorb. The economic benefits are around 30 billion KRW (USD 27 million) <sup>(KEI 2009)</sup>.

The Ministry of Environment is also engaging with industries in order to facilitate production, distribution and procurement of environment-friendly products. The Ministry has concluded the Voluntary Agreement on Green Procurement with 123 domestic corporations to enhance participation from the private sector. Also, the Green Procurement Guideline for Industries was distributed so that green purchasing in corporations can occur continuously and consistently. Moreover, overseas policy training programs are provided to build capacity of personnel in charge of green procurement within each company. Owing to the diverse efforts, the sales of eco-friendly products are continuously increasing, amounting KRW 560.1 billion (USD 509 million) in 2006, KRW 1.116 trillion (USD 1 billion) in 2009, with a slight decrease in 2010 to KRW 868.2 billion (USD 789 million) <sup>(E-National Index 2011)</sup>.

With the Framework Act on Low Carbon, Green Growth taking effects in April 2010, the Korean government defined green products as products which minimize energy/resource

input and GHGs/pollutants release. The government is also urging Korean citizens to be more aware of green management by corporations and to expand spending on green products. By certifying the adequacy of green products, obligating public procurement and providing technical assistance, the government is requiring the vendors to make greater efforts so that consumers can easily recognize green products. Moreover, the Administrator of the Public Procurement Service, in consultation with public agencies, has the authority to adjust those agencies' purchase orders to buy green products. He can also urge that buildings to reflect green values from the design phase, also in consultation with the agencies ordering constructions.

After five years of experience in implementing the Environment-Friendly Product Act, Korean government's green procurement policy has made substantial achievements. Moreover, by enacting the Framework Act on Low Carbon, Green Growth, green products can now be used in construction design, which is expected to enhance awareness and performance of green products.

For green products to become better known, used, and commercialized, the following efforts are needed.

- 1 The government should prepare supporting measures for green product producers and develop economic incentive systems so that more consumers can buy green products.
- 2 Corporations should develop clean production systems and promote environmental management techniques, such as environmental accounting. At the same time, corporations should consider conducting product life cycle assessments as well as applying eco-design with the goal of realizing product stewardship. Moreover, corporations should keep in mind the development of environment-friendly product components, green marketing, green procurement, and corporate social-ethical responsibility.
- 3 Distributors are the agents that link producers and consumers. Therefore, they should devise ways to expand the number of stores which carry green products, provide information on green product consumers, and accumulate additional points for green product use.
- 4 Consumers should make responsible consumption decisions, reflecting on the entire process from product purchase, use, to product disposal. Furthermore, the media, government and NGOs should consistently educate, advertise and campaign, recommending the right choices for consumers.

## IV-8. Green Jobs

The International Trend and Korea's Future Prospects

### Jobs in Green Growth: Motive for Creation and its Current Definition

Green jobs are defined in various terms. In 2007, the United Nations Environment Programme (UNEP) defined green jobs as humane jobs created by the agricultural, manufacturing, research and development, management, and service industries intended to reduce the environmental threats faced by humans<sup>(UNEP 2007)</sup>. Thereafter, in 2008, UNEP additionally described green jobs to include jobs that contribute to maintaining or revitalizing the quality of the environment through protecting the ecosystem's diversity and its system, reducing use of energy and resources, lessening carbon exhaust, and reducing contamination. In 2009, the Korea Labor Institute defined green jobs in two ways. The first definition classified green jobs as those jobs that directly intend to improve the environment or reduce harmful effects to the environment (e.g. wind power turbine engineer). The second definition dealt with a broader concept that was inclusive of all jobs that directly or indirectly led to positive environmental benefits, or reduced environmental threats<sup>(UNEP 2008)</sup>.

### Types of Green Jobs

According to the American economist Robert Polin's report (2008), there are various types of green jobs. They include jobs in green growth research and development, product design, product manufacture, sales and distribution, installation of facilities, and operation and maintenance of facilities. These jobs require a skilled workforce<sup>(Figure 4-21)</sup>. Green jobs are now coined as green collar jobs, not unlike white collar jobs and blue collar jobs, terms that refer to salaried professionals and hourly wage earners, respectively<sup>(UNEP 2008)</sup>.

### The Present State of Green Jobs

It is impossible at this stage to get the current statistics for green jobs, as the concept of green jobs itself is yet to be clearly defined. However, jobs in the renewable energy and environmental sectors are opening up at a fast pace, and green growth industries have taken a stronghold in the job market in recent times. In its 2008 report, UNEP estimated that

300,000 workers worldwide were in the wind power industry, while over 100,000 were in the photovoltaic industry. In China, Europe, and the United States of America, over 600,000 were working in the solar power industry.

Similarly, in Brazil, USA, Germany and China, a total of 1.2 million workers were employed in the biomass sector, in which plant and animal wastes are used as energy resources. UNEP expected that the number of workers in the renewable energy area currently standing at around 2.3 million will hit the 20 million mark in 2030. The latter number includes the 6.3 million workers in the solar energy development industry (Garrett-Peltier et al. 2008).

In March 2008, Schreus' publication argued that the number of green jobs were on the rise. In 2004, there were 160,500 green jobs in the renewable energy area, a number that increased to 249,300 in 2007. Of these, 134,000 job openings were attributed to the German renewable energy legislation. In specific, 39% of these jobs were created in the biomass industry. Additionally, the hydropower sector that created 63,000 jobs in 2004 expanded its workforce to up to 84,300 in 2007. In year 2007 alone, 38,600 jobs in solar power; 4,200 jobs in geothermal energy; 9,400 jobs in hydropower; and 4,300 jobs in the renewable energy research, scientific organizations and government funded public institutions were created (Schreus 2008).

Korea has yet to come up with a report on green job statistics. Nevertheless, an overview of the current status of green jobs can be found in the Environment Industry Survey Report

■ Figure 4-21: Green Jobs

ITEM	INDUSTRY	Type of JOBS
Renewable Energy	Wind Energy	Environmental engineer, steel worker, water mill designer, sheet metal working engineer, mechanic, electric apparatus engineer, construction equipment operator, industrial truck driver, production manager
	Solar PV	Electrical engineer, electrician, mechanic, welder, metal assembler, electric apparatus assembler, installation assistant, building manager
	Biochemical Organic Fuel	Chemical engineer, chemist, chemical equipment operator, compound machinery operator, farmer, industrial truck driver, agricultural manager, agricultural products supervisor
Environment	Atmospheric Pollution	Environmental engineer, atmospheric environment engineer, operator for anti-atmospheric pollution equipment
	Waste Management	Waste treatment engineer, waste collector and truck driver, hazardous substance removal specialist, repair specialist, environmental engineer, heavy equipment engineer
	Water and Wastewater Treatment	Water quality industry engineer, water quality management specialist, sewerage repair and manager, water treatment facility operator, plumber, waterworks construction engineer, environmental engineer
Others	Traffic	Public works engineer, track engineer, electrician, welder, bus driver, traffic supervisor, electricity generation and transmission specialist
	Construction Remodeling	Electrician, heating and cooling equipment engineer, carpenter, construction equipment operator, roof supervisor, building superintendent

Source: Pollin (2008)

published in 2008 by the Ministry of Environment. According to the report, the total number of workers in the environment industry was 390,406 with roughly 45.6% of the total working directly on the environment, while 54.4% were employed in jobs indirectly related to green growth. However, such data does not provide adequate information to analyze the ever-expanding green job market in a comprehensive manner. Therefore, it is important to gather and completely account for the country's labor market, i.e. skilled workers and minimum wage earners for all the industry sectors, so that strategic policies and measures can be put in place.

### The Korean Government Plans to Promote Green Jobs

The government has prepared a plan to cultivate a green workforce on the national level to construct a favorable cycle that will create green jobs and stimulate green growth. Specifically, it identified eight policy projects from two areas of expansion of green professional development and foundational work for green jobs (The 6th Meeting of the PCGG on Green Jobs Creation and Workforce Training Plan on 5 November 2009).

- (1) To lay the foundation for green jobs, the government plans to establish partnerships between national and provincial governments, public and private, labor and management, as well as implement policies regarding green employment outlook and impact assessment and regularly monitor workforce status in the green industry area. After partnerships are formed, plans are set to provide fitting workforce in the industry scene. Moreover, additional employment notifications will be posted online at the work net ([www.work.go.kr](http://www.work.go.kr)) to support green job opportunities and employment.
- (2) Plans are also underway to expedite and promote the growth of green social enterprises with a total of 40 enterprises in 2009, and expand to 300 enterprises by hiring underemployed groups. In order to improve working conditions in these companies, workplaces containing chemical substances such as rulruen, normal hexane, dimeteolporeum will be managed in three levels distinguished by the colors green, yellow and red, respectively. In addition, plans are set to expedite the transition to green business and promote environmental friendly working options through energy saving employment such as teleworking (Kim 2009).

The policies to expand professional green skilled jobs are: (i) in order to accelerate the growth of new green industries, vocational training centers will be expanded to supply workforce in fields of high manpower demand, including in areas of renewable energy, LED smart grid, environment-friendly construction. (ii) there exist initiatives to provide reimbursements for the training costs and wages involved in the industries' execution of

worker transition training systems and in order to support labor transition training systems in major industries such as that of the automobile, steel, shipbuilding in particular towards greening their workforce. In the case of companies, organizations, universities that make up a consortium of human resources development, green skill alliance to conduct specialized green skills training, support will be provided in the form of KRW15 billion (USD 13.6 million) for facilities and equipment for three years and up to KRW 1.2 billion (USD 1 million) in labor costs for six years. The existing national qualification system will be further greened by introducing new certification for green qualification (e.g. LED applied light fixture craftsman, electric motor vehicle drivers, carbon emission dealer).

### Challenges in Creating Green Jobs

The first challenge that must be tackled in the efforts to create green jobs is the R&D of related green technologies and the practical application of such technologies. The system must be improved to simultaneously expedite R&D and applicability of green technologies. For example, the taxation system must be reorganized to allow businesses to undertake environment-friendly decisions and labor costs incurred by green jobs could be shared by the government to some extent.

Green growth produces labor demand with simple technical jobs. A problem arises from the fact that simple technical jobs typically provide unfavorable working conditions and unstable employment. This is especially true with jobs related to recycling. Workers in this field usually face not only safety issues and health hazards, but also experience serious problems in terms of job security. Considering these challenges, efforts must be geared towards providing worker safety and better working conditions.

Nevertheless, most jobs that are created in the process of the implementation of green growth policies and measures are expected to come from related areas. Education and training programs that enable labor transition is an important challenge along with R&D. However, the current data on the supply and demand of green jobs are only at its initial stages, while more in-depth analysis such as information about the education level of the workforce is still in progress.

## IV-9. Green Talents

New Workers for the Preservation and Restoration of the Environment

### Green Jobs and Green Talent

The United Nations Environment Programme (UNEP) and the International Labour Organization (ILO) co-authored the Green Jobs Report in 2008, in which they defined green jobs as jobs that will contribute to the restoration and preservation of the quality of the environment by reducing the environmental harm caused by businesses and other economic corporations to a manageable level.

According to the report, green jobs include not only jobs that emerge from the invention of new green technologies, but also those pre-existing jobs in the agriculture, manufacture and service industries that have undergone a process of *greening* whereby they can contribute to the overall efforts towards green growth. In essence, all staff and personnel engaged in green jobs are classified as green talent with key personnel distinguished as ‘core green talent’ who are responsible for the development of new green technologies <sup>(UNEP, ILO, IOE, ITUC 2008)</sup>.

### Cultivating Green Talent

Green technology refers to technology that conserves energy and resources efficiently and minimizes the emissions of GHGs and pollutants through GHG reduction technology; energy efficient technology; clean production technology; clean energy technology; resource recycling; and environment-friendly technology. Green technology is a broad field of technology that seeks to realize low carbon technology towards green industrialization. The development and utilization of these new green technologies requires the creation of a new class of workers. In other words, it is necessary to cultivate a class of green talent <sup>(Hwang 2009)</sup>.

The following points should be considered in this respect. First, a plan must be prepared in which the development of workforce is promoted in conjunction with the relevant technologies. The direction of technology development and future technology demand must be taken into consideration, together with the level and scale of demand for the labor required to leverage such technologies. Moreover, policy measures must be put in place to address

uncertainties and limitations of the technology and human resources in the long-term.

With respect to energy and carbon emissions, the developments of renewable energy and clean energy that will replace fossil fuels are needed in the long-term. In the short term, carbon emissions must be controlled, while energy efficiency improving measures are also needed. The use of carbon capture and storage (CCS) technologies that are currently under development needs to be improved.

Green technology utilizes solar power, which produces less carbon emissions while at the same time producing usable energy. It is oriented to reduce the destruction of the ecosystem, while allowing the ecosystems to recover naturally through its clean, emissions-free electricity generation mechanism.

Due to the technical skills development in the green technology, labor demand prospects increases for the energy-environment based technology. Renewable and sustainable concepts should also be applied to human resources. There should be continuous manpower development in order that the labor market can respond to the ongoing and future technological development and advancement. It is necessary to equip the workers with the ability to adapt and an inherent ability to respond consistently to such kind of situations.

### Korean Government Plans to Cultivate Green Workforce

The Korean government came up with a green workforce training strategy to meet the growing workforce demand in response to green growth (The 6th Meeting of the PCGG on Green Jobs Creation and Workforce Training Plan on 5 November 2009). It plans to grant a total of KRW 1.1 trillion (USD 1 billion) by 2013 to the core members who will lead green growth policy development that will directly result in the creation of about 10 million green workers. In addition, government support will be provided to the first 13 specialized graduate schools that will provide advanced and specialized training for key green technology workforce by 2012 (Korean National Commission for UNESCO 2009).

Moreover, in order to foster the development of an internationally recognized level of green research staff, the government has provided its support to strengthen world-class universities and research institutes. Moreover, in the endeavor to develop local green talent, 19 esteemed local universities in six regional areas are in the process of becoming green education centers for local green workforce creation.

Finally, plans are also underway to increase the number of professionals in green service industries such as green finance, green business and carbon emissions. In order to educate specialists in a systematic manner, specialized high schools will receive support for their diverse vocational programs.

### Green Certification System

In order to cultivate green workers, a certification system must be established to distinguish individual ability and level (Figure 4-22). This system standardizes the skills and capabilities of the green workers (Kim 2009).

The reality and problems of such a certification system regarding green workers are as follows:

Figure 4-22: Major Green Technologies and Related Qualifications

Classification	Green Technology		Related Qualifications
	Category	Sub-Category	
Prediction Technology	Climate Change Prediction & Assessment	Climate Change Prediction	Climate prediction engineer, meteorologist
		Climate Change Adaptation	Climate change effects assessor
Energy Technology	Renewable Energy	Solar PV	
		Bioenergy	
	Nuclear/Nuclear Fusion	Nuclear Energy	Nuclear energy engineer
		Nuclear Fusion	Nuclear energy engineer
Hydrogen Fuel Cell	Hydrogen Creation and Storage		
	Fuel Cell		
	Eco Friendly Manufacturing Process / Enhancing Raw Material Efficiency	Ecofriendly Manufacturing Process and Products	Horticulturalist, agrichemical engineer, bioengineer
High-Efficiency Technology	Enhancing Efficiency and Applicability of Fossil Fuels	CTL, CTG	Underground resource management specialist
		Automobiles, Rail, Ship, Space Aeronautics, Traffic	Vehicle engineer, traffic engineer, driver, commercial driver, distribution specialist
	Green Territory	Green city	Architect, city planning official, gardener, construction worker
		Green Home / Building	Architect
	Eco Friendly Manufacturing Process / Enhancing Raw Material Efficiency	Manufacturing Process / Enhancing Raw Material Efficiency	
	Enhancing Electricity Efficiency	LED, IT, Machinery	
Superconduction, Power IT, Energy Storage		Electricity dispatch and distribution officer	
After Treatment Technology	Athmospheric Pollution Monitoring and Control	CO <sub>2</sub> Capture, Storage, Treatment	Atmospheric administration official
		Non-CO <sub>2</sub> Monitoring and Treatment	Atmospheric administration official
	Water Quality Environment	Water Treatment	Water quality management official
		Securing Water Resources	
Waste	Waste to Resources and Waste to Energy	Waste treatment specialist	
Waste and Environmental Preservation	Evaluating Harmfulness	Environmental effects assessor	
Promotion of Non-polluting Economy (knowledge-based)	CT, Soft-Based IT and Knowledge Service	Virtual Reality	

Source: Revised from Kim Hyun Soo (2008)



- (1) In the forecasting bureaus, there are weather forecast technicians and professional engineers. They normally give weather forecasts on a day-to-day basis, rather than offering long-term forecasts stemming from climate change. Meanwhile, environmental impact assessors are also associated with climate change. However, they too are not climate change experts and there are considerable differences in the nature of their work.
- (2) In the energy technology field, though there are professionals in the nuclear power and nuclear fusion discipline, there is no qualification system for the renewable energy and hydrogen fuel cell technology fields.
- (3) In areas of high-energy efficiency technologies, there are professional engineers in coal gas combined cycle technology and mineral resources. There are also qualification systems in the high efficiency and low emission vehicle technology area, examples being the production professionals including vehicle engineers, intelligent transportation logistics technology engineers, industry engineers, and logistics managers. In areas of power, information technology, and improving efficiency of electrical equipment, there are qualification systems for shipping and distribution engineers. Meanwhile, in the areas of ecology and urban spaces and renewable technology, there are qualification systems for architects, city planning engineers, landscape engineers and industry engineers. Eco-friendly low energy building technology systems have architected eligibility policies. However these qualification systems are not consistent with the 27 key green technologies presented by the government.
- (4) In the area of post-processing technology, there are qualification systems for engineers in carbon dioxide capture, storage, and processing technology and GHG management systems, except carbon dioxide. There are quality management engineers in the water quality assessment and management technology area, while in the waste reduction, recycling, and waste disposal field, there is qualification for waste management engineers. There are environmental impact assessment specialists in the field of hazardous substance exposure monitoring and processing technology, but they do not exactly match the original work. In the global trend of environment-friendly, low carbon green growth, we must go beyond just cultivating existing traditional environment industries. It is necessary to actively discover and foster areas of renewable energy, energy efficient technologies and GHG reduction technologies in order to maximize the effectiveness of green industries' integration.

As green technology development and security become the key element to industrial competitiveness, its importance will increase in the future. The active participation of industries in establishing green credentials and quality management is inevitable. Also, continuing the development of the education system in conjunction with the qualification

system is important.

In the areas of construction, machinery, transportation, and product design, a continuous training system must be conducted in order for people to acquire the knowledge necessary to operate in new green industries. Recently, the Ministry of Environment (ME) was authorized to give an assessment of qualification to individuals who have completed the EDP Auditors Training Program. The Ministry also continues to conduct training related to climate change. Furthermore, it is worth considering implementation of 'echo test' qualification system which can raise awareness about the green industry and create consensus and knowledge sharing to acquire basic information. If this policy were to be implemented, qualified professionals and the general public alike can acquaint themselves with environmental problems in detail through short-term training courses. As an example, in 2006, Japan implemented the Environmental Social Assessment Test which was similar in nature to the echo test. Once qualified, job seekers will be granted extra points during employment processes, and companies that hire such people can enjoy the benefit of an improved corporate image <sup>(Hwang 2009)</sup>.



# Green City, Transportation and Building



V-1. Green City	152
V-2. Building Energy Management Policy	156
V-3. Green Buildings	162
V-4. Fuel Efficiency and Greenhouse Gas Regulations	168
V-5. Green transportation	172
V-6. Bicycle and Low Carbon Transportation	175

## V-1. Green City

City to Vitalize Economy without Carbon Emissions

### A New Type of City Demanded by Climate Change

Historically, cities can be categorized as follows: Traditional Pre-Modern Walking City, Industrial Transit City, Modern Automobile City, and a Post-Modern Sustainable City (Figure 5-1).

Among these, Post-Modern Sustainable City is based on a new paradigm of urban planning with foundations in sustainable development. Moreover, it has evolved into the concept of the Eco-City, attempting to provide a solution to climate change related problems such as extreme heat, heavy snowfall, concentrated rainfall, environmental destruction, decreasing biodiversity and global warming. In addition to this concept of Eco-City, as the Kyoto Protocol came into effect in 2002, the Carbon-Neutral City has emerged with emphasis on: an urban structure for absorption and reduction of carbon emissions, energy plans, resource recycling, rehabilitation of ecosystem, and reforestation.

### A City where the Environment and Economy Coexist

The low carbon, green city is a new and multi-dimensional concept that covers ideas for carbon reduction and absorption as well as economic growth. Significantly, this new concept includes the pre-existing alternative urban concepts such as the garden city, green city, ecopolis, eco-city, amenity city, environmental protection city, and sustainable city. In other words, the low carbon, green city aims to build a low energy consumption socio-economic system that promotes the environment and economic growth at the same time, while working to address climate change (Figure 5-2). The low carbon, green city can also be interpreted as a city in which the environment and economy coexist through reforming structure into low carbon ones and achieving economic stimulation through creating jobs and fostering new engines of growth (Figure 5-4).

### Korea's Plans and Measures for Low Carbon Green Growth

In July 2009, the Ministry of Land, Transport and Maritime Affairs (MLTM) announced Guidelines for Urban Planning in Pursuit of a Low Carbon, Green City. The

guidelines set rules for collecting GHG emissions statistics, assessing impacts of climate change on cities, and establishing climate response plans by city type.

Moreover, the Ministry of Environment has been promoting development of a climate response pilot city. In July 2009, Gangreung City in Gangwon Province, one of the eight provinces of Korea and located in the northeast part of the Korean peninsula, was selected as the pilot city. Gangreung City with an ambition to become a world-class low carbon city

Figure 5-1: Characteristics of Four City Types

Category	Traditional Pre-Modern Walking City	Industrial Transit City	Modern Automobile City	Post-Modern Sustainable City
Economy/Technology	- Small household industries - Local and small regional economy	- Larger industries concentrated in parts of cities - National and regional economy	- Large scale industries scattered through city - National and regional economy	- Information, Service-oriented industry - Global economy
Social Organization	- Person-to-person - Community-based	- Bigger cities losing person-to-person contact - Community-oriented in suburbs	- Individualistic and isolated	- Local community based - Global linkage
Transportation	Walking	Streetcars and trains (also walking and cycling)	Cars (almost exclusively)	Walking/Bicycle (local), Public Transportation (between cities), Automobile, Airplane (Global)
Urban Form	Walking City (small, dense, mixed, organic)	Transit City (Medium density suburbs, dense mixed center, corridors with green wedges)	Automobile City (High rise CBD, low density suburban sprawl zoned to further separate functions)	Sustainable City (Local urban villages (high density) linked across city by transit, medium and low density areas around villages. No more sprawl)
Environment	Resources	Low	Medium	High
	Wastes	Low	Medium	High
	Nature Orientation	Close to the rural areas (dependent)	Some connection through green wedges	Low (independent)

Source: Ministry of Environment and Kangnan Province (2009)

Figure 5-2: Stream of City Paradigm

Category	→			
	1970~ Early 1980s	Late 1980s ~1990s	2000s	
	Eco-City		Carbon-Neutral City	
Objectives	Environmental conservation	Biological Diversity	Resource Recycling	Climate Stabilization
Key Interests	- Environmental resource conservation - Green park	- Ecological network - Biotope restoration - Regional culture diversity	- Resource recycling - Renewable energy - Ecological residence	- Environmental disaster prevention - Ecology, climate planning - Eco-friendly industrial structure
Related Studies	Bioecology	Landscape Ecology	Resource Ecology	Climate Ecology
Similar Concepts	Green City, Environmental City, Eco-City, Sustainable City, Ecopolis		Zero emission City, Low carbon City	

Source: Korea Research Institute for Human Settlements (2009)



developed an urban regeneration plan. Also, relatively small cities with less than 1 million population such as Buchun-city, Ansan-city and Gosung-district were selected as pilot for eco-cities. These three cities announced their respective eco-city master plan in 2008.

### Improving Green City Policies

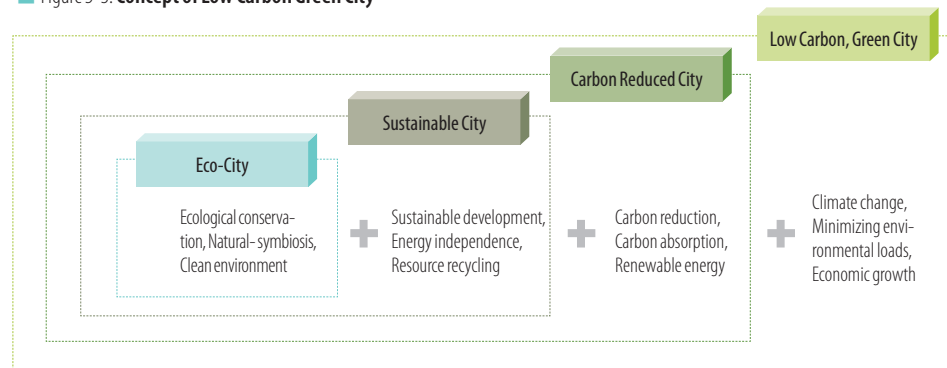
However, there is a problem with the current green city related policies in Korea. First, the actions for climate change adaptation are relatively weak mainly because they are focused on GHG emissions reduction. Second, there is lack of consistency in policies and guidelines. And lastly, there is an insufficient support and cooperation among the related government offices and institutions to implement the policies.

Therefore, the need for an integrated policy at the macro level is required. Problems at the macro level include improvement of urban planning systems and related

guidelines, as well as the establishment of a comprehensive inventory database. Hence, comprehensive policy guidelines that cover such problems should be developed. In addition, each local authority should analyze GHG emissions reduction potential of the city and set a GHG emissions reduction goal for the city considering the urban space structure, road conditions, differences in traffic volumes.

As for a micro level perspective, there needs to be an effective plan on the improvement in urban space planning. Specifically, segmentation into city, town, and facilities that constitute a city, not the city as a whole, will be necessary to effectively address climate change at the city level. Also, projects on alternative energies such as photovoltaic, tidal power, wind energy, geothermal power, and hydropower should be promoted and related support system should be prepared at city level.

Figure 5-3: Concept of Low Carbon Green City



Source: Ministry of Land, Transport and Maritime Affairs (2009)

Figure 5-4: Korea's Climate Change Policies

Plans	Details
The 1 <sup>st</sup> Comprehensive Counter Plan(1999~2001)	Composed of 36 Projects, Decreasing GHG Emissions, Applying the Flexibility Mechanism, Developing Technology
The 2 <sup>nd</sup> Comprehensive Counter Plan(2002~2004)	Composed of 84 Projects, Building Negotiation Capability, Developing Technologies for GHG Emissions Reduction, Enhancing GHG Reduction Measures, Building Statistical Database, Expanding Citizens' Participation
The 3 <sup>rd</sup> Comprehensive Counter Plan(2005~2007)	Composed of 91 Projects, Establishing Foundation of the Implementation of Agreements, Reducing Sectoral GHG Emissions, Building Mechanism for Adapting Climate Change
The Comprehensive Plan on Combating Climate Change(CPCCC)(2008~2010)	Drawing Actual Results from Climate Change 3 Main areas: GHG Emissions Reduction, Climate Change Adaptation, Research and Development
The Comprehensive Plan on Combating Climate Change(CPCCC)(2008~2010)	Developing Climate Industry as a new engines for economic growth Contributing to the global efforts to combat climate change Improving the quality of life and the environment

Source: Ministry of Land, Transport and Maritime Affairs, et.al (2010)

## V-2. Building Energy Management Policy

Increase in the Number of Net Zero Energy Buildings

### Energy Efficiency Policy: from Autonomous to Regulatory

The building sector accounts for approximately 48% of the world's energy consumption and is projected to further rise <sup>(WBCSD 2011)</sup>. Consequently, the building sector has the greatest GHG mitigation potential.

International organizations that address this issue include: International Energy Agency (IEA), International Organization for Standardization (ISO), and Asia-Pacific Partnership on Clean Development and Climate (APP). The latter is an organization composed of seven member countries including Korea, the U.S., China, and India. Together, they consume over 50% of the world's energy <sup>(APP 2011)</sup>. These organizations focus on the idea of net zero energy buildings to increase energy efficiency in buildings. They have already started preparing measures for the upcoming ten years with the aim to increase the number of net zero energy buildings.

In order for Korea to achieve this goal, the following three points should be considered.

### Building Energy Reduction

Left: Ceremony for the Agreement on Green Design Vitalization between the Construction Association and the Ministry of Environment;

Right: Signing of the MOU on Environment Friendly Buildings between the city of Seoul and Samsung C&T. Korea is carrying out diverse measures to enhance building energy efficiency.



- (i) A medium-term goal for building energy efficiency in Korea should be established.
- (ii) A specific action plan to meet the goal should be formulated.
- (iii) Strong policy and support from the Korean government is necessary.

In the past, energy efficiency policy for buildings was carried out autonomously by the market. However, developing countries have come to realize it will be impossible to attain the goal by depending solely on the market autonomy. Thus, governments are making a transition to introducing regulatory policies.

### Energy Efficiency Rating System

Korea is currently pursuing various measures to raise energy efficiency in buildings. For example, the Ministry of Land, Transport and Maritime Affairs (MLTM) introduced the Building Act and the Ministry of Knowledge Economy the Energy Use Rationalization Act. To enhance energy efficiency, the Building Act focuses on energy conservation from the planning phase of new buildings and the Energy Use Rationalization Act on the operations of existing buildings and the use of highly efficient equipment.

Energy efficiency policy in the building sector first began with the insulation standard for new buildings in 1979. Since then, Korea has revived energy intensive buildings to submit energy conservation plans on a mandatory basis since 1985. In 2001, a building energy efficiency rating system was introduced by establishing the Energy Conservation Design Standard which categorizes use by type.

Energy efficiency policies for buildings can be divided into policies for new buildings and existing buildings. For new buildings, there is the insulation standard which can be applied to all buildings. For energy intensive buildings above a specified size, the Building Energy Conservation Design Standard is applied. For apartment buildings, the Environment-Friendly Housing Performance Standard is enforced as a mandatory obligation.

The Building Energy Conservation Design Standard was developed based on the Building Act and Regulation for Facilities in Building. This standard outlines mandatory requirements to ensure energy efficiency from the design phase of new buildings. More specifically, the standard is organized in four components: buildings, machinery, electricity, and new and renewable energy.

The individual standards which had been previously announced were unified in 2001. Since the publication of the integrated standard, the Energy Conservation Design Standard is periodically modified and strengthened. As a result, the required performance level was enhanced by around 20% in 2010.

The Building Energy Efficiency Rating System ranks buildings according to the level of



increase in energy use efficiency above the required standard. Generally, this process is initiated once the building owner applies for the Building Energy Efficiency Rating System. The government then recognizes and certifies the value of high efficiency buildings, just like the energy efficiency rating system for automobiles and refrigerators. Certification by the government fosters interest in energy efficiency in the construction market. It also provides greater opportunity for the consumers to choose high efficiency buildings. In July 2010, the law was amended so that construction standards on floor area ratio, landscaping area, and building height controls can be relaxed up to 9%, if a building acquires energy efficiency rating above 2<sup>nd</sup> class rating. This law was applicable only to apartment buildings between 2001 and 2009, but since 2010 it has been extended to office buildings. All public government buildings are obligated to acquire first class rating. Currently, private buildings can participate on a voluntary basis. Starting in 2012, the Mandatory Indication of Efficiency Rating is scheduled to be enacted.

### Environment-friendly Housing Performance Standard and Environment-friendly Certification System

The Environment Friendly Building Certification System, based on the Building Act,

#### Young-Dong Expressway, Duck-pyung Service Area

Duck-pyung Service area, built as an environment-friendly building by applying systems and construction designs to raise energy efficiency. This service area won the hearts of many travellers for its pond and scenic walking trails.



declares the building's eco-friendliness by assessing the elements which have impact on the environment, such as energy and resource conservation, emitted pollutants reduction, harmony with surroundings. These other factors considered throughout the entire process including production of construction materials, construction, management and demolition. The completed buildings are usually evaluated for certification, however building owners can apply for evaluation at the design stage and be granted a preliminary certification. The certification system's scope of target buildings has been continuously expanding: the certification system began in 2002 covering apartment buildings. In 2003, it was extended to include residential-commercial buildings and office buildings. In 2005, school facilities were covered and in September 2009 retail and accommodation facilities (including remodeled buildings) were added.

The Environment friendly Housing Performance Standard was enacted in 2009 to enhance energy efficiency in apartment buildings. This standard is based on the Ministry of Land, Transport and Maritime Affairs' regulations on building construction standards. When constructing an apartment building comprised of over 20 households, it is required that apartment with area of over 60m<sup>2</sup> must reduce energy consumption and CO<sub>2</sub> emissions by more than 15% compared to their current level. Housing with area below 60m<sup>2</sup> should reduce by more than 10%. The performance of environment-friendly housing is evaluated in four sectors (heating, water heating, heat source and electricity), and by 14 elements including exterior walls, side walls, windows, floor, boiler, new and renewable energy, etc. The additional construction costs incurred to satisfy performance standards can be included in the apartment/building price.

For new buildings, there is also the Housing Performance Grading Indication System, which certifies and indicates overall housing performance, including noise, structure, external environment, living environment, etc. The Use of New and Renewable Energy in Public Institutions requires building contract for public institutions to install new and renewable energy systems. This measure was enacted under the Act on the Promotions of the Development, Use and Diffusion of New and Renewable Energy.

With the number of existing buildings amounting over 6.6 million (*E-National Index 2011*), it is difficult to achieve mitigation targets without proper measures for small and medium sized buildings. Since there is a focus on regulating only large and energy intensive buildings, a measure to enhance energy efficiency of individual small/medium sized buildings, in particular the privately owned buildings, is necessary. Currently, there is the Guidelines for Energy Use Rationalization for existing public institutions, the Voluntary Agreement (VA) for large, energy intensive buildings, and the Energy Service Company (ESCO) System, a program to improve and repair buildings to raise energy efficiency.

For general buildings, there is the Building Energy Management Standard which has not been very effective as it is not compulsory. For example, in the industry sector, about 70% of the total GHGs can be regulated by controlling the top 600 most energy intensive businesses. However, for buildings, the energy consumption of 850 buildings is above 2,000 TOE. Registering their activities only accounts for less than 6% of total building energy consumption. Thus, the government's existing efforts are inadequate *(Ministry of Environment 2010)*.

### The Framework Act on Low Carbon, Green Growth and National Integrated Management of Building Energy

Various policies and measures are being implemented to manage building energy in Korea. However, the lack of coherence and consistency in management has been criticized, with different ministries involved in the management process. There are also limitations in conducting CO<sub>2</sub> mitigation assessments, as Korea's building management practices have been specification-centered, rather than performance-oriented. Moreover, as management models from developed countries were directly introduced domestically, application of the systems was quite difficult.

The Framework Act on Low Carbon, Green Growth which has been in force since April 2010 suggests the following for buildings:

- 1 Modification of policies to promote and support green industry;
- 2 Establishment of technology and measures for resource recycling;
- 3 Standardization of green technology and green industry;
- 4 Introduction of target management by sector, including households and businesses;
- 5 Carbon statistics for climate change response, and management of carbon statistics;
- 6 Introduction of Emissions Trading System;
- 7 Creation of energy/resource-independent, carbon-neutral city, which corresponds with the Basic Principles for Green Land and Transport; and
- 8 Management of green building design standard, rating system, and emissions.

The Framework Act on Low Carbon, Green Growth has stimulated the transition from the previous energy-oriented to carbon-oriented indicators. It is also significant that the Act covers carbon emissions from entire building stock, including the existing buildings. In order to quantitatively manage carbon emissions from buildings, a building energy management system centered on performance and aggregate amount must be established. Moreover, the Life Cycle CO<sub>2</sub> Assessment (LCCO<sub>2</sub>) method must be introduced for a carbon-oriented evaluation. This method assesses carbon emissions from energy use in

not only the operation phase, but also throughout the material production, construction, and demolition phases.

To realize the GHG Target Management System and emissions trading system and prepare an accurate inventory, the establishment of the National System for Building Energy Management Systems, which compiles and manages the energy use of individual buildings in detail, is urgently needed. This system which connects energy suppliers with energy consumption by individual buildings will make possible precise mitigation target management by building type. In addition, economic penalties can be imposed on those buildings which emit more carbon than the target amount.

## V-3. Green Buildings

### Land-reviving Buildings

#### Resource-efficient and Environment-friendly Buildings

Green buildings emerged as a new agenda together with the concept of ‘Environmentally Sound and Sustainable Development (ESSD)’. Green buildings can be defined as environment-friendly buildings which are resource efficient throughout the whole lifecycle of the building, from design, construction, operation, maintenance, management, and demolition. With the recent rise of environment and energy as global issues, green buildings can be narrowly seen as energy-efficient buildings. But from a wider perspective, green buildings include construction activities which are in a symbiotic relationship with nature with consideration for aspects such as environment-friendly construction materials, water use efficiency, waste discharge reduction, and harmonization with surrounding environments.

#### New Paradigm for Sustainable Development

In order for buildings to be continuously environmentally friendly, people must first understand the impact of construction activities throughout the building’s lifecycle, i.e., design, construction, operation, maintenance, and demolition, and then develop relevant technologies. To decrease environmental burden and increase comfort, cutting edge green building technologies such as resource reduction, energy conservation,

Figure 5-5: New Direction of Green Building Production Activities

Building Production Activities	Existing building production activities	→	Green building production activities
Planning Phase	Excessive design, mass resource input	→	Optimized design, reduced resource, enhanced quality of life
Material/Construction Phase	Released pollution, mass production	→	Released pollution, mass production
Operation Phase	Large energy use, raised burden	→	Reduced burden, saved energy
Maintenance/Management Phase	Excessive consumption, reconstruction	→	Reduced maintenance/management costs, lengthened longevity
Demolition Phase	Mass demolition	→	Reuse

Source: Shin Sung Woo (2007)

Figure 5-6: Examples of Technologies to Realize Sustainable Green Buildings

Item	Description	Technologies for Sustainable Green Buildings		
Symbiosis with Nature	(1) Local ecosystems conservation	1) Arrangement compatible with geographic features 3) Biotope	2) Green networks 4) Others	
	(2) City climate mitigation, ground water recharge	1) Green land within site 3) Green walls 5) Others	2) Green roof 4) Permeable pavements	
	(3) Waste reduction	1) Design with consideration for separate garbage collection 2) Waste conveying system		
	(4) Production of building by-products suppression	1) Prefabrication 2) Consideration for temporary materials 3) Waste soil disposal		
Reduction of Environmental Burden	Burden Prevention	(1) Exterior wall, ceiling, floor insulation	1) High insulation 3) Concrete core activation 4) Others	2) Exterior insulation
		(2) Window insulation, sunlight proofing	1) Solar reflective/absorbing glass 3) Pair /Low-E/Heat mirror glass 5) Double skin 6) Louver 7) Others	2) Awning 4) Air flow window
		(3) Spot cooling, local exhaust ventilation	1) Task ambient air conditioning 3) Local exhaust ventilation 5) Others	2) Under floor air conditioning 4) Air cleaner
	Natural Energy Use	(1) Daylighting	1) Window design with consideration for daylighting 3) Top light / high side light 5) Daylight cross-coupling control system	2) Light shelf 4) Blinds 6) Others
		(2) Natural ventilation	1) Hybrid ventilation 3) Ventilator, ventilation damper control	2) Night purge 4) Others
		(3) Natural energy use	1) Solar PV 3) Geothermal energy 5) River/ocean thermal energy 7) Fresh air cooling/heating 9) Others	2) solar hot water heating system 4) Wind power 6) Hydraulic power 8) Cooling tower cold water
	Efficient Energy / Resource Use	(1) Efficient energy use	1) Cogeneration (engine/turbine) 3) Waste heat recovery 5) Others (sewage energy, etc.)	2) Fuel cell 4) Waste heat recovery (heat exchanger, etc.)
		(2) Burden equity	1) Chilled water storage 3) Latent heat storage 5) Condensation (NAS battery, etc.)	2) Ice storage 4) Soil heat storage
		(3) Recovered energy minimization	1) VAV 3) Ventilated air amount control (CO/CO2) 5) Energy conservation in elevators	2) VAV 4) Optimized plumbing system 6) Others
(4) Lighting energy minimization		1) High-efficiency lighting 3) Daylight Response Dimming System 5) Others	2) Self-control 4) Task ambient lighting	
(5) Effective water resources use		1) Best reuse 3) Water reclamation/reuse system	2) Drainage reuse 4) Others	
(6) Optimized operation		1) Building energy management system 3) Building management system 5) Others (PMV sensor, BOFD, etc.)	2) Smart grid system 4) Load prediction and control system	
(1) Space securement	1) Building level height space 3) Land area space	2) Floor load space 4) Consideration for remodeling and etc.		

Item	Description	Technologies for Sustainable Green Buildings		
Reduction of Environmental Burden	(2) Construction material durability	1) Materials of good durability, anti-shock, fire-resistance, repair 2) Structural system allowing easy partial replacement 3) Others		
	(1) Materials which reduce environmental load	1) Natural materials (wood, stone, etc.)	2) Minimal use of disposable materials (air filters, etc.)	
		3) Consideration for materials which are difficult to recycle (FRP, VLP, etc.) 4) Others		
Environment-friendly materials	(2) Form (mold) use rationalization	1) Increase use of forms	2) PC	
	3) Systems which do not use forms, others			
	(3) Renewable resource use	1) Waste construction materials use 3) Recycled aggregate use	2) Electric steel use expansion 4) Others	
Comfort	(1) Odor and ventilation of indoor air	1) Natural ventilation 3) Heat transfer ventilation system	2) Waste heat recovery ventilation (HRV) system 4) Others	
	(2) Indoor temperature, humidity control	1) Temperature/humidity control device 3) Others	2) Insulation and sunproofing by window	
	(3) Noise prevention	1) Sound insulation structure system 3) Others	2) Fast-tightness of windows	
Living Conditions	Safety	(1) Health	1) Natural material use 3) Others	2) Materials which are harmless for the human body
		(2) Crime prevention	1) Unmanned security system 3) Others	2) Automated alarm system
		(3) Disaster prevention	1) Fireproof structure 3) Disaster prevention system	2) Earthquake-proof structure 4) Others
Convenience	(1) Information Communication Environment	1) Building automated system 3) Radio frequency identification (RFID)	2) Combined wired-wireless broadband networks 4) Others	
	(2) Space Convenience	1) Convenience of shared space 3) Others	2) Convenience of office space	

longevity lengthening, and recycling, must be applied. In other words, there is a need to shift the past paradigm of development-oriented construction activities into a new paradigm of sustainable development (Figure 5-5) (Shin 2007).

Circular building production system suggests the following three specific technologies to realize green buildings: 1) technology to reduce environmental load, which minimizes energy and resource input into buildings; 2) technology in symbiosis with nature, which minimizes pollutant emissions from buildings and at the same time, establishes green circulation system and water circulation system; and 3) technology to raise living quality (Figure 5-6).

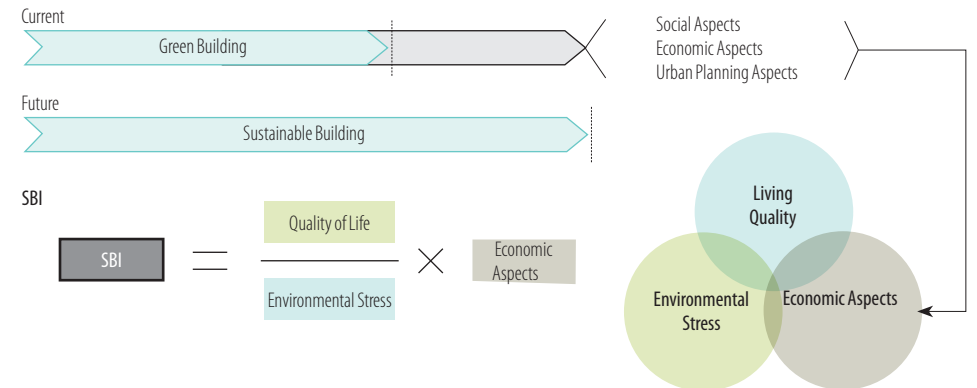
### Assessment Technology of Green Buildings' Environmental Impact

Measures to reduce CO<sub>2</sub> emissions, such as adding insulation materials during the building operation phase can increase CO<sub>2</sub> emissions in the construction material production phase and the construction phase. Thus, CO<sub>2</sub> emissions from the overall building development must be calculated to minimize the total CO<sub>2</sub> emitted by buildings.

Korea's Sustainable Building Research Center (ERC) (<http://susb.hanyang.ac.kr>) developed the Sustainable Building Total Assessment Integrative Program (SUSB-STEP, SUSB-Sustainable Total Evaluation Package) and has been applying the program to evaluate CO<sub>2</sub> emissions throughout the lifecycle of buildings.

For sustainable green buildings, the trade-off between efficiency and cost should be factored into. Building owners cannot ignore economic considerations when they make investment decisions to enhance building efficiencies. Considering this, the concept of green building is being extended, from one centered on environmental aspect to one encompassing social-economic aspect as well. In this context, it is necessary to prepare

Figure 5-7: Sustainable Building Index



e.g.) SCI (Sustainable Community Index) SUI (Sustainable Urban Index) SNI (Sustainable National Index)

Source: Sung Woo Shin (2008), "Sustainable Super Tall Building and Engineering Role", 7th International Conference on Fracture and Deformation Mechanics, 2008.9

Figure 5-8: Plan on Vitalization of Green Buildings

Four Main Plans	Description	Schedule
Strengthen energy standard for new buildings	Strengthen standards on building insulation	2010
	Prepare standards on cooling energy consumption reduction	2010
	Make compulsory the installation of standby power blocking device	2010
	Introduction and extension of aggregate amount energy consumption system	2010
	Increase the scope and percentage of those subject to mandatory new and renewable energy use	2010~2012
Stimulate energy efficiency improvement in existing buildings	Make mandatory issuance of energy use certification	2012
	Make mandatory energy assessments of low-efficiency buildings	2013
	Introduce a certification system for buildings using new and renewable energy	2010
Encourage conservation by building users	Implement carbon point system	2009
	Make compulsory the designation of an energy manager for large buildings	2010
Develop green building technology and establish infrastructure	Develop technology to enhance energy efficiency in high-rise buildings	2009~2014
	Train and educate design and engineering professionals	2009~2013



a sustainable index to evaluate sustainable development of buildings <sup>(Figure 5-7)</sup>. Korea's Sustainable Building Research Center developed the Sustainable Building Index (SBI) and the Sustainable Cluster Index (SCI).

### Korea's GHG Mitigation Target and the Task for Green Buildings

In Korea, 25% of the total GHG emissions come from the building sector. The Korean government aims to reduce GHG emissions from the building sector up to 31% from Business As Usual (BAU) and implement a compulsory zero-energy policy for new buildings by 2025 <sup>(the 6th Committee Meeting of the PCGG in 2009)</sup>.

In an effort to achieve these goals, the Korean government formulated the Plan on Vitalization of Green Buildings which includes actions on strengthening energy standards on new buildings, improving energy efficiency of existing buildings, inducing building residents' energy conservation, developing related technologies, and establishing the necessary infrastructure <sup>(Figure 5-8)</sup>.

First, the insulation standard for windows from which the greatest heat loss occurs will be doubled by 2012 to reduce heating energy. All types of buildings including hospitals and department stores above 500m<sup>2</sup> should submit energy conservation plans with assessment of energy use of their elements (e.g. insulation, building equipment) to get the building construction approval. In addition, for new buildings, their annual aggregate energy consumption will be the main construction approval standard, in place of consumption by their component (e.g., windows). Moreover, the Korean government plans to gradually raise the annual energy consumption standards by the building type (e.g. residential buildings and non-residential buildings). The government will promote construction of 'nest housing (Bogumjari Housing)' a type of residential building that displays high energy efficiency.

The government continues to work to reduce Korea's building energy consumption to the levels of that of developed countries by: (i) introducing a mandatory eco-friendliness certification for all public buildings above a certain size; (ii) expanding the mandatory requirement to new and renewable energy based equipment to more building types.

Second, the Korean government will trigger private sector participation by making compulsory the issuance of energy consumption certificate, applying green building certification to existing buildings, and providing incentives such as exemption of acquisition tax, registration tax, and environment improvement levy for green certified buildings.

Third, the Korean government plans to introduce the carbon point system to promote energy conservation and GHG reduction activities by the general public. The government will also introduce a top-runner program to enhance the energy efficiency of household appliances. It will provide guidelines for energy conservation in everyday life and instruc-

tions for proper use of equipment and household appliances to support energy conservation efforts by households and offices.

Fourth, the Korean government will increase support to technology development for green buildings, aiming to achieve the most advanced level of energy efficiency for all major building equipment by 2015. Korea also plans to invest in raising green building experts and establishing infrastructure such as information system on building energy consumption data. It also has a vision of developing a world class model of zero energy apartment building.

The Korean government set a target of mitigating up to 63 million tons of CO<sub>2</sub> solely from the building sector by 2020 through increasing the distribution of green buildings throughout the country. It is equal to reducing approximately 17.6 million TOE of oil, and creating energy cost reduction effect of about USD 7.9 billion <sup>(Ministry of Land, Transport and Maritime Affairs et al. 2009)</sup>.



## V-4. Fuel Efficiency and GHG Regulations

### Single Elective Regulation to Relieve Auto Industry of Burden

#### A Regulation Alleviating Manufacturers' Burden

As of 2008, 96% of Korea's total energy consumption has been imported. 32.6% of this was consumed by vehicles, which eventually contributed 14% of the country's total GHG emissions (Korea Energy Statistics Information System, [www.ksesis.net](http://www.ksesis.net)).

The Presidential Committee on Green Growth (PCGG) announced on 6 July 2009, a National Guideline on Improving the Standard for Vehicles Fuel Efficiency and GHG Emissions. The guideline introduced new regulations on reducing GHG emissions from all sources of vehicles while maintaining the existing policy on fuel efficiency. The guideline allows manufacturers to choose between the two requirements for vehicles: either fuel efficiency or less GHG emissions. The intention is not to burden car manufacturers with double regulations. The media and the public welcomed the government's new regulation that sends a strong message to vehicle companies that they should manufacture cars with better efficiency and less GHG emissions in order to survive in the climate energy era.

#### Regulation on Fuel Efficiency and Emissions

Before the announcement of these new guidelines from the PCGG, the Fuel Efficiency Regulation under Energy Use Rationalization Act, and Emission Regulation under the Clean Air Conservation Act were the only laws related to emissions reduction from vehicle sources.

- (1) Korea began to implement grade-labeling programs on passenger cars in 1988. After revisions, the country required showing fuel efficiency, efficiency grade and average efficiency

(Figure 5-9)

According to the Energy Use Rationalization Act, Article 15 and 16 and enforcement ordinances Article 7 under the same Act, and Notification No. 2008-162 of the Ministry of Knowledge and Economy's Regulations on Indication of Vehicle Fuel Efficiency and

Efficiency Grade (hereafter, Vehicle Efficiency Regulation), passenger cars and vans are required to show their efficiency and grade, while trucks are required to indicate their fuel efficiency.

Since 2005, all passenger cars are required to show fuel efficiency under Article 17 of the Energy Use Rationalization Act and Article 11 of Enforcement Ordinance under the same Act, and Article 8 of the Vehicles Efficiency Regulations. If a manufacturer or an importer of passenger cars does not comply the aforementioned rule, he will receive an enforcement notice by the government. If the manufacture or importer still refuses to comply, the infringement will be made public. In December 2007, the government announced a new efficiency requirement that would require 15% higher efficiency starting in 2012 (Figure 5-9). This standard was further strengthened in the PCGG's announcement on 6 July 2009.

- (2) The government introduced regulations on emissions from vehicle sources in 1980 in an effort to reduce air pollutants in car emissions. According to Articles 46 and 48 of the Clean Air Conservation Act, and Article 46 of the enforcement ordinance under the same Act, and Articles 62 and 63 of the enforcement regulation under the same Act, manufacturers must be certified by the Minister of Environment (ME) to ensure that their products conform to the emission standard set by the government. Otherwise, penalties are in place according to the same Act, Articles 89, 90 and 91.

Appendix 17 of the Clean Air Conservation Act defines regulated substances as petroleum and alcohol for petroleum-based vehicles; carbon monoxide, hydrocarbon, nitrogen oxide, aldehyde for gas-based vehicles; and carbon monoxide, hydrocarbon, hydrogen oxide, exhaust gas and particulate matters for diesel-based vehicles. However, it does not mention GHG containing carbon dioxide (Figure 5-10).

Figure 5-9: Average Energy Consumption Efficiency of Passenger Vehicle

Period	Standards
Until 2011	12.4 km/L for vehicles below 1,600cc; 9.6km/L for vehicles over 1,600cc
Starting from 2012	14.5 km/L for vehicles below 1,600cc; 11.2km/L for vehicles over 1,600cc

Figure 5-10: Emissions Standards for Passenger Vehicles on Gasoline or Gas

Category	Carbon Oxide	Nitrogen Oxide	Hydrocarbon		
			Pipeline Gas	Blow-by Gas	HC
Passenger Vehicle	Below 2.11g/km	Below 0.62g/km	Below 0.25g/km	0g/drive	2g/test
	Below 2.11(2.75)g/km	Below 0.40(0.62)g/km	Below 0.25(0.3)g/km	0g/drive	2g/test

Source: Clean Air Conservation Act

## Single Elective Regulation Policy in Korea

The Framework Act on Low Carbon, Green Growth, which focused on regulating GHG emissions from vehicle sources, was proposed to the National Assembly in February 2009. This is an executive order, which decides the level of GHG emission allowance, and its supplementary provision eliminated the old vehicle efficiency code under Energy Use Rationalization Act.

Announced on 6 July 2009 by the Presidential Committee on Green Growth, the National Guideline on Improving the Standard for Vehicles Fuel Efficiency and GHG Emissions was discussed. The result was to introduce regulations both on fuel efficiency and GHG emission, considering the global trends on GHG emission regulations. This guideline ensures that automobile manufacturers are regulated by either two of the regulations that they choose to comply with.

The Korean government decided to require efficiency of 17km/L and GHG emissions below 140g/km. This decision is said to be a compromise between the weaker American standard of 155.3g/km and the higher EU's 130g/km. The single elective regulation on efficiency and GHG emissions came into effect through the Act <sup>(Clause 2, Article 47)</sup> on which the National Assembly passed on 29 December 2009.

In making enforcement ordinances of the Act, the government had numerous discussions as to whether it is adequate to consider the competent authorities and legal nature that deal with the regulations in terms of industrial growth or environmental regulations. The conclusion was that it is more appropriate to approach from the perspective of environmental regulations following international practice. The Ministry of Knowledge and Economy (MKE) set efficiency standards and the Ministry of Environment (ME) for the GHG allowance. Both ministries have concluded that these standards are to be determined by ME based on consultation with MKE and will be applied and regulated solely by ME.

Accordingly, the enforcement decree of Framework Act on Low Carbon, Green Growth which was enacted on 14 April 2010 specifies that ME shall take charge of regulation on fuel efficiency and GHG in discussion with MKE in details as follows:

Article 37 (Management of Efficiency of Average Energy Consumption of Automobiles and Allowable Exhaust Emissions of GHG)

- In pursuing affairs for management of GHG in the traffic sector according to Article 47(2) of the Act, the Minister of Knowledge Economy and the Minister of Environment shall respectively determine the standards for efficiency of average energy consumption of automobiles and the standards for allowable exhaust emissions of GHG from automobiles. The Minister of Environment shall oversee application and management of the standards for efficiency of

average energy consumption of automobiles and the standards for allowable exhaust emissions of GHG from automobiles regarding automakers including importers (the same shall apply hereinafter). In such case, the Minister of Environment shall provide the Minister of Knowledge Economy with materials on application and management of such standards.

- In consideration of the domestic and overseas conditions of the auto industry, international regulatory trends, measurement methods and procedures, unification of applicable sanctions, the Minister of Environment shall publicly announce, by publication in an official gazette, the standards whereby automakers may selectively comply with the standards for efficiency of average energy consumption of automobiles and the standards for allowable exhaust emissions of GHG from automobiles as provided in Paragraph (1), based on consultation with the Minister of Knowledge Economy.

## Legal and Political Issues to Resolve

The Framework Act and its Enforcement Decree only state essential principles and corresponding responsible authorities, but are not compulsory on automobile manufacturers. Therefore, the ME in charge of regulations is required to revise the relevant legislation, in particular the Clean Air Conservation Act.

Some argue that the law should be flexible, considering the difficulties it might cause the car industry. Change might include: applying differentiated levels of regulation by vehicle weight; giving grace periods for manufacturers whose sales are below a certain number; enhancing incentives for green cars; applying carry-back and carry-forward of shortfall/excess; allowing trade of excess credits; and improving measurement and relevant procedures of emissions, efficiency and GHG emissions.

Meanwhile, direct regulations on automobile manufacturers have limited ability to reorganize the consumer market toward low-carbon and high-efficiency. Thus, regulations need to be supplemented by consumer oriented measures. Incentive/disincentive programs should be introduced associated with the fuel efficiency and GHG emissions. In other words, the current capacity-based vehicle tax needs to be changed to an efficiency or GHG emission-based one through enhancing environmental improvement charges and utilizing the vehicle tax system.

This global trend is inevitable. Laws on automobile efficiency and GHG need to be reorganized. Better legal measures should be developed in order to respond to international trends without delay. The automobile industry is important to Korea. Once vehicle-related laws are well designed, Korea will be able to face and respond to climate change challenges now and in the future.

## V-5. Green Transportation

### Reducing Reliance on the Automobile

#### A New Transportation System that Prevents Congestions and Environmental Disruptions

The term green transportation means a transportation system applying principles of green growth policy to transportation. The existing system has resulted in congested traffic and environmental harm. Green transportation aims at reducing environmental and social effects caused by current transportation system.

Green transportation generates less pollution, congestion and social costs. Transportation-related social costs Korea in 2008 amounted to KRW 62.9 trillion (USD 57 billion) - KRW 20.7 trillion (USD 18.9 billion) for traffic congestions alone. Costs for auto accidents and environmental degradation accounted for 6.1% of GDP, which is higher than figures for the UK (4.7%) and France (5.6%) (Ministry of Land, Transport and Maritime Affairs 2009).

#### Reponses of the Market to Traffic Congestion

In Korea, the number of car registrations are increasing. Koreans on average drive far more than many others; average daily mileage is 59.2km, twice as high as than Japanese (KORAIL Research Institute, 2010). However, the growth in the number of cars in Korea has slowed since 2002. According to a recent research, the number of passenger cars is estimated to reach 26 million in 2031 and begin to decline thereafter (Korea Transport Database 2008).

There have been some changes in the direction of transportation policy. The Seoul City Council passed an ordinance to stop the department stores from offering free parking vouchers. But this was suspended due to objections from store owners. However, the city administration responded to reinforce its control and responsibility over public roads. It has begun a so-called "road diet" which narrows car lanes to open bicycle path. It also removes facilities for cars such as pedestrian overpasses and overpasses for automobiles. This seems to have a tacit signal of the city council's intention of inconveniencing car users.

#### Green Vehicles and Green Divide

Green transportation has been developed in an effort to reduce fossil fuel consump-

tion and find alternatives. One focus was to develop an innovative technology to structurally reduce petroleum consumption, just like the Toyota Prius, a hybrid vehicle.

Low-emission and hybrid cars are becoming popular in Korea. They are regarded as models of an environment-friendly technology, which enhances productivity and generates consumption without compromising the environment. However, low-emission cars are sold at relatively high prices, which only high-income people can afford. In order for more people to buy green cars, the government should devise a program that offers benefits and incentives to those who will be purchasing this type of vehicle.

#### Rail Transportation: Ensuring Efficiency and Environmental Sustainability

Even if the green car is more environmentally acceptable, it is still not a good solution to address the perennial problem of traffic congestion. Other solutions for better traffic and pollution prevention should be considered such as: (i) expanding public transportation particularly rail transportation, such as subway for commuters; and (ii) promoting bicycles for individuals.

Rail transportation obviously addresses urban traffic needs. It relieves traffic congestion and provides convenience to the majority of the commuting public. Aside from its outstanding economic role, it also emits insignificant amounts of GHGs after it is constructed. The government is considering introducing and/or developing cutting-edge transportation technologies like bi-modal trams which have a features of both railway and bus. These bi-modal trams can run on both rail tracks and urban roads (110km/h class).

Recently, KAIST recently developed an on-line electric vehicle (OLEV), which was tested at the Seoul Grand Park in 2010. The OLEV can be recharged on the road through a non-contact magnetic charging method, even while running. Innovative transportation research such as this should be encouraged.

#### Government's Strategy for Green Transportation

Transportation represents 21% of Korea's total energy consumption and produces 20% of Korea's GHG emissions. This will increase due to its rising demand (KORAIL Research Institute, 2010).

During the 6<sup>th</sup> Meeting of the Presidential Committee on Green Growth held on 5 November 2009, it announced the Strategy for Promoting Low Carbon Green Transportation. The strategy primarily seeks to hold down investment in new roads, while raising the current railway investment from 29% up to 50% of the total Social Overhead Capital investment by 2020. The strategy further aims at shifting the paradigm from the current road-centered system to a green transportation system, while maximizing the efficiency of existing transportation facilities.

The strategy is covered by five policies, which include: (i) reinforcing transportation demand control; (ii) promoting walking and the use of bicycles as daily transportation; (iii) realizing rapid and convenient public transport; (iv) establishing green logistics via rail and sea; and (v) developing green transportation technologies. These policies aim to reduce GHG emissions by 33-37% from transportation sources from the BAU emissions ratio in 2020. The government forecasts that it will be able to cut 46.5 million tons of GHG through green transportation promotion.

The transportation demand control also includes designating excessive CO<sub>2</sub> emitting areas and over-congested area as green transportation assisted area for special management. The government will give priority to green transportation such as electric cars, impose congestion charges, and offer eco-point which can be redeemed for discounted transportation fares in the designated areas.

In order to promote bicycle usage, a park-and-ride service will be improved by gradually expanding trains and buses where passengers can carry their bicycles with them, and increasing bicycle racks to 15,000 at train stations and bus stops by 2013. In the meantime, the government will foster a practical bicycle path network connected with train stations and bus stops which seek to boost bicycle's share of total transportation, from 1.2% currently to more than 10% by 2020.

The government is looking at increasing public transportation's share of total transportation from 50% in 2007 to around 65%. Among the measures to do this are expanding the wide range of express bus services to the Seoul metropolitan area; launching express bus transfer system at highway reststops; and making Seoul express main line buses cover the whole metropolitan area.

## V-6. Bicycle and Low Carbon Transportation

From the Age of Four Wheels to the Age of Two

### Modern Bicycle First Appeared in Korea in 1882

Around 1882, the bicycle was the first western transportation that made its appearance in Korea, long before the introduction of the automobile. After a demonstration by an American naval captain, Emperor Gojong<sup>i)</sup> was amazed that a man could ride a vehicle which did not have any supports on the ground.

The city of Sangju in the northern part of Gyeongsang province probably has the longest history of bicycles. Surrounded with a wide breadbasket that brought economic prosperity, Sangju popularized bicycles to its residents as early as 1910. The National Cycle Race held in the square in front of the train station since 1923 may be another historical reason that of Sangju became a bicycle heaven.

### Easy Transportation in Crowded Modern Cities

The bicycle can be considered as the epitome of sustainable development due to the fact that it is efficient, environment-friendly and socially acceptable. Although it can not be used for long distance travel, and cannot carry as much as cars, it can be a supplement or substitute for cars on a personal level.

The virtue of the bicycle can be easily found in a world-famous ecologist Lester Brown's work *(Lester Brown, translated by Euihang Hwang and Chongwook Lee, Plan B 3.0, Doyosae, 2008)*.

*“Six bicycles can typically fit into the road space used by one car. For parking, the advantage is even greater, with 20 bicycles occupying the space required to park a car. It is an ideal way of restoring a balance between caloric intake and expenditure. Regular cycling exercise reduces chance of cardiovascular disease, osteoporosis, and arthritis, and it strengthens the immune system.”*

i) Gojong is the other name of the Emperor Gwangmu (8 September 1852–21 January 1919). Gojong was the twenty-sixth king of the Chosun Dynasty and the first emperor of the Korean Empire

For this reason, it is more efficient and costs less to build paths for bicycles and pedestrians and design other amenities at the beginning of urban development and redevelopment plans than to add them later.

The bicycle's mobility within a five-mile radius is no lower than automobile's in congested modern cities. The bicycle can move freely thanks to its capability for dotted-linear movement while cars get often tied up in traffic since they can only follow a linear path.

### Changwon's Great Love of Bicycles

The city of Changwon in the southern part of Gyeongsang province published a slogan "Changwon, the Bicycle Metropolis." Changwon aims at raising the current bicycle use rate of 10% to 20% by 2010. They collected and recycled abandoned bicycles and lent them to birdwatchers at Joonam reservoir during the Meetings of the Ramsar Convention on Wetlands.

The Changwon city government encouraged organizations and private entities to establish travel allowances as an incentive, and also designated the 22<sup>nd</sup> of each month to use bicycles.

The most important part of Changwon's core strategy is a policy to reduce cars. There are in place some meaningful measures including fees on, or closing of, public parking lots as well as improving bus routes between residential and industrial areas, reinforcing illegal parking controls, and protecting and prioritizing those vulnerable to the traffic. Meanwhile, the city government made bicycle safety education mandatory in order to promote a bicycle friendly culture.

The next step for Changwon is to combine policies to promote bicycle use with medium-to long-term development plans and the urban and transportation master plan. Bicycle is an important growth engine for the environment-friendly city. In addition, its unification with neighboring cities expanded its size and population, and now this has become a new priority for the unified Changwon.

### City of Sangju, Proud to be Bicycles' Heaven

The City of Sangju is often called as "Bicycles' Heaven" thanks to its affluence and terrain. In this oval-shaped city with a 5km radius, a bicycle can reach anywhere within 10-20 minutes. The city lies in a flat basin where the maximum inclination of the road does not exceed five degrees.

Sangju has spurred bicycle use under the slogan of "Bicycle Mecca, Sangju" since 1994. As a result, the number of bicycles per household is 2.0 and per person is 0.6, far higher than

in other cities. The bicycle to total transportations ratio is as high as 18.6%. A famous local saying is "Children learn to ride a bicycle before they walk."

The city's various investments in bicycle infrastructure include developing mountain bicycle routes, building a circular bicycle path on Namsan Mountain, hosting a bicycle festival and developing a bicycle tour path along Nakdong River. Bicycle-only lanes was built on sidewalks at first, then immediately moved on the road when they proved inconvenient for both riders and pedestrians.

Furthermore, there is a Bicycle Museum that houses various materials about bicycle. Sangju requires a license test for bicyclists. "No drunk-riding" is a safety rule shown on the city's website. Banners saying "Riding a bicycle secures a bright future for the earth" flutter throughout the city.

### The Promotion of the Use of Bicycles Act of 1996

The Korean Ministry of Public Administration and Security (MOPAS) established the first Five-Year Bicycle Facilities Maintenance Plan after the Promotion of the Use of Bicycles Act was legislated in 1996. Since then public interest in bicycle is rising. Setting its goal in 2010, this program aimed at raising the bicycle to total transportation ratio to 10%.

Since the program was introduced, Between 1997 and 2002, the length of bicycle paths increased 3.2 times (to 824km in 2002), bicycle racks 3.9 times (to 63,259 units in 2002), and pavement facilitating bicycle use 4.1 times (to 8,681 places in 2002). The bicycle use rate on a national level was 2.4% in 2001 and increased to 2.5% to 3.0% due to amenities in small/medium-sized cities and bicycle riding promotion.

To promote the use of bicycles, the following challenges need to be met:

- The stereotyped perception that bicycles are dangerous. About 80% of bicycle accidents happen at intersections and merging roads. Bicycles often crash into cars at parking lot entrances, intersections, garages and gas stations.

■ Figure 5-11: Bike Ride Population by Country

Country	Population (10,000 persons)	Vehicle Ownership	Bicycle			
			Number of Ownership	Road Extension(km)	Bike Ride Population Ratio	% of Transportation
Korea	4,808	1,540	800	9,170	16.6%	1.2%
Germany	8,249	4,552	7,200	30,000	87.3%	10%
Japan	12,778	7,237	8,665	78,638	67.8%	14%
Netherlands	1,627	490	1,600	19,000	98.3%	27%

Source: KOTI, MOPAS



- Most bicycle paths are on sidewalk. About 90% of bicycle path is bicycle-pedestrian path.
- There is no continuous maintenance on bicycle path and other facilities. New bicycle paths and facilities have been built well, but investment in existing facilities for regular inspection and maintenance are rarely made.
- It is mere a copy of the previous projects. Local administrations too often simply copy other cities' plans regardless of their own city's regional characteristics. There is not enough understanding of why bicycle programs succeeded in different cities. Bicycle registration programs were enacted in some regions. The city of Jeju gave away helmets. The Gangdong district of Seoul offered free registration plates with padlocks. However, requirements for registration have not been settled and the monthly registration rate has not exceeded one yet. As a consequence, the program became nothing more than a campaign that people bring bicycles out once a year on Earth Day (April 22) for the last decade.

Between 2003 and 2007, the Korean government invested KRW 1,243.2 billion (USD 1.13billion) in bicycle facilities, while most of the investment was concentrated on hardware construction such as bicycle paths. Nevertheless, the rate of bicycle ownerships and bicycle to total transportation ratio remained low compared to expanded facilities. According to a recent research conducted by the Korea Transport Institute, the length of bicycle path per head was 0.19km, only a half of Germany's 0.36km. The bicycle to total transportation ratio was 1.2%, which is only one-eighth of that of Germany.

### In 2009, "Connect Everywhere in the Country through Bicycle Paths."

The handover of bicycle-related works to local authorities weakened related investment. The policy depended on the local administration head's leadership and finance. There was no comprehensive policy at the national level after the handover. For instance, one officer takes charge of bicycle-related affairs with KRW 2.1 billion (USD 1.9 million) in Sangju city, whereas Changwon city has twelve officers under the Department of Bicycle Policy with KRW 6.8 billion (USD 6.1 million) budget.

Under such circumstances, the President in his New Year's address in 2009 proclaimed that Korea will connect all parts of the country by bicycle paths to promote ecological culture. Promotion of bicycle use is required as a new paradigm of green transportation to resolve the problems of environmental pollution, energy, and traffic congestion in low carbon era.

With the President's address, the Promotion of the Use of Bicycles Act (Act No. 9844, 2005) was partly revised on 29 December 2009. The revised law requires expanding bicycle parking facilities and set up amenities for bicycle use when planning urban

development. Heads of local authorities and schools are obliged to educate the public on bicycle safety. Furthermore, the Road Traffic Act (Act No. 9845) was also revised. It strengthened drivers' responsibility to protect bicycle riders, required protection gears for children and allowed children and elderly to ride on the sidewalk.

Following these revisions, the MOPAS announced a 2010 Bicycle Promotion Plan on 9 March 2010. To raise the bicycle to total transportation ratio to 5% by 2012 from 1.2% in 2009, the ministry planned to: (i) expand bicycle infrastructure; (ii) promote bicycle use; and (iii) improve relevant policies.

According to the plan, the government plans to expand bicycle path through a pilot project with local authorities. 60km and 760km of bicycle path will be built by the central government and local administrations, respectively. Facilities including 22,371 bicycle racks, 3,913 safety installations, and parking lots at subway stations will be created as well. Most of the local governments prefer the road diet approach for bicycle paths. It is a road adjustment technique which slows down the traffic speed and secures room for bicycle and pedestrian by reducing car lanes and narrowing car lane width (Guidelines for Bicycle Use Facilities Installation and Maintenance, 2010).

However, it is not easy to build bicycle path on roads because of the resistance from car drivers. The reason why European countries succeeded in their bicycle policy was that they made car driving inconvenient for most drivers. Most local authorities in Korea hesitate to do so, but bicycle policy can only succeed through a firm political will.

The road diet approach for securing bicycle paths in urban areas requires more than six lanes or four lanes with less large-vehicle traffic when narrowing width of car lanes. If it is difficult to secure space for bicycles through narrowing lane width, it is advisable to reduce the numbers of lanes.

The MOPAS has sponsored the Bicycle Riding Festival to popularize bicycle use since its 1st occasion in 2009 and has donated 2,900 bicycles to the poor. The World Bicycle Show was held in the city of Goyang on 22-24 October 2010.

According to the Bicycle Promotion Plan, institutional foundations for promoting bicycle use will be established.

- Insurance for riding bicycles will be introduced through five private underwriters.
- Policy basis for installing bicycle facilities in developing cities and housing areas will be prepared. Particularly, 10 hub cities for bicycle were designated to show visible results for expanded infrastructure for bicycles. Those hub cities are Gangneung, Gumi, Gunsan, Seogwipo, Suncheon, Asan, Ansan, Jeungpyeong, Jinju, and Changwon. Bicycle paths, racks, and other infrastructure will be constructed with KRW 10 billion (USD 9 million) investment

starting in March 2010. Hub cities are expected to increase bicycle ratio and ownership rate to 15% and 60%, respectively.

- Additionally, a national standard for public bicycle operating systems will be developed and distributed. The plan is to create circumstances in which everyone can use public bicycles anywhere at a low cost by securing compatibility among the existing operating systems such as Nubija of Changwon, Tashu of Daejeon, and Fifteen of Goyang.
- MOPAS will also give priority to bicycles over cars as a rider-centered policy and force drivers to be cautious about bicycles. A Bicycle Day will be designated. Systematic bicycle registration is gathering nationwide grounds.

The Ministry of Culture, Sports and Tourism (MCST) is also making contributions to popularize bicycles. They held a large bicycle race traveling around the country including the Jeju International Bicycle Challenge *(26-28 March 2010)* and Tour de Korea 2010 *(22 April-2 May 2010)* to promote the use of bicycles. The Ministry has developed various bicycle routes (200km, 400km, 600km) connecting principal cities in the country that can help local tourism. Furthermore, it will make a map for bicycles to offer through public information services, have standardized signposts installed and support the development of sports science-based racing bicycles.

The Ministry of Environment (ME) plans to designate and support three cities as Eco Bicycle City (provisional) every year for bicycle promotions in 2010. Following the trial of the Nakdong River office in the second half of 2009, they will choose Green Wheel model companies that encourage bicycle use to the workplace.

### Promotion of Bike Riding for Leisure

The government plans to build bicycle paths running along the country's four major rivers and sub-paths connecting to living areas as one of the Green New Deal projects. Paths linking the whole country are also being developed. There were debates on contrasting bicycles for leisure and for everyday use. It has been concluded that bicycles for leisure should be promoted in order to promote bicycles for everyday use since the number of people who have switched to bicycles for everyday use from those for leisure was relatively high, which is illustrated by the Dutch case. In Netherlands, its bicycle share of the total transportation is estimated at over 20% *(MOPAS, A Research on Establishing Master Plan for National Bicycle Path, 2010)*.

Korea is suffering from severe traffic congestions on weekends with the introduction of five-day work-week. Given that congestion-caused cost is proportional to national income, the cost of weekend traffic congestion is estimated to be at least 25% and KRW 5

trillion (USD 4.5 billion) every year. The popularization of recreational trip by cars is a key factor for weekend congestion. To eliminate such challenges, the government needs to encourage those who go on a weekend holiday with their cars to use public transportations and bicycles. Through this social transformation, KRW 5 billion (USD 4.5 million) cost for weekend congestions would be reduced, and the national health will improve to decrease medical expenses which will enhance national competitiveness at the same time.



# Green Life



VI-1. Resource Recycling Policy	184
VI-2. Scrap Metal Recycling	189
VI-3. Green Purchasing and Consumption	194
VI-4. Green Education	200

## VI-1. Resource Recycling Policy

The Era of Going Underground for Resources is Over

### From Regulation Basis to Resource Recycling

Resource recycling until the 1990s mainly focused on expanding waste disposal facilities to prevent pollution and strengthening regulations for waste management. In the 1990s, as the volume-based garbage disposal system was introduced and the Act on the Promotion of Saving and Recycling of Resources took effect, the primary focus moved to the reduction of waste emissions. Related policies were implemented to maximize the level of waste recycling and dispose of unrecyclable waste in environmentally friendly ways. From the year 2000 onwards, the waste issue has been dealt with in terms of the nation's overall resource management within a broad socioeconomic perspective. In particular, waste management was perceived as the main means to achieve the goal of the Formation of Resource Recycling Society that paved for the advancement of national resource management.

Efficient waste management is an important factor in the economy of a nation because depletion of natural resources and climate change are increasingly threats. Misdistribution of mineral resources and growing demand from newly industrialized countries have deepened the global resource and energy crises through persistent price-rises for raw materials and oil. Therefore, oil producing countries and other main resource holding countries are strengthening their national control over natural resources to protect their economic status in the international market.

The resource problem in Korea is more serious. Korea's energy self-sufficiency is only 5.7%. Korea imports more than 90% of mineral resources, mainly for industrial use. Moreover, economic development causes waste emissions to increase further through construction of new cities and expansion of heavy industry. It is expected that the waste emission level of 320,000 tons per day in 2006 will rise to 450,000 tons per day by 2011 in which case the waste emission level per unit area is expected to be 7.6 times of the USA (63kg/km<sup>2</sup>/day) and 1.3 times of Japan (372kg/km<sup>2</sup>/day). All these factors make supply of resources weak and unstable in Korea (Korea Environment Corporation 2009).

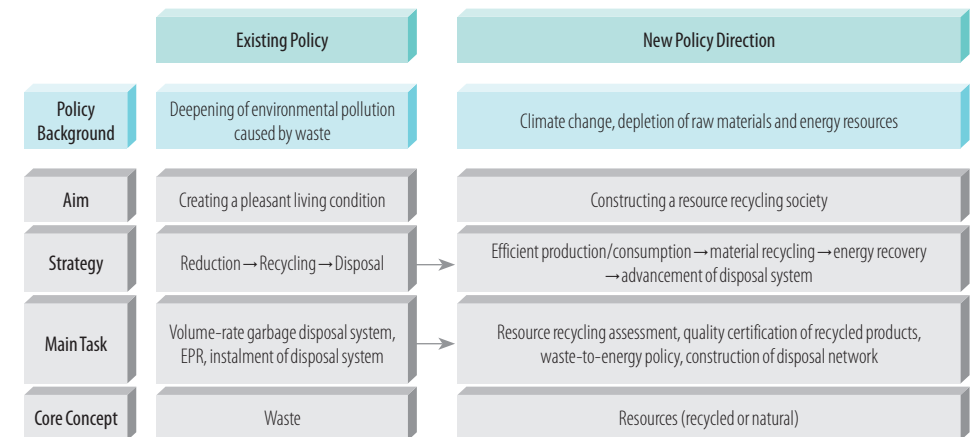
Realizing the mounting resource problems, the Korean government's declaration of Low Carbon Green Growth has a prospect for a resource recycling society. This brings the paradigm shift from the pollutant-focused waste management system to the resource recycling system.

The Korean government introduced the concept of resource recycling in March 2008. In March 2009 it amended the Act on Saving Resources and Recycling Promotion to incorporate assessment of products' recyclability, as well as the recycling criteria and indices. In May 2009, the Korean government also established measures for utilizing waste resources and biomass.

### Paradigm Shift on Waste Policy

A paradigm shift has occurred in waste policy from the prevention of environmental pollution towards comprehensive waste management through recycling and improved productivity. The policy mechanism has also been shifted from the reduction, recycling and disposal approach to efficient production and consumption, material recycling, energy recovery and advancement of the disposal system. The main objective of the paradigm shift is to eventually construct a resource recycling society, a society where environmental damage is minimized by controlling waste emissions, recycling and disposing waste in appropriate ways. In other words, it is a social system in which a one-way flow of materials and resources (production → consumption → discard) is transformed into a cyclical flow (production → consumption → recycling → heat recovery → disposal) (Figure 6-1).

Figure 6-1: Paradigm Shift of Waste Policy





## The Justification for a Resource Recycling Policy for Green Growth

During the industrial period, resources were perceived to be obtained from oil fields or mines. However, there should be a shift in perception. Waste is not something that we should discard, but rather a valuable resource. All products we use in our daily lives such as paper, computers, mobile phones, and cars are not waste after they are being used, but are resources that we can reuse in the recycling system.

Owing to volume-rate garbage disposal system and extended producer responsibility (EPR), the increase in the domestic waste emission level has been kept under 1% per year since 1995. This signifies the escape from the correlation between consumption and waste emissions. The daily domestic waste emission level per person was 1.04kg, which is high. But approximately 82.3% of the total waste was recycled and the landfill ratio is gradually decreasing *(Korea Environment Corporation 2009)*.

Policies such as volume-rate garbage disposal systems, EPR, and reduction of disposable product use are credited as successful models worldwide. The OECD *(2006)*, in its Environmental Performance Reviews which assessed each nation's environmental policies, has recognized Korea's waste management as the best among the member states.

The Korean government is continuing with its efforts to construct a resource recycling society. In August 2010, the Act on Waste Management was amended to set up basic principles for resource recycling society such as waste emission control, recycling, and the safe disposal. The government has particularly been emphasizing such practices in economic activities involving production, consumption, distribution and disposal, which forms the basis for the establishment of the win-win system where the environment and



### Garbage Separate Collection:

The separate garbage collection system is settled nationwide. The Korean government is adhering to the principles to maximize the level of waste recycling and otherwise to dispose of unrecyclable waste in environmentally-friendly ways.

economy can co-exist. Two representative policies are Waste-to-Energy Policy and Scrap Metal Recycling Policy.

#### 1 Waste-to-Energy Policy

In July 2008, the Ministry of Knowledge Economy and the Ministry of Public Administration and Security together with other related departments announced the Action Plan for Waste Resource and Biomass Energy Measures. It mainly targeted the recollection and recycling of dumped resources in the form of incineration, landfill and ocean dumping to be used as a source of energy. For instance, as the scrap paper and scrap plastic waste collected from the typical garbage bag are combustible, they can be solidified and be used as an excellent source of energy. Food waste, sewage sludge and animal excretion are organic wastes that can be the source of biogas or be used as fuel when dried. Moreover, the heat from incineration and landfill sites can be recovered and used for heating.

#### 2 Scrap Metal Recycling Policy (Hidden Metal-Resource Hunting Project)

The Scrap Metal Recycling Policy in September 2009, there was motivated by concerns over the uneven geographical distribution of mineral resources and the possibility of resources being used as a threat by resource-rich countries. Also the price of metals was rising due to increased demand.

Korea is one of the major metal-consuming countries in the world but is very poor in mineral reserves, importing more than 95% of its total consumption. Even worse, its low level of metal-recycling capacity has led to resource waste and environmental pollution. In an effort to overcome this, the Korean government plans to strengthen EPR home appliances and vehicles and to review the recovery system of recyclable resources. It also plans to develop new technology to purify scrap metal and build an industrial complex for the resource recycling industry.

## Assignment for Sustainable Material Management

It is noteworthy that recently there has been a very active discussion about Sustainable Materials Management (SMM) led by the OECD. Sustainable Materials Management is defined as “an approach to promote sustainable materials use, integrating actions targeted at reducing negative environmental impacts and preserving natural capital throughout the life-cycle of materials, taking into account economic efficiency and social equity<sup>(OECD 2007)</sup>.” The Korean government, closely following the initial purpose of SMM, planned to analyze the flow of resource recycling during extraction, processing, utilization and disposal by analyzing the material revenue and expenditure of the nation or local provinces and for some specific products. It also planned to use this data to set policy goals and as criterion to assess



achievement. The government, at the same time, is going to establish an information system based on the data which is accessible by relevant stakeholders. For example, if the material flow management is applied to a business, the business can use it as a means to improve resource productivity, to reuse, recycle and reduce. The government planned to set up the first basic plans for national resource recycling by integrating the economy, industries and society in order to promote a resource recycling society.

The ultimate goal of the resource recycling society is a society where there is no waste. Recycling is essential not only to improve the quality of environment, but also to achieve green growth sooner. Businesses are encouraged to continuously strive and keep their environmental competitiveness in order to compete internationally. They must keep in mind their products' sensitivity to the environment. Of course, such efforts by businesses should be accompanied by government's help and support.

## VI-2. Scrap Metal Recycling

Discovery of Urban Mines and Extraction

### Reusing Various Metals in Waste as Raw Materials

Scrap metal resource recycling refers to the recovery and recycling of various metals from household and industrial waste to use them as raw materials of production. The Korean Ministry of Environment began its scrap metal recycling policy in 2000 by concluding a voluntary agreement with the electronic industry regarding the recovery and recycling of electronics waste. In 2003, Extended Producer Responsibility (EPR) was first implemented in Korea by enacting the Act on Saving Resources and Recycling Promotion which imposes recycling obligations on the manufacturers of the top five electronic products including televisions, refrigerators, washing machines, air conditioners and personal computers. Later, EPR expanded to cover the top ten electronic products as well as to passenger vehicles according to the Act on Resource Recycling for Electrical-Electronic Products and Vehicles. In consequence, the recycled volume has expanded from 58,000 tons in 2003 to 93,000 tons in 2006. Despite such positive indicators, the recovery rate of electrical and electronic waste in Korea is still low, being only 43% of total turnover. The recycling rate of scrap metal resources is also just 35.8% (Ministry of Environment, 2008).

### Raw Ore in Developing Countries, Recycling Technology in Developed Countries

Because more than 80% of raw ore is unevenly deposited in China, Canada, Congo, Australia, and the US, sudden rises in international metal prices and unreliable supply have become globally recognized problems. It is even worse for rare earth minerals such as lithium, chrome, manganese and iridium. These essential materials for cellular phones, electrical vehicles, the IT industry and renewable energy. China's export prohibition measures were a recent extreme case of manipulating the supply of natural resources.

The implications for Korea are significant. Korea imports more than 90% of metal resources and therefore, suffers from unreliable supply, trade imbalance, and weakening of international competitiveness. Waste is also a problem. Waste collection and recycling capacities are insufficient to manage the increasing amount of industrial waste, result-

ing in environmental pollution and waste of resources. The problem is even more serious considering that metal resources are an essential component of industrial development. They are 75% of automatics, 70% of home appliances, and 47% small-sized appliances.

Under these circumstances, recycling of scrap metal is an effective alternative. In fact, waste recycling is well-established in developed countries. Japan, in particular, which has much in common with Korea in terms of resource availability and industrial structure, has long been practicing recycling of electrical and electronic waste and nurturing related businesses under the title of ‘urban mining’.

### Korea’s Recycling Technology

In 2003, when EPR was first implemented in Korea, 58,000 tons from the top five electronic products were recycled. When EPR was expanded to include the top 10 products in 2006, the amount recycled increased by 37.6% to 93,000 tons. The amount of scrap metal resource recycling is continuously increasing (Ministry of Environment et al. Policy Measures of Scrap Metal Resource Recycling Sept. 2009).

The recovery rate of electrical and electronic waste in Korea is still low, being only 43% of total turnover. The recycling rate of scrap metal resources is also just 35.8% (ME 2009). Collected electrical and electronic products are disposed of through various channels including recycling enterprises, second-hand markets, and export. However, Korean recycling businesses have a problem with supply because some second-hand goods and material waste flow overseas.

For vehicles, there was an increase of 30.6% in recycling from 460,000 tons in 2008 to 601,000 tons in 2009. Annually, 4.8 million end-of-life vehicles are decomposed and



### Waste Recycling

Geumcheon-gu, Seoul, is carrying out the urban mining project which extracts scarce metal resources from scrap household appliances and mobile phones.

recycled in 440 different vehicle-decomposing sites throughout Korea. 80% of steel and nonferrous metal scraps are recycled, whereas only 10-15% of the other by-products such as liquid waste, sludge and dust are recycled (Ibid.). Due to lack of recycling technology, the rest flow overseas or are disposed of through landfill or incineration.

Korea’s recycling technology only reaches 50-70% of that of developed countries. The recovery rate of rare metals in scrap metal resources is even lower. This is because Korea’s recycling technology is 20-30% behind developed countries. Korea also lacks the utilization technology of an integrated system. Despite diversified product qualities and the shortened lifecycle of recyclable goods, they are only recycled to low quality products or, with only limited usage due to constraints in the recycling technology (Korea Environment Corporation 2011).

In 2008, the Korean government established a comprehensive plan for deriving energy from waste in order to make efficient use of resources that do not disappear during the waste disposal process, to increase the recycling rate of energy sources and to create more jobs. In 2009, a plan for scrap metal resources was proposed, which was further developed into the Action Plan for Revitalization of Scrap Metal Resource Recycling (which includes 18 tasks in four areas) in 2010.

### 18 Tasks to Revitalize Scrap Metal Recycling

Highlights of the Action Plan for Revitalization of Scrap Metal Resource Recycling are as follows (Ministry of Environment 2010):

- 1 Reinforcement of the Recycling System:** In order to reinforce the scrap metal resource recycling system, types of electronic products to be recycled will be expanded from the current

Figure 6-2: The Level of Scrap Metal Recycling Technology by Countries

Name of Technology	Japan	USA	EU	China	Japan
Recycling technology of electric and electronic plastics	○	○	◎	△	△
Metal recycling technology	◎	△	△	△	○
Scarce metal production technology	◎	○	○	△	×
Scare metal recycling technology	◎	○	○	○	×
Separation and selection recycling technology	◎	○	◎	△	○

(◎: Very high, ○: High, △: Low, X: Very low)

Source: Korea Institute of Geoscience and Mineral Resources (2010), ‘Research on the Development of Future-Oriented Scrap Metal Recycling Technology’

Figure 6-3: Classification of the Strategic Recycling Metals (an Example)

Strategic Metals	Metal Materials (23 in total)			
	Iron (1)	Precious Metals (2)	Ordinary Nonferrous Metals (4)	Scarce Metals (16)
Fe	Au, Ag	Cu, Al, Zn, Pb	Si, Ni, Cr, Mn, Mo, Sn, Ti, Co, V, W, Pt, Pd, Rh, Ir, Ru, Os	

ten types. For vehicles, all three types of vehicles will be covered by 2013. By 2020, all units of vehicles will be covered. Moreover, the recycling system will expand its boundaries to various products that are not specified in the law such as secondary lithium batteries that are increasingly used in hybrid vehicles, cellular phones, and laptop computers. The Recycling requirements for electrical and electronic waste together with the criteria and method of recycling for each product will be reviewed to increase the recycling volume per person by 30% from 2.3kg in 2008 to 2.9kg in 2013.

The target-recycling rate for end-of-life vehicles will be raised to 85% by 2014 and 95% by 2015. In particular, a system where the manufacturers are responsible for recycling vehicles' non-metal materials including automobile shredder residue (ASR), airbag and gas waste will be introduced. Decomposition of automobiles, arrangement of management guidelines, and introduction of quality certification of second-hand materials will be prepared to revitalize the reuse of materials from end-of-life vehicles. Recycling boundaries for scrap metal resources from industrial sites such as catalyst waste and liquid waste will be extended. Also, confiscated scrap metal resources from various illegal activities will not just be disposed but will be recycled through a demonstration project that transforms customs-confiscated-goods into valuable resources.

- 2 **Efficiency Improvements in the Collection System:** To improve the collection system for scrap metals from households, an all-time-collection-system is to be implemented. Measures to accomplish this include: exemptions from the discarding fee for small-sized household appliances; introduction of a segregated discarding system for small-sized appliances and scrap metals; and adjustment of discarding fees for big-sized appliance waste such as televisions and refrigerators. Starting in 2011, within ordinary residential areas, collection boxes for small-sized appliances and scrap metals will be installed to facilitate waste-segregation. This will be linked to the Clean House Project in which lower income households that are comprised of the elderly or the disabled are given cleaning and disinfection services. At the same time, the hidden resource hunting project, a nationwide campaign of collecting end-of-life cellular phones and batteries, and the pilot project of Home Appliance Waste Collection Center will be implemented to construct the groundwork for scrap metal recycling policies.
- 3 **Enhancing Recycling Technology and Industrial Competitiveness:** To enhance recycling technology, a project to devise a medium to long-term recycling technology development plan is being conducted. Furthermore, metals will be categorized and some of them will be selected as strategic recycling metals. Among household wastes, steel, precious metals and strategic metals under general metal category are to be recycled at a 90% rate by 2013. Metals under the rare metal category are to be recycled by 70-80% by 2020. In addition, to increase the number of enterprises that recycle scrap metal resources, which is just 363 (8.8%) out of

4,128, recycling industry promotional loan will be expanded from the current level of USD 65million to USD 70million by 2014 (Figure 6-3).

By 2020, special industrial complexes for the resource recycling industry are planned to be built in six different provinces, at least one in each province, in order to consider local characteristics of waste and enhance competitiveness through conglomeration and economies of scale. Moreover, to establish a basis for stable supply of raw materials for the scrap metal resource recycling industries, the 177 public recycling collection and storing centres around the nation as of 2008 have been and will be expanded. In addition, local area resource recycling networks are planned to be constructed together with nationwide resource recycling networks that can oversee the connection among local networks based on the consideration of local waste emission, recycling related businesses, and technology infrastructure.

- 4 **Policy and Infrastructure Improvement:** To improve the scrap metal resource recycling system, the enforcement ordinance of the Act on Resource Recycling of Electrical and Electronic Products and Vehicles will be amended in 2011. Also recycling criteria for the processing of recent battery-formed renewable energy such as lithium secondary batteries, solar batteries and fuel batteries will be developed. By amending the enforcement ordinance of the Act on Saving Resources and Recycling Promotion, many scrap metal resources including steel slag and the specified residue from coal cinder (including catalyst waste, liquid waste, contaminated soil, dust waste, scraps, and slag) are to be recycled. Until recently, the material recovery industry was not able to move into an industrial complex because it was excluded from the manufacturing category in the Korean standard industrial classification. However, such a problem was resolved by the amendment of the Act on Direct Revitalization of Industry and Founding Factories. The process of obtaining a permit under the Act on Waste Management by businesses has been simplified in 2011 from two stages (advanced suitability reporting and approval) to one stage (advanced suitability reporting) in order to lessen the burden imposed on the related businesses.

If the Action Plan operates successfully, 3.12 million tons of metal resources are expected to be recovered from scrap metals between 2010 and 2013. this has a monetary value of USD 3.804 billion. The trade imbalance is also expected to improve by more than USD 3.35 billion. The action plan can also reduce the use of energy from natural resources. This will result in the reduction of 1.56 million tons of CO<sub>2</sub> emissions and the creation of 4,000 green jobs. In addition to this, until 2020, there are a lot of benefits to be expected: revenue from metal production of around USD 14.8 billion, the improvement in the trade imbalance by USD 11.2 billion, an increase in the number of jobs by 16,000, reductions of CO<sub>2</sub> emission by 1.1 million tons, and the reduction in landfill and incineration fees by USD 456 million.

## VI-3. Green Purchasing and Consumption

The Low Carbon Life

### Refraining from Over-consumption and Change of Consumption Patterns

Green purchasing has two main meanings: (i) purchasing products after considering the necessity of the product thoroughly to prevent over-consumption; (ii) choosing and buying eco-friendly products and services that change consumption patterns.

A report by the UNEP, Green Jobs: towards sustainable work in a low-carbon world (Renner et al 2008) suggests the implementation of eco-label on all consumer goods to provide consumers information which would make it easy for them to take environmental concerns into account when purchasing products. International discussions on eco-label are carried out by international organizations and administrative organizations such as the International Organization for Standardization (ISO) and the World Trade Organization (WTO).

As early as 1998, ISO 14020 proposes the use of eco-label on all goods and categorizes the labels into three standard groups (Figure 6-4). Relevant Korean domestic systems are (i) Eco-labeling system (Development and Support for Environmental Technology Act), (ii) Environmental Self-regulation System (Act on Fair Labeling and Advertising), and (iii) Environmental Declaration of Products System (Development and Support for Environmental Technology Act).

### Eco-label Providing the Environmental Information about the Product

Eco-labeling is a system whereby producers voluntarily employ verifiable measures that

■ Figure 6-4: Relations between ISO 14020 Series and Domestic System

Type	Details	Related Domestic System
Type I	Environmental influence of a product's entire life-cycle evaluated by a third party	Eco-labeling system (Act relating to Environmental Technology Support and Development),
Type II	Label or slogan attached for a business to self-assert environmental friendliness of its product	Environmental Self-regulation System (Fair Labeling and Advertising Act)
Type III	Making environmental performance of a product's entire life-cycle measurable and labeling the result on the product	Environmental Declaration of Products System (Act Relating to Environmental Technology Support and Development)

significantly reduce the harmful effects of their production processes and products. It then provides consumers with exact environmental information on the product while calling on producers to develop and produce goods that meet the eco-consumption patterns (Korea Environment Industry & Technology Institute). This system is under Type I, one of the three types of eco-labeling of ISO.

Since the first introduction of 'Der Blaue Engel,' Germany's eco-label in 1979, around 40 governments and organizations including the EU, the Nordic countries, Japan are implementing eco-labeling. About 26 countries, including Korea joined as a member in 1997, have formed Global Eco-labeling Network (GEN), which is an consultative group of eco-labeling system operating organization actively engaged in eco-label system (www.globalecolabelling.net).

Korea has been implementing eco-labeling from 1992 before becoming the member of GEN. The past eco-label which was well known for its slogan "cleaner, greener" was used from April 1992 to July 2004, and the new eco-label (Figure 6-6) is being used from August 2004. Eco-labeling system is operated in various forms according to cultural, economic, and social conditions of each country. For Korea, eco-labeling is managed by both the Ministry of Environment and the Korea Environment Industry & Technology Institute (KEITI).

After the Act on the Encouragement of Purchase of Environmentally Friendly Products has been enacted in 2004, the number of eco-label certified product and the sales related to the products has been rapidly increasing. Looking into the current situation of eco-labeling certification on 31 August 2010, 143 product categories, 1,606 businesses, and 7,655 products were certified with eco-labels. Also, during the same period, the sales of eco-label products that were only 1.6 trillion KRW (USD 14.5 billion) in the

■ Figure 6-5: Current Situation of EDP Certification (Updated on August 31, 2009)

Categories	The number of product categories	The number of businesses	The number of products
Office machines & furniture & office supplies	22	364	2,929
Residential and construction materials & facilities	38	506	2,042
Personal care items & housewares	18	218	765
Household appliances & furniture	16	27	415
Transportation, leisure, culture related goods	12	16	47
Industrial equipment & facilities	15	76	200
Mixed-uses & etc.	22	399	1,287
Total	143	1,606	7,655

Source: www.keiti.re.kr



year 2004 tremendously grew to 18.8 trillion KRW (USD 17 billion) in the year 2008.

According to the result of the Survey on general public awareness about eco-product conducted in March 2010, consumer's awareness towards eco-labeling was 39.3 percent as compared to 8.8% in 2007. So far, consumers who do not know much about eco-labeling exceed the number of people who knows about it. The survey also shows that 51.7 % of consumers bought 5-10 % of eco-labeled products on the average (Ministry of Environment 2010).

### Producers' Environmental Self-regulation System

Environmental Self-regulation that conforms to Type II is eco-labeling system that allows manufactures, importers, distributors, and retailers to self-assert environmental superiority of their products without any certification of an independent third party. This system has the merit of providing various forms of environmental information to the consumers, but also has some parts that can be quite deceptive. In other words, in the process of a business asserting their own environmental information without any third party's certification, there are possibilities of providing environmental information not based on the objective facts which would lead to negative influence on consumer purchase decision. This method could be seen as *green washing* which is a way of some businesses making profit by taking advantage of eco-brand image without actually engaging in environmental friendly activities.

Additional information on the label is as much important as reliability of the eco-label. According to the 2008 Green Gap Survey conducted by the research company, Cone (www.coneinc.com/content1136), more than 30 percent of the consumers responded that the environmental information provided by corporates is insufficient.

The situation is the same in Korea. The existing Environmental Labeling and Advertisement Evaluation Guide only has terms and examples such as 'pollution-free,' 'low pollution,' 'recycle,' 'reducing waste,' 'ozone layer protection,' 'resolvability', 'reuse,' and 'refill,' and yet shows 'low-carbon green consumption' environment related terms as 'low carbon,' 'green,' 'carbon neutrality,' 'sustainable,' 'eco-friendly' and their actual examples of application. It is necessary to build conditions that enable environmental self-regulation based on consumer's understanding, consumer preferences, and accurate information (Lee & Hwang 2009).

### Quantifying the Environmental Effects of Product's Entire Process

Environmental Declaration Products (EDP) System is about putting the product's environmental effects (use of natural resources, pollutant produced, and the environmental effects of the pollutant during the product life-cycle involving collection of the raw materials, consumption, and disuse) into numbers and graphs and attaching it on the product. This facilitates the consumer's purchase considering the environmental product and great-

ly contributes to eco-friendly product manufacture since it enables manufacturing companies to select eco-friendly component when procuring components. Also, it potentially induces market-driven continuous environment improvement by easily and transparently opening the exact environmental information to support green consumer's purchase on eco-products.

By opening quantitative environmental information to consumers, it helps them decide on their green purchasing and green consumption, thus further contributes to environmental preservation. It also contributes to build foundation to properly respond to international trend of environmental paper wall.

EDP is based on Life Cycle Assessment (LCA) Technique, which can quantitatively assess environmental effect of entire product life-cycle. LCA is about defining environmental pollutant emitted during product life cycle including collection of the raw materials, product manufacturing, distribution, consumption and discarding, and is technique of scientifically and systematically quantifying how much influence these pollutant have on Earth environment in aspects of global warming and acidification. Briefly looking into LCA, it can be classified into four stages of defining purpose and range, analysis of inventories, assessment of influence, and interpretation. By identically defining application methodology such as product function/functional unit, system boundary, data quality requirement, assignment, data collection, and estimation methods LCA makes

Figure 6-6: Eco Mark of Korea



Figure 6-7: Environment Grade Mark

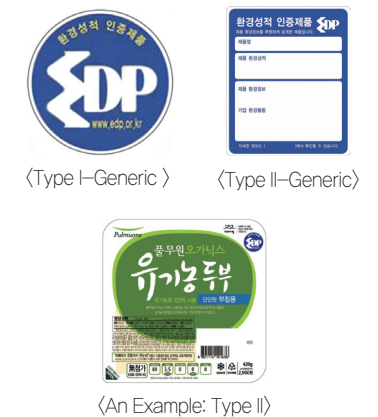
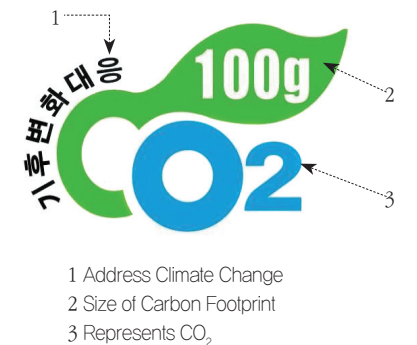


Figure 6-8: Carbon Footprint Mark



it possible to environmentally compare various products which are included in the same product category (Ministry of Environment 2002).

There are three types of EDP: Type 1 and Type 2 which are attached to the package or the container, and Type 3 which are published in product brochure and in the Internet (Refer to Figure 6-7).

EDP is to be attached as uniformed labels on the product. The Report on Environmental Performance of Certified Products is published online. As could be seen in the Figure 6-7, **Pulmuone Co Ltd.**'s<sup>i)</sup> 1 package tofu, Pulmuone Organics Organic Tofu and the other six kinds (Certified Period 16 January 2007 - 15 January 2010) provides the EDP on its package cover.

In April 2001, six product categories including home refrigerator were first to be selected as EDP target product categories, as of 31 August 2009, 309 products were certified (Korea Environmental Industry & Technology Institute 2009).

### Label that Shows GHG Emission Product Life Cycle

Carbon Footprint Label is a system that aims market-driven reduction of GHG and spreading the low carbon consuming culture by providing the consumer with the label that indicates CO<sub>2</sub> emission converted from GHG emission that occurs in life cycles including production, transportation, distribution, use, and disuse of products and services (www.edp.or.kr). The Carbon Footprint Label is called in multiple other names such as Greenhouse Gas Labeling or Carbon Labeling. For example, 500ml Coca Cola plastic bottle sold in Korea has total of 168g of carbon emission, and analyzing from the life cycle of this bottle, pre-manufacturing stage was 76 percent, manufacturing stage 25%, use stage 0 percent, and discarding stage 1 percent. Manufacturer would have the carbon emission of the Coca Cola certified and label it on the product so that the consumers recognize the label (www.coca-cola.co.uk).

Carbon Footprint Label is implemented in UK, Sweden, US, and Canada under the name of Carbon Reduction Label, Carbon Conscious Product Label, Climate Declaration, and Carbon Counted Carbon Label, respectively. State of California US has announced Carbon Labeling Act (AB 2538) and its promotion in March 2008 while Japanese Ministry of Economy, Trade and Industry (METI) is enforcing carbon labeling system on the product of larger retailers on a trial basis from 2009 (State of California 2008).

Carbon Footprint Label system was introduced in Korea on February 2009 and actual certification label on the product was distributed from 15 April of the same year. Prior to the actual set in of the system, public hearing on Carbon Footprint Label system and briefing session were held in May and June respectively, and in the same year December, Carbon

i) Pulmuone is a leading domestic food company that specializes eco friendly, organic food product. (www.pulmuone.co.kr)

Footprint Label Demonstration Certificate were given to ten items. In Korea's distribution industry, **Homeplus**<sup>ii)</sup> is in the lead of presenting government certified Carbon Footprint Label products.

Carbon Footprint Label Certification is not a system compelled by law. It consists of two steps of certification process which is based on corporate's voluntary participation. First step to determine the baseline of carbon emissions quantity by each requested product. Step two is to certify the low carbon product, which is granted to the products that qualified for the Step and also have achieved government suggested reduction goal by developing low carbon technology.

Of course, certifying as low carbon product only indicates that the product has reduced the amount of carbon emission and does not mean that the product is necessarily superior to other products in the market. It is an assurance provided by the government that the certified products have successfully reduced GHG emissions with low carbon technology (Figure 6-8). Except for medical supplies and devices, agriculture-fishing-livestock-forest product, Carbon Footprint Labels are applied to all other product categories.

Carbon Footprint Label Certification draws on the Ministry of Environment notification No. 2009-86 which states the Regulation related to Carbon Footprint Labels Certification Work, the Carbon Footprint Labels Guidelines and the Regulation related to Carbon Footprint Labels Certification.

Starting on 31 March 2009, 23 products from 12 corporates including **Asiana Airlines**<sup>iii)</sup>, **Woongjin-Coway**<sup>iv)</sup>, and **Haitai**<sup>v)</sup> achieved the first Carbon Footprint Label Certification, and so far 234 products of 53 corporates were certified with Carbon Footprint Labels. However, though it has been more than a year since the system was implemented, more promotion is needed since many consumers are not even familiar with the system itself. Since the success of this system could only be guaranteed by the market-driven consumer power, there has to be additional ways to give incentives to the consumers who purchase Carbon Footprint labeled products, other than just Carbon Points.

ii) Homeplus is a South Korean based discount store retail chain jointly owned by Samsung and Tesco with 113 branches throughout South Korea (<http://corporate.homeplus.co.kr>).

iii) Asiana Airlines Inc. is one of South Korea's two major airlines, along with Korean Air (<https://flyasiana.com/index.htm>).

iv) Woongjin Coway is a Korea based company that produces air purifiers, water filtration devices, digital bidets, megasonic cleaning device, and other well-being home appliances. Woongjin-coway

v) Haitai is a Korean based conglomerate, with its main business in retail and instant foods, especially confectionery, beverage and ice cream.

## VI-4. Green Education

From Children to Adults

### Korean Green Growth Education Model

The Ministry of Education Science and Technology (MEST) and the relevant authorities jointly established the Policy Measures for Green Growth Education to build green growth infrastructure and foster global citizens and talents *(the 5th Meeting of the Presidential Committee on Green Growth on 24 August 2009)*.

With ‘Realizing a Green Growth Nation through Green Education’ as the vision for Green Growth Education, the Korean government set up three objectives along with eight policy issues:

1. **Elementary to Secondary School Green Growth Education Reinforcement:** The Korean government reflected the contents of green growth education in the future curriculum text books (notified in December 2009), developed new text books, and trained green education human resources. Also, by designating and operating green growth education centers, Korea is promoting leading educational institutions while preparing green growth experiencing centers inside the regional museums and science museums.
2. **University and Nationwide Green Growth Education Reinforcement:** The Korean government is steadily enlarging foundations for civic education by fostering green growth education in the university through the enlargement of the green campus movement, implementing green growth lifelong education, opening green growth education programs for social leaders, and spreading the green lifestyle movement.
3. **Globalization of Green Growth Education:** The Korean government is strengthening international society’s cooperation related to green growth education by Internationally implementing the UN Decade of Education for Sustainable Development while spreading the Korean green growth education model to lead the globalization of green growth education.

### Development and Implementation of Green Growth Curriculum

According to the Notification of Future Oriented Curriculum Amendment *(December 2009)*,

the Korea Foundation for the Advancement of Science and Creativity associated with the Ministry of Education, Science and Technology (MEST), established the Task Force on Green Growth Education. The Task Force has developed curriculum and standard textbook for the subject Environment and Green Growth for secondary schools in July 2010. This subject will be taught in schools starting spring semester of 2011.

This curriculum has been revised by adding the concept of low carbon green growth in the existing curriculum of environment *(Figure 6-10)*. The new curriculum emphasizes an environment project by letting the students plan, execute their own projects. The students can also build their creativity and personality by searching for topics and performing the given assignment.

This curriculum also deals with the concept, necessity, and the potential of green growth, and environmental infrastructure. It also suggests how to embody green lifestyles as an individual, as a member of a family, school and community. The curriculum integrates almost all the relevant subjects while stresses the practical aspects.

The Task Force on Green Growth Education ran the training program for the teachers and experts who are going to teach the subject ‘Environment and Green Growth’ in August 2010 to assist the actual application of the subject to real classrooms. In the future, The Task Force plans to publish a web-based digital archive called Green Education Resources Center *(www.gerc.or.kr)*.

■ Figure 6-9: Reinforcement of Policies on Green Growth Education

Elementary-secondary School Green Growth Education Reinforcement	Developing and institutionalizing green growth curriculum
	Developing green growth school text books
	Establishing training system for teachers of green growth education
	Designating and operating leading green growth education center
	Connecting green growth education inside and outside the school
University and Nationwide Green Growth Education Reinforcement	Fostering university education for green growth
	Building educational foundation for nationwide green lifestyle
Globalization of Green Growth Education	International social cooperation towards green growth education

Figure 6-10: High School Curriculum of 'Environment and Green Growth'

Major Concept	Subdivision	Details
Environmental Project		<ul style="list-style-type: none"> <li>• Topic Exploration &amp; Selection</li> <li>• Establishment &amp; Execution of Plans</li> <li>• Result Announcement &amp; Evaluation</li> </ul>
Environment and Life of Mankind	Human and Earth Ecosystem	<ul style="list-style-type: none"> <li>• Global Ecosystem, livelihood of Human Life</li> <li>• Composition and Feature of Global Ecosystem</li> <li>• Substance Cycle and Energy Flow of Ecosystem</li> </ul>
	Human Civilization and Environment	<ul style="list-style-type: none"> <li>• Relationship between Human, Environment and Economic Activity</li> <li>• Industrialization and Environmental Issues</li> <li>• Eco-awareness and Environmental Ethics</li> </ul>
	Sustainable Development and Green Growth	<ul style="list-style-type: none"> <li>• Understanding Sustainable Development</li> <li>• Understanding Green Growth</li> <li>• Relationship between Sustainable Development and Green growth</li> </ul>
Environmental Issues and Countermeasure	Atmospheric Environment	<ul style="list-style-type: none"> <li>• Relationship between Atmospheric Environment and Human</li> <li>• Comprehension and Countermeasure of Atmospheric Environmental Issues</li> </ul>
	Water Environment	<ul style="list-style-type: none"> <li>• Relationship between Water Environment and Human</li> <li>• Comprehension and Countermeasure of Water Environmental Issue</li> </ul>
	Soil Environment	<ul style="list-style-type: none"> <li>• Relationship between Soil Environment and Human</li> <li>• Comprehension and Countermeasure of Soil Environmental Issue</li> </ul>
	Biotic Environment	<ul style="list-style-type: none"> <li>• Relationship between Biotic Environment and Human</li> <li>• Comprehension and Countermeasure of Biotic Environmental Issue</li> </ul>
Resources and Energy	Types and Utilization of Resources and Energy	<ul style="list-style-type: none"> <li>• Types of Resource and Energy</li> <li>• Transition in Resource and Energy Utilization</li> </ul>
	Resource and Energy Issues	<ul style="list-style-type: none"> <li>• Resources and Energy Sources Development and Exhaustion</li> <li>• Consumption of Resources and Energy and Environmental Issues</li> <li>• Interregional and International Conflict and Cooperation</li> </ul>
	Eco-friendly Utilization of Resources and Energy	<ul style="list-style-type: none"> <li>• Saving Resources and Energy</li> <li>• Waste Resources and Resource Cyclical Society</li> <li>• Future Resources and Renewable Energy</li> </ul>
Understanding and Response to Climate Change	Cause and Effect of Climate Change	<ul style="list-style-type: none"> <li>• Phenomenon of Climate Change and Its Cause</li> <li>• Direct/Indirect Influence of Climate Change</li> </ul>
	Countermeasure against Climate Change	<ul style="list-style-type: none"> <li>• Response to Climate Change</li> <li>• Adaptation to Climate Change</li> <li>• Climate Change and International Cooperation</li> </ul>
Green growth and Sustainable Society	Green Industry and Policy	<ul style="list-style-type: none"> <li>• Possibility of Green Growth</li> <li>• The Present and Future of Green Technology</li> <li>• Green Industry and Green Jobs</li> <li>• Green Policies</li> </ul>
	Establishment of Eco-friendly Foundation	<ul style="list-style-type: none"> <li>• Conservation and Restoration of Ecosystem</li> <li>• Eco-friendly Infrastructure</li> <li>• Environmental Network</li> </ul>
	Sustainable Society- Culture	<ul style="list-style-type: none"> <li>• Green Lifestyle and Green Consumption</li> <li>• Environmental Justice and Cultural Diversity</li> <li>• Participation and Voluntary Service</li> </ul>
Transition to Green Society	Practice of Individual and Local Society	<ul style="list-style-type: none"> <li>• Best Practice of Individual and Family</li> <li>• Best Practice of School and Local Society</li> </ul>
	National and International Efforts	<ul style="list-style-type: none"> <li>• Green Growth Efforts of Other Countries</li> <li>• Activity of Environmental Groups and Related Organizations</li> <li>• International Cooperation</li> </ul>



## I. Institutional Foundations

- European Commission on Climate Action. ([http://ec.europa.eu/clima/documentation/package/index\\_en.htm](http://ec.europa.eu/clima/documentation/package/index_en.htm)).
- Giddens, A. (2009). *The Politics of Climate Change*. Cambridge : Polity.
- Korea Institute of Finance. (<http://www.kif.re.kr/>).
- Le Grenelle Environnement. (<http://www.legrenelle-environnement.fr/-Lois-.html>).
- UNEP. (2009). *Overview of the Republic of Korea's Green Growth National Vision*. Geneva: UNEP DTIE.
- United Kingdom Legislation Information. (<http://www.legislation.gov.uk/ukpga/2008/27/contents>).
- United Nations Environment Programme. (2009). *The Global Green New Deal*.

## II. Climate Policy

- BBC News. 2 May, 2009. Burma Cyclone Misery One Year On. ([http://news.bbc.co.uk/2/hi/south\\_asia/8030301.stm](http://news.bbc.co.uk/2/hi/south_asia/8030301.stm))
- CBC News Online. 4 Sept. 2005. Indepth: Hurricane Katrina. ([http://www.cbc.ca/news/background/katrina/katrina\\_timeline.html](http://www.cbc.ca/news/background/katrina/katrina_timeline.html))
- Choi, S. G. (2010). Extraordinary Weather Conditions, Generating Tremendous Loss to the Agriculture Industry. *Nongmin Shinmun*. 23 Jung 2010.
- ICLEI. 2010. *Local Government Operations Protocol for the Quantification and Reporting of GHG emissions inventories*. Version 1.1. ICLEI, Bonn: Germany.
- Intergovernmental Panel on Climate Change. 2006. *2006 IPCC Guidelines for National GHG Inventories*. Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). IGES: Japan.
- IPCC. (2007). *Climate Change 2007: Impacts, Adaptation, and Vulnerability, Intergovernmental Panel on Climate Change*. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press.
- IPCC. (2007). *Climate Change 2007: Synthesis Report*. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Core Writing Team, Pachauri, R.K and Reisinger, A.(eds.). IPCC, Geneva: Switzerland.
- Jung, E. M. (2011). Local Food Management System by Case and the Implication in *Agriculture Outlook 2011: New Market and Opportunity for Agriculture, Rural Areas and the Agri-food Industry*. Korea Rural Economic Institute.
- Korea Environment Institute. (2005). *The Health Impacts of Climate Change and Adaptation Measures*.
- Kim, C. G. (2011) Climate Change and the Future of Agriculture in the Korean Peninsula,

*Agriculture Outlook 2011: New Market and Opportunity for Agriculture, Rural Areas and the Agri-food Industry*; Korea Rural Economic Institute.

- KEI. (2009). *Economic Analysis of Climate Change in Korea*.
- Korea Institute of Health and Social Affairs. (2008). *Surveillance Improvement of Diseases due to Climate Change*.
- Lee, C. H., Lee, M. Y., Cho, Y. M., Cho, W. S., and Ahn, O. S., (2011) Future Forecasting of Agricultural Technology. *Agriculture Outlook 2011: New Market and Opportunity for Agriculture, Rural Areas and the Agri-food Industry*. Korea Rural Economic Institute.
- Lee, D. B. and Shim, K. M. (2011). The Impact of Climate Change on Agriculture and Its Measures. *Agriculture Outlook 2011: New Market and Opportunity for Agriculture, Rural Areas and the Agri-food Industry*. Korea Rural Economic Institute.
- Presidential Committee on Green Growth. (2009). *National Strategy for Green Growth and its Five-Year Action Plan*.
- Stern, N. (2006). *Stern Review on the Economics of Climate Change, Great Britain: Treasury*.
- WRI/WBCSD. (2004). *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard* (Revised Edition). WRI/WBSD, Geneva: Switzerland/Washington DC: USA

## III. Green Energy

- IEA. (2007). 25 Energy Efficiency Improvement Policy Recommendations.
- Korea Energy Statistics Information System. ([www.kesis.net](http://www.kesis.net)).
- Ministry of Knowledge and Economy. (2010). Trends and Prospects for Energy Demand and Supply.
- Amin S. and Wollenberg B. (2005) Toward a Smart Grid. *Power and Energy Magazine*.
- Korea Institute of Energy Technology Evaluation and Planning. (2011) (<http://www.ketep.re.kr/english/index.jsp>).
- Hwang, S., Kim, M., Lee, J. and Lee, W. (2009). A Simulation-based Study on the Economical Operating Strategies for a Residential Fuel Cell System. *Transactions of the Korean Hydrogen and New Energy Society*: 20 (2) p. 104-115.
- Republic of Korea. Office of the President. National Assembly Library. (2009). *Collection of Speeches by President Lee Myung-bak*. Vol. 1.
- Shin, J., Jung, T. and Ahn, H. (2009). Power Variation of Solar Cell According to Electrolyte. *The Journal of the Korean Institute of Electrical and Electronic Material Engineers*. 10.
- Lee, K., Moon, J. and Jung, M. (2008). *Economic Analysis for the Photovoltaic System*. Korean Institute of Industrial Engineers.
- Presidential Committee on Green Growth. ([www.greengrowth.go.kr](http://www.greengrowth.go.kr)).

- Jung, J. (2004). The Competitiveness and Politic Implications in Wind Energy Industry. *The Journal of the Korean Institute of Power Electronics*. Vol. 2.
- Hassan, A. Y, and Hill D. R. (1986). *Islamic Technology: An illustrated history*. Cambridge University Press. p. 54.
- Betz A. (1966). *Introduction to the Theory of Flow Machines* (D.G. Randal, Trans.) Oxford: Pergamon Press.
- Cleveland C. J. (2004). *History of Wind Energy in Encyclopedia of Energy*. Vol. 6 p. 426.
- Ministry of Knowledge and Economy. (2010). *Offshore Wind Power Technology Development Roadmap*. (<http://www.mke.go.kr/news/bodo/bodoView.jsp?pCtx=1&seq=64629>).
- SMBA. (2009). The Present and Future of Green Technology (<http://eng.smba.go.kr/>).

#### IV. Green Technology and Industry

- Capoor, K. and Ambrosi, P. (2009). State and Trends of the Carbon Market 2009. *Annual Report on State and Trends of the Carbon Market*.
- Cheil. (2010). Survey on the Awareness and consumption Pattern of the Green Consumer. ([www.cheil.com](http://www.cheil.com)).
- Climate Change Adaptation Committee. (2008). *Master Plan for the Long Term Research and Development for Climate Change Mitigation*. ([http://www.korea.kr/expdoc/viewDocument.req?id=11526&call\\_from=admin](http://www.korea.kr/expdoc/viewDocument.req?id=11526&call_from=admin)).
- Construction Daily News. 2008. Interview with Korea Eco-Products Institute (KOECO)'s Seung-sik Moon on 23 October, 2008.
- Coway. ([www.coway.com](http://www.coway.com))
- E-National Index. Eco-friendly Product Purchase Viewed on 4 April 2011 ([http://www.index.go.kr/egams/stts/jsp/potal/stts/PO\\_STTS\\_idxMain.jsp?id\\_idx\\_cd=1376](http://www.index.go.kr/egams/stts/jsp/potal/stts/PO_STTS_idxMain.jsp?id_idx_cd=1376))
- Garrett-Peltier, H., Heintz J., Pollin, R., and Scharber H. (2008). *Green Recovery: A Program to Create Good Jobs and Start Building a Low-Carbon Economy*, University of Massachusetts Press.
- Global Action Plan. (2007). An Inefficient Truth.
- Green Product Information System Website. Green Growth in Statistics. Viewed on 4 April 2011 (<http://www.greenproduct.go.kr/>).
- Gyeonggi Research Institute. (2011). *Policy Brief* No. 88 Nov. 2011. *in the Information Age*.
- Integrated Environment-friendly Product Network (ECOI) Website. Public Procurement, Statistics, Yearly Procurement Record. Viewed on 4 April 2011, (<http://www.ecoi.go.kr/portalServer/jsp/pkks/pkks0011.jsp>)
- Kim, Seung Taik (2009). Studies on Job Creation in Green Growth. Korea Labor Institute.
- Korea Environment Institute. (2009). *Environment Policies for Low Carbon, Resource Recycling*

*Society*:

- Korea Environmental Industry & Technology Institute (KEITI) website. Current Status of Eco-labeled products of 31 January 2011. Viewed on 4 April 2011 ([http://www.keiti.re.kr/info\\_center/info\\_mrg/bbs\\_view.jsp](http://www.keiti.re.kr/info_center/info_mrg/bbs_view.jsp))
- MEST. (2009). *Comprehensive Plan for the Research and Development of Green Technologies*. ([http://now.go.kr/newClass/newClassViewD.jsp?tableName=BOARD\\_ISSUE\\_PAPER&uno=102&new\\_class=04](http://now.go.kr/newClass/newClassViewD.jsp?tableName=BOARD_ISSUE_PAPER&uno=102&new_class=04)).
- Ministry of Education, Science and Technology. (2009). *Comprehensive Plan for the Research and Development of Green Technologies*. ([http://now.go.kr/newClass/newClassViewD.jsp?tableName=BOARD\\_ISSUE\\_PAPER&uno=102&new\\_class=04](http://now.go.kr/newClass/newClassViewD.jsp?tableName=BOARD_ISSUE_PAPER&uno=102&new_class=04))
- MEST. (2010). *2010 Analytical Report on the Research and Development of Green Technologies*.
- Ministry of Public Administration and Security. 2009. *New Green ICT Korea*. (<http://www.mopas.go.kr/gpms/ns/mogaha/user/userlayout/bulletin/userBtView.action?userBtBean.bbsSeq=1013644&userBtBean.ctxCd=1012&userBtBean.ctxType=21010002&userBtBean.categoryCd=>).
- National Energy Council. (2008). *The First National Energy Plan*.
- National Information Agency. (2008). *A study on the Analysis of present situation of energy use in IT sector and development of Green IT Policy*.
- National Science and Technology Council. (2009). *Development of Green Technologies*. ([http://now.go.kr/newClass/newClassViewD.jsp?tableName=BOARD\\_ISSUE\\_PAPER&uno=102&new\\_class=04](http://now.go.kr/newClass/newClassViewD.jsp?tableName=BOARD_ISSUE_PAPER&uno=102&new_class=04)).
- Nature2 Energy.Com.(2010). <http://nature2energy.com/fl3/why-recycling-used-electronics-could-help-27129.html>
- OECD. (2010). Interim Report of the Green Growth Strategy: Implementing our commitment for a sustainable future. *Meeting of the OECD Council at Ministerial Level*.
- Office of Fair Trading. 2004. *Assessing the Impact of Public Sector Procurement on Competition*. Vol. 1. OFT: London, UK.
- Paul Israel. (1998). *Edison: a Life of Invention*. Wiley.
- PCGG. (2009a). *Comprehensive Strategy for Development and Commercialization of Core Green Technologies*. ([http://now.go.kr/boardAnal/boardpaperView.jsp?qs1=1&tableName=BOARD\\_ISSUE\\_PAPER&uno=125](http://now.go.kr/boardAnal/boardpaperView.jsp?qs1=1&tableName=BOARD_ISSUE_PAPER&uno=125)).
- PCGG. (2010). *Strategy for the Development and Commercialization of Major Green Technologies*. (<http://www.greengrowth.go.kr/www/about/news/commission/userBbs/bbsView.do>).
- Public Procurement Service. 2010. Press Release. "PPS, Second Designations of Minimum Green Standard Products", Distributed on 30 August 30 2010.
- Reason Magazine.(2002). Silent Spring at 40: Rachel Carson's classic is not aging well. (<http://reason.com/archives/2002/06/12/silent-spring-at-40>)
- Schreurs, M (2008). Environmental protection, technological innovation and green jobs – A study based on German models <International Labor Brief>, Vol.6, No.12, Korea Labor Institute.
- The Climate Group. (2008). *SMART 2020: Enabling the Low Carbon Economy*

- United Nations Environment Programme(UNEP) (2007). Background Paper on Green Job, Viewed 10 April 2011, ([http://www.unep.org/labour\\_environment/pdfs/green-jobs-background-paper-18-01-08.pdf](http://www.unep.org/labour_environment/pdfs/green-jobs-background-paper-18-01-08.pdf))
- United Nations Environment Programme(UNEP) (2008). *Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World*, Viewed 10 April 2011, ([http://www.unep.org/labour\\_environment/PDFs/Greenjobs/UNEP-Green-Jobs-Report.pdf](http://www.unep.org/labour_environment/PDFs/Greenjobs/UNEP-Green-Jobs-Report.pdf))

## V. Green City, Transportation and Building

- Asia-Pacific Partnership on Clean Development and Climate website 2011. APP Fact Sheet. Viewed on 4 April 2011. ([http://www.asiapacificpartnership.org/pdf/translated\\_versions/Fact\\_Sheet\\_English.pdf](http://www.asiapacificpartnership.org/pdf/translated_versions/Fact_Sheet_English.pdf))
- Choi, M. 2011. Greenhouse Gas from Building Sector, 31% Mitigation Target by 2020, *The Kyunghyang Sinmun*, 31 January 2011. ([http://news.khan.co.kr/kh\\_news/khan\\_art\\_view.html?artid=201101312101085&code=940701](http://news.khan.co.kr/kh_news/khan_art_view.html?artid=201101312101085&code=940701)).
- E-National Index Website. 2011. Status of Buildings, Viewed on 4 April 2011. ([http://www.index.go.kr/egams/stts/jsp/potal/stts/PO\\_STTS\\_idxMain.jsp?idx\\_cd=1226&bbs=INDX\\_001&clas\\_div=C&rootKey=6.48.0](http://www.index.go.kr/egams/stts/jsp/potal/stts/PO_STTS_idxMain.jsp?idx_cd=1226&bbs=INDX_001&clas_div=C&rootKey=6.48.0))
- IEA. (2008). *Review of International Policies for Vehicle Fuel Efficiency 2008*. pp. 15-24.
- Korail Research Institute, 2010. Low Carbon Transportation Strategy for Post-2012 Regime ([http://news.korail.com/upload/article/14493/%C0%FA%C5%BA%BC%D2%20%B1%B3%C5%EB%CO%FC%B7%AB%BD%C7%C3%B5%B9%E6%BE%C8\\_%BE%E7%C1%D8%B1%D4.pdf](http://news.korail.com/upload/article/14493/%C0%FA%C5%BA%BC%D2%20%B1%B3%C5%EB%CO%FC%B7%AB%BD%C7%C3%B5%B9%E6%BE%C8_%BE%E7%C1%D8%B1%D4.pdf))
- Korea Transport Database, 2008. ([http://www.ktdb.go.kr/html/b/B01010603\\_2008.jsp?parent\\_menu\\_id=B01000000&menu\\_id=B01010603&1depth=2&2depth=1](http://www.ktdb.go.kr/html/b/B01010603_2008.jsp?parent_menu_id=B01000000&menu_id=B01010603&1depth=2&2depth=1))
- Korea's Sustainable Building Research Center (ERC) website 2011, viewed on 6 April 2011 (<http://susb.hanyang.ac.kr/>)
- Ministry of Environment et al. (2009). *Policy Measures of Scrap Metal Resource Recycling*. ([http://img.kisti.re.kr/originalView/originalView.jsp?url=/soc\\_img/society/kirrd/RSOCB3/2010/v19n4/RSOCB3\\_2010\\_v19n4\\_3.pdf](http://img.kisti.re.kr/originalView/originalView.jsp?url=/soc_img/society/kirrd/RSOCB3/2010/v19n4/RSOCB3_2010_v19n4_3.pdf)).
- Ministry of Environment. (2010). *Backgrounds on GHG and Energy Target Management System*. ([http://www.me.go.kr/kor/info/info\\_view.jsp?gubun=3&code=A30704&inpyrd=20110120175945](http://www.me.go.kr/kor/info/info_view.jsp?gubun=3&code=A30704&inpyrd=20110120175945))
- ME. (2010). *Action Plan for Revitalization of Scrap Metal Resource Recycling*. March 2010, Ministry of Environment.
- Ministry of Land, Transport and Maritime Affairs, 2009. Report on National Transport Cost and Traffic Conditions in 2008.
- Ministry of Land, Transport and Maritime Affairs, Ministry of Education, Science and Technology, Ministry of Public Administration and Security, Ministry of Knowledge Economy, Ministry of Environment and Korea Forest Service. (2009) *Plan on Vitalization of Green Buildings and Green*

*Cities*, 5 November 2009.

- Ministry of Land, Transport, and Maritime Affairs. (2009). *Urban Planning Measurements in Pursuit of a Low Carbon, Green City*. ([http://www.mltm.go.kr/USR/0204/m\\_45/dtl.jsp?id=5073](http://www.mltm.go.kr/USR/0204/m_45/dtl.jsp?id=5073))
- Republic of Korea. Office of the President. National Assembly Library. (2004). *Act on Eco-product Purchase Promotion*. (<http://likms.assembly.go.kr/law/jsp/main.jsp>)
- Shin, S. (2007). *Sustainable Building Technology. Kimoondang*; Seoul.
- Shin, S. (2008). Sustainable Super Tall Building and Engineering Role. *In 7th International Conference on Fracture and Damage Mechanics*. 9-11 September.
- PCGG. (2009). *National Guideline on Improving the Standard for Vehicles Fuel Efficiency and GHG Emissions*. ([http://www.greengrowth.go.kr/www/about/news/announce/userBbs/bbsView.do?bbs\\_cd\\_n=17&bbs\\_seq\\_n=24](http://www.greengrowth.go.kr/www/about/news/announce/userBbs/bbsView.do?bbs_cd_n=17&bbs_seq_n=24))
- World Business Council for Sustainable Development website. *Energy Efficiency in Buildings*. Viewed on 4 April 2011. (<http://www.wbcsd.org/templates/TemplateWBCSD5/layout.asp?type=p&MenuId=MTA5NQ&doOpen=1&ClickMenu=LeftMenu#>).

## VI. Green Life

- Korea Environment Industry & Technology Institute (<http://www.keiti.re.kr>)
- Ministry of Environment (2002) (<http://www.me.go.kr/kor/index.jsp> ([http://www.greengrowth.go.kr/resource/images/policy/01\\_home01.pdf](http://www.greengrowth.go.kr/resource/images/policy/01_home01.pdf)))
- Cone. (2008). *Green Gap Survey* (<http://www.coneinc.com/content1136>)
- KEITI (2009) <http://eng.keiti.re.kr/>
- Korea Environment Corporation. (2009). *Nationwide Waste Emission and Processing in 2008*. Korea Environment Corporation.
- Korea Institute of Geoscience and Mineral Resources. (2010). *Research on the Future-Oriented Scrap Metal Resources Recycling Technology Development*.
- Lee, K. and Hwang, E. (2009). *Study on Measures to Activate the Information for Practicing Low-Carbon Green Consumption*. Korea Consumer Agency.
- Ministry of Environment. (2008). Evaluation of the Five-Year Implementation of Extended Producer Responsibility. Press Release. November 2008. Ministry of Environment.
- OECD. (2006). *Environmental Performance Reviews*.
- OECD. (2007). *Outcome of the First OECD Workshop on Sustainable Materials Management*. Working Group on Waster Prevention and Recycling, 27 September 2007. OECD: Environment Policy Committee.
- Presidential Committee on Green Growth 2009, Press Release on 5 November. The 6th Meeting of Presidential Committee on Green Growth (PCGG).

- Renner, M., Sweeney, S. and Kubit, J. (2008). *Green Job: Towards Sustainable Work in a Low-Carbon World*. United Nations Environment Programme, World Watch Institute, Cornell Labour Institute. September 2008. ([http://www.unep.org/PDF/UNEPGreenJobs\\_report08.pdf](http://www.unep.org/PDF/UNEPGreenJobs_report08.pdf))
- State of California. (2008). *Greenhouse Gas Emissions: Consumer Product Labeling 2008: California Legislature—2007-2008 Regular Session*. ([http://info.sen.ca.gov/pub/07-08/bill/asm/ab\\_2501-2550/ab\\_2538\\_bill\\_20080222\\_introduced.pdf](http://info.sen.ca.gov/pub/07-08/bill/asm/ab_2501-2550/ab_2538_bill_20080222_introduced.pdf))

supplement

supplement

FRAMEWORK ACT ON LOW CARBON, GREEN GROWTH

ENFORCEMENT DECREE OF THE FRAMEWORK ACT ON LOW CARBON, GREEN GROWTH

# FRAMEWORK ACT ON LOW CARBON, GREEN GROWTH

Act No. 9931, Jan. 13, 2010

## CHAPTER I

### GENERAL PROVISIONS

#### Article 1 (Purpose)

The purpose of this Act is to promote the development of the national economy by laying down the foundation necessary for low carbon, green growth and by utilizing green technology and green industries as new engines for growth, so as to pursue the harmonized development of the economy and environment and to contribute to the improvement of the quality of life of every citizen and the take-off to a mature, top-class, advanced country that shall fulfill its responsibility in international society through the realization of a low-carbon society.

#### Article 2 (Definitions)

For the purposes of this Act:

1. The term “low carbon” means lowering dependence on fossil fuels, expanding the use and distribution of clean energy, and reducing greenhouse gases to an appropriate or lower level by expanding carbon sinks;
2. The term “green growth” means 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;
3. The term “green technology” means technology for minimizing the emission of greenhouse gases and discharge of pollutants by saving and using energy and resources efficiently throughout the entire course of social and economic activities, such as technology for reducing greenhouse gases, technology for using energy efficiently, technolo-

gy for clean manufacturing, technology for clean energy, technology for recycling of resources, and environmentally friendly technology (including related convergence technology);

4. The term “green industries” means all industries for achieving low carbon, green growth by producing goods and providing services for enhancing the efficiency of energy and resources and improving the environment in all economic activities, such as economy, finance, construction, transportation, logistics, agriculture, forestry, fisheries, and tourism;
5. The term “green products” means products that minimize the consumption of energy and resources and the generation of greenhouse gases and pollutants;
6. The term “green life” means a life style of being conscious of the seriousness of climate change, saving energy in daily life, and minimizing the generation of greenhouse gases and pollutants.;
7. The term “green management” means management through which an enterprise fulfills its social and ethical responsibilities by saving and using resources and energy efficiently and by minimizing the emission of greenhouse gases and the occurrence of environmental pollution in its business activities;
8. The term “sustainable development” means the sustainable development defined in subparagraph 2 of Article 2 of the Sustainable Development Act.
9. The term “greenhouse gases” mean carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrofluorocarbon (HFCs), perfluorocarbon (PFCs), sulfur hexafluoride (SF<sub>6</sub>), and other substances specified by Presidential Decree in the form of gas in the atmosphere, which absorb or reemit radiant heat to cause a greenhouse effect;
10. The term “emission of greenhouse gases” means both direct emission of greenhouse gases, which

emits, discharges, or leaks greenhouse gases generated as a consequence of human activities, and indirect emission of greenhouse gases, which discharges greenhouse gases by using electricity or heat (limited to those from a heat source generated with a fuel or electricity) supplied by another person;

11. The term “global warming” means a phenomenon in which the temperatures of the earth’s surface and atmosphere rise additionally throughout the earth as greenhouse gases, generated as a consequence of human activities, are accumulated in the atmosphere to increase the concentration of greenhouse gases;
12. The term “climate change” means a change in the climate system, which is incurred by changes in the concentration of greenhouse gases as a consequence of human activities, in addition to a natural climate change that has been observed during a considerable period;
13. The term “recycling of resources” means the recycling of resources defined in subparagraph 1 of Article 2 of the Act on the Promotion of Saving and Recycling of Resources;
14. The term “new and renewable energy” mean the new and renewable energy defined in subparagraph 1 of Article 2 of Act on the Promotion of the Development, Use and Diffusion of New and Renewable Energy;
15. The term “level of self-sufficiency in energy” means the ratio of an aggregate of the quantity of domestically produced energy and the quantity of energy developed abroad by the Republic of Korea (including acquired shares of equity), both new and renewable energy, to the total quantity of domestically consumed energy.

#### Article 3 (Basic Principles of Promotion of Low Carbon, Green Growth)

Low carbon, green growth shall be promoted in compliance with the following basic principles:

1. The Government shall promote a comprehensive strategy for national development, including the resolution of problems of climate change, energy, and resources, the expansion of growth engines, the enhancement of enterprises’ competitiveness, the efficient utilization of national land, and the development of a comfortable environment;
2. The Government shall vitalize market functions to the maximum and promote low carbon, green

growth initiated by the private sector;

3. The Government shall adopt green technology and green industries as core engines for economic growth and establish a new economic system for creating and expanding new job opportunities;
4. The Government shall intensify investment and support focused on green technology and green industries, which have high potentiality and competitiveness for growth, so as to use the State’s resources efficiently;
5. The Government shall enhance efficiency in the use of energy and resources in social and economic activities and facilitate recycling of resources;
6. The Government shall rearrange infrastructure, including national land and cities, buildings and transportation, road, ports and harbors, and waterworks and sewerage systems, to make them suitable for low carbon, green growth while preserving the value of national resources and environment at the same time;
7. The Government shall distribute resources efficiently by reorganizing taxation and financial systems so that economic expenses incurred by environmental pollution or emission of greenhouse gases can be reflected reasonably in market prices of goods or services and shall encourage citizens vigorously to change their patterns of consumption and life so as to contribute to low carbon, green growth. In such cases, consideration shall be given to avoid weakening international competitiveness of domestic industries;
8. The Government shall endeavor to materialize low carbon, green growth with all citizens’ participation and the cooperation of national agencies, local governments, enterprises, economic organizations, and non-governmental organizations;
9. The Government shall ascertain and analyze new international trends for low carbon, green growth to reflect such trends reasonably in national policies and shall heighten the stature and dignity of the State by performing its responsibilities and roles earnestly as a member of international society.

#### Article 4 (Responsibilities of the State)

- (1) The State shall endeavor to enable the basic principles for low carbon, green growth to be reflected in every aspect of state affairs, political, economic, social, educational, and cultural.
- (2) The State shall, whenever it formulates various policies, take into consideration impacts on the



harmonized development of the economy and environment and climate change.

- (3) The State shall encourage and support local governments' measures for low carbon, green growth and may take measures as may be necessary for establishing and proliferating green growth, such as providing business entities, citizens, and non-governmental organizations with information and financial support.
- (4) The State shall examine countermeasures for coping with crises in energy and resources and problems of climate change and evaluate the results therefrom periodically and shall analyze movements of international negotiations and policies of major countries to prepare appropriate measures.
- (5) The State may actively participate in international countermeasures against climate change and international cooperation in development of energy and resources and may provide developing countries with technical and financial support.

#### Article 5 (Responsibilities of Local Governments)

- (1) Each local government shall fully cooperate in the State's measures for realizing low carbon, green growth.
- (2) Each local government shall, whenever it formulates and enforces measures for low carbon, green growth, take into consideration local characteristics and conditions of the local government.
- (3) Each local government shall comprehensively consider impacts that its plans and projects have on low carbon, green growth in the course of formulating of various plans and executing of projects within its jurisdiction and shall intensify education and advocacy of low carbon, green growth for local residents.
- (4) Each local government shall seek for measures necessary for encouraging activities of business entities, residents, and non-governmental organizations for low carbon, green growth, such as providing them with information and financial support.

#### Article 6 (Responsibilities of Business Entities)

- (1) Each business entity shall initiate green management, reduce emission of greenhouse gases and pollutants in the entire course of its business activities, and expand investment and employment in research and development of green technology as well as in green industries to fulfill its

social and ethical responsibilities for the environment.

- (2) Each business entity shall actively participate and cooperate in policies enforced by the Government and each local government for low carbon, green growth.

#### Article 7 (Responsibilities of Citizens)

- (1) Every citizen shall actively practice green life in his/her home, school, workplace, and any other place.
- (2) Every citizen shall pay attention to the green management of enterprises and increase consumption and use of green products to facilitate such green management.
- (3) Every citizen shall be aware that he/she, him/herself, is one of the last troubleshooters to solve problems of serious climate change and crises in energy and resources that human beings face and shall actively participate in the campaign for green life to hand over a comfortable environment to his/her posterity.

#### Article 8 (Relationship with other Acts)

- (1) This Act shall take precedence over other Acts in application to low carbon, green growth.
- (2) Other Acts related to low carbon, green growth shall, whenever any of such Acts is enacted or amended, be brought into conformity with the purposes and basic principles of this Act.
- (3) Administrative plans and policies that the State and each local government establish pursuant to other Acts and subordinate statutes shall be in harmony with the basic principles for the promotion of low carbon, green growth under Article 3 and the national strategy for low carbon, green growth under Article 9.

## CHAPTER II

### NATIONAL STRATEGY FOR LOW CARBON, GREEN GROWTH

#### Article 9 (National Strategy for Low Carbon, Green Growth)

- (1) The Government shall establish and enforce the national strategy for low carbon, green growth (hereinafter referred to as "national strategy for green growth"), which shall include the targets of the State's policies for low carbon, green growth, the strategy for promotion, and main tasks of promotion.
- (2) The national strategy for green growth shall include the following matters:
  1. Matters concerning the realization of the green economic system under Article 22;
  2. Matters concerning green technology and green industries;
  3. Matters concerning policies for coping with climate change, policies on energy, and policies on sustainable development;
  4. Matters concerning the green life, the green homeland under Article 51 and the low-carbon traffic system under Article 53;
  5. Matters concerning international negotiations and cooperation in relation to low carbon, green growth, including climate change;
  6. Other matters considered necessary for low carbon, green growth, including procurement of financial resources, taxation, financing, training of human resources, education, and public relations activities.
- (3) The Government shall, whenever it intends to establish or revise the national strategy for green growth, bring a proposed bill to the Presidential Committee on Green Growth under Article 14 and then to the State Council for deliberation: Provided, That the foregoing shall not apply to modifications to minor matters prescribed by Presidential Decree.

#### Article 10 (Establishment and Implementation of Action Plans by Central Administrative Agencies)

- (1) The head of each central administrative agency shall establish and implement an action plan for matters under his/her jurisdiction (hereinafter referred to as "central action plan"), as prescribed by Presidential Decree, so as to execute the national strategy for green growth efficiently and systematically.

- (2) The head of each central administrative agency shall, whenever he/she establishes or revises the central action plan, report it to the Presidential Committee on Green Growth under Article 14, as prescribed by Presidential Decree: Provided, That the foregoing shall not apply to modifications to minor matters prescribed by Presidential Decree.

#### Article 11 (Establishment and Implementation of Action Plans by Local Governments)

- (1) The Special Metropolitan City Mayor, each Metropolitan City Mayor, each Do Governor, and the Governor of a Special Self-Governing Province (hereinafter referred to as "Mayor/Do Governor") shall establish and implement a local action plan for green growth (hereinafter referred to as "local action plan") in conformity with the national strategy for green growth, as prescribed by Presidential Decree, so as to facilitate each local government's low carbon, green growth.
- (2) Each Mayor/Do Governor shall, whenever he/she intends to establish or revise the local action plan, report a proposed bill to the local council after bringing it to the local committee on green growth under Article 20 for deliberation, and then submit it to the Presidential Committee on Green Growth under Article 14 without delay: Provided, That the foregoing shall not apply to modifications to minor matters prescribed by Presidential Decree.

#### Article 12 (Review and Evaluation of Current Status of Performance)

- (1) The Prime Minister shall review and evaluate the performance of the national strategy for green growth and central action plans, as prescribed by Presidential Decree. In such cases, the Prime Minister shall consult with the Presidential Committee on Green Growth under Article 14 about the procedures and standards for, and results of, the evaluation and other relevant matters.
- (2) Each Mayor/Do Governor shall review and evaluate the performance of local action plans, report the results thereof to the local council, and submit them to the Presidential Committee on Green Growth under Article 14 without delay, as prescribed by Presidential Decree.

#### Article 13 (Presentation of Opinions on Policies)

- (1) The Presidential Committee on Green Growth

under Article 14 may, if considered necessary as the result of a review and evaluation of performance under Article 12, present its opinion to the head of an appropriate central administrative agency or a Mayor/Do Governor.

- (2) The head of each appropriate central administrative agency or a Mayor/Do Governor shall, upon receiving an opinion pursuant to paragraph (1), endeavor to reflect the opinion in policies of the agency or the local government.

### CHAPTER III

#### PRESIDENTIAL COMMITTEE ON GREEN GROWTH, ETC.

##### Article 14 (Composition and Operation of Presidential Committee on Green Growth)

- (1) The Presidential Committee on Green Growth (hereinafter referred to as the "Committee") shall be instituted under the control of the President in order to have the Committee deliberate on the State's major policies and plans related to low carbon, green growth and matters concerning the performance of such policies and plans.
- (2) The Committee shall be comprised of not more than 50 members, including two Chairpersons.
- (3) The Prime Minister shall serve as one of Chairpersons of the Committee, and the other Chairperson shall be appointed by President from among the members under paragraph (4) 2.
- (4) Other members of the Committee shall be either specified or commissioned from among the following persons:
  1. Public officials specified by Presidential Decree, such as the Minister of Strategy and Finance, the Minister of Knowledge Economy, the Minister of Environment, and the Minister of Land, Transport and Maritime Affairs;
  2. Persons commissioned by the President from among those who have abundant knowledge and experience in low carbon, green growth, such as climate change, energy and resources, green technology, green industries, or sustainable development.
- (5) The Committee shall have one secretary to assign him/her to carry out administrative affairs of the Committee, and matters concerning the appointment of the secretary shall be prescribed by Presidential Decree.
- (6) Each Chairperson shall represent the Committee, respectively, and shall have overall control over affairs of the Committee.
- (7) If any Chairperson is unable to perform his/her duties due to any extraordinary circumstance or event, the member designated in advance by the Prime Minister, as one of Chairpersons, shall act for and on behalf of the Chairperson.
- (8) The term of office for each member under paragraph (4) 2 shall be one year but may be renewed consecutively.

##### Article 15 (Committee's Functions)

The Committee shall deliberate on the following matters:

1. Matters concerning the basic direction for policies on low carbon, green growth;
2. Matters concerning the establishment, revision, and enforcement of the national strategy for green growth;
3. Matters concerning the basic plan for coping with climate change, the basic plan for energy, and the basic plan for sustainable development;
4. Matters concerning the management of targets of promotion of low carbon, green growth and the review, survey on the actual state, and evaluation thereof;
5. Matters concerning the adjustment of, and the support for, policies of appropriate central administrative agencies and local government with respect to low carbon, green growth;
6. Matters concerning the legal system related to low carbon, green growth;
7. Matters concerning the direction of distribution of resources for low carbon, green growth and the efficient use of such resources;
8. Matters concerning international negotiations and cooperation, education and public relations activities, training of human resources, and the establishment of the foundation for low carbon, green growth;
9. The survey on, and the resolution of, problems that enterprises and other sectors have in relation to low carbon, green growth, and recommendation of corrective measures for, or expression of opinions on, such problems;
10. Matters that any other Act requires to be brought before the Committee for deliberation;
11. Other matters that Chairpersons consider necessary in connection with low carbon, green growth.

##### Article 16 (Meetings)

- (1) Each Chairperson shall convene meetings of the Committee and shall take the chair of such meetings.
- (2) Meetings of the Committee shall be divided into regular meetings and extraordinary meetings, and an extraordinary meeting shall be convened by a Chairperson, when the Chairperson deems it necessary or when five or more members demands to convene the meeting.
- (3) A meeting of the Committee shall be duly consti-

tuted to open with the attendance of a majority of members and shall adopt a resolution by an affirmative vote of a majority of members present at the meeting. Provided, That the Committee may deliberate on and adopt a resolution in writing on any case specified by Presidential Decree.

- (4) Matters necessary for the operation of the Committee, such as the time to hold a regular meeting, shall be prescribed by Presidential Decree in addition to provisions of paragraphs (1) through (3).

##### Article 17 (Subcommittees)

- (1) The Committee may have subcommittees, as prescribed by Presidential Decree, in order to have the subcommittees carry out affairs of the Committee, assist the Committee, and examine, coordinate, or process affairs delegated by the Committee.
- (2) A subcommittee shall be comprised of commissioned members, and the chairperson of a subcommittee shall be elected by and from among members of the subcommittee.
- (3) Any public official of a central administrative agency, who is a member of the Senior Civil Service, may attend an appropriate subcommittee to present his/her opinion on any item of agenda regarding the relevant area.
- (4) Matters necessary for the operation of subcommittees shall be determined by Chairpersons of the Committee, subject to the resolution of the Committee, in addition to provisions of paragraphs (1) through (3).

##### Article 18 (Green Growth Task Force<sup>48</sup> Ministry of Government Legislation Korean Laws on Green Growth)

- (1) The Committee shall have the Green Growth Task Force (hereinafter referred to as the "Task Force") to have the Task Force assist subcommittees in the operation and business affairs of subcommittees.
- (2) Matters necessary for the composition and operation of the Task Force shall be prescribed by Presidential Decree.

##### Article 19 (Request for Dispatching Public Officials)

The Committee may, if necessary for the operation of the Committee or the Task Force's execution of tasks, request any central administrative agency or local gov-

ernment to dispatch public officials under its control or authorize public officials under its control to hold a concurrent office or request a non-governmental organization, organization, research institute, or enterprise to dispatch executives or employees or authorize its executives or employees to hold a concurrent office.

#### Article 20 (Composition and Operation of Local Committees on Green Growth)

- (1) Each local government may have a local committee on green growth (hereinafter referred to as “local committee on green growth”) under the control of the Mayor/Do Governor to have it deliberate on matters concerning its major policies and plans related to low carbon, green growth and the performance thereof.
- (2) Matters necessary for the composition, operation, and functions of a local committee on green growth and other relevant matters shall be prescribed by Presidential Decree.

#### Article 21 (Designation of Green Growth Officer<sup>49</sup> Framework Act on Low Carbon, Green Growth)

The head of each central administrative agency or each Mayor/Do Governor may designate a Green Growth Officer from among public officials under his/her control for the efficient promotion of low carbon, green growth.

### CHAPTER IV

#### PROMOTION OF LOW CARBON, GREEN GROWTH

##### Article 22 (Basic Principles for Materialization of Green Economy and Green Industries)

- (1) The Government shall strengthen the national economy and materialize the economy pursuing sustainable development (hereinafter referred to as “green economy”) by reducing the use of fossil fuels step by step and fostering green technology and green industries.
- (2) The Government shall, whenever it establishes and enforces a policy on green economy, give balanced consideration to various areas, such as finance, industries, science and technology, environment, national land, and culture, from a cohesive point of view.
- (3) The Government shall endeavor to enable the industrial structure of large consumption of energy and resources to be converted into the low carbon, green industrial structure step by step through creation of new green industries, conversion of existing industries into green industries, and connection between related industries.
- (4) The Government shall seek for balanced development between regions in promoting low carbon, green growth and shall provide low-income groups with support and care to protect them from being neglected.

##### Article 23 (Fostering of and Support for Green Economy and Green Industries)

- (1) The Government shall enhance the soundness and competitiveness of the national economy by materializing green economy, search for and foster new green industries with high growth potential, and prepare measures for fostering and supporting a green economy and green industries.
- (2) Measures for fostering and supporting a green economy and green industries under paragraph (1) shall include the following matters:
  1. Matters concerning domestic and overseas economic conditions, and prospects therefor;
  2. Matters concerning the gradual conversion of the conventional, industrial structure into a green industrial structure;
  3. Matters concerning targets for the medium- and long-term and for each phase for facilitating green industries and the strategy for the

facilitation;

4. Matters concerning the fostering of, and support for, green industries for new growth engines;
5. Matters concerning the conversion of existing, national infrastructure, including electric, information and telecommunications, and traffic systems, into an environmentally friendly structure;
6. Matters concerning the fostering of the industry of advisory services for green management;
7. Matters concerning the training of human resources for green industries and the creation of job opportunities;
8. Other matters concerning the facilitation of green economy and green industries.

##### Article 24 (Facilitation of Recycling of Resources)

- (1) The Government shall prepare various measures for fostering and supporting the resources recycling industry to save and use resources efficiently, to reduce the generation of wastes, to facilitate the recycling of resources, and to improve the productivity of resources.
- (2) Measures for fostering and supporting the resources recycling industry under paragraph (1) shall include the following matters:
  1. Establishment of targets of facilitating the recycling of resources and improving the productivity of resources;
  2. Supply and management of resources;
  3. Control of the use of substances hazardous or hard to re-manufacture or recycle;
  4. Control of the generation of wastes and conversion of wastes into resources through re-manufacturing or recycling;
  5. Collection and utilization of biomass, such as wood, plants, and agricultural produce, that may be used as resources for energy;
  6. Development of technology related to recycling of resources and fostering of the industry therefor;
  7. Matters concerning education, training, and fostering of human resources to improve the productivity of resources.

##### Article 25 (Facilitation of Enterprises’ Green Management)

- (1) The Government shall support and facilitate

enterprises’ green management.

- (2) The Government shall establish and enforce measures, including the following matters, to support and facilitate enterprises’ green management:
  1. Technical support for converting into an environmentally friendly production system;
  2. Disclosure of enterprises’ achievements in green management, including efficient use of energy and resources, reduced emission of greenhouse gases, development of forests, conservation of natural environment, and information about sustainable development;
  3. Support for green management of small and medium enterprises;
  4. Other matters concerning assistance in business activities for low carbon, green growth.

##### Article 26 (Facilitation of Research, Development, and Commercialization of Green Technology)

- (1) The Government may establish and enforce measures, including the following matters, to facilitate research, development, and commercialization of green technology:
  1. Collection, analysis, and furnishing of information related to green technology;
  2. Development and diffusion of techniques for evaluation of green technology;
  3. Financial support for the facilitation of research, development, and commercialization of green technology;
  4. Fostering of human resources for green technology and international cooperation therein.
- (2) The Government shall facilitate convergence of technology for information and communications, nanotechnology, and biotechnology and shall promote swift transformation into the low carbon, knowledge-based economy by securing intellectual property of green technology.
- (3) If any measure under paragraph (1) is to be included in the basic plan for science and technology under the Framework Act on Science and Technology, the Committee’s opinion shall be sought in advance.

##### Article 27 (Diffusion and Utilization of Technology for Information and Communications)

- (1) The Government shall establish and enforce the following measures for utilizing technology and services for information and communications to the maximum extent possible in order to save

energy, improve the efficiency in the use of energy, and reduce greenhouse gases:

1. Expansion of infrastructure for information and communications, such as networks for broadcasting and communications;
  2. Development and diffusion of new services for information and communications;
  3. Facilitation of the development of green technology for the industry of information and communications and the equipment and devices therefor.
- (2) The Government shall establish and implement measures for broadcasting and communications to proliferate the life style for low carbon, green growth, such as boosting of home-based working, virtual conference, remote education, and remote medical treatment.
- (3) The Government shall enable the provision of electricity services of high quality, optimize the efficiency in the use of energy, and reduce greenhouse gases drastically by developing intelligent electricity networks and upgrading such networks with technology for information and communications.

#### Article 28 (Support for and Boosting of Finance)

The Government shall establish and enforce financial measures, including the following matters, to facilitate low carbon, green growth:

1. Raising of financial resources for supporting green economy and green industries and financial support therefor;
2. Development of new financial products for supporting low carbon, green growth;
3. Encouragement of private investment in projects for the establishment of infrastructure for low carbon, green growth;
4. Reinforcement of the public disclosure system for information about enterprises' green management and expansion of financial support for enterprises adopting green management;
5. Establishment of a carbon market (referring to a market in which rights to emit greenhouse gases or results of performance of reducing or absorbing greenhouse gases are traded; the same shall apply hereinafter) and stimulation of transactions therein.

#### Article 29 (Establishment of and Support for Companies for Investment in Green Industries)

- (1) A green industries investment company (refer-

ring to a collective investment scheme defined in Article 9 (18) of the Financial Investment Services and Capital Markets Act; the same shall apply hereinafter) for the purpose of distributing earnings therefrom to investors may be established by investing its assets in green technology or green industries.

- (2) Green technology or green industries eligible for investment by a green industries investment company shall be the following projects or enterprises:
1. Projects of research and development or technical support for research on green technology under subparagraph 3 of Article 2 and production and commercialization of prototypes;
  2. Business that falls under the category of green industries under subparagraph 4 of Article 2;
  3. Enterprises that engage in investment in, or business for, green technology or green industries.
- (3) The Government may, if a public institution under Article 4 of the Act on the Management of Public Institutions intends to invest in a green industries investment company, provide all or some of the funds therefor within the extent of budget.
- (4) The Financial Services Commission may demand a green industries investment company in which a public institution has invested pursuant to paragraph (3) (including the asset management company, asset custodian company, and general administration company for the company; the same shall apply hereafter in this Article) to submit data or a report on the business and property of the company, and an appropriate central administrative agency may demand the Financial Services Commission to submit relevant data.
- (5) An appropriate central administrative agency may, if considered necessary to conduct an inspection on data or a report submitted pursuant to paragraph (4), request the Financial Services Commission to inspect the business and property of the relevant green industries investment company, and the Financial Services Commission may, if it finds as a result of such an inspection that the company has a serious problem, cancel the registration of the company, subject to consultation with the appropriate central administrative agency.
- (6) Matters concerning the establishment and operation of, and the financial support for, green industries investment companies under paragraphs (1)

through (5) and other necessary detailed matters shall be prescribed by Presidential Decree.

#### Article 30 (Operation of Taxation System)

The Government shall operate the State's taxation system in the direction of reducing goods and services that generate greenhouse gases and pollutants or that show low efficiency in the use of energy and resources and facilitating environmentally friendly goods and services instead in order to cope with crises of energy and resources and problems of climate change and to facilitate low carbon, green growth.

#### Article 31 (Support and Special Privileges for Green Technology and Green Industries)

- (1) The State or any local government may provide support as may be necessary for green technology and green industries, such as the payment of subsidies.
- (2) The Korea Credit Guarantee Fund, established pursuant to the Credit Guarantee Fund Act, and the Korea Technology Guarantee Fund, established pursuant to the Korea Technology Credit Guarantee Fund Act, may provide credit guarantees preferentially to green technology and green industries or preferentially treat green technology and green industries in terms and conditions of guarantee.
- (3) The State or any local government may support enterprises related to green technology and green industries by abating or exempting them from income tax, corporate tax, acquisition tax, property tax, registration tax, or other tax, as provided for by the Restriction of Special Taxation Act and the Local Tax Act.
- (4) The State or any local government shall endeavor to assist an enterprise related to green technology or green industries to the fullest extent possible, when the enterprise invites foreign investment under Article 2 (1) 4 of the Foreign Investment Promotion Act.

#### Article 32 (Standardization and Certification of Green Technology and Green Industries)

- (1) The Government provide support necessary for establishing a foundation for standardization of green technology and green industries already developed or under development within the Republic of Korea to meet international standards under subparagraph 2 of Article 3 of

the Framework Act on National Standards and for activities for international standardization of green technology and green industries.

- (2) The Government may grant certification of conformity for green technology, green projects, and green products or accreditation of specialized green enterprises, impose an obligation to purchase on public institutions, or provide technical guidance in order to facilitate the development of green technology and green industries.
- (3) The Government shall cancel the certification of conformity or the accreditation of a specialized green enterprise under paragraph (2) in any of the following cases:
1. If a person obtained the certification or accreditation by fraud or other wrongful means;
  2. If the certification or accreditation is considered improper due to a serious defect.
  - (4) Other necessary matters concerning the standardization, certification, and cancellation under paragraphs (1) through (3) shall be prescribed by Presidential Decree.

#### Article 33 (Support for Medium and Small Enterprises)

The Government may establish and enforce the following measures to facilitate green technology and green management of medium and small enterprises:

1. Preferential support for joint projects between large enterprises and medium and small enterprises;
2. Assistance in large enterprises' technical guidance, transfer of technology, and dispatch of technical human resources for medium and small enterprises;
3. Facilitation of commercialization of green technology of medium and small enterprises;
4. Use of public facilities for facilitating the development of green technology;
5. Training, supply, and overseas expansion of professional human resources for green technology and green industries;
6. Other matters for facilitating green technology and green management of medium and small enterprises.

#### Article 34 (Development of Clusters and Complexes for Green Technology and Green Industries)

- (1) The Government may develop clusters and com-



plexes for the joint research and development of green technology, the joint utilization of facilities and equipment, and the establishment of networks connecting industrial sectors, academic circles and research institutes or may support the development of such clusters and complexes.

- (2) When a project is promoted pursuant to paragraph (1), the following matters shall be taken into consideration:
  1. Matters concerning the current status of industrial clustering in each industrial complex;
  2. Matters concerning enhancing the ability of enterprises, universities, and research institutes to research and develop and the mutual connection of them;
  3. Matters concerning the expansion of infrastructure for industrial clustering and the inducement of outstanding human resources for green technology and green industries;
  4. A project promotion system and a plan for raising financial resources for green technology and green industries.
- (3) The Government may authorize an institution or organization specified by Presidential Decree to develop a cluster or complex for green technology or green industries.
- (4) The Government may fully or partially subsidize expenses incurred to an institution or organization under paragraph (3) in carrying out a project for developing a cluster or complex for green technology or green industries under the aforesaid paragraph.

#### Article 35 (Creation of Jobs for Green Technology and Green Industries)

- (1) The Government shall create and expand jobs for green technology and green industries so that every citizen can benefit from green growth.
- (2) The Government shall facilitate efficient mobility and conversion of manpower in each industrial sector in the course of creating jobs for green technology and green industries, expand opportunities for citizen to learn new technology, and provide financial and technical support for creating jobs for green technology and green industries.

#### Article 36 (Advanced Regulation)

- (1) When the Government intends to introduce regulation for using resources efficiently and reducing

the generation of greenhouse gases and pollutants, it shall endeavor to reduce social and economic expenses by inducing persons who cause the generation of greenhouse gases or pollutants to voluntarily reduce the generation of greenhouse gases and pollutants.

- (2) When the Government intends to introduce regulation for reducing the generation of greenhouse gases and pollutants, it shall establish an advanced regulation system to avoid duplicate regulation so as to avoid the frustration of autonomy and creativity of the private sector and enhance industrial competitiveness by conducting surveys on the actual state, in the Republic of Korea and abroad, of regulation on enterprises.

#### Article 37 (Countermeasures for International Norms)

- (1) The Government shall collect, survey, and analyze movements and information about systems and policies that any foreign government or international organization intends to establish or introduce, arrange related systems and policies reasonably, and establish a supportive system therefor, and prepare appropriate countermeasures.
- (2) The Government shall inform enterprises and citizens of movements, information, and countermeasures under paragraph (1) sufficiently for domestic enterprises and citizens to improve their ability to respond to changes.

### CHAPTER V

#### REALIZATION OF LOW CARBON SOCIETY

##### Article 38 (Basic Principles for Coping with Climate Change)

The Government shall establish and implement a policy for coping with climate change and related plans in accordance with the following principles in order to realize a low carbon society:

1. It shall recognize the seriousness of problems of climate change ensuing from global warming, cope with such problems comprehensively by putting together capacities of the State and citizens, and participate in global efforts actively;
2. It shall establish the State's medium- and long-term targets for the reduction of greenhouse gases by analyzing costs of and benefits from the reduction of greenhouse gases in the economic aspect and taking domestic and overseas conditions into consideration and promote the reduction of greenhouse gases efficiently and systematically by introducing a cost-effective, reasonable regulation system based on pricing functions and market system;
3. It shall develop and utilize high technology and convergence technology, such as technology for information and communications, nanotechnology, biotechnology, to reduce greenhouse gases drastically;
4. It shall enable to adopt various means for reduction autonomously by clarifying rights and obligations in connection with the emission of greenhouse gases and allowing transactions of such rights and obligations in the market and shall be prepared for the international carbon market by boosting the domestic carbon market;
5. It shall be prepared against natural disasters on a large scale and changes in environmental ecosystem and the status of crops, minimize impacts of climate change, and protect the safety and property of citizens from such dangers and disaster.

##### Article 39 (Basic Principles of Policies on Energy)

The Government shall establish and implement policies on energy and plans related to energy in accordance with the following principles in order to promote low carbon, green growth:

1. It shall gradually reduce the use of fossil fuels, such as petroleum and coal, and improve the level

of self-sufficiency in energy;

2. It shall prevent global warming, conserve the environment, and convert the economic and social structures into the structures of low energy consumption and recycling of resources by rationalizing energy prices, saving energy, improving efficiency in the use of energy, and reinforcing the control over demands for energy;
3. It shall expand the development, production, use, and distribution of new and renewable energy, such as solar energy, energy from wastes, bioenergy, wind power, geothermal energy, tidal power, fuel batteries, and hydrogen energy, and shall diversify sources of energy;
4. It shall expand the introduction of elements of market competition to energy prices and energy industries, establish the order of fair trade, and introduce and improve regulation on energy industries reasonably, referring to international norms and foreign legal systems, to create a new market;
5. It shall expand benefits from the use of energy to the low-income groups, improve the equitableness in the use of energy, and expand welfare related to energy so that every citizen can benefit from low carbon, green growth equally;
6. It shall reinforce national security in energy by securing domestic and overseas resources of energy, diversifying imports of energy, storing energy, and thus supplying energy stably.

##### Article 40 (Basic Plan for Coping with Climate Change)

- (1) The Government shall establish and implement a basic plan every five years for coping with climate change for a planning period of 20 years in accordance with the basic principles for coping with climate change.
- (2) The Government shall, whenever it intends to establish or amend the basic plan for coping with climate change, bring a proposed plan to the Committee and then to the State Council for deliberation: Provided, That the foregoing shall not apply to modifications to insignificant matters prescribed by Presidential Decree.
- (3) The basic plan for coping with climate change shall include the following matters:
  1. Tendency and forecast of domestic and overseas climate changes and changes in concentration of greenhouse gases in the atmo-



- sphere;
2. Current status and outlook of the emission and absorption of greenhouse gases;
  3. Establishment of medium- and long-term targets for the reduction of emission of greenhouse gases and countermeasures for each area by phase;
  4. Matters concerning international cooperation in coping with climate change;
  5. Matters concerning cooperation between the State and local governments in coping with climate change;
  6. Matters concerning research and development for coping with climate change;
  7. Matters concerning training of human resources for coping with climate change;
  8. Matters concerning measures for adaptation, such as monitoring, forecasts, and evaluation of impacts of climate change, evaluation of weakness therefor, and prevention of disasters;
  9. Matters concerning education and public relations activities for coping with climate change;
  10. Other matters necessary for promoting measures for coping with climate change.

#### Article 41 (Establishment of Basic Plans for Energy)

- (1) The Government shall establish a basic plan for energy every five years (hereafter referred to as “basic energy plan” in this Article) for a planning period of 20 years in accordance with basic principles for policies on energy.
- (2) The Government shall, whenever it intends to establish or amend a basic energy plan, present a proposed plan to the Energy Committee under Article 9 of the Energy Act and then to the Committee and the State Council consecutively for deliberation: Provided, That the foregoing shall not apply to modifications to minor matters prescribed by Presidential Decree.
- (3) A basic energy plan shall including the following matters:
  1. Matters concerning trends and prospects of domestic and overseas demand and supply of energy;
  2. Matters concerning measures for stable securing, import, supply, and management of energy;
  3. Matters concerning the targets of demand for

- energy, the composition of energy sources, the saving of energy, and the improvement of efficiency in the use of energy;
4. Matters concerning the supply and use of environmentally friendly energy, such as new and renewable energy;
5. Matters concerning measures for the safety control of energy;
6. Matters concerning the development and diffusion of technology related to energy, the training of professional human resources, international cooperation, the development and use of natural resources of energy, and welfare in energy.

#### Article 42 (Coping with Climate Change and Management of Targets for Energy)

- (1) The Government shall establish medium- and long-term targets and the goals attached to each particular phase for the following matters and seek for measures necessary for accomplishing the targets in order to cope with the global reduction of greenhouse gases actively and to promote low carbon, green growth efficiently and systematically:
  1. Targets for the reduction of greenhouse gases;
  2. Targets for energy saving and targets for efficiency in the use of energy;
  3. Targets for self-sufficiency in energy;
  4. Targets for the supply of new and renewable energy.
- (2) The Government shall, when it establishes targets under paragraph (1), take into consideration domestic conditions and movements in other countries.
- (3) The Government may require appropriate central administrative agencies, local governments, and public institutions specified by Presidential Decree to establish targets for energy saving and targets for the reduction of greenhouse gases for each agency, local government or institution, and provide guidance and supervise over their performance, as prescribed by Presidential Decree (1).
- (4) The Government shall establish targets for each sector, such as industries, traffic, transportation, household, and commerce, and shall actively prepare measures necessary for accomplishing such targets in order to accomplish targets under paragraph (1) 1 and 2.
- (5) The Government shall establish and manage tar-

gets for each entity that emits greenhouse gases, and each entity that consumes energy, in the standard quantity specified by Presidential Decree or more (hereinafter referred to as “controlled entity”) in a measurable, reportable, and verifiable manner in order to accomplish targets under paragraph (1) 1 and 2. In such cases, the Government shall consult with controlled entities in advance and shall take into consideration the past record of emission of greenhouse gases or the use of energy, technical levels, international competitiveness, and national targets.

- (6) Each controlled entity shall observe targets under paragraph (5) and shall report its performance to the Government, as prescribed by Presidential Decree.
- (7) The Government shall keep records of the register of the performance reported pursuant to paragraph (6) and manage the register systematically.
- (8) The Government may, if a controlled entity’s performance fails to meet targets under paragraph (5), order the entity to make improvements as may be necessary for accomplishing the targets. In such cases, the controlled entity shall prepare a performance plan in compliance with the order for improvements and carry out the plan earnestly.
- (9) Each controlled entity shall prepare a report on its performance under paragraph (8) in a measurable, reportable, and verifiable manner, receive verification thereon from a reliable, independent, specialized institution specified by Presidential Decree, submit the report to the Government, and disclose it to the public.
- (10) The Government may, if necessary, provide controlled entities with support in finance, taxation, business management, and technology, conduct surveys on and examine their actual conditions, and furnish them with data and information so that controlled entities can accomplish targets under paragraph (5) and carry out a performance plan under paragraph (8) without fail.
- (11) Matters necessary for the management of the register and the support for controlled entities shall be prescribed by Presidential Decree in addition to the provisions of paragraphs (5) through (9).

#### Article 43 (Facilitation of Earlier Action for Reduction of Greenhouse Gases)

- (1) The Government shall recognize the results of the performance voluntarily made by a controlled

entity before it becomes subject to the control of targets under paragraph (5) as a result of the performance of the targets subject to control, or allow such an entity to trade the results of such performance, or encourage controlled entities otherwise to take action for voluntarily reducing greenhouse gases in advance.

- (2) Matters necessary for the method of, and the procedures for, trading the results of performance under paragraph (1) shall be prescribed by Presidential Decree.

#### Article 44 (Reporting on Quantity of Greenhouse Gases Emitted and Quantity of Energy Consumed)

- (1) Each controlled entity shall prepare a statement of the quantity of greenhouse gases emitted and the quantity of energy consumed in each place of business in a measurable, reportable, and verifiable manner and report it to the Government every year.
- (2) Each controlled entity shall, when it makes a report under paragraph (1), receive verification on the reliability of the statement from a reliable, independent, specialized institution specified by Presidential Decree. In such cases, the Government may issue an order to correct or supplement any defect or omission, if any, in the statement.
- (3) The Government shall manage the statements systematically and may disclose essential information included in the statements of each controlled entity: Provided, That a controlled entity may request the Government to keep the information confidential, if it has any extraordinary reason to believe that such disclosure may significantly infringe on its rights or trade secret.
- (4) The Government shall, upon receiving a request from a controlled entity to keep information confidential pursuant to the proviso to paragraph (3), organize an examination committee and shall notify the entity of the results thereof within 30 days.
- (5) The contents of each statement, the methods of reporting, management, and disclosure, and matters necessary for the organization and operation of the examination committee shall be prescribed by Presidential Decree.

#### Article 45 (Establishment of Integrated Information Management System for Greenhouse Gases)

- (1) The Government shall establish an integrated information management system for greenhouse

gases with which it shall develop, verify, and manage the State's quantity of green house gases emitted and absorbed, the emission and absorption factors, and various information and statistics related to greenhouse gases.

- (2) The head of each appropriate central administrative agency shall prepare and provide information and statistics about matters under his/her jurisdiction, such as energy, industrial process, agriculture, wastes, and forestry, and give active cooperation so that the integrated information management system under paragraph (1) can be operated smoothly.
- (3) The Government shall, when it prepares and manages various information and statistics and establish the integrated information management system pursuant to paragraph (1), reflect international standards therein to the fullest extent possible to improve expertise, transparency, and reliability.
- (4) The Government shall analyze and verify various information and statistics under paragraph (1) and announce the results thereof to the public every year.
- (5) The detailed method of management of information and statistics and the institution responsible for management shall be prescribed by Presidential Decree in addition to the provisions of paragraphs (1) through (4).

#### Article 46 (Introduction of Cap and Trade System)

- (1) The Government may operate a system for trading emissions of greenhouse gases by utilizing market functions in order to accomplish the State's target of reduction of greenhouse gases.
- (2) The system under paragraph (1) shall include a system for setting a cap on emission of greenhouse gases and for trading emissions and other internationally recognized trading system.
- (3) The Government shall, when it implements the systems under paragraph (2), consider international negotiations related to climate change and may take necessary measures in relation to controlled entities under Article 42 (5), if international competitiveness is likely to be degraded significantly.
- (4) The method of allocation of the allowable quantity of emission, the methods of registration and management, and the establishment and operation of an exchange for implementing the system under

paragraph (2) shall be provided by another Act separately.

#### Article 47 (Management of Greenhouse Gases in Traffic Sector)

- (1) Any person who intends to manufacture means of transportation, such as automobiles, shall prepare a scheme for reducing greenhouse gases emitted from such transportation means and shall actively endeavor to conform with the international competition system for reducing greenhouse gases.
- (2) The Government shall establish standards for the efficiency of average energy consumption of automobiles and standards for allowable emission of greenhouse gases from automobiles respectively to promote energy saving by improving average energy consumption efficiency of automobiles and to maintain a pleasant and appropriate atmospheric environment by reducing greenhouse gases in exhaust gases from automobiles, but shall allow auto makers (including importers) to choose one of such standards to avoid double regulation and shall ensure that measuring methods do not overlap.
- (3) The Government may take measures for improving financial support for persons who purchase an automobile emitting less greenhouse gases, while imposing a charge on persons who purchase automobiles emitting more greenhouse gases
- (4) The Government may seek for schemes for financial and taxation support, research and development, and improvement of related systems to facilitate the manufacturing and distribution of low-carbon, high-efficiency transportation means, such as hybrid vehicles and fuel cell electric vehicles.

#### Article 48 (Assessment of Impacts of Climate Change and Implementation of Measures for Adaptation)

- (1) The Government shall improve the ability to observe, forecast, provide information on, and utilize weather phenomena; analyze and assess potentials continuously to secure new and renewable energy sources, such as solar power, wind power, and tidal power, for each area and for each region; and establish and operate meteorological information management system for such purposes.
- (2) The Government shall implement measures for survey and research, the development of technology, the support for related specialized institu-

tions, and the establishment of domestic and overseas cooperative system to improve the accuracy of monitoring and forecast of climate change and to research and analyze the status of changes in biomass and water resources as well as impacts of climate change, such as impacts on citizens' health.

- (3) The Government shall research and assess impacts of climate change on ecosystem, biodiversity, atmosphere, water resources, water quality, public health, agricultural produce, fishery products, foodstuffs, forest, oceans, industries, and prevention of disasters and weakness therein and shall announce results therefrom to the public.
- (4) The Government shall exert itself preferentially for preventive management to reduce damage that may be caused by climate change and shall establish and implement countermeasures for mitigating impacts of climate change or for coping with health and natural disasters, as prescribed by Presidential Decree.
- (5) The Government may provide citizens and business entities, who conduct activities in response to measures for adaptation, with technical and financial support as may be necessary.

#### CHAPTER VI

#### REALIZATION OF GREEN LIFE AND SUSTAINABLE DEVELOPMENT

#### Article 49 (Basic Principles for Green Life and Sustainable Development)

The State's measures for realizing green life and sustainable development shall be implemented in accordance with the following basic principles:

1. It shall be realized that our homeland is the base for green growth and the exhibition place of results thereof, and thus, efforts shall be made to harmonize the development of our homeland with conservation and management so that the present and future generations can enjoy a comfortable life;
2. National land, the urban space structure and buildings, and traffic systems shall be reorganized into the structure of low carbon, green growth, and circumstances in which manufacturers and consumers can produce and purchase green products voluntarily and actively;
3. The State, local governments, enterprises, and citizens shall perform international agreements related to sustainable development in good faith, and shall endeavor to practice green life in citizens' daily lives, and settle green culture throughout the society;
4. The State, local governments, and enterprises shall facilitate environmental conservation by developing and reorganizing systems for land use and production so as to protect the ecological base, which serves as the foundation for economic development.

#### Article 50 (Establishment and Implementation of Basic Plans for Sustainable Development)

- (1) The Government shall perform international agreements related to sustainable development, such as Agenda 21 adopted at the United Nations Conference on Environment and Development, held in Brazil in 1992, and the plan of implementation adopted at the World Summit on Sustainable Development, held in the Republic of South Africa in 2002, in good faith and shall establish and implement a basic plan every five years for sustainable development for a planning period of 20 years to facilitate the State's sustainable development.

- (2) The Government shall, whenever it intends to establish or revise the basic plan for sustainable development, bring a proposed plan to the Commission on Sustainable Development under Article 15 of the Sustainable Development Act for deliberation and then to the Committee and the State Council consecutively for deliberation: Provided, That the foregoing shall not apply to modifications to minor matters prescribed in Presidential Decree.
- (3) The basic plan for sustainable development shall include the following matters:
1. Matters concerning the current status of sustainable development, changes in circumstances, and prospects thereof;
  2. Matters concerning the vision and goals of sustainable development, the strategy and principles for promotion, the direction of the basic policy, and major indexes for sustainable development;
  3. Matters concerning the performance of international agreements related to sustainable development;
  4. Other matters necessary for sustainable development.
- (4) The head of each central administrative agency shall establish and implement a central basic plan for sustainable development for matters under his/her jurisdiction, which shall be included in the central action plan, in conformity with the basic plan for sustainable development under paragraph (1).
- (5) Each Mayor/Do Governor shall establish and implement a regional basic plan for sustainable development, which shall be included in the local action plan, in conformity with the basic plan for sustainable development under paragraph (1), taking into consideration local characteristics and conditions of the local government.

#### Article 51 (Management of Green Homeland)

- (1) The Government shall establish and implement plans specified by Presidential Decree, such as the comprehensive national land plan, and the basic urban plan, etc. in accordance with the basic principles for green life under Article 49 and sustainable development in order to develop the homeland so as to bring its healthy and comfortable environment and beautiful landscape in harmony with economic growth and social development

(hereinafter referred to as "green homeland").

- (2) The Government shall prepare measures, including the following matters, in order to create a green homeland:
1. Development of carbon-neutral cities self-sufficient in energy and resources;
  2. Expansion of forests and greenbelts and conservation of greater-regional ecological axes;
  3. Environment-friendly development, use, and conservation of oceans;
  4. Construction of low-carbon ports and harbors and conversion of existing ports and harbors into low-carbon ports and harbors;
  5. Expansion of environment-friendly traffic systems;
  6. Mitigation of damage to the homeland by natural disasters;
  7. Other matters concerning creation of green homeland.
- (3) The Government shall, whenever it establishes a plan specified by Presidential Decree, such as the comprehensive national land plan under the Framework Act on the National Land and the balanced national development plan under the Special Act on Balanced National Development, hear opinions, of the Committee in advance.

#### Article 52 (Water Management for Coping with Climate Change)

The Government shall establish and implement measures, including the following matters, in order to cope efficiently with natural disasters, such as drought caused by climate change, water stress, deterioration of water quality, and changes in the aquatic ecosystem and to ensure that every citizen can benefit from water equally:

1. Supply of clean and safe potable water and securing of stable water resources in preparation for drought, etc.
2. Conservation and management of the aquatic ecosystem and improvement of water quality;
3. Control of demand, including water saving, rearrangement of the cycling system of water, such as the use of rainwater and the reuse of sewage, and prevention of flood disasters;
4. Environment-friendly conservation and restoration of rivers;
5. Development of technology for prevention and treatment of water pollution and providing related services.

#### Article 53 (Establishment of Low-Carbon Traffic Systems)

- (1) The Government shall set and manage goals, etc. for the reduction of greenhouse gases, as prescribed by Presidential Decree, in order to develop the environment for reducing greenhouse gases in the traffic sector and to manage emission of greenhouse gases and energy efficiently.
- (2) The Government shall set and manage medium- and long-term and phased goals for the share of public transportation and the share of railroad transportation in order to establish low-carbon traffic systems minimizing energy consumption and emission of greenhouse gases.
- (3) The Government shall expand investment in railroads continuously so that railroads can serve as the basis of main national transportation networks, expand means of public transportation, such as buses, subways, light rail transit systems, etc. and encourage the use of bicycles and coastal navigation.
- (4) The Government shall prepare measures for the management of demand for transportation, including the following matters, in order to minimize greenhouse gases and air pollution, to reduce social costs incurred by traffic congestion drastically, and to solve traffic congestion in big cities, the Seoul Metropolitan Area, etc. thoroughly:
  1. Improvement of the systems of traffic congestion charges and traffic inducement charges;
  2. Expansion of exclusive lanes for buses and low-pollution vehicles and no-entry zones for passenger cars;
  3. Expansion and establishment of intelligent traffic information systems that can disperse traffic efficiently.

#### Article 54 (Expansion of Green Buildings)

- (1) The Government shall establish and implement policies, such as a grading system for green buildings and other systems, in order to expand buildings with high efficiency in the use of energy, a high ratio of new and renewable energy, and minimum emission of greenhouse gases (hereinafter referred to as "green buildings").
- (2) The Government shall set and manage medium- and long-term and periodic goals for buildings that meet or excel the standards prescribed by Presidential Decree in order to reduce the consumption of energy and the emission of green-

house gases in buildings.

- (3) The Government shall prepare and implement measures and standards for each stage of design, construction, maintenance, dismantling, etc., such as enhancing design standards and the procedures for permits and reviews, in order to minimize consumption of energy and resources and reduce emission of greenhouse gases in the entire process of design, construction, maintenance dismantling, etc. of buildings.
- (4) The Government shall implement energy inspections, energy saving programs under Article 25 of the Energy Use Rationalization Act, and activities for reducing greenhouse gases through such programs so that existing buildings can be converted into green buildings.
- (5) The Government may require the installation and management of intelligent meters for controlling and reducing consumption of energy such as power consumption, etc. in newly constructed or renovated buildings.
- (6) The Government shall apply the measures under paragraphs (1) through (5) to buildings of central administrative agencies, local governments, public institutions, educational institutions, etc. specified by Presidential Decree so that they can play the role of leaders toward green buildings and shall inspect and control their implementation.
- (7) The Government shall endeavor to increase or supply green buildings when developing a new city or re-developing cities on a scale not smaller than that prescribed by Presidential Decree.
- (8) The Government may, if necessary for expanding green buildings, provide support, such as financial support, tax abatement or exemption, and other measures as prescribed by Presidential Decree.

#### Article 55 (Promotion of Environment-Friendly Agriculture and Fisheries and Expansion of Carbon Sinks)

- (1) The Government shall develop agricultural technology for saving energy and producing bioenergy, minimize the use of chemical fertilizers, materials, and agro chemicals to the greatest extent by developing production technology of environment-friendly agricultural products which accommodate climate change and expand the production, distribution, and consumption of environmentally friendly and organic agricultural produce, fishery products, and wooden products.

- (2) The Government shall increase carbon sinks by preserving and developing farmland and developing sea groves (referring to communities of seaweeds, such as *Gelidium amansii*, to be developed in seawater to absorb greenhouse gases in the atmosphere).
- (3) The Government shall expand carbon sinks substantially through conservation and development of forests and facilitate the utilization of biomass in forests.
- (4) The Government shall establish and implement measures that can raise self-sufficiency in food through the improvement of new varieties that can cope with climate change positively.

#### Article 56 (Facilitation, etc. of Eco-Tourism)

The Government shall facilitate eco-tourism by preserving, restoring, and using habitats of flora and fauna, ecologically outstanding natural environmental assets, and unique cultural assets in each locality harmoniously as resources for tourism to boost the regional economy and shall ensure that every citizen can utilize such resources as places for experience and education of ecosystem.

#### Article 57 (Spread, etc. of Culture in Production and Consumption for Green Growth)

- (1) The Government shall establish and implement appropriate measures for saving and utilizing energy and resources efficiently and reducing greenhouse gases and pollutants throughout the entire process of production, consumption, transportation, and disposal of goods (hereinafter referred to as “production, etc.”).
- (2) The Government shall ensure that the consumption of energy, the emission of carbon, etc. can be reasonably linked to and reflected in the price of goods and services and that accurate information thereon shall be disclosed and communicated to consumers.
- (3) The Government may establish and operate an information management system with which the consumption of energy and resources and emission of greenhouse gases and pollutants in the entire process of production, etc. of goods can be analyzed and evaluated and the results thereof can be stored and used.
- (4) In order to facilitate and expand the use and consumption of green products, the Government may establish and implement measures to require

manufacturers, distributors, etc. of goods to indicate and disclose information or grade on the quantity of greenhouse gases and pollutants generated in the course of production, etc. of such goods so that consumers can easily recognize such information.

#### Article 58 (Facilitation of Green Life Campaigns)

- (1) The Government shall prepare measures enabling citizens and enterprises to get used to green life, establish a cooperation system with local governments, enterprises, non-governmental organizations, and other organizations, intensify education and public relations activities therefor, and initiate nationwide green life campaigns.
- (2) The Government may provide relevant non-governmental organizations and other organizations with financial and administrative support necessary for developing green life campaigns as voluntary action movements driven by the private sector.

#### Article 59 (Education and Public Relations Activities for Practice of Green Life)

- (1) The Government shall ensure that industrial entities and citizens can participate voluntarily in policies and activities for low carbon, green growth and that they can practice green life culture in their daily lives by expanding education and public relations activities for low carbon, green growth.
- (2) The Government shall strengthen school education for low carbon, green growth by developing textbooks and teaching materials including curriculum books and training teaching staff so that citizens can get used to practice of green life from the early childhood and also strengthen educational courses integrated with and linked to general education programs, occupational education programs, basic lifelong education programs.
- (3) The Government strengthen education and public relations activities through mass media, including newspapers, broadcasting media, internet portal services, etc. so as to facilitate the settlement and spread of green life culture.
- (4) Public broadcasting media shall produce and broadcast programs related to climate change resulting from global warming and energy and shall also endeavor actively to boost public service advertisements.

### CHAPTER VII SUPPLEMENTARY PROVISIONS

#### Article 60 (Request for Submission of Data)

- (1) The Committee shall, if deemed necessary for performing its duties, request the head of a relevant central administrative agency, a local government, or a public institution to submit information or data on low carbon, green growth.
- (2) The head of a relevant agency, local government, or institution shall, upon receiving a request pursuant to paragraph (1), comply with such request, unless any justifiable reason exists to the contrary, such as matters requiring confidentiality for the purpose of national defense or national security.

#### Article 61 (Enhancement of International Cooperation)

- (1) The Government shall prepare various measures for promoting international cooperation and expansion in overseas markets through information exchange on low carbon, green growth with foreign and international organizations and through participation in technical cooperation, standardization, and joint surveys and research.
- (2) The State shall endeavor to provide developing countries with financial support, so that they can cope with climate change effectively and facilitate sustainable development, to earnestly perform its national responsibilities meeting the expectations of international society, and to heighten the State's diplomatic stature.
- (3) The Government shall exert itself to cope with climate change actively, strengthen international cooperation, and provide relevant information sufficiently so as to heighten the national stature and reputation in reliable national indexes for evaluation of countermeasures against climate change, which are announced by international organizations and related institutions.

#### Article 62 (Reporting to National Assembly)

- (1) The Government shall, when it establishes the national strategy for green growth pursuant to Article 9 (1), report it to the National Assembly without delay.
- (2) The head of each central administrative agency shall, when he/she establishes a central action plan, report it to the competent

Standing Committee (or the competent Special Committee) without delay and shall report results of performance thereof to the competent Standing Committee (or the competent Special Committee) by the end of February of the following year.

#### Article 63 (Preparation of National Reports)

- (1) The Government may prepare national reports, as stipulated in the United Nations Framework Convention on Climate Change.
- (2) The Government may, if necessary for preparing a national report pursuant to paragraph (1), request the head of relevant central administrative agency to submit data. In such cases, the head of a relevant central administrative agency shall comply with such request, unless any special reason exists to the contrary.
- (3) The Government shall, when it intends to submit a national report under paragraph (1) to the Conference of the Parties to the United Nations Framework Convention on Climate Change, undergo deliberation by the Committee.

#### Article 64 (Fines for Negligence)

- (1) A persons falling under the following paragraphs shall be punished by a fine for negligence not exceeding ten million won:
  1. A person who fails to make a report under Article 42 (6) or (9) or 44 (1) or who makes a false report;
  2. A person who fails to comply with an order of improvement under Article 42 (8);
  3. A person who fails to make a disclosure under Article 42 (9);
  4. A person who fails to comply with an order for correction or supplementation under Article 44 (2).
- (2) Fines for negligence under paragraph (1) shall be imposed and collected by the head of a relevant administrative agency, as prescribed by Presidential Decree.

**ADDENDA****Article 1 (Enforcement Date)**

This Act shall enter into force three months after the date of its promulgation. (Proviso Omitted.)

**Article 2 (Special Cases concerning Preparation of Statements)**

Notwithstanding Article 44, controlled entities shall prepare and report a statement on the quantity of greenhouse gases emitted and the quantity of energy consumed during the latest three years in the first year after this Act enters into force.

**Article 3 (Transitional Measures concerning National Strategy for Green Growth)**

The national strategy for green growth, which was established by the Green Growth Committee, installed pursuant to the former Presidential Directive No. 239, and which is in force, after undergoing deliberation by the State Council, at the time this Act enters into force, shall be deemed the national strategy for green growth under Article 9.

**Article 4 Omitted.**

## ENFORCEMENT DECREE OF THE FRAMEWORK ACT ON LOW CARBON, GREEN GROWTH

Presidential Decree No. 22124, Apr. 13, 2010

**CHAPTER I****GENERAL PROVISIONS****Article 1 (Purpose)**

The purpose of this Decree is to prescribe matters delegated pursuant to the Framework Act on Low Carbon, Green Growth and matters necessary for the enforcement thereof.

**Article 2 (Greenhouse Gases)**

Hydro fluoro carbons (HFCs) and perfluorocarbons (PFCs) set forth in subparagraph 9 of Article 2 of the Framework Act on Low Carbon, Green Growth (hereinafter referred to as the "ACT") are as specified in Table I annexed hereto.

**CHAPTER II****NATIONAL STRATEGY OF LOW CARBON, GREEN GROWTH****Article 3 (Modifications to National Strategy of Low Carbon, Green Growth)**

"A modification to any minor matter specified by Presidential Decree" in the proviso to Article 9 (3) of the Act means a modification to a matter that does not affect the essential elements of the national strategy of low carbon, green growth under paragraph (1) of the same Article (hereinafter referred to as the "national strategy"), such as a partial modification to the composition or details of practical tasks and detailed tasks, an annual implementation plan, or a matter regarding the main responsible agency or a related agency within the direction of the policies.

**Article 4 (Establishment of Five-Year Plans for National Strategy of Low Carbon, Green Growth)**

The Government may establish a five-year plan for the national strategy of low carbon, green growth (hereinafter referred to as "five-year plan") for each five-year period in order to implement the national strategy in an efficient and systematic manner. In such cases, the plan shall undergo deliberation by the Green Growth Committee under Article 14 of the Act (hereinafter referred to as the "Committee") and then by the State Council.

**Article 5 (Establishment of Central Implementation Plan)**

- (1) Pursuant to Article 10 (1) of the Act, the head of each central administrative agency shall establish an implementation plan for matters under his/her jurisdiction (hereinafter referred to as "central implementation plan"), including the following matters, for each five-year period, within three months from the date on which the national strat-



egy or a five-year plan is established or revised so as to implement the national strategy and the five-year plan:

1. Analysis on the current status related to the promotion of green growth in the areas under his/her jurisdiction, domestic and overseas trends, and the course and results of implementation;
  2. Matters concerning the vision for green growth, the direction of policies, and agenda in policies in the areas under his/her jurisdiction;
  3. Annual implementation plans for the areas under his/her jurisdiction;
  4. Other matters necessary for the implementation of the national strategy and the implementation of the five-year plan.
- (2) The Committee may prescribe appropriate guidelines and notify such guidelines to the head of each central administrative agency in order to assist them in efficiently establishing central implementation plans.

#### Article 6 (Reporting on Central Implementation Plans)

- (1) The head of each central administrative agency shall, whenever he/she establishes or revises a central implementation plan, report to the Committee thereon within two months pursuant to Article 10 (2) of the Act.
- (2) The Committee shall, upon receiving a report on a central implementation plan pursuant to paragraph (1), deliberate on the conformity of the five-year plan with the national strategy and may present its opinion thereon to the head of the appropriate central administrative agency.
- (3) The head of a central administrative agency shall, upon receiving an opinion pursuant to paragraph (2), reflect the opinion in the agency's central implementation plan and related policies, unless any exceptional circumstance exists otherwise.
- (4) "A modification to any minor matter specified by Presidential Decree" in the proviso to Article 10 (2) of the Act means a partial modification to agenda in policies within the direction of policies, which constitutes a matter that does not affect the essential elements of a central implementation plan.

#### Article 7 (Establishment of Regional Implementation Plans)

- (1) Pursuant to Article 11 (1) of the Act, the Special Metropolitan City Mayor, each Metropolitan City Mayor, each Do Governor, or the Governor of each Special Self-Governing Province (hereinafter referred to as "Mayor/Do Governor") shall establish a regional implementation plan for green growth (hereinafter referred to as "regional implementation plan"), including the following matters, for each five-year period within six months from the date on which the national strategy or a five-year plan is established or revised:
  1. Analysis on the current status related to the promotion of green growth in the Special Metropolitan City, each Metropolitan City or Do, or each Special Self-Governing Province (hereinafter referred to as "City/Do") and the course and results of implementation;
  2. Matters concerning the vision, the strategy, the direction of policies, and the agenda of policies, in which each local government's particulars are reflected, in connection with the national strategy, the five-year plan, and central implementation plans;
  3. Annual implementation plans;
  4. Future prospects and expected effects from the implementation of the regional implementation plan;
  5. The regional green growth implementation system linked to local governments within his/her jurisdiction;
  6. Other matters necessary for the local government's implementation of low carbon, green growth.
- (2) The Committee may prescribe appropriate guidelines and notify the guidelines to competent Mayors/Do Governors so as to assist them in establishing regional implementation plans efficiently.
- (3) Necessary matters concerning the method and procedure for the establishment of regional implementation plans and the procedure for implementation of the plans shall be prescribed by Municipal Ordinance, in addition to matters prescribed in paragraphs (1) and (2).
- (4) "A modification to any minor matter specified by Presidential Decree" in the proviso to Article 11 (2) of the Act means a partial modification to agenda in policies within the direction for policies,

which constitutes a matter that does not affect the essential elements of a central implementation plan.

#### Article 8 (Review and Evaluation of Current Status of Performance of National Strategy, etc.)

- (1) Pursuant to Article 12 (1) of the Act, the Prime Minister shall review and evaluate the performance of the national strategy and central implementation plans every year in compliance with the Framework Act on Public Service Evaluation.
- (2) The head of each appropriate central administrative agency shall reflect the results of the review and evaluation under paragraph (1) in establishing and revising the central implementation plan for the areas under his/her jurisdiction or in enforcing related policies.

#### Article 9 (Review and Evaluation of Current Status of Performance of Regional Implementation Plans)

- (1) Pursuant to Article 12 (2) of the Act, each Mayor/Do Governor shall review and evaluate the current status of performance of the relevant regional implementation plan every year.
- (2) Each Mayor/Do Governor shall reflect the results of the review and evaluation under paragraph (1) in establishing and revising the City/Do regional implementation plan or in enforcing related policies.
- (3) Necessary matters concerning the principles of the evaluation under paragraph (1), agencies subject to the evaluation, the procedure for the evaluation, and other relevant matters shall be prescribed by Municipal Ordinance.

### CHAPTER III

#### GREEN GROWTH COMMITTEE, ETC.

#### Article 10 (Composition and Operation of Green Growth Committee)

- (1) "Public officials specified by Presidential Decree, such as the Minister of Strategy and Finance, the Minister of Education, Science and Technology, the Minister of Knowledge Economy, the Minister of Environment, and the Minister of Land, Transport and Maritime Affairs" in Article 14 (4) 1 of the Act refers to the Minister of Strategy and Finance, the Minister of Education, Science and Technology, the Minister of Foreign Affairs and Trade, the Minister of Public Administration and Safety, the Minister of Culture, Sports and Tourism, the Minister for Food, Agriculture, Forestry and Fisheries, the Minister of Knowledge Economy, the Minister of Environment, the Minister of Gender Equality and Family, the Minister of Land, Transport and Maritime Affairs, the Chairperson of the Korea Communications Commission, the Chairperson of the Financial Services Commission, and the Minister of the Prime Minister's Office.
- (2) The Minister of the Prime Minister's Office shall serve as the secretary under Article 14 (5) of the Act.
- (3) The Committee Chairperson may, if considered necessary, require the head of a central administrative agency to attend a meeting of the Committee and present his/her opinion on an item of agenda within his/her jurisdiction or require an appropriate expert to appear before the Committee to hear his/her opinion.

#### Article 11 (Deliberation on Direction of Distribution of Financial Resources Related to Green Technology)

- (1) The Committee may, when it completes deliberation on matters concerning the direction of distribution, and the efficient use of, financial resources for research and development projects for green technology for low carbon, green growth pursuant to subparagraph 7 of Article 15 of the Act, present its opinion to the National Science and Technology Council under Article 9 of the Framework Act on Science and Technology.
- (2) The Committee may designate an appropriate

specialized institution to have the institution assist the Committee in the deliberation under paragraph (1).

#### Article 12 (Meetings)

- (1) In principle, the Committee shall hold regular meetings under Article 16 (2) of the Act on a half-yearly basis.
- (2) The Committee Chairperson shall, when he/she intends to convene a meeting, notify each committee member of the time schedule and agenda of the meeting not later than seven days before opening the meeting; Provided, That the foregoing shall not apply to an emergency case or any case in which an exceptional circumstance exists.
- (3) "Any case specified by Presidential Decree" in the proviso to Article 16 (3) of the Act means any of the following cases. In such cases, the Committee Chairperson shall prepare a written resolution and report to the next meeting of the Committee on the results thereof:
  1. Where there is insufficient time to hold a meeting due to urgency;
  2. Where it is difficult due to a natural disaster or any other unavoidable cause or event to achieve a quorum for the meeting by attendance of committee members or where the Committee Chairperson considers it exceptionally necessary.

#### Article 13 (Composition of Subcommittees)

- (1) Subcommittees installed within the Committee pursuant to Article 17 (1) of the Act and business affairs assigned to each subcommittee are as follows:
  1. Subcommittee for Green Growth and Industry: National strategy, finance, legal system, green technology, creation of jobs related to green growth, and training of human resources therefor;
  2. Subcommittee for Climate Change and Energy: The basic plan for coping with climate change and the basic energy plan under Articles 40 and 41 of the Act, the establishment of the Integrated Information Management System for Greenhouse Gases under Article 45 of the Act, and the system for trading greenhouse gas emissions under Article 46 of the Act;
  3. Subcommittee for Green Life and Sustainable

Development: The basic plan for sustainable development, proliferation of green life, green land, green buildings, establishment of low carbon traffic systems, and water management under Articles 50 through 54 of the Act;

- (2) The Committee Chairperson may, if necessary to carry out and support the Committee's business efficiently, establish a subcommittee taking charge of international negotiations, international cooperation, and processing of corporate grievances in addition to subcommittees under paragraph (1), after undergoing resolutions of the Committee.
- (3) Each subcommittee under paragraph (1) or (2) shall be comprised of not more than 15 commissioned members.

#### Article 14 (Green Growth Task Force)

The Green Growth Task Force under Article 18 of the Act (hereinafter referred to as the "Task Force") shall take charge of the following matters:

1. Matters concerning assistance in the operation of the Committee and subcommittees;
2. Preparation and examination of items of agenda that shall be brought to meetings of the Commission and subcommittees for deliberation;
3. Matters concerning assistance, consultation, and adjustment in the establishment of central and regional implementation plans;
4. Matters concerning assistance in surveys and research pertaining to low carbon, green growth and related projects;
5. Matters concerning cooperation with the Integrated Greenhouse Gases Information Center under Article 36 (hereinafter referred to as the "Center") in relation to the operation of the Committee and subcommittees;
6. Other matters designated by the Committee Chairperson to assist the Committee and subcommittees in the operation of their business.

#### Article 15 (Composition and Operation of Regional Green Growth Committee)

- (1) A regional Green Growth Committee under Article 20 of the Act shall be comprised of not more than 50 members, including two Committee Chairpersons.
- (2) The Administrative Deputy Mayor or Administrative Deputy Governor under Article 73 (2) of the Enforcement Decree of the Local

Autonomy Act (or the Administrative Deputy Mayor or Administrative Deputy Governor appointed by the competent Mayor/Do Governor in the case of a City/Do in which there are two or more Administrative Deputy Mayors or Administrative Deputy Governors) and a person appointed by the competent Mayor/Do Governor from among members under paragraph (3) 2 shall serve as Chairpersons of each regional Green Growth Committee.

- (3) Members of a regional Green Growth Committee shall consist of the following persons:
  1. Public officials appointed by the competent Mayor/Do Governor, among public officials of the City/Do in the rank of the head of an office or bureau;
  2. Persons commissioned by the competent Mayor/Do Governor, among persons who have ample knowledge and experience in low carbon, green growth, including climate change, energy and resources, green technology and green industry, and sustainable development.
- (4) Each regional Green Growth Committee shall deliberate on the following matters:
  1. Matters concerning the fundamental direction of low carbon, green growth of the local government;
  2. Matters concerning the establishment of and revision to the regional implementation plan;
  3. High-priority tasks and action plans for implementing the regional implementation plan;
  4. Other matters that the Chairperson of the regional Green Growth Committee considers necessary in connection with low carbon, green growth of the local government.
- (5) Matters necessary for the composition and operation of each regional Green Growth Committee shall be prescribed by Municipal Ordinance of each local government, in addition to matters prescribed in paragraphs (1) through (4).

## CHAPTER VI

### PROMOTION OF LOW CARBON, GREEN GROWTH

#### Article 16 (Establishment of Green Industry Investment Companies)

- (1) A company eligible for investment in green industry pursuant to Article 29 (1) of the Act shall be a collective investment scheme (referring to a collective investment scheme defined in Article 9 (18) of the Financial Investment Services and Capital Markets Act) that contributes or invests not less than 60/100 of the total contributions, total trust money, or capital in green technology or green industry under paragraph (2) of the aforesaid Article.
- (2) Technology or business related to green technology or green industry under Article 29 (2) 1 or 2 of the Act means the technology or business eligible for certification publicly notified pursuant to Article 19 (6) respectively.
- (3) An enterprise related to green technology or green industry under Article 29 (2) 3 of the Act shall be an enterprise whose sales from the transfer of green technology or green business under paragraph (2) or the manufacturing of related products amount to not less than 30/100 of total sales during the year immediately preceding the year in which an application for certification is filed.
- (4) The Financial Services Commission may, upon receiving an application for registration of a green industry investment company in which a public institution invests pursuant to Article 29 (3) of the Act, notify the head of the competent central administrative agency of details thereof and may consult with him/her as to what decision shall be made with regard to the registration.

#### Article 17 (Financial Support for and Operation of Green Industry Investment Companies)

- (1) The head of an appropriate central administrative agency may, when he/she grants a public institution a subsidy for contribution to a green industry investment company pursuant to Article 29 (3) of the Act, determine matters necessary for financial support, such as the scale, method, and terms and conditions of support, considering the feasibility of the business.
- (2) The head of an appropriate central administrative agency may, if it is found that a green indus-

try investment company in which a public institution has invested pursuant to Article 29 (3) of the Act fails to satisfy requirements under Article 16 (1) through (3) or has difficulties in continuing its business in a normal condition, require the public institution to abstain from making any additional investment, to recover investments, or to take other necessary measures.

- (3) A public institution to which the Government has granted a subsidy pursuant to Article 29 (3) of the Act shall segregate accounts for investments from the institution's own accounts and install separate accounts to account for revenue and expenditure related to such investments separately.

#### Article 18 (Standardization of Green Technology and Green Industry)

- (1) The Minister of Education, Science and Technology, the Minister of Culture, Sports and Tourism, the Minister for Food, Agriculture, Forestry and Fisheries, the Minister of Knowledge Economy, the Minister of Environment, the Minister of Land, Transport and Maritime Affairs, and the Chairperson of the Korea Communications Commission may each promote the following projects and provide support necessary for such projects so as to lay down a foundation for the standardization of green technology and green industry under jurisdiction of each of them pursuant to Article 32 (1) of the Act:
1. Projects for the establishment of foundations for standardization in compliance with international standards and the system for evaluation of conformity;
  2. Projects for the standardization of developed green technology;
  3. Projects for the standardization of green technology and green industry still in the process of research and development in the Republic of Korea;
  4. Projects for training professional human resources for laying down foundations for standardization;
  5. Other projects necessary for laying down foundations for standardization.
- (2) The Minister of Knowledge Economy shall take overall charge of affairs pertaining to the establishment of foundations for the standardization of green technology and green industry under paragraph (1) and may take measures necessary to fur-

nish citizens with necessary information in a swift manner.

#### Article 19 (Certification of Conformity of Green Technology and Green Projects and Accreditation of Specialized Green Enterprises)

- (1) Pursuant to Article 32 (2) of the Act, the head of each central administrative agency shall grant the certification of conformity and the accreditation of a specialized green enterprise (hereinafter referred to as "green certification") to any green technology and a green project (referring to a project that has great economic and technical effects, among economic activities related to green growth, such as the installation of facilities and infrastructure for green industries and the application, dissemination, and diffusion of green technology and green industries) under his/her jurisdiction.
- (2) Any person who intends to obtain green certification shall file an application for green certification with the head of the competent central administrative agency, and the head of the competent central administrative agency shall, upon receiving such an application, designate an institution to have it evaluate contents of the application (hereinafter referred to as "evaluating institution") for green certification.
- (3) Appropriate central administrative agencies shall jointly form a committee for deliberation on green certification (hereinafter referred to as the "Certification Committee") in order to have it confirm results of the evaluation of an evaluating institution and make a decision on whether to grant green certification.
- (4) The head of the competent central administrative agency shall entrust the Korea Institute for Advancement of Technology under Article 38 of the Industrial Technology Innovation Promotion Act with the receipt of applications for green certification under paragraph (2) and assistance to evaluating institutions in evaluations.
- (5) The head of the competent central administrative agency may require a person who files an application for green certification pursuant to paragraph (2) to bear expenses incurred in certification.
- (6) Matters necessary for green certification, including subject matters of green certification, the standards, procedure, and method for green certification, the designation of evaluating institu-

tions, and the composition and operation of the Certification Committee, in addition to matters prescribed in paragraphs (1) through (5), shall be jointly prescribed and notified to the public through the Official Gazette by the Minister of Strategy and Finance, the Minister of Education, Science and Technology, the Minister of Culture, Sports and Tourism, the Minister for Food, Agriculture, Forestry and Fisheries, the Minister of Knowledge Economy, the Minister of Environment, the Minister of Land, Transport and Maritime Affairs, and the Chairperson of the Korea Communications Commission.

#### Article 20 (Facilitation of Public Institutions' Purchases of Green Products)

- (1) The Administrator of the Public Procurement Service may designate and publicly notify items necessary to facilitate public institutions' purchases of green products pursuant to Article 32 (2) of the Act and prepare guidelines of procurement for such purchases.
- (2) The Administrator of the Public Procurement Service may purchase green products as substitute for products that the head of a public institution has requested to purchase or may reflect green products in plans and designs for a project that the head of a public institution has requested to place an order, subject to prior consultation with the head of the public institution.

#### Article 21 (Support for Green Technology and Green Management of Medium and Small Enterprises)

The Administrator of the Small and Medium Business Administration shall establish and implement annual promotion plans for the promotion of green technology and green management of medium and small enterprises pursuant to Article 33 of the Act.

#### Article 22 (Institutions Promoting Projects for Development of Clusters and Complexes for Green Technology and Green Industries)

"An institution or organization specified by Presidential Decree" in Article 34 (3) of the Act refers to any of the following institutions or organizations:

1. A project executor under Article 4 of the Act on Special Cases concerning Support of Technoparks;
2. The Korea Industrial Complex Corporation

under Article 45-3 of the Industrial Cluster Development and Factory Establishment Act;

3. A specific research institute under Article 2 of the Support of Specific Research Institutes Act or a joint management organization under Article 8 of the aforesaid Act;
4. A university, an industrial college, a junior college, or a technical college under the Higher Education Act;
5. A government-funded science and technology research institute under the Act on the Establishment, Operation and Fostering of Government-Funded Science and Technology Research Institutions;
6. The Korea Industrial Technology Association under the Technology Development Promotion Act and the Enforcement Decree of the aforesaid Act;
7. The Korea Environment Corporation under the Korea Environment Corporation Act;
8. The Korea Environmental Industry and Technology Institute under Article 5-2 of the Development of and Support for Environmental Technology Act;
9. The Korea Transportation Safety Authority under the Korea Transportation Safety Authority Act;
10. A project executor under Article 16 (1) 1 of the Industrial Sites and Development Act.

## CHAPTER V

## REALIZATION OF LOW CARBON SOCIETY

**Article 23 (Revision to Basic Plan for Coping with Climate Change)**

"A modification to any minor matter specified by Presidential Decree" in the proviso to Article 40 (2) of the Act means any of the following cases:

1. Where a matter related to Article 40 (3) 1 or 2 of the Act (limited to the current status of emission and absorption of greenhouse gases) is partially modified according to domestic or overseas circumstances;
2. Where part of the basic plan for coping with climate change is revised within the maximum of 10/100 of total financial resources required in connection with a matter that does not affect essential elements of the basic plan for coping with climate change, among the matters under Article 40 (3) 6, 7, and 9 of the Act.

**Article 24 (Revision to Basic Energy Plan)**

"A modification to any minor matter specified by Presidential Decree" in the proviso to Article 41 (2) of the Act means a case where part of the basic energy plan is revised within the maximum of 10/100 of total financial resources required in connection with a matter that does not affect essential elements of the basic energy plan, among the matters under the subparagraphs of paragraph (3) of the aforesaid Article.

**Article 25 (Establishment and Management of National Targets for Reduction of Greenhouse Gases)**

- (1) The target for the reduction of greenhouse gases under Article 42 (1) 1 of the Act shall be to reduce total nationwide emissions of greenhouse gases in 2020 to 30/100 of the estimated emissions of greenhouse gases in 2020.
- (2) The Committee shall, when it intends to deliberate on measures necessary for the establishment of detailed targets of reduction and the target for each sector under Article 42 (4) of the Act to achieve the target of the reduction of greenhouse gases under paragraph (1) and for the assistance in performance therefor, table the matters before the Council for Coordination of Economic Policies under Article 2 of the Regulation on the Council for Coordination of Economic Policies

for deliberation before the Committee deliberates thereon.

- (3) The Committee shall, when it deliberates on the basic direction of policies on low carbon, green growth, take into consideration, first among other things, schemes through which the conformity of central and regional implementation plans with the national strategy can be realized to ensure that reduction targets under paragraph (1) are achieved and the basic plan for coping with climate change under Article 40 of the Act, the basic energy plan under Article 41 of the Act, and the basic plan for sustainable development under Article 50 of the Act can be systematically linked.

**Article 26 (Principles and Roles of Target Management for Greenhouse Gases and Energy)**

- (1) The Minister of Environment shall carry out functions of overall control and coordination in relation to the establishment and management of targets of the reduction of greenhouse gases and measures necessary therefor.
- (2) The Minister of Environment shall prepare comprehensive standards and guidelines for the establishment, management, and verification of targets under Article 42 (5) of the Act and publicly notify such standards and guidelines through the Official Gazette, taking into consideration the consolidation and linkage of target management for greenhouse gases and energy, conditions of domestic industries, international trends, prevention of double regulation, and advancement of related regulations. Such standards and guidelines shall be subjected to prior consultation with the head of each appropriate central administrative agency responsible for each sector under paragraph (3) (hereinafter referred to as "agency responsible for each sector") and deliberation by the Committee.
- (3) An agency responsible for each sector shall take charge of the establishment and management of targets under Article 42 (5) of the Act for the sector under its jurisdiction and matters regarding measures necessary therefor according to the following categories. In such cases, agencies responsible for each sector shall cooperate with the Minister of Environment in overall control and coordination under paragraph (1) to the maximum extent possible:
  1. The Ministry for Food, Agriculture, Forestry and Fisheries: Agriculture and Livestock

industry;

2. The Ministry of Knowledge Economy: Industries and power generation;
  3. The Ministry of Environment: Wastes;
  4. The Ministry of Land, Transport and Maritime Affairs: Buildings and Transportation.
- (4) The Minister of Environment may, if necessary to raise the reliability of the target management under Article 42 (5) of the Act, conduct comprehensive inspection and evaluation on administrative affairs under jurisdiction of the agency responsible for each sector under paragraph (3) and demand the agency responsible for the sector to take necessary measures, such as issuing orders to business entities emitting greenhouse gases and business entities consuming energy under Article 42 (5) of the Act (hereinafter referred to as "controlled entities") to make improvements according to results of such inspection and evaluation, and the agency responsible for each sector shall comply with such a demand, unless any exceptional circumstance exists otherwise.
  - (5) The Minister of Environment may, if he/she considers that there is a serious problem in results of controlled entities' performance for the targets of reduction of greenhouse gases and energy saving or the reliability of the statements under Article 34, conduct an investigation into actual conditions of controlled entities jointly with the agency responsible for each sector.
  - (6) The Minister of Environment may request the agency responsible for each sector to furnish him/her with data necessary for the inspection and evaluation under paragraph (4).

**Article 27 (Public Institutions subject to Target Management)**

"Public institutions specified by Presidential Decree" in Article 42 (3) of the Act refers to the following institutions:

1. Public institutions under Article 4 of the Act on the Management of Public Institutions;
2. Local government-invested public corporations under Article 49 of the Local Public Enterprises Act and local government public corporations under Article 76 of the aforesaid Act;
3. Hospitals under the Act on the Establishment of National University-Affiliated Hospitals, the Act on the Establishment of National University-Affiliated Dental Hospitals, the Establishment of

Seoul National University Hospital Act, and the Establishment of Seoul National Dental Hospital Act;

4. National universities and public universities under Article 3 of the Higher Education Act.

**Article 28 (Method and Procedure for Target Management of Central Administrative Agencies, etc.)**

- (1) The head of each central administrative agency under Article 42 (3) of the Act, each local government, or each public institution under Article 27 (hereinafter referred to as "central administrative agency or similar entity") shall submit to the Center a plan for performance of targets of reduction of greenhouse gases and energy saving for the following year, including the following matters, not later than December 31, each year in electronic form:
  1. Annual targets of reduction of greenhouse gases and energy saving and a plan for performance of such targets;
  2. Emissions of greenhouse gases and consumption of energy;
  3. Facilities emitting greenhouse gases and facilities using energy;
  4. Emissions of greenhouse gases from each facility and consumption of energy per facility;
  5. Other matters prescribed by the Minister of Environment to achieve targets of reduction of greenhouse gases and energy saving.
- (2) The Minister of Environment may, if he/she finds that a performance plan under paragraph (1) is not proper, demand the head of the competent central administrative agency or similar entity to improve or supplement the performance plan, subject to consultation with the Minister of Public Administration and Security and the Minister of Knowledge Economy.
- (3) The head of a central administrative agency or similar entity shall, upon receiving a demand for improvement or supplement pursuant to paragraph (2), submit a performance plan, in which such demand is reflected, to the Center within one month from the date on which such demand is issued.
- (4) The head of a central administrative agency or similar entity shall submit a report on results of performance of the performance plan under para-



graph (1) to the Center in electronic form by not later than March 31, the following year.

- (5) The Minister of Public Administration and Security, the Minister of Knowledge Economy, and the Minister of Environment shall jointly evaluate reports on results of performance under paragraph (4) within three months and shall report the results thereof to the Prime Minister.
- (6) The Prime Minister may, if necessary according to results of evaluation under paragraph (5), order the heads of central administrative agencies and similar entities to take measures necessary to promote the reduction of greenhouse gases and energy saving.

#### Article 29 (Standards for Designation of Controlled Entities)

- (1) "Each entity that emits greenhouse gases, and each entity that consumes energy, in the standard quantity specified by Presidential Decree or more" in Article 42 (5) of the Act refers to any of the following business entities:
  1. A business entity whose average total quantities per year of greenhouse gases emitted from and energy consumed in all its places of business during the latest three years as of January 1 of the pertinent year meet all standards in Tables 2 and 3 annexed hereto;
  2. A business entity's place of business in which average total quantities per year of emissions of greenhouse gases and consumption of energy during the latest three years meet all the standards in Tables 4 and 5 annexed hereto, among the business entity's places of business.
- (2) The agency responsible for each sector shall select business entities under paragraph (1) as controlled entities and shall notify the Minister of Environment of such entities not later than March 31 each year, along with relevant materials attached thereto.
- (3) The Minister of Environment shall, upon receiving a notice under paragraph (2), examine duplication or omission in selection of controlled entities, appropriateness of regulation, etc. and notify the agency responsible for the sector of results thereof, and the agency responsible for the sector shall, upon receiving such a notice, designate controlled entities and give public notice thereof through the Official Gazette not later than June

30, each year.

- (4) Any controlled entity that has an objection to the designation under paragraph (3) may file the objection with the agency responsible for the sector, along with supporting materials attached thereto, within 30 days from the date of public notification.
- (5) The agency responsible for each sector shall, upon receiving an objection under paragraph (4), review the case and shall notify the relevant controlled entity of results thereof within 30 days from the filing date of the objection, subject to the confirmation of the Minister of Environment, and the agency responsible for each sector shall, if there is any change in the designation of a controlled entity, give public notice of the change in detail through the Official Gazette.
- (6) The Minister of Environment may integrate lists of controlled entities, designated and publicly notified by the agency responsible for each sector pursuant to paragraph (3), to make a comprehensive announcement.

#### Article 30 (Method and Procedure for Target Management for Controlled Entities)

- (1) Pursuant to Article 42 (5) of the Act, the agency responsible for each sector shall establish targets of the reduction of greenhouse gases, energy saving, and efficiency in the use of energy of controlled entities for the following year not later than September 30, each year and shall notify the targets to the controlled entities and the Center.
- (2) The agency responsible for each sector shall, when it establishes targets of the reduction of greenhouse gases, energy saving, and the efficiency in the use of energy of controlled entities pursuant to paragraph (1), organize and operate a council comprised of appropriate central administrative agencies and non-governmental experts pursuant to the latter part of Article 42 (5) of the Act.
- (3) Each controlled entity that has received a notice of targets under paragraph (1) shall submit a performance plan for the following year, including the following matters, to the agency responsible for the sector in electronic form not later than December 31, each year, and the agency responsible for each sector shall submit the plan to the Center without delay:
  1. Annual targets for each five-year period and a performance plan therefor;

2. The current status and operating ratio of production facilities in each place of business;
  3. Types and quantity of greenhouse gases emitted from each place of business and types and quantity of energy consumed in each place of business;
  4. Targets of reduction of greenhouse gases, energy saving, and the efficiency of the use of energy in each place of business and the method of performance therefor;
  5. The current status of greenhouse gases emitted from each main manufacturing process and the consumption of energy in each main production process;
  6. Targets of reduction of greenhouse gases, energy saving, and the efficiency of the use of energy in each main manufacturing process and the method of performance therefor;
  7. The method of calculating the quantity of greenhouse gases emitted from each place of business and the quantity of energy consumed in each place of business (including calculation and measurement methods);
  8. Results of reduction, absorption, removal of greenhouse gases.
- (4) Each controlled entity shall report results of performance of the performance plan under paragraph (3) to the agency responsible for the sector in electronic form by not later than March 31, the following year, and the agency responsible for each sector shall verify the accuracy of reports on results and whether such reports have been prepared in a measurable, reportable, and verifiable manner and submit the reports to the Center.
  - (5) The agency responsible for each sector shall, when it finds that results of the performance of a controlled entity under paragraph (4) fail to meet targets or that the method applied to measurement, reporting, or verification, among details in a report, is inadequate, issue an order for improvement under Article 42 (8) of the Act or take other necessary measures and notify the Minister of Environment thereof.
  - (6) Any controlled entity that has received an order for improvement pursuant to paragraph (5) shall, when it establishes a performance plan under paragraph (3), reflect it in the plan.

#### Article 31 (Management of Register)

- (1) The Center shall, upon receiving results of the performance from the agency responsible for each sector under Article 30 (4), enter such details in the register under Article 42 (7) of the Act and manage and operate such information comprehensively in electronic form.
- (2) The following matters shall be included in the register under paragraph (1):
  1. Trade name or name of the controlled entity;
  2. The representative of the controlled entity;
  3. Addresses of the main office and places of business of the controlled entity;
  4. Matters concerning the designation of the controlled entity;
  5. Matters concerning the performance plan, reports on results, an order for improvement, etc. under Article 30 (3) through (5);
  6. Matters concerning the statements under Article 34.

#### Article 32 (Testing Institutions, etc.)

- (1) "A reliable, independent, specialized institution specified by Presidential Decree" in Article 42 (9) of the Act refers to an institution designated and publicly notified by the Minister of Environment, subject to consultation with the agency responsible for the sector, as an institution equipped with human resources and physical capacity that can carry on the measurement, reporting, and verification of quantities of greenhouse gases emitted and energy consumed in a professional manner.
- (2) The Minister of Environment may, if necessary to raise the reliability of the measurement, reporting, and verification of controlled entities, request an independent specialized institution, designated pursuant to paragraph (1), (hereinafter referred to as "testing institution") to furnish him/her with relevant materials, and the testing institution so requested shall comply with the request, unless any exceptional circumstance exists otherwise.
- (3) Matters concerning the standards and procedure for the designation of testing institutions, the selection of testing institutions for controlled entities, and other relevant matters shall be determined and publicly notified by the Minister of Environment through the Official Gazette, subject to prior consultation with the agency responsible for each sector, in addition to matters prescribed in paragraphs (1) and (2).



### Article 33 (Facilitation of Early Action for Reduction of Greenhouse Gases)

The results of voluntary reduction of greenhouse gases under Article 43 of the Act, which have been tested and verified by a testing institution, may be taken into consideration in setting up the allocated quantity of emissions of greenhouse gases under the system for trading emissions of greenhouse gases under Article 46 of the Act.

### Article 34 (Procedures for Reporting and Management of Statements)

- (1) Each controlled entity shall prepare a statement of the quantities of greenhouse gases emitted and energy consumed for the relevant year pursuant to Article 44 (1) of the Act and shall submit it to the agency responsible for the relevant sector not later than March 31, the following year, along with results of testing performed by the testing institution, in electronic form.
- (2) A statement under paragraph (1) shall include the following matters:
  1. The scale of the entity, manufacturing facilities, raw materials of products, and manufacturing quantity;
  2. Types and quantity of greenhouse gases emitted from each place of business and types, scale, quantity, and operating hours of facilities emitting greenhouse gases;
  3. Types and quantity of energy used in each place of business, the composition of fuel in use, and types, scale, quantity, and operating hours of facilities using energy;
  4. The quantity and types of greenhouse gases emitted from each manufacturing process and facility and the scale of each manufacturing process and facility;
  5. Types, scale, processing efficiency, quantity, and operating hours of facilities for preventing emission of greenhouse gases used in manufacturing process;
  6. Types and quantity of greenhouse gases collected and disposed of;
  7. The calculation and measurement method of the quantity of greenhouse gases emitted from each sector under subparagraphs 2 through 6 and the quantity of energy used in each sector;
  8. The procedure for quality management of statements;
  9. Results of reduction, absorption, and removal

of greenhouse gases;

10. Other matters recognized by the agency responsible for each sector, subject to prior consultation with the Minister of Environment, for the control of the quantity of greenhouse gases emitted and the quantity of energy used by each controlled entity.
- (3) The agency responsible for each sector shall, upon receiving a statement pursuant to paragraph (1), examine contents thereof and then submit the statement to the Center, along with relevant data, without delay, and the Center shall keep and maintain them in the register under Article 31 (1).
- (4) As to a reliable, independent, specialized institution for verifying the reliability of statements under Article 44 (2) of the Act, Article 32 shall apply mutatis mutandis.
- (5) Matters concerning the method of preparing statements and the procedure for reporting shall be determined and publicly notified through the Official Gazette by the Minister of Environment, subject to prior consultation with the agency responsible for each sector, in addition to matters prescribed in paragraphs (1) through (4).

### Article 35 (Disclosure of Statements, etc.)

- (1) In principle, a statement under Article 34 shall be disclosed, unless any exceptional circumstance exists otherwise, and the agency responsible for each sector and the Center may, upon receiving a request from a relevant administrative agency or a public institution under Article 4 of the Act on the Management of Public Institutions, furnish it with such a statement, subject to deliberation by the Committee.
- (2) The Center may, upon receiving a request from the Financial Services Commission or the Korea Exchange for the disclosure of a listed corporation's business report pursuant to Article 163 of the Financial Investment Services and Capital Markets Act, forward the relevant controlled entity's statement.
- (3) The disclosure of a statement under Article 44 (3) of the Act shall be made in electronic form through the web-site of the agency responsible for each sector or the Center's integrated information management system for greenhouse gases.
- (4) Any controlled entity that intends to request non-disclosure of a statement pursuant to the proviso to Article 44 (3) of the Act shall file an explan-

atory letter regarding reasons for non-disclosure, along with the statement.

- (5) The Center shall have a committee for examination on disclosure of statements under Article 44 (4) of the Act (hereinafter referred to as the "Examination Committee") in order to have it examine and decide whether to disclose information entirely or partially when a request for non-disclosure of a statement is filed pursuant to paragraph (4).
- (6) The Examination Committee shall be comprised of not more than seven members, including one Committee Chairperson.
- (7) Committee members shall consist of four public officials working for the agency responsible for each sector and appointed by the head of the agency responsible for the sector and non-governmental members commissioned by the Minister of Environment, subject to consultation with the agency responsible for the sector, among persons who have ample knowledge and experience in green growth and disclosure of information, while the Committee Chairperson shall be appointed by the Minister of Environment from among committee members.
- (8) A meeting shall be duly formed to be open with the attendance of a majority of incumbent committee members and shall adopt resolutions by the affirmative vote of a majority of members present at the meeting.
- (9) Matters necessary for the composition and operation of the Examination Committee shall be determined by the Committee Chairperson, subject to resolution of the Examination Committee, in addition to matters prescribed in paragraphs (6) through (8).

### Article 36 (Establishment and management of National Integrated Information Management System for Greenhouse Gases)

- (1) In order to establish and manage the national integrated information management system for greenhouse gases under Article 45 (1) of the Act, the Minister of Environment shall establish the Integrated Information Center for Greenhouse Gases under his/her control.
- (2) The Center shall take charge of the following affairs:
  1. Assistance in setting up targets of the reduction of greenhouse gases at the national level

and for each sector;

2. Operation of the national integrated information management system for greenhouse gases in compliance with international standards;
3. Cooperation and assistance in business affairs and furnishing information to appropriate central administrative agencies pursuant to Articles 26 through 35;
4. Survey and research on support for reduction of domestic and overseas greenhouse gases;
5. Cooperation with international institutions and organizations related to low carbon, green growth, as well as with developing countries.
- (3) The Minister of Environment shall organize and operate a council comprised of public officials, who shall be members of the Senior Executive Services, of appropriate central administrative agencies, including the Ministry of Strategy and Finance, the Ministry of Public Administration and Security, the Ministry for Food, Agriculture, Forestry and Fisheries, the Ministry of Knowledge Economy, and the Ministry of Land, Transport and Maritime Affairs, and the head of the Task Force in order to have the Center carry out its business affairs efficiently and systematically.
- (4) Pursuant to Article 45 (2) of the Act, the agency responsible for each sector shall submit to the Center information and statistics regarding greenhouse gases during the previous year for each sector under its jurisdiction according to the following categories by not later than June 30 each year:
  1. The Minister for Food, Agriculture, Forestry and Fisheries: Agriculture and forestry;
  2. The Minister of Knowledge Economy: Energy and industrial process;
  3. The Minister of Environment: Wastes;
  4. The Minister of Land, Transport and Maritime Affairs: Buildings and transportation.
- (5) In order to secure international reliability of the national integrated information management system for greenhouse gases, the Minister of Environment shall examine the validity of information and statistics regarding greenhouse gases under paragraph (4) and shall have standing as the national agency for integrated information management for greenhouse gases externally. In such cases, the Minister of Environment shall consult with the Commissioner of the Korea National

Statistical Office to secure the fairness and reliability of statistics of greenhouse gases.

- (6) The Center may, if considered necessary to carry out its business affairs efficiently, request any of the following institutions related to low carbon, green growth, including climate change, energy, and sustainable development, to render necessary assistance with human resources, information, and analysis, subject to prior consultation with the head of the competent central administrative agency:
1. A research institute under Article 8 (1) of the Act on the Establishment, Operation and Fostering of Government-Funded Research Institutions;
  2. A research institute under Article 8 (1) of the Act on the Establishment, Operation and Fostering of Government-Funded Science and Technology Research Institutions;
  3. A public institution under Article 4 of the Act on the Management of Public Institutions.

#### Article 37 (Management of Average Energy Consumption Efficiency of Automobiles and Allowable Emission of Greenhouse Houses)

- (1) The standards for average energy consumption efficiency of automobiles shall be prescribed by the Minister of Knowledge Economy, while the standards for allowable emission of greenhouse gases from automobiles shall be prescribed by the Minister of Environment in executing business affairs for the control of greenhouse gases from traffic sector pursuant to Article 47 (2) of the Act, but the application to auto makers (including importers; the same shall apply hereinafter) and management of the standards for average energy consumption efficiency of automobiles and the standards for allowable emission of greenhouse gases from automobiles shall be under jurisdiction of the Minister of Environment. In such cases, the Minister of Environment shall furnish the Minister of Knowledge Economy with materials regarding the application and management of such standards.
- (2) The Minister of Environment shall publicly notify standards that allow auto makers to alternatively comply with the standards for average energy consumption efficiency of automobiles and the standards for allowable emission of greenhouse gases from automobiles under paragraph (1) through

the Official Gazette, taking into consideration domestic and overseas conditions of the automobile industry, international trends of regulation, the method and procedure for measurement, and simplification of sanctions, subject to prior consultation with the Minister of Knowledge Economy.

#### Article 38 (Assessment of Impact of Climate Change and Establishment of Measures for Adaptation)

- (1) Pursuant to Article 48 (4) of the Act, the Minister of Environment shall establish and enforce measures for adaptation to climate change, including the following matters, for each five-year period, subject to prior consultation with the heads of appropriate central administrative agencies:
  1. Matters concerning international agreements, etc. for adaptation to climate change;
  2. Matters concerning improvement of capability of monitoring, forecast, information, and utilization of climate change;
  3. Matters concerning assessment of the impact of climate change and weaknesses in each sector and each region;
  4. Matters concerning measures for adaptation to climate change in each sector and each region;
  5. Matters concerning prevention of disasters resulting from climate change;
  6. Matters concerning joint promotion of the green life campaigns under Article 58 of the Act and measures for adaptation to climate change;
  7. Other matters that the Minister of Environment considers necessary for adaptation to climate change.
- (2) The head of each appropriate central administrative agency and each Mayor/Do Governor shall establish and implement a detailed implementation plan for measures to adapt to climate change for matters under his/her jurisdiction in accordance with the measures for adaptation to climate change under paragraph (1).

#### CHAPTER VI

#### REALIZATION OF GREEN LIFE AND SUSTAINABLE DEVELOPMENT

##### Article 39 (Modification to Basic Plan for Sustainable Development)

"A modification to a minor matter specified in Presidential Decree" in the proviso to Article 50 (2) of the Act means any of the following cases:

1. Where a matter under Article 50 (3) 1 and 4 of the Act is modified;
2. Where part of the basic plan for sustainable development is modified with the maximum of 10/100 of total financial resources required to the extent that shall not affect essential elements of the basic plan for sustainable development.

##### Article 40 (Management of Green Homeland)

- (1) "Plans specified by Presidential Decree, such as the comprehensive national land plan and the basic urban plan" in Article 51 (1) of the Act refers to the plans listed in the Table 6 annexed hereto.
- (2) The plans concerning which it is required to hear the Committee's opinion in advance pursuant to Article 51 (3) of the Act in establishing each plan are as follows:
  1. The comprehensive national land plan under Article 9 (1) of the Framework Act on the National Land and the comprehensive Do plan under Article 13 (1) of the aforesaid Act;
  2. The five-year regional development plan under Article 4 (1) of the Special Act on Balanced National Development;
  3. The Seoul Metropolitan Area Readjustment Plan under Article 4 (1) of the Seoul Metropolitan Area Readjustment Planning Act;
  4. Other plans that the Committee Chairperson considers necessary, subject deliberation by the Committee.

##### Article 41 (Targets of Reduction of Greenhouse Gases from Traffic Sector)

Pursuant to Article 53 (1) of the Act, the Minister of Land, Transport and Maritime Affairs shall establish and enforce targets of the reduction of greenhouse gases from traffic sector, energy saving, and the efficiency in the use of energy, including the following matters, subject to consultation with heads of appropriate cen-

tral administrative agencies:

1. The current status of greenhouse gases emitted from each transportation means, such as automobiles, trains, aircraft, and ships, and the energy consumption rate of such transportation means;
2. The current status of greenhouse gases emitted from each type of energy;
3. Targets of the reduction of greenhouse gases, energy saving, and the efficiency in the use of energy for each five-year period and the performance plan therefor;
4. Annual targets of the reduction of greenhouse gases, energy saving, and the efficiency in the use of energy and the performance plan therefor.

##### Article 42 (Standards of Green Buildings)

- (1) "Buildings that meet or excel the standards prescribed by Presidential Decree" in Article 54 (2) of the Act refers to buildings under Article 91 (2) of the Enforcement Decree of the Building Act.
- (2) Pursuant to Article 54 (2) of the Act, the Minister of Land, Transport and Maritime Affairs shall establish an implementation plan in order to establish and manage the quantity of energy consumed in building under paragraph (1) and the target of reduction of greenhouse gases and may, if necessary, establish detailed standards for the consumption of energy and the reduction of green gases.

##### Article 43 (Expansion, etc. of Green Buildings)

- (1) "Public institutions and educational institutions specified by Presidential Decree" in Article 54 (6) of the Act refers to the following institutions:
  1. Public institutions under Article 4 of the Act on the Management of Public Institutions;
  2. Local government-invested public corporations under Article 49 of the Local Public Enterprises Act and local government public corporations under Article 76 of the aforesaid Act;
  3. Research institutes under Article 8 of the Act on the Establishment, Operation and Fostering of Government-Funded Research Institutions and research groups under Article 18 of the aforesaid Act;
  4. Research institutes under Article 8 of the Act on the Establishment, Operation and Fostering of Government-Funded Science and Technology Research Institutions and

research groups under Article 18 of the aforesaid Act;

5. Local government-invested research institutes under Article 4 of the Act on the Establishment and Operation of Local Government-Invested Research Institutes;
  6. Hospitals under the Act on the Establishment of National University-Affiliated Hospitals, the Act on the Establishment of National University-Affiliated Dental Hospitals, the Establishment of Seoul National University Hospital Act, and the Establishment of Seoul National Dental Hospital Act;
  7. National universities and public universities under Article 3 of the Higher Education Act.
- (2) “A new city development project or an urban redevelopment project in a scale not smaller than the scale specified by Presidential Decree” in Article 54 (7) of the Act refers to any of the following projects:
1. A housing site development project executed in an area of not less than 3.3 million square meters pursuant to the Housing Site Development Promotion Act;
  2. The Multifunctional Administrative City Construction Project executed pursuant to the Special Act on the Construction of Multifunctional Administrative City in Yeongi-Gongju Area for Follow-up Measures for New Administrative Capital;
  3. An enterprise city development project executed pursuant to the Special Act on the Development of Enterprise Cities;
  4. An innovation city development project executed pursuant to the Special Act on the Construction and Support of Innovation Cities Following Relocation of Public Agencies;
  5. Other urban development project in an area of not less than one million square meters.
- (3) The Government may provide financial support, abate or exempt taxes, or provide support otherwise in any of the following cases in order to expand green buildings pursuant to Article 54 (8) of the Act:
1. A building certified as an environment-friendly building pursuant to Article 65 of the Building Act;
  2. A building with its total sum of energy performance indicators calculated according to

the standards for the efficient energy management in buildings, publicly notified by the Minister of Land, Transport and Maritime Affairs pursuant to Article 66 (2) of the Building Act, amounting to not less than 80 points or with its building energy efficiency grade certified pursuant to Article 66-2 of the aforesaid Act;

3. Where the Minister of Land, Transport and Maritime Affairs considers it necessary to provide support to improve the energy efficiency of any building that has been used for five years since its use was approved pursuant to Article 22 of the Building Act;
4. Where the Minister of Land, Transport and Maritime Affairs considers it necessary to provide financial support or abate or exempt taxes in order to expand green buildings on any other ground.

## CHAPTER VII

### PENAL PROVISIONS

#### Article 44 (Imposition and Collection of Fines for Negligence)

- (1) Fines for negligence under Article 64 (1) of the Act shall be imposed and collected by the agency responsible for each sector, subject to prior consultation with the Minister of Environment.
- (2) The guidelines for the imposition of fines for negligence under paragraph (1) are as prescribed in Table 7 annexed hereto.
- (3) The agency responsible for each sector may aggravate or mitigate a fine for negligence by not more than one-half of the amount of the fine for negligence in Table 7 annexed hereto, taking into consideration the degree, motive, and consequences of the offense: Provided, That the amount as aggravated shall not exceed the maximum amount of the fine for negligence in Article 64 (1) of the Act.

## ADDENDA

#### Article 1 (Enforcement Date)

This Decree shall enter into force on April 14, 2010; Provided, That the amended provisions of Articles 17-2, 17-3, and 17-4 of the Enforcement Decree on the Promotion of the Conversion into Environment-Friendly Industrial Structure from among the amended provisions of Article 3 (2) of the Addenda shall enter into force on July 14, 2011.

#### Article 2 (Transitional Measure concerning Five-Year Plans, etc.)

Five-year plans and central and regional implementation plans already established when this Decree enters into force shall be deemed five-year plans under Article 4, central implementation plans under Article 5, and regional implementation plans under Article 7, respectively.

#### Article 3 (Amendment of other Act and Subordinate Statutes) Omitted.

#### [Table 1] Hydro fluoro carbons (HFCs) and perfluorocarbons (PFCs) (Related to Article 2)

1. Hydro fluoro carbon (HFCs)	HFC-23, HFC-32, HFC-41, HFC-43-10mee, HFC-125, HFC-134, HFC-134a, HFC-143, HFC-143a, HFC-152a, HFC-227ea, HFC-236fa, HFC-245ca
2. Perfluorocarbon (PFCs)	PFC-14, PFC-116, PFC-218, PFC-31-10, PFC-c318, PFC-41-12, PFC-51-14

#### [Table 2] Standards for Greenhouse Gases Emitted from Designated Controlled Entities (Related to Article 29 (1) 1)

1. Standard applicable until December 31, 2011: Not less than 125 kilotonnes CO<sub>2</sub>-eq
2. Standard applicable on and after January 1, 2012: Not less than 87.5 kilotonnes CO<sub>2</sub>-eq
3. Standard applicable on and after January 1, 2014: Not less than 50 kilotonnes CO<sub>2</sub>-eq

#### [Table 3] Standards for Energy Consumption of Designated Controlled Entities (Related to Article 29 (1) 1)

1. Standard applicable until December 31, 2011: Not less than 500 terajoules
2. Standard applicable on and after January 1, 2012: Not less than 350 terajoules
3. Standard applicable on and after January 1, 2014: Not less than 200 terajoules

#### [Table 4] Standards for Greenhouse Gases Emitted from Designated Places of Business of Controlled Entities (Related to Article 29 (1) 2)

1. Standard applicable until December 31, 2011: Not less than 25 kilotonnes CO<sub>2</sub>-eq
2. Standard applicable on and after January 1, 2012: Not less than 20 kilotonnes CO<sub>2</sub>-eq
3. Standard applicable on and after January 1, 2014: Not less than 15 kilotonnes CO<sub>2</sub>-eq

#### [Table 5] Standards for Energy Consumption of Designated Places of Business of Controlled Entities (Related to Article 29 (1) 2)

1. Standard applicable until December 31, 2011: Not less than 100 terajoules
2. Standard applicable on and after January 1, 2012: Not less than 90 terajoules
3. Standard applicable on and after January 1, 2014: Not less than 80 terajoules

#### [Table 6] Plans Related to Green Homeland (Related to Article 40 (1))

1. The basic plan for support of biotechnology under Article 4 (2) of the Biotechnology Support Act;
2. The comprehensive plan for promotion of atomic energy under Article 8-2 (1) of the Atomic Energy Act;
3. The basic plan for the development and promotion of fusion energy under Article 4 (1) of the Fusion Energy Development Promotion Act;
4. The basic plan for the control of radioactive waste under Article 6 (1) of the Radioactive Waste Control Act;

5. The long-term plan for the promotion of tourism under Article 3 (1) of the Framework Act on Tourism;
6. The basic plan for the development of tourism under Article 49 (1) of the Tourism Promotion Act;
7. The comprehensive plan for the rearrangement of agricultural and fishing villages under Article 4 (1) of the Rearrangement of Agricultural and Fishing Villages Act and the plan for the rationalization of use of water in agricultural and fishing villages under Article 15 (1) of the aforesaid Act;
8. The plan for the development of agriculture and fisheries, rural Communities, and food industry under Article 14 (1) of the Framework Act on Agriculture and Fisheries, Rural Community and Food Industry;
9. The basic plan for works against land erosion or collapse under Article 3-2 (1) of the Work against Land Erosion or Collapse Act;
10. The basic forestry plan Under Article 11 (1) of the Framework Act on Forestry;
11. The plan for fostering environment-friendly agriculture under Article 6 (1) of the Environment-Friendly Agriculture Fosterage Act;
12. The plans under Article 4 (2) 9 and 10 of the Special Act on Balanced National Development, among five-year regional development plans under Article 4 (1) of the aforesaid Act;
13. Comprehensive measures for sustainable management under Article 19 (1) of the Industrial Development Act;
14. The basic plan for the development of industrial clusters under Article 3 (1) of the Industrial Cluster Development and Factory Establishment Act;
15. The basic plan for the promotion of development, use, and diffusion of technology for new and renewable energy under Article 5 (1) of the Act on the Promotion of the Development, Use and Diffusion of New and Renewable Energy;
16. The basic plan for the rationalization of energy use under Article 4 (1) of the Energy Use Rationalization Act;
17. The basic plan for the supply of electricity under Article 25 (1) of the Electric Utility Act;
18. Comprehensive measures under Article 3 (1) of the Act on the Promotion of the Conversion into Environment-Friendly Industrial Structure;
19. The comprehensive plan for the improvement of air quality under Article 11 (1) of the Clean Air Conservation Act and comprehensive measures for the prevention of damage by the yellow dust under Article 13 (1) of the aforesaid Act;
20. The basic plan for the preservation of specific islands under Article 5 (1) of the Special Act on the Preservation of the Ecosystem in Island Areas including Dokdo;
21. The basic plan for the protection of Baekdu-Jiri Grand Mountain Ranges under Article 4 (2) of the Act on the Protection of Baekdu-Jiri Grand Mountain Ranges;
22. The basic plan for the management of air quality in Seoul Metropolitan area under Article 8 (1) of the Special Act on the Improvement of Air Quality in Seoul Metropolitan Area;
23. The basic plan for the improvement of waterworks under Article 4 (1) of the Water Supply and Waterworks Installation Act and the comprehensive nationwide waterworks plan under Article 5 (1) of the aforesaid Act;
24. The basic plan for the conservation of water quality and ecosystem in each greater region under Article 24 (1) of the Water Quality and Ecosystem Conservation Act;
25. The basic plan for the conservation of wetlands under Article 5 (1) of the Wetlands Conservation Act;
26. The basic plan for the protection of wild fauna and flora under Article 5 (1) of the Protection of Wild Fauna and Flora Act;
27. The basic plan for the control of toxic chemicals under Article 6 (1) of the Toxic Chemicals Control Act;
28. The basic plan for parks under Article 11 (1) of the Natural Parks Act;
29. The basic plan for the conservation of natural environment under Article 8 (1) of the Natural Environment Conservation Act;
30. The basic plan for the cycling of resources under Article 7 (1) of the Act on the Promotion of Saving and Recycling of Resources;
31. The basic plan for the encouragement of purchase of environment-friendly products under Article 4 (1) of the Act on the Encouragement of Purchase of Environment-Friendly Products;
32. The comprehensive plans for the nationwide waste management under Article 10 (1) of the Wastes Control Act;
33. The basic plan for the soil conservation under Article 4 (1) of the Soil Environment Conservation Act;
34. The comprehensive plan for national environment under Article 12 (1) of the Framework Act on Environmental Policy and the comprehensive medium-term plan for environment conservation under Article 14-2 (1) of the aforesaid Act;
35. The comprehensive plan for the development of environmental technology under Article 3 (1) of the Development of and Support for Environmental Technology Act;
36. The basic plan for the supply of aggregate under Article 5 (1) of the Aggregate Extraction Act;
37. The basic plan for the national traffic safety under Article 15 (1) of the Traffic Safety Act;
38. The plan for the national main transport networks under Article 4 (1) of the National Transport System Efficiency Act;
39. The comprehensive national land plan under Article 9 (1) of the Framework Act on the National Land;
40. The greater-regional urban plan under Article 11 (1) of the National Land Planning and Utilization Act and the basic urban plan under Article 18 (1) of the aforesaid Act;
41. The basic plan for metropolitan transport systems in metropolitan areas under Article 3 (1) of the Special Act on the Management of Metropolitan Transport in Metropolitan Areas;
42. The long-term plan for the construction of dams under Article 4 (1) of the Act on Construction of Dams and Assistance, etc. to their Environs;
43. The basic plan for the improvement of roads under Article 22 (1) of the Road Act;
44. The plan for the readjustment of the Seoul Metropolitan Area under Article 4 (1) of the Seoul Metropolitan Area Readjustment Planning Act;
45. The comprehensive housing plan under Article 7 (1) of the Housing Act;
46. The greater-regional development project plans under Article 5 (1) and (2) of the Balanced Regional Development and Support for Local Small and Medium Enterprises Act;
47. The basic plan for groundwater management under Article 6 (1) of the Groundwater Act;
48. The national railroad network construction plan under Article 4 (1) of the Railroad Construction Act;
49. The comprehensive long-term plan for water resources under Article 23 (1) of the River Act and the comprehensive water management plan for basins under Article 24 (1) of the aforesaid Act;
50. The basic plan for the reclamation of public waters under Article 4 (1) of the Public Waters Management Act;
51. The basic plan for the management of fishing grounds under Article 3 (1) of the Fishing Ground Management Act;
52. The consolidated coast management plan under Article 6 (1) of the Coast Management Act and the basic plan for the rearrangement of coasts under Article 21 (1) of the aforesaid Act;
53. The basic plan for harbors and ports under Article 5 (1) of the Harbor Act;
54. The basic plan for the conservation and management of marine ecosystems under Article 9 (1) of the Conservation and Management of Marine Ecosystems Act;
55. The basic plan for the development of marine fisheries under Article 6 (1) of the Framework Act on Marine Fishery Development;
56. The comprehensive plan for the management of marine environment under Article 14 (1) of the Marine Environment Management Act;
57. The basic plan for the sustainable development of national transport and logistics systems under Article 7 (1) of the Sustainable Transportation Logistics Development Act;
58. The basic plan for the rearrangement of urban and residential environments under Article 3 (1) of the Act on the Maintenance and Improvement of Urban Areas and Dwelling Conditions for Residents;
59. Other major medium- and long-term administrative plans selected by the Committee Chairperson, subject to the resolution of the Committee.

**[Table 7] Guidelines for Imposition of Fines for Negligence (Related to Article 44 (2))**

Offense	Applicable provisions	Amount of fine for negligence
1. Where a controlled entity fails to make a report under Article 42 (6) of the Act or makes a false report: (a) If not more than one month has passed: (b) If more than one month, but not more than three months have passed: (c) If more than three months have passed: (d) If a false report is made:	Article 64 (1) 1 of the Act	3 million won 5 million won 7 million won 10 million won
2. Where a controlled entity fails to make a report under Article 42 (9) of the Act or makes a false report: (a) If not more than one month has passed: (b) If more than one month, but not more than three months have passed: (c) If more than three months have passed: (d) If a false report is made:	Article 64 (1) 1 of the Act	3 million won 5 million won 7 million won 10 million won
3. Where a controlled entity fails to make a report under Article 44 (1) of the Act or makes a false report: (a) If not more than one month has passed: (b) If more than one month, but not more than three months have passed: (c) If more than three months have passed: (d) If a false report is made:	Article 64 (1) 1 of the Act	3 million won 5 million won 7 million won 10 million won
4. Where a controlled entity fails to perform an order of improvement under Article 42 (8) of the Act: (a) First offense: (b) Second offense; (c) Third or further offense:	Article 64 (1) 2 of the Act	3 million won 6 million won 10 million won
5. Where a controlled entity fails to make a disclosure under Article 42 (9) of the Act:	Article 64 (1) 3 of the Act	10 million won
6. Where a controlled entity fails to perform an order of correction or supplementation under Article 44 (2) of the Act: (a) First offense: (b) Second offense; (c) Third or further offense:	Article 64 (1) 4 of the Act	3 million won 6 million won 10 million won