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The Current Status of Green Growth in Korea: Energy and Urban Security□□韓国における「緑」の成長の現状―エネルギーと都市の安全性

David von Hippel, Sun-Jin YUN, Myung-Rae Cho

The Current Status of Green Growth in Korea: Energy and Urban Security[1]

Sun-Jin YUN, Myung-Rae Cho and David von Hippel

Introduction

The Republic of Korea's economy has been one of the economic marvels of the last few decades, growing rapidly and steadily, with few downturns. By 2010, the ROK had the world's 12th largest GDP, and ranked 10th among nations in electricity consumption and production, 10th in gas imports, 9th in oil consumption, and 4th in oil imports.[2] The ROK has become an international force in several industries, including steel, automobiles, and electronics, and has experienced a large increase in the living standards of its people, as well as in urbanization. Much of the ROK's energy needs are supplied by imports, and the ROK has embraced nuclear power as a key source of electricity.

The last decade has seen some transitions in the ROK energy sector, including a partial restructuring of the electricity sector, expanded investment in oil and gas producer nations, and a drive to export nuclear technologies. In August 2008, President Lee Myung-bak announced "low carbon green growth" as a "new national development paradigm" in his speech on the 60th anniversary of national independence. The years since that announcement have seen the development, and the very early phases of implementation, of green growth principles in South Korea, and of policies related to the reduction of greenhouse gas emissions.

This paper explores the energy sector and energy security policies in the ROK, describes the genesis and current status of green growth and GHG emissions reduction policies and projections, reviews the strengths and weakness of existing green economy policies, and suggests how green economy and energy security policies in the ROK can be developed and carried out.

Overview of the energy and economic situation in the ROK

As of the end of the Korean War, the ROK's economy and infrastructure, to the extent that it had survived the ravages of the conflict, was largely agricultural, with most energy provided by biomass (wood and crop wastes) and from the ROK's modest reserves of anthracite coal. The country's rapid industrialization, particularly in the last 30 years, has been fueled largely with imported energy, such that as of now only a small percent of energy is supplied from domestic sources, and much of that is combustion of municipal and other wastes. By 2010, domestic coal constituted only about 1.8 percent of total ROK coal use, and much less than one per cent of total energy use.[3]

Figure 1 shows trends in ROK GDP, primary energy use (that is, including inputs to processes such as electricity generation and oil

refining), and final energy use (use of energy by consumers). Both GDP and primary energy use have increased approximately 5-fold since 1980, with strong growth throughout the period except during the Asian Financial Crisis of 1997-98. As implied in Figure 1 and shown more clearly in Figure 2, the trend in intensity of energy use, that is, the use of energy per unit of ROK GDP, has shown two distinct trends: increasing (more energy use per unit GDP) until about 1997, then slowly decreasing, through 2007, due to a combination of greater efficiency of energy use and a slow shift to less energy-intensive industries. Although growth in energy consumption exceeded growth in GDP in every year from 1988 through 1997, since 1999, growth in GDP has exceeded growth in energy consumption in every year except 2003. Electricity consumption has grown faster than primary or final energy consumption as ROK consumers as end-uses of electricity have increased faster than those for other fuels.

Figure 1: GDP, Primary Energy Use, and Final Energy Use in the ROK, 1980 - 2009[4]

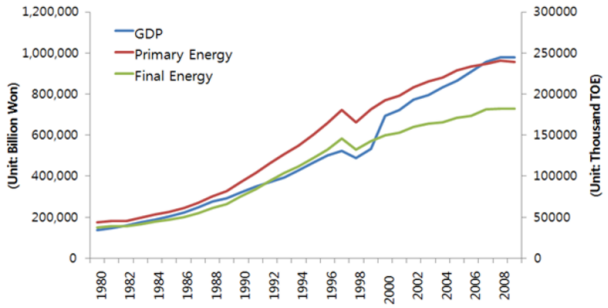


Figure 2: Trends in Economic and Energy Sector Activity in the ROK, 1990 - 2009[5]

