A Measurement Strategy for Green Economy in Korea

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Abstract

In Korea, a measurement strategy for Green Economy has been implemented through three approaches; indicator sets, environmental accounts, and green industry statistics. First, Green Growth Indicators (GGIs) and Green Life-style indicators (GLIs) have been compiled as a statistical indicator system for cross-check and evaluation of green growth policies. An official website, where these indicators are included, has been constructed and open to the public in order to help both the government and members of society recognize green policies and their performance. Second, a system of environmental-economic accounts (SEEA) has been developed for monitoring environmental policies and concrete activities of Green Growth strategy. Finally, the green industry statistics have been compiled to measure the greening level of the economy.

1. Background

1.1 Green Economy and Green Growth

Chapter 40 of Agenda 21 called on countries and the international community to develop indicators of sustainable development. The UN Commission on Sustainable Development (UNCSD) has stated that "such indicators are needed to increase focus on sustainable development and to assist decision-makers at all levels to adopt sound national sustainable development policies". Recently, as new concepts go beyond purely economic dimensions, Green Economy and Green Growth have emerged. However, for statistical offices, the challenge of providing information on them is not new because many relevant issues were already addressed by developing Sustainable Development Indicators (SDIs). The United Nations and the OECD have both conducted advanced work on conceptual definitions of Green Economy and Green Growth, and have elaborated on the nature of their relationship to sustainable development.

The *Green Economy* can be defined as an economy where economic prosperity goes hand-in-hand with ecological sustainability. It is closely linked to and rooted in the broader framework of sustainable development, which is already described in Agenda 21. It aims to integrate the 3 pillars of economic development, environmental sustainability and social development. In other words, the *Green Economy* is a new strategy in the sense that it focuses on greening economic systems through a system change. Sustainable development as defined in Agenda 21 describes the need for incorporating environmental sustainability into economic policies without providing guidance on “how”. Therefore, The *Green Economy* has evolved into a new development paradigm illustrating how economic development and environmental sustainability can reinforce each other and create a win-win synergy to overcome the trade-offs of the conventional paradigm. In fact, an investment on ecological resources and services, which include a stable climate, bio-diversity, and clean air and water, can be an opportunity for profit, employment, and growth rather than a cost and burden on economy. On the other hand, *Green Growth* is the process of greening a conventional economic system and a Strategy to arrive at the *Green Economy*. Hence, *Green Growth* can be a concrete strategy for achieving sustainable development[1]. In fact, *Green growth* means fostering economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies. To do this, it must catalyze investment and innovation which will underpin sustained growth and give rise to new economic opportunities.

[1] UNESCAP, Conceptual Framework for Green Economy / Green Growth, 2011

1.2 Statistics for Green Economy

Since the 'Stockholm Declaration on the Human Environment' in 1972 and the 'Rio Declaration on Environment and Development' in 1992, the interaction between environment and economy has been recognized as an essential element of human life. So, in order to improve the quality of human life, actions to protect the natural environment from pollution or destruction have progressed throughout the economic development of advanced countries. In order to reduce air or water emissions of pollution materials, a green innovation on life-style has been propagated worldwide. For example, less use of pollution-oriented products or more use of eco-friendly products has become preferable in consumption behavior. Hence, the growth paradigm has changed from quantitative-oriented growth, in which high or rapid growth rates were preferred in order to increase society members' welfare, to qualitative-oriented growth which could increase the quality of their lives including sustainable and serviceable natural environment.

Until now, however, the natural environment has been shown to be worsening on a global scale. Due to growth that is more rapid than the ability for earth to absorb polluted materials from this growth, emissions of CO2 have increased continuously, and so, the global warming has been sustained. This global warming has caused climate changes like melting snow in frozen lands, frequent heavy rains, and droughts to magnify. Therefore, through critical review of this stylized growth and development, sustainable development has been suggested as a new growth engine, and has been realized in some countries. For mitigation of climate change in particular, Low Carbon-Green Growth has been started and put into practice since the announcement of the Koyto protocol. In Korea, this Low-Carbon-Green Growth strategy has become a new vision of growth. Now, a long-term plan for implementation of the green growth strategy has been prepared in government policies and activated in the economy and society in Korea.

Data for statistics on Green Growth are collected from surveys or registered administrative records. Green industry statistics may be compiled from survey data in order to measure sales of green products and the number of green jobs. Moreover, many kinds of data on the environment and economic performance have been produced for multiple purposes, and have cumulated within sources such as databases. Basically, these statistics provide primary information for the System of Environmental-Economic Accounts (SEEA).

Now, by using individual statistics and SEEA data, indicator sets could be designed for a special purpose. For example, some indicator sets such as GGIs and GLIs could be officially constructed and used for implementation of a green growth strategy and review of green life-style behavior. Of course, each element in indicator sets should be representative of its category or field. On the other hand, a composite indicator may be calculated and utilized as an index style. But this index is not labeled as an official statistic because there is a lack of methodology for aggregation. Anyway, in practice, statistics on Green Growth seem to be compiled in different styles; individual statistics, indicators, and composite indexes. In the case of aggregated indicators like GGIs or SEEA, their quality would expect to be better than disaggregated data or individual statistics.

1.3 Green Growth and Measurement Strategy in Korea

On August 15, 2008, which marked the 60th anniversary of the founding of the Republic of Korea, "Low Carbon-Green Growth" was proclaimed to be the new national vision to guide economic development during the next 50 years. This vision's principal outcome was a change from the contemporary development paradigm of quantity-oriented growth for a rapid increase of national income to the new paradigm of the quality-oriented growth for enhancement of wellbeing. Until now, the quantity-oriented growth has led to a very big increase in personal income, even though the use of fossil-fuel, which includes petroleum and natural gas, has increased in geometrical progression. For example, GNI per capita increased from about 1,000 US$ in 1977 to about 20,000 US$ in 2007. In

contrast to the policy emphasizing quantity-oriented growth, the new paradigm of growth is focused on using less fossil-fuel for environmental protection, and is thus called “Low-Carbon Green Growth”.

To more effectively implement the national vision of green growth, the National Strategy for Green Growth was prepared in July 2009 as a national agenda to be implemented through the collaborative efforts of a number of governmental organizations, industries and civil society. In addition, a “Low Carbon-Green Growth” Law was officially released in 2010. In fact, this law was designed to empower the Government to implement the green growth strategy. In the short term, a Five-Year Plan for Green Growth was launched. Under this plan, it was expected that the government would spend approximately 2 percent of the annual GDP on green growth programs and projects. These programs and projects included constructions of various green infrastructures as well as expenditures for research and development of green technologies. This National Strategy for Green Growth was given three strategies and ten policy directions as will be explained later.

In order to fully support this national growth strategy, Statistics Korea (KOSTAT) has been developing green growth statistics such as indicator sets, SEEA, and green industry statistics. In practice, these statistics can be regarded as measures of Green Economy. First, a *Green Growth Indicator Set* has been designed as a measurement framework for the performance of the government’s green growth policies. In addition, a *Green Life Indicator Set* has been built to check the current situation in citizens’ Green Lives. Some data for these indicators has been collected by a nationwide survey. Second, research on compiling SEEA have been carried out in order to analyze the systematic relationship between the environment and economy. Methodologies of some accounts like the Economy-Wide Material Flow Account (EW-MFA) and Air Emission Account (AEA) have been studied. Green-house Gas emission statistics and the Environmental Protection Expenditure Account (EPEA) have been published every year. Finally, *Green Industry Statistics* has been compiled as a pilot research project. Actually, Green Production and Green Employment have been estimated with data from the Economic Census of 2010.

2. A Framework of Green Growth Indicators

2.1 Objectives of Green Growth

“Low Carbon-Green Growth” aims to simultaneously achieve the following three objectives by creating a synergistic relationship between economic growth and environmental protection. The first objective is to promote eco-friendly new growth engines for the national economy. For this objective, research and development of eco-friendly environmental products and their production technology should be encouraged. In addition, production and consumption of these products should be increased in the economic activity. The second objective is to improve people’s quality of life and promote a green revolution in their life-style. In this case, people mean the members of the society or economy. For successful green growth, members of society should be aware of the importance of green life-style and green products in order to reduce environmental pollution and preserve natural capital resources which can continuously give an environmental service to them. Next, they should put their collaborative efforts into the implementation of green growth strategies in cooperation with the government, firms, and NGOs. For example, members of local societies could change their life style so as to consume more and more eco-friendly green products. The third and final objective is to contribute to international efforts to fight climate change and other environmental trends. Government and society should try to reduce greenhouse gas emissions in production and consumption. Greenhouse gases are regarded as major materials which bring about climate change. Therefore, according to the Koyto protocol, environment policies for reduction of greenhouse gases have been made and carried out in advanced countries.

2.2 Development Process of a Indicator Set

Generally speaking, the development process of an indicator set could be divided into 5 steps. First, a measure object of the indicator set should be defined. In GGIs, the conceptual definition of green growth has to be determined before a framework of indicators is designed. In the case of GLIs, a green life-style should be defined conceptually. In addition, a scope and a concrete definition of the object to be measured have to be decided. For example, according to Article 2 of the "*Low Carbon-Green Growth*" Law, the term "green growth" means the economic growth achieved by saving of energy or efficient use of resources, which aims to reduce climate change and damage to the environment. It becomes a new growth engine through research and development of green technology, and so creates new job opportunities in the production process of green products with a harmony between the environment and economy.

Second, a framework of indicators should be designed. First of all, a theoretical background of the indicator set has to be reviewed. For example, a relationship between the GGIs and Green Growth policies needs to be considered. For an international comparison, indicator sets in an international organization like OECD need to be benchmarked. Third, tentative indicators should be selected from a potential indicator set. As indicator selection criteria, experts' insights, policy relevance, and data reliability could be utilized. Fourth, the metadata on each indicator should be collected and put within a database. Here, the metadata information includes definitions of indicators, related policies, and policy targets of indicator values. If no data corresponds to any indicator, then the indicator or related statistics should be developed and compiled. Finally, a utilization plan should be made and carried out. Especially, the time series of indicator data should be analyzed to show their trends or comparisons between indicator values and policy target levels. Moreover, a composite index could be calculated from the indicator set by standardization of each indicator.

2.3 Framework and Use of GGIs in Korea

A framework of GGIs is based on the policy structure and targets which were derived from a 5-Year Action Plan, which was prepared in 2009 according to the National Green Growth Strategy. This GG strategy consists of 3 categorized strategies with 10 policy directions and 50 action assignments. Korean GGIs have been designed so that categories and groups are in line with this green growth policy structure, because GGIs are aimed to check and assess outcomes and results of 50 concrete green growth policies.

In practice, 30 core indicators were selected according to criteria of these indicators: policy relevance, analytical soundness, and data availability. For example, some indicators were selected because the policy relevance is high. In addition, alternative indicators were reviewed as representative indicators which could check and manage a group of concrete policies. As a result, Green Growth Indicators in Korea have 3 categories and 10 groups of indicators, which are corresponding to the action plan of green growth strategy. Of course, each indicator has been compiled from nation-wide economic, social and environmental statistics.

A framework of GGIs assists with the linkage of statistical indicators to the corresponding policies. Some good indicators are utilized for determining the target value of the future of corresponding green policies. For example, the target value on total emissions of greenhouse gases was decided to be about 670 million equivalent tons of CO_2 in 2020. Of course, if data on indicators are not available in time, data gaps are identified between GGIs and green policies. Required statistics should be developed and compiled in the future.

Anyway, why is the indicator set on Green Growth (GGIs) compiled? Why are GGIs needed just now? There are three reasons. The first reason is to monitor the level of progress toward Green Growth in Korea, which is similar to OECD member countries. The second reason is to evaluate the performance of Green Growth policies and feedback so that concrete green policies may be improved or revised.

The third reason is to make polices which can promote Green Growth activities. For example, alternative green policies could be prepared if the performance of the specific green growth policy has not been improved all.

3. A Framework of Green Life-style Indicators

3.1 Background of Green Life-style Survey

In order to achieve sustainable economic development through *Green Growth*, changes in energy and industrial fields should accompany it. In other words, a *Green Revolution* strategy must be implemented within life-styles, so that it will change each citizen's fundamental life-style to a *green* life-style in every way. In order to successfully carry out this Green Revolution strategy, policy makers and citizens need to understand current patterns in their life-styles, and then establish long-term policy-targets. In fact, these life-style patterns could be monitored through statistical data from the life-style survey on households. Of course, a series of research on Green Life-style Indicators (GLIs), which is a statistical tool for checking the life-style patterns, has been conducted.

First of all, a project on development of GLIs has been carried out. After that, potential indicators were reviewed and an indicator set on the green life-style was selected. Next, research on survey methodology was executed in order to collect data for these indicators. In practice, a Green Life Survey on households was conducted in the field, and administrative data were also collected. After the editing process of data was finished, Green Life-style Indicators (GLIs) were compiled. Just after that, GLIs could be used to evaluate green life-style policies and publicized to members of society.

3.2 Sample Frame for the Survey

The Green Life-style Survey is designed to help researchers understand the level of green activities and their patterns in citizens' daily lives. This survey was first conducted in May of 2011. The questionnaire consisted of 41 items. As a sample, 9,700 households were selected nationwide, and about 19,000 household members who were more than 20 years old were interviewed concerning their green life-style.

The second survey was conducted in March of 2013. The number of items in the questionnaire increased from 41 to 46. The sample size for the survey was 9,750 households, similar to that of the first survey. Hence, about 19,000 household members who were more than 20 years old were interviewed in the field over a 10-day period.

3.3 Framework and Use of GLIs in Korea

Green Life-style Indicators (GLIs) have 3 categories with 7 groups of indicators. The first category, Green Life-style at Home has 4 groups of indicators: purchase of eco-friendly products, efficient use of energy, saving of resources and expansion of methods for re-use, and reduction of polluted materials and solid waste. The second category, Green Life-Style in Transportation includes 2 groups of indicators: installation of habits to use cars economically and use of eco-friendly transportation. The last category, Green Life-style in Community has just one group of indicators collectively called the Activation of Green Life Campaign.

In the website, an on-line program has been launched to publicize green policies. With this program, members of society can check their green life-style personally in 4 fields: purchase, home, transportation, and workplace. In addition, they can calculate scores of personal habits in this program directly. Furthermore, they may compare their scores with household averages in the surveys. For example, Mr.Kim, displayed on the screen, has the best green life-style because of the high scores, 96.2, 79.8, 66.7, 100.0, which are recorded respectively in the fields of Green Purchase, Green Home, Green Transportation, and Green Workplace. The average of scores, 85.7, is 23.1 points higher than the average of household 62.6.

4. A Development Strategy of SEEA-CF

4.1 Current Activities on SEEA-CF

Concerning the environmental-economic accounts (EEA), two kinds of statistics have been compiled in Korea.

First, the environmental protection and expenditure accounts (EPEA) has been compiled since 2006. The EPEA for 2004 – 2006 was developed by the Bank of Korea, and was approved as an official statistic by Statistics Korea. However, the EPEA for 2007 was compiled together by the Bank of the Korea and Ministry of the Environment according to the transfer plan of a compilation agency. Since then, the EPEA has been compiled by the Ministry of Environment and the Korea Environment Institute. The EPEA consists of 3 main tables and 1 appended table: A, B, B1, and C. “A” is a table on environmental protection expenditure, “B” is a table on production of environmental services,“B1” is a table on supply and use of environmental services, “C” is a table on financing of environmental protection expenditure. These tables are compiled according to Classification of Environmental Protection Activities and Expenditure (CEPA 2000). In contrast to the EPEA, the Environmental Protection Expenditure and Revenues (EPER) was compiled at the request of the OECD. In practice, 4 kinds of data sources are used for the compilation of the EPEA and EPER: budgetary documents and reports of central and local governments; survey data and statements of the business sector; survey data on environment industry; and administrative records.

Second, the statistics on the Environmental Goods and Services Sector / Industry (EGSS) has been compiled officially by the Ministry of Environment and the Korea Environment Corporation. As an initial pilot study, the Environment Industry Survey for EGSS statistics was implemented three times in 2000, 2002, and 2004 by Statistics Korea and the Ministry of Environment. As a result, this statistic was approved officially by Statistics Korea, and since then, has been published annually as the Report on the Environment Industry Survey. Due to difficult conceptual definitions of cleaner technologies and products, this statistic covers two of 3 groups suggested by the EGSS: the Pollution Management Group and Resource Management Group. In the Pollution Management Group, there are the production of equipment and specific materials, construction and installation, and provision of services. Among the Resource Management Group, it covers only water supply and recycled materials. However, the Survey on Environment Industry covers 109 classes of a total of 148 classes (sub-industries) of Special Classification of Environment Industry in Korea, which is made according to the EGSS Classification.

4.2 Future Activities on Implementation of SEEA-CF

Now, the long-term schedule for the development of the Korean SEEA is being suggested, and in a short time, the implementation plan will be prepared in detail if the statistical infrastructure for the SEEA is reviewed and redesigned. Recently, the development strategy concerning the Korean SEEA is being reviewed, and only the long-term schedule for SEEA development from 2014 to 2022 has been set-up. In addition, principal directions and potential targets for the long-term development have been reported with this schedule to the National Statistics Committee.

First of all, the statistical infrastructure for the development of the Korean SEEA will be reviewed, in particular, for physical flow accounts and environmental asset accounts. After that, the Cooperation Network between government agencies and the Technical Advisory Group (TAG) will be established in order to elaborate on work programs of the development process and get some support for required knowledge such as economics, ecology, geology, physics and chemistry. If these preparations were completed, then practical action plans and detailed accounts should be prepared for implementation of the Korean SEEA. Of course, existing challenges for pilot studies concerning some accounts will continue to progress.

4.3 Research Agenda on SEEA-CF

Practically, compilation methodologies on some accounts of the EEA have been studied since 2012 as a pilot study in Statistics Korea. The existing methodology on EW-MFA, which was designed in the past by the Korea Environment Institute, has been reviewed in 2012 by the Statistical Research Institute (Statistics Korea), and a pilot compilation of EW-MFA is being conducted with a target of completion at the end of 2013. However, many data sources should be collected from various agencies such as the Korea Environment Corporation and the Korea Customs Service.

The methodology on Air Emissions Accounts has also been studied according to existing compilation guides or manuals in 2012. Moreover, emissions were estimated for 6 non-greenhouse gases: CO, NOx, SOx, VOC, PM10, NH_3. In 2013, the estimation of emissions is conducted for 6 greenhouse gases (CO_2, N2O, CH_4, HFCs, PFCs, SF_6), but focuses on re-classification of greenhouse gas inventory statistics, which are compiled as an official statistic approved by Statistics Korea.

In 2014, EW-MFA and Air Emissions Accounts will be reviewed again in detail, according to aspects of statistical tables and compilation methods, in order to be approved officially. If they are approved as official statistics, their accounts will be released and used by policy makers and researchers.

5. A Compilation of Green Industry Statistics

5.1 Green Industry and Green Products

A Green Industry is defined as a group of industrial special activities for achieving green growth with low carbon. These activities produce green products which can *enhance efficiencies of energy and resources, minimize environmental pollution, and protect or improve the environment* in economic activities. This conceptual definition is based on the "Low Carbon-Green Growth Law 2" and "Green Technology Certification Act 3". Article 2 in the "Low Carbon-Green Growth" Law describes conceptual definitions of green industry and green goods or services. In the "Green Technology Certification Act", there is a list of green technologies which can be applied to producing green goods and services.

Green products need to be listed systematically according to purposes, functions, or other characteristics in order to easily identify green industry and analyze green production activity. In the Korean project, a classification of green products has 4 categories, 15 groups, and 47 classes as shown in Appendix 4. In other words, all green goods and services are classified into the 4 following categories: green energy, pollution control, enhancement of energy efficiency, and enhancement of resource efficiency. Moreover, each category has 3 or 4 groups of lower level classification. The first category of *Green energy* covers products related to alternative energies that reduce fossil fuel use. The second category of *Pollution control* includes products to treat, prevent, or control environmental emissions in the air, water or soil. The third category, *Enhancement of Energy Efficiency*, groups energy efficiency products in the context of reduction of fossil fuel use through conservation of energy or minimization of energy loss in economic activities. The last category, *Enhancement of Resource Efficiency*, contains resource efficiency products to preserve and use sustainable natural resources such as water, raw material, land, biodiversity and the ecosystem.

5.2 Survey Framework

A survey for data on the green industry was designed in the Economic Census of 2010. A question on green activity was designed to be inserted into the census questionnaire. In the original questionnaire, there were 3 items as follows: category of green industry the activity belongs to, detailed descriptions of green goods or services, and sales of green products. The census questionnaire with green items was assigned only to establishments for 9 industries (ISIC Rev.4): 'Agriculture, forestry and fishing (A)', 'Mining and quarrying (B)', 'Manufacturing (C)', 'Electricity, gas, steam, and water supply (D)', 'Sewerage, waste management and remediation activities (E)', 'Construction (F)', 'Information and

communication (J)', 'Professional, scientific and technical activities (M)', and 'Administrative and support service activities (N)'. Also, due to the constraints of survey budget and survey burden caused by the inclusion of small establishments which are expected to have no green activity, establishments with less than 5 workers were not included in the census interview.

Activities in the Green Industry covered almost the same as those in the Environment Goods and Services Sector (EGSS) of EUROSTAT[2]. However, as previously mentioned, the Korean case extended coverage of the enhancement of energy efficiency and resource efficiency.

5.3 Data Collection and Estimation

The survey for data collection was implemented step-by-step in the span of the time schedule. In 2010, a classification of green goods and services and a well-designed questionnaire were prepared. In 2011, data for green activities were collected from establishments for 9 industries through a comprehensive Economic Census of 2010. In 2012, collected data were edited according to rigid rules. Especially, data editing was internally implemented 6 times even during the process of conducting the survey. In addition, data editing was carried out with external information from registered data which was obtained from a number of industry associations and government organizations. A list of green products and a list of establishments with a green technology certificate, which are made by the "Green Technology Certification Act" and "Eco-Energy efficiency Certification Regulation", were most useful for this editing work in identifying practical green products on the borderline. After collecting and editing, code numbers were given to all green goods and services according to the classification system.

Green production and green employment were basically calculated with information on sales of green products. Sales of green products as an indicator of green production were calculated directly with data on the sales at the level of establishment. It was then summed up to industry level and recounted by category and group of green products. Green employment should be estimated using a separate method which is based on strong assumptions, because information on green employment was not collected at the green product level in the Economic Census of 2010. For example, if an estimation method has a strong assumption that the sales ratio of green products equals the employment ratio for production of these green products at the establishment level 5, green jobs in employment of each establishment could be calculated straight from existing survey data. Of course, green jobs may be inferred to be jobs which are allocated for the production of green goods or services. Just now, green jobs could be aggregated to industry level and recounted by category and group of green products like the estimation process for green production.

6. Use of Indicators and Statistics in Policy

6.1 Utilization of Indicators and Statistics

Statistics for Green Economy including Green Growth Indicators (GGIs) and Green Life-style Indicators (GLIs) will be utilized in 6 fields: Data Service, Development of Statistics, Policy Evaluation, Making Credible Policy, Comparison between Countries, and Check of Progress.

First, GGIs and GLIs can be utilized to provide service of statistical data on policies for Green Economy. In fact, the database on GGIs and GLIs has been constructed and open to the public for members of society in various fields. Second, as mentioned earlier, required data for green growth policies and a green revolution strategy could be identified within a framework of GGIs and GLIs. In addition, the quality of existing indicators could be improved because statistical data or administrative records would be collected during the implementation process of green policies. Third, GGIs and

[2] EUROSTAT (2009) was published as a data collection handbook on environmental goods and service sector.

GLIs could be utilized in the evaluation process of Green Growth policies and Green Revolution in life-style. For example, present values in GGIs may be compared with policy targets, and then, green policies with lower levels than these targets should have been promoted. Forth, progress level of policies for Green Economy could be checked with trends of GGIs, GLIs, and other statistics on the environment, and then reform of these policies could be considered by policy makers. Fifth, Statistical measurements for progress of Green Economy could be utilized in comparison to environmental status between Korea and other countries, and then, some issues could be derived from such comparison. Finally, policy makers could prepare more credible policies for Green Economy and ultimately a high-level wellbeing Society, and even revise these policies for their better outcome through feedback of assessment with statistical data.

6.2 Website on Statistical Data for Green Economy

In Korea, a website on statistical data for Green Growth strategy has been designed and operated to provide information to the public. Of course, in this website, the database on GGIs and GLIs has been constructed. In addition, the website includes Sustainable Development Indicators (SDIs). (The website address GGIs is http://green.kostat.go.kr)

As mentioned earlier, Korea's Green Growth Indicators consist of 30 time series. In a database, Green Life-style Indicators consist of 41 indicators on Awareness and Action of Household and 13 indicators on Performance of green life-style. Sustainable Development Indicators consist of 77 indicators in 3 categories. Environment Performance Indexes are compiled with 22 time series. In particular, the composite index is calculated by applying the same weights or voluntary weight which users can control on the web-site.

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Appendix1. Relationship between green growth/green economy and sustainable development

1) Green Economy and Sustainable Development

The Green Economy according to UNEP is defined as an economy that results in “improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities” therefore, an economy that is “low-carbon, resource efficient and socially inclusive”. In a green economy, “growth in income and employment are driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services”. The “key aim for a transition to a green economy is to enable economic growth and investment while increasing environmental quality and social inclusiveness”.

The green economy approach is also an “attempt to unite under one banner a broad suite of economic instruments relevant to sustainable development”. Additionally, the green economy has to take care of the three pillars of sustainability (environmental protection, social equity and economic development) as being a tool for sustainable development and not its substitute. Nevertheless, apart from achieving a balanced approach on the three pillars of SD poverty eradication should be kept as a primary objective.

2) Green growth and Green economy

Conceptually, *Economy* means "static" or "result" while *Growth* emphasizes "change" or "power". Green economy emerged prior to the OECD's Green Growth Strategy (GGS) and Low-carbon Green Growth in Korea. The scope of Green growth is narrower than that of Green Economy. However, from the view point of both policy framework and measurement framework, Green Growth is more concrete strategy.

The OECD Green Growth Strategy is targeting a democratic market economy. Being compared to Green Economy, the approach of the OECD GGS is based on the principles of more advanced market economy. Green economy includes "de-growth" and takes into account developing countries and under developed countries; “Green Economy also allows for shrinkages and reductions (selective de-growth) where those are also needed, (...)” (Green Economy Report UNEP 2011)

< Official definitions for SD, GE, GG>

Sustainable Development (UN WCED):
The ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs

Green Economy (UNEP):
Economy that results in human well-being and social equity, while significantly reducing environmental risks and ecological scarcities, which is low carbon, resource efficient and socially inclusive.

Green Growth Strategy (OECD):
Green growth means fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies. To do this it must catalyze investment and innovation which will underpin sustained growth and give rise to new economic opportunities.

Low Carbon & Green Growth (Korea):
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. (Law on Green Growth, Article 2)

Appendix2. A Set of Green Growth Indicators (GGIs) in Korea

3 Strategies	10 Policy agendas	Green Growth Indicators	Trends
Mitigation of Climate Change and Energy Self-reliance	Effective reduction of greenhouse gas emissions	GHG emissions per unit of GDP	↘ ↗
		Total GHG emissions	↗
		GHG absorption by forests	↗
	Enhancement of energy self-reliance for post petroleum paradigm	Energy consumption per unit of GDP	↘ ↗
		Self-development ratio of oil and gas	↗
		Share of new and renewable energy	↗
	Strengthening capacity to adapt climate change	Self-sufficiency ratio of food	↘ ↗
		Accuracy of rainfall forecast	↗ ↘
		Share of disaster prevention budget in government budget	↗
Creation of New Engines for Growth	Development of green technology for growth engine	Share of green R&D in government R&D expenditures	↗
		Share of total R&D expenditures compared with GDP	↗
		Number of international patent applications	↗
	Greening existing industries and fostering green industries	Domestic material consumption per unit of GDP	↘
		Share of sales in environmental industries compared with whole industry	↗
		Sales in new and renewable energy industries	↗
	Improvement of industrial structure for large service industry	Share of value added in service industries compared with whole industries	↗ ↘
		Share of value added in knowledge industries compared with whole service industries	↗
		Share of GDP in information and communication industries compared with total GDP	↗
	Engineering structural basis for green economy	GHG reduction purchased by government	↗
		Number of ISO14001-certified businesses	↗
		Share of environmental taxes in government overall revenues	↘ ↗
Improvement in Quality of Life and Enhancement in National Status	Building green territory and green transportation system	Urban green space per capita	↗
		Share of public transit in passenger transportation between different regions	↗ ↘
		Share of environmental protection expenditures compared with GDP	↗
	Green innovation in daily life	Household energy consumption per capita	↘ ↗
		Municipal water use per capita	↘
		Municipal waste generation per capita	↗ ↘
	Becoming a role model nation as green growth leader	Certification for GHG emission reduction under CDM	↗
		Share of ODA disbursements compared with GNI	↘ ↗
		Share of green ODA in ODA disbursements	↗

Appendix3. A Set of Green Life-style Indicators (GLIs) in Korea

3 Domains	7 Areas	Indicators
Home	Purchasing eco-friendly products	Purchasing products with eco symbol
		Purchasing low-carbon products
		Purchasing energy efficient products
		Purchasing organic foods
		Purchasing local foods
		Checking food additives
		Purchasing refill products
	Energy Efficiency	Unplugging electronics when not in use
		Wearing long underwear in winter
		Using energy efficient electrical appliances
		Maintaining proper indoor temperature in summer & winter
	Resource saving and recycling	Saving water
		Separating recyclable wastes by material type
		Using recycled cartridge or refill
	Reducing waste	Reducing synthetic detergent
		Reducing food waste
		Using reusable grocery bags
Transportation	Eco-driving	Participating in the no-driving every-5th-day system
		Recording information for car management
		Practicing eco-driving
	Using eco-friendly transportation	Commuting by public transport
		Commuting by bicycle
Community	Environmental Issues	Level of concern about climate change in daily life
		Opinions on environmental degradation caused by human lifestyle
		Participating green movements
		Opinion on dealing with environmental problem
	System for green lifestyle	Awareness of carbon point system
		Awareness of eco mark
		Awareness of carbon footprint mark
		Awareness of energy efficiency grade mark
	Green lifestyle at work	Using own cup
		Separating recyclable wastes at workplace
		Unplugging electronics at workplace when not in use
		Reusing paper at workplace

Appendix4. Classification of Green Products in Korea

Category	Group	Class
1. Green Energy	**11. Renewable Energy**	Solar energy, Solar heat, Wind power, Bio energy, Ocean energy, Geothermal heat, Water power, Waste energy, Other renewable energy (9)
	12. New Energy	Fuel cell, Hydrogen energy, Clean fossil energy (3)
	13. Other Green Energy	Nuclear power (1)
2. Pollution Control	**21. Air Pollution**	CO_2 treatment, Non-CO_2 treatment (2)
	22. Waste/Waste Resource	Collecting or Recycling waste/waste resource, Waste/Waste Resource treatment, Other services on Waste (3)
	23. Soil/Water	Wastewater/Excrement treatment, Water purification, Soil purification and eco-friendly detergent, Other purification activity (4)
	24. Other Pollution Control	Eco-friendly agricultural production, Purifying indoor air, Noise/Vibration reduction, Other control activity (4)
3. Enhancement of Energy Efficiency	**31. Green Home & Green Commercial**	New light source with high-efficiency, Home appliance with high-energy efficiency, Other energy appliance (3)
	32. Green Transportation	Green car, Intelligent transportation system, Other green transportation (3)
	33. Green Architecture	Building with high-energy efficiency (1)
	34. Other Energy Efficiency	IT on Power, Energy storage, Green computing/SW, Other activity with energy efficiency (3)
4. Enhancement of Resource Efficiency	**41. Water Resource**	Ocean resource, Water reuse, Leakage protection and water saving (3)
	42. Forest Resource	Recycling waste paper/timber, Establishment of Green space, Forest resource management (3)
	43. Mineral Resource	Recycling or Remanufacturing mineral resource (1)
	44. Other Resource Efficiency	Ecosystem protection, Preservation of biological diversity, Natural disaster prevention (3)

Appendix5. Sales and its Share of Green Production by Industry and Category

(Unit: Billion Won, %)

Industry (ISIC Rev. 4)	Category of green products				
	Sub-total	Green energy	Pollution control	Energy efficiency	Resource efficiency
Sales totaled in 9 industries (Billion Won)	92,501	19,943	21,557	28,167	22,834
B. Mining and quarrying & C. Manufacturing	41,397	8,504	7,033	17,501	8,360
D. Electricity, gas, steam, and water supply	11,133	7,101	10	4,022	-
E. Sewerage, waste management and remediation activities	12,259	23	6,874	-	5,362
F. Construction	15,408	2,442	4,946	302	7,718
M. Professional, scientific and technical activities	10,987	1,854	2,573	6,085	476
Other Industries (A, N, J)	1,316	18	121	257	919
Shares by category in 9 industries (%)	100.0	21.6	23.3	30.5	24.7
B. Mining and quarrying & C. Manufacturing	100.0	20.5	17.0	42.3	20.2
D. Electricity, gas, steam, and water supply	100.0	63.8	0.1	36.1	-
E. Sewerage, waste management and remediation activities	100.0	0.2	56.1	-	43.7
F. Construction	100.0	15.9	32.1	2.0	50.1
M. Professional, scientific and technical activities	100.0	16.9	23.4	55.4	4.3
Other Industries (A, N, J)	100.0	1.4	9.2	19.6	69.9