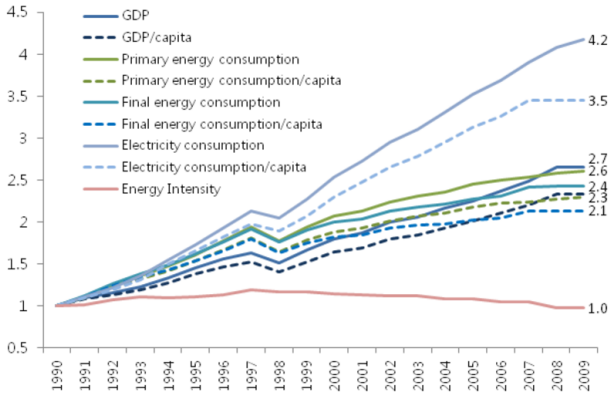


Figure 3 provides a schematic summary of energy supply and demand in the ROK as of 2007. Here "exploitation" denotes extraction of resources, either in the ROK or abroad, with "self-exploitation" meaning resource extraction controlled by Korean firms. "Introduction in Figure 3 means moving resources to the ROK. In 2009, 96.4 percent of energy resources were imported. Primary energy, denoting energy forms before they are processed into the fuels, electricity, and heat used by final consumers, was 42.1 percent crude oil (over 80 percent of it from the Middle East) and oil products in 2009, with LNG 13.9 percent, bituminous coal, mostly for power plants, 25.8 percent, and nuclear energy (as input to 34.1 percent of electricity generation) 13.1 percent. Anthracite coal and new and renewable energy comprised the remainder of less than 5 percent of energy needs. As shown in Figure 4, one of the most notable changes in the last two decades in the ROK energy sector has been the increase in the use of natural gas, with a corresponding decrease in the use of oil. Industry still consumes the majority of final energy use in the ROK, with nearly half of industrial energy use being feedstock materials, mainly the oil product "naptha", which is used as an input in the petrochemical industry.

Among industries, as shown in Figure 5, the energy-intensive subsectors (iron and steel, non-metallic products including cement, and petrochemicals) have accounted for about three

quarters of energy use and about 30 percent of industrial value added over the past two decades, though within the energy-intensive industries there has been a significant shift in the fractions of energy used in producing petrochemicals and away from the other two traditional heavy industries, even as the fractions of value added by heavy industries have remained roughly constant. The largest change since 1990 has been the vast increase in the fraction of industrial value added in the ROK economy that has come from the fabricated metal subsector, including vehicle production, though the fraction of energy consumed in that subsector has risen only modestly. The fraction of industrial energy used and value added produced by the paper and publishing, textile and apparel, and food and tobacco industries has declined over time, and though the fraction of energy used in "other" industries, including, for example, the electronics industry, has increased substantially since 1990, its share of value added has declined.

Figure 3: Flow of Energy Consumption and Production in the ROK, 2009[6]

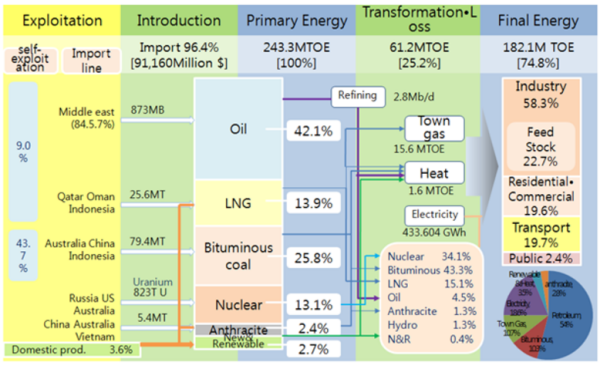


Figure 4: Primary Energy Supply by Fuel in the ROK, 1990 - 2009[7]

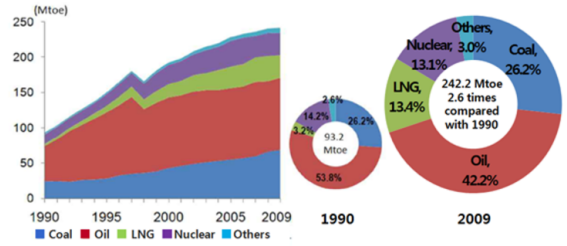
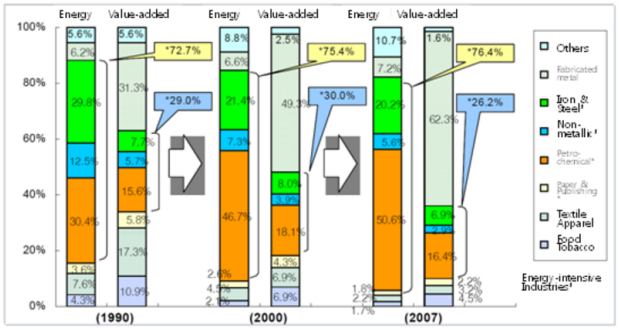


Figure 5: Trends in Industrial Energy Use and Value Added in the ROK, 1990 - 2007[8]



Limited domestic energy resources, a growing manufacturing base in industries highly relevant to nuclear power development, and the desire to develop expertise in nuclear technologies, among other considerations, led the ROK to emphasize nuclear power as an energy supply security measure. 21 nuclear reactors are now under operation, with ongoing expansion expected to result in 28 operating reactors as of 2016. Nuclear generation accounted for 34.1 percent of generation in 2009, and plans call for an additional 6 reactors to be constructed by 2023. By 2010, the ROK's nuclear capacity and generation ranked sixth among the world's nations, its fraction of generation produced by nuclear power ranked fourth among the 10 countries with the largest installed nuclear capacity, and the ROK was first by a wide margin among the top 10 nuclear power users when considering its nuclear capacity per unit of land area[9]. The ROK has also been actively promoting nuclear technology exports, including a recent deal to build reactors in the United Arab Emirates.[10]

The development of the ROK's climate and green economy policies

A combination of factors has focused ROK attention on climate and green economy policies in recent years. Over the last century, climate records show that Korea's temperature has increased by 1.5℃, a rate double the global average (0.7℃), and the temperature in Seoul has increased by 2.5℃[11]. At the same time, the ROK's high energy consumption and near-complete import dependence are strong inducements to reduce exposure to energy supply security risk by developing domestic resources. The ROK also ranks ninth among the world's nations in CO_2 emissions from fuel combustion, and first in the rate at which its GHG emissions grew between 1990 and 2007, more than doubling (increasing by 103 percent) over that span.[12] As of 2007, energy use accounted for by far the largest fraction of the ROK's GHG emissions, at almost 85 percent, with industrial sector non-energy emissions, including emissions of chlorofluorocarbons from refrigeration systems and other sources, sulfur hexafluoride, perfluorocarbons, and other compounds used as solvents and cleaning agents in the electronics and other industries, and CO_2 from cement production, constituting the next largest source of emissions in terms of CO_2 equivalent (CO_2e) at somewhat less than 10 percent.[13] Of energy-related sources of GHGs, energy transformation (dominated by electricity generation) was the largest, at over 36 percent, with industry accounting for 32.4 percent.

The ROK's first major set of climate change-related policies was set out in the 1999 draft of the "1st Comprehensive Counter Plan for the Framework Convention on Climate Change (1999~2001) Act on Countermeasures Against Global Warming." From 1999 through 2007, the ROK's policy responses related to climate changes were modest in scope, calling for emissions reduction from "business as usual" levels that were not particularly aggressive, and were protective of what was seen as the required increases in energy use to drive a growing economy. Figure 6 summarizes the Basic National Plan for Energy as of 2008, in which growth in energy use slows from the levels of the last decade, but overall energy use continues to climb, even with a program of demand-side management (DSM) assumed to be implemented. In 2008, however, as indicated in Table 1, a major change occurred in the ROK's climate policies, which shifted from what can be termed a "defensive" position to one that is relatively proactive in addressing climate issues. Though the Lee Myung-bak administration began its tenure with an emphasis on high economic growth supported by a massive scale of civil engineering development, its second year (2008) saw a sudden turn toward green growth. This policy change was underscored by presidential announcements, at G20 meetings in Japan and Italy in 2008 and 2009, of ROK plans for significant mid-term GHG emission reduction targets, followed by the release in August 2009 of three scenarios for reduction targets produced by The Presidential Committee on Green Growth. Both domestic and international considerations played into the Lee administration's change in approach. In his speech on the 60th anniversary of national independence, President Lee emphasized green growth as a "new national development paradigm" to allow coming generations to secure a reasonable standard of living, in contrast to the focus in the previous 60 years on economic growth and export targets, with reductions in GHG emissions as a key indicator of "low carbon green growth." At the same time, the administration sought to upgrade the ROK's international image by positioning it as an "early mover" in the green economy transition, thus improving the ROK's "brand value" and positioning the ROK as a trusted mediator between developing and developed nations, building on its status as a (relatively) newly industrialized nation with strong economic links to both the developed and

developing world.[14]

Figure 6: Targets of the 2007 ROK Basic National Energy Plan, 2006 - 2030[15]

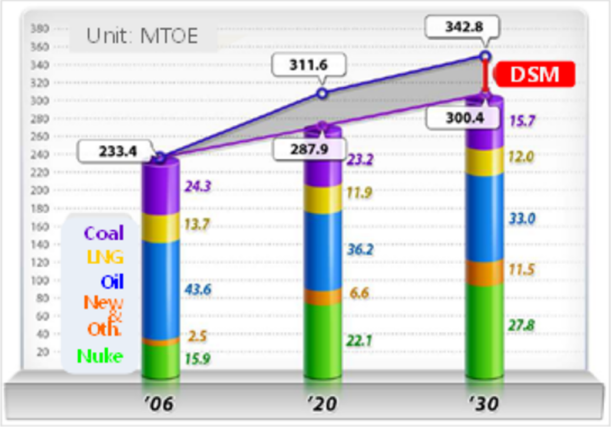
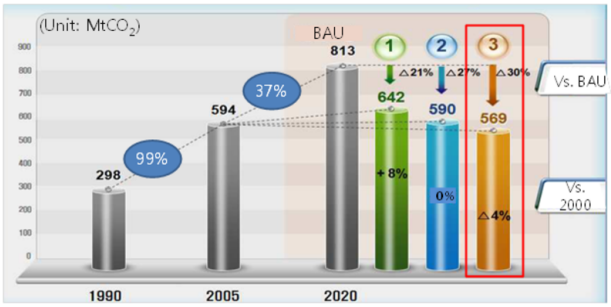


Table 1: Evolution of ROK Climate Policies, 1999 - 2008[16]

Plans	Sector /project	Detail	Note	
The 1st Comprehensive Counter Plan (1999)	4 /36	1. Decreasing GHG Emissions (27) 2. Applying the Flexibility Mechanism(1) 3. Decreasing PFC, HFC, SF6 Emissions (1) 4. Creating Infrastructure of Reducing GHG Emissions (7)	• Korea's first national plan on climate change • A Three-year plan	Defensive Position
The 2nd Comprehensive Counter Plan (2002)	5 /84	1. Building Negotiation Capacity (6) 2. Exploiting technologies for GHG Emissions Reduction (20) 3. Enhancing GHG Reduction Measures (40) 4. Kyoto Mechanism & Building Statistical Database (8) 5. Scaling up citizens' Participation and Cooperation (1)	• Establishing Basic Framework	
The 3rd Comprehensive Counter Plan (2005)	3 /91	1. Establishing foundation of the Implementation of Agreements(30) 2. Reducing Sectoral GHG emissions (45) 3. Building Infrastructure for Adapting CC (16)	• Adding Adaptation Measures	
The 4th Comprehensive Counter Plan (2007)	5 /19	1. GHG Emissions Reduction (6) 2. Climate Change Adaptation (3) 3. Research and Development (4) 4. Building Infrastructure (4) 5. International Cooperation (2)	• Presidential transition period • A Five-year plan	Relatively Proactive Position
The Comprehensive Plan on Combating Climate Change (2008)	4 /176	1. Developing Climate industry as a new economic driving force (48) 2. Improving the Quality of Life and the Environment (106) 3. Contributing to the Global Efforts to Combat CC (12) 4. Key Policy Tools (10)	• "Low Carbon, Green Growth" Vision • A Five-year plan	

The nominal goals of recent ROK climate and development policies are to pursue development of a "new economy coupled with ecology," in effect creating a virtuous circle between economy and ecology, leading to a green economy that can be a new growth engine. Despite the development of an array of related policies, however, it is too early to discern significant actual green economy progress in the ROK resulting from green growth strategies promulgated during 2009 and 2010. Figure 7 summarizes the three target scenarios of mid-term (2020) GHG emissions reduction announced by the Presidential Committee on Green Growth in 2009. Each represents a considerable departure from the pattern of emissions growth to date and from the BAU (business as usual) case. The BAU case includes continued reduction in emissions per unit of economic output that is overwhelmed by increasing affluence on per-capita emissions in the ROK, even as the population begins to decline. The most aggressive of the three target scenarios shown in Figure 7, with 2020 emissions 30 percent below the BAU case and 4 percent lower than in 2005, was adopted by the ROK government in November 2009[17] and submitted to the UN in January of 2010.

Figure 7: Mid-term Target Scenarios of GHG Reduction in the ROK[18]



Following President Lee's speech on the 60th anniversary of National Independence, (August 15, 2008), all ministries were almost immediately engaged in producing policy programs to institutionalize green growth strategy, with competition between ministries not uncommon. In just over 5 months between August 2008 and January 2009, the following policy programs (and others) were put forward, all focused on developing new energy and industrial technologies and generating jobs in the field of green economy:

- The National Energy Basic Plan, and Industrial Development Strategy for Green Energy

- The Basic Plan for Comprehensive Action against Climate Change
- The Long-term Master Plan for National R&D on Climate Change
- The "Green New Deal"
- Comprehensive Measures for R&D (Research and Development) on Green Technologies
- The Vision and Development Strategy for New Growth Power

The three institutional pillars for Green Growth in the ROK to date have been the establishment of the Presidential Commission on Green Growth in January 2009, the launching of the National Strategy and 5 Year Plan for Green Growth in July of 2009, and legislation of the Framework Act on Low-Carbon Green Growth in December 2009, which went into effect on April 14, 2010. A "5 Year Green Growth Plan" had as its vision elevating the ROK to the 7th leading "Green Power Country" as of 2020, and to 5th by 2050, based on three strategies and 10 policy directions:

- Strategy 1: climate change adaptation and energy independence, including effective reduction of GHG emissions, reduction of petroleum use and increasing energy independence, and strengthening of the ROK's adaptation capability against climate change impacts.
- Strategy 2: creation of "new growth power" through green technology development and its utilization to promote new growth power, greening industries and promotion of green industries, deepening of the ROK's industrial structure, and building the base of the green economy.
- Strategy 3: quality-of-life improvement and upgrading of national status through construction of "green territory"—meaning developing green spaces and the planting of trees and other vegetation throughout Korea, in all settings from urban to rural—and green transportation systems, green reform of the patterns of everyday life, and embodiment of the global model nation of green growth.

To implement these strategies, the ROK was to spend 107 trillion won (107 billion US dollars) on green growth projects between 2009 and 2014, equivalent to 2% of GDP, with an annual growth rate of 10.2 percent. Of the total green growth investment, however, about 20 percent was allocated to the "Four Major Rivers" project, which Korean civil society has criticized as a civil engineering project that will "kill green rivers."[19]

Strengths and weaknesses of current ROK green economy policies

Although the green energy policies developed during the last few years are a notable departure, at least nominally, from earlier policies, it is not clear that the policy shift represents a heartfelt conversion to the green economy concepts as defined above. Rather, ROK green economy policies to date have tended to focus on establishment of techno-bureaucratic and hardware-oriented institutions for green growth, and have resulted in over-politicization of green growth without building much of a constituency and concern for green growth among the general public. Rather than improvements in the environment, the last few years have arguably seen a deterioration of the environmental performance of the national economy. The 2010 Environmental Performance Index released by the World Economic Forum rated the ROK 94th among 163 countries, a drop of 43 places since 2008, and the lowest ranking among OECD member nations.[20]

It can be argued that "green growth" as currently implemented in the ROK is a largely a product of conceptual and ideological degradation of previous meanings of the term. The "two ecos" (economy and ecology) have

been at the heart of environmental policy in the ROK since the Kim Dae-Jung Government (1998-2003). Moreover, sustainable development, a higher-level conception of green growth, was instituted as a national priority policy during the Kim Dae-Jung and Roh Moo-Hyun Government (2003-2008). Current advocates of green growth in the ROK misinterpret sustainable development as a West-centered and ecology-biased concept, and thus not suitable for the ROK. There has thus been a process of excluding and discriminating against traditional "green" views, beginning with the downgrading of the original Presidential Commission on Sustainable Development (PCSD) into a ministerial commission under the Minster of Environment, with its policy review position taken over by the current Presidential Commission on Green Growth (PCGG). Although the PCSD was typical of a governance body representing a wide range of different stakeholders, the PCGG is composed almost entirely of pro-governmental techno-bureaucratic experts representing largely business interests and excluding green advocates from civil society. This has resulted, essentially, in representation in green-growth policymaking limited to advocates of "market-driven green growth." When the second term of the PCGG commenced in July 2010 and took up the theme of market-driven green growth in its 8th general meeting, suggestions from the industrial and business community were the primary topics debated, with business and allied interests complaining that green growth policies included in proposals offered "only green, no growth", the reverse of the "only growth, no green" complaints of the environmental community voiced at an earlier stage of the green growth policy debate.

As a result of this shift in how the green growth concept is put into practice, the prospects for fundamental reform of the ROK's environmental performance based on current policies are limited by the paradox of the ROK's policies of green growth and the green economy. Essentially, at present, these policies emphasize the economy first, and "green" second. The current green growth strategy comprises two key approaches: 1) "low-carbonization", meaning reduction of greenhouse gas emissions and other environmental pollution to accomplish "defensive green growth", and 2) "green industrialization", meaning generation of new growth, power, and jobs for "offensive green growth." These priorities are reflected in the chapter structure of the "Framework Act on Low-Carbon Green Growth," which read:

1. Promotion of Green Economy and Industry
2. Measures for Climate Change and Energy
3. Construction of Sustainable Territory and Environment

Operationally, in green growth policy implementation priority is placed on "the promotion of green economy and industry," while policies that address climate change and energy security, sustainable land use, and other environmental causes are implemented only to the extent that they support the priority agenda. This reveals the standpoint of the current Korean government that "the economy (growth) is first, green is second." Such growth, even if considered "green", is unlikely to result in significant environmental gain due to the following chain of logic. First, the linkage between low-carbon development and green industrialization is "green technology." Green technologies, in turn are eco-efficient technologies that offer a relative reduction in the amount of environmental pollution per unit economic (resource and energy) input, but do not necessarily imply that the absolute amount of environmental pollution produced by the economy will actually be lower than in "business as usual" or some other policy scenario. This further implies that the more green growth based on the principle of eco-

efficiency is successfully pursued, the more environmental pollution it generates. As a result, the green economy generated by the ROK's current green growth policies is likely to end up being neither sustainable nor secure.

The ROK's "green growth" energy policy may be efficient, but by more standard global definitions of the concept, is rather un-green. Although the ROK's 2020 target of greenhouse gas reduction is 30 percent of the 2020 BAU emissions estimate, on closer examination the largest portion of green energy included in policies to achieve the target comes from nuclear power, a type of efficient but un-green energy. Nuclear power use is planned to increase from 36 percent of total 2007 power generation to 59 percent in 2030, in so doing absorbing the largest share of the budget for green technology development (35.9 percent in 2009).

This planned nuclear development, however, is not without opposition in the ROK. Within a few years, the ROK's existing sites for nuclear power plants will have all of the reactor units they can reasonably accommodate, and new plant sites will be required. As of 2010, although almost 90 percent of ROK residents acknowledged the need for nuclear power, a growing number (over 50 percent) were concerned about nuclear safety, and just over a quarter (27.5 percent) of survey respondents found the prospect of new nuclear plants in their own communities acceptable.[21] Many experts consider it likely, in the aftermath of the Fukushima accident, that a similar survey would find less positive public perceptions of nuclear power in the ROK. In reality, however, there was little change in the support for nuclear power among the Korean public. In a public opinion survey carried out by WIN-Gallup International from March 21 to April 10, 2011, the fraction of respondents favorable to nuclear power in Korea was 64 percent, down only marginally from 65 percent before the Fukushima accident, though the fraction of respondents describing themselves as unfavorable to nuclear power increased from 10 percent to 24 percent. These polls suggest that in spite of the fact that one of the two worst nuclear reactors accidents in history had just occurred in Japan, there is broad pessimism within the ROK public that there is no practical alternative to nuclear power for Korea. The Korean government has publicly announced, following the Fukushima accident, that there will be no change in ROK nuclear power expansion policy.

Meanwhile, under current government plans, renewable energy, a form of green energy, will continue to occupy a minor proportion of the total energy consumption over the coming 50 decades, rising from 2.7 percent in 2009 to only 6.1 percent in 2020, and only then to a more substantial 30 percent in 2050. Korea's green growth strategy seems to see renewable energy technologies as merely a new economic growth engine, rather than as energy sources required for energy and environmental transitions. The ROK government has nevertheless announced its intention to implement renewable portfolio standards starting in 2012. Under these standards, utility companies would be obliged to produce a specified fraction of the power needs of their customers using power generated from renewable sources. As a result, the development of a network of tidal power generation stations is being planned, though such stations, which involve erecting dams or barrages across the mouths of rivers or bays, can have serious impacts on marine ecosystem, as well as on the local fishing communities and others that depend on those ecosystems for their livelihood.[22] Concern for energy independence as manifested in the ROK's green power policies is not so acute: the ROK's rate of energy independence (the fraction of energy supplies from domestic sources) excluding nuclear power in 2007 was 3.4%, but rose to 16 percent if nuclear power is considered a domestic resource (though the ROK imports

nuclear fuel and licenses some nuclear technologies from other nations). There is no clear target for energy independence based on green energy. As the ROK's export-oriented economic growth system operates almost entirely through the import of cheap energy from overseas, the claim of a goal of energy independence by application of current policies appears rhetorical at best even in the very long run, and only then with the most aggressive fuel substitution policies. This likely lack of progress on energy supply security implies that without changing Korea's economic growth regime—which is sustained by energy efficiency (measured as income per unit energy use), which is the lowest (that is, its energy intensity is the highest) among OECD countries, in part because of the concentration of heavy industries in the ROK—substantially improving energy supply security seems unfeasible under current green growth policies.

Thus, the Korean government's policy is to continue to pursue the expansion of the ROK's nuclear power sector even with the Fukushima accident as a sobering reminder of the risks of nuclear power. Currently, Korea has 21 reactors (18.7 GWe) in operation, 7 reactors under construction, 4 reactors under preparation for construction, and 2 additional reactors for which planning is complete. In 2010, nuclear power accounted for 12.2 percent of national primary energy use, 24.8% of total installed generation capacity, and 34.1 percent of total electricity generation. The government plans to expand the share of nuclear power to 41 percent of total installed capacity, producing 59 percent of total electricity output, by 2030. Korea is the only country that is building new reactors and planning to further expand its nuclear power use among the 10 countries with the largest current nuclear reactor fleets.[23] As of 2011, Korea ranks 5th in terms of nuclear installed capacity and in terms of number of nuclear reactors. Korea's nuclear density (192.5 kW/km^2), that is, its nuclear installed capacity per unit land area, is the second highest in the world, just behind Belgium (195.7 kW/km^2), which hosts 7 reactor units. Since Belgium has no plan to build additional reactors, Korea will become the nation with the highest nuclear density in the near future. This high density of nuclear facilities, coupled with a relatively high population density, arguably cannot but mean higher vulnerability to nuclear incidents resulting in release of radioactive substances, whether caused by natural forces/accidents or by acts of aggression. In addition, at present, the ROK government has no firm plans for long-term spent fuel management/disposal, though investigation of several potential paths (some with significant drawbacks) is underway.[24] Despite these considerations, the government continues to tout nuclear as the primary power source for Korea's future green growth.

A substantial fraction of the ROK's green growth program is an outgrowth of a bias toward large civil engineering projects as drivers of development. As such, the green growth program features arguably "high-carbon" construction of so-called "green cities." In this focus, the green growth strategy stems from the civil engineering approach that the current ROK administration, with its emphasis on civil engineering projects, is pursuing. The Green New Deal program, part of the green growth strategy package, clearly shows this propensity. 64 percent of the total program budget (some 50 trillion won, or nearly half of the total green growth budget) is to be allocated to projects associated with civil engineering work, including the restructuring of four major rivers, generating 910,000 construction jobs out of the total 950,000 jobs estimated to be created by the Green New Deal.

The Four Major Rivers project has been controversial. The Lee Myung-bak government has argued that the project is essential to the green growth movement and to the "Green New Deal" because it offers significant

employment potential while restoring four major rivers. Civil society, however, has resisted the project because dam construction and dredging are its core. These activities, many in civil society argue, will actually kill the four major rivers rather than restoring them.[25] In addition, it is argued that the project actually offers little in the way of employment opportunities, that the jobs that are created by the project, mostly short-term jobs in construction, do not help to solve the major unemployment problem in Korea, namely, providing jobs for a highly-educated younger generation. In response to surveys, more than 70 percent of Koreans polled expressed objections to the project. Though the government announced that around 340,000 jobs will be created, opposing groups argue that only two thousand long-term jobs will be created.[26]

Though the ROK is a highly urbanized society, there is as yet no national target to reduce the total energy consumed and greenhouse gas produced in urban areas, despite the fact that globally cities consume 75 percent of total final energy and produce 80 percent of total GHG emissions. In the ROK, most of the policy efforts planned for the greening of cities tend to be skewed toward constructing new green cities, which are projected to use 30 percent less energy than existing cities, rather than improving the energy efficiency of existing built areas. It is unclear from existing plans whether the considerable GHG emissions used in constructing new cities have been factored into the overall carbon budget for the project, or whether GHG emissions savings will somehow be achieved by retiring existing built areas as new cities are built. As a case in point, the pilot project to build a low-carbon city now underway in the district of Keongpyo in Kangneung (Gangneung),[27] is largely a demonstration of new promising green technology and industry, and is understood by local residents to be primarily a new regional development project.

Typical of the focus on civil engineering in its green growth program is the government's plan to supply 1 million "green homes" as a flagship project for the green economy. The green home project is designed to generate new housing technologies and industries. The approach is typical of top-down government-initiated policy programs, in that it expands the supply of environmentally efficient housing by addressing the "hardware" of the housing stock, with little effort to involve consumers in greening the patterns of their everyday life. By contrast, in Ireland, a program also called "Green Homes"[28] has been initiated by community based organizations. It focuses on greening family life as well as community life, for example, through a "green school" component.

The ROK's green growth strategy, if pursued as currently planned, has a significant probability of running afoul of Jevon's Paradox, which states that as the efficiency with which a resource is used increases, the use of the resource tends to increase as well, absent measures (such as higher taxes) to prevent same, as consumers find they can afford more of the resource. Likewise, it is likely that the more Korea's green growth is pursued, the more energy the Korean economy will consume, and the more greenhouse gases it will produce, because the green growth policies rely heavily on the intriguing principle of eco-efficiency. Thus, more investment in eco-efficient hardware such as passive housing, green industries and green cities will be likely to end up consuming more total energy and producing more total greenhouse gas than is presently produced. Given current policies, higher energy demand will also result in the installation of more nuclear power, with its attendant risk of nuclear accidents as well as production of additional spent fuel, both burdens that would have to be shouldered by Korean society now and far into the future. This implies that Korea's future green economy, if shaped by the current green

growth strategy will be neither sustainable nor secure.

Conclusion: green economy policies in Republic of Korea

The ROK's green growth strategy, as currently formulated, includes some impressive targets and demonstration projects, but at its heart it emphasizes economic growth and national industrial competitiveness rather than being a true plan for "greening" of the Korean economy and society. As such, current "green" policies mainly benefit existing large ROK industries, including the nuclear and construction industries. As a result, energy and urban security in Korea's feeble green economy can be secured only insofar as Korea's current growth policy regime is either abandoned or reborn as a genuine environmental welfare regime. To do so, more autonomy, and likely more resources, should be provided to the civil society organizations that are best placed to initiate greening of the everyday lives of Koreans in cities and towns at the grassroots levels.

Such a shift calls for analysis of what additional inputs nascent local policies will need to succeed, and for a re-alignment of the goals of development of the green economy with those of sustainable development. Such a re-alignment would, among other goals, seek to change patterns of energy consumption in existing cities, pursue a green economy that makes better use of local resources, and reduce the considerable separation between where energy (especially electricity) is produced and where it is consumed. Tools to accomplish such a re-alignment would include energy pricing schemes that favor local electricity generation (such as attractive feed-in tariffs for distributed generation), and promote energy efficiency (such as rates that increase as a household or business consumes more). Efforts should be made to site power plants closer to consumers so as to more closely relate the impacts of electricity generation and transmission to those that use the power (and reduce the impacts on those that do not). Again, support for distributed generation and "smart grid" development can help.

In addition, green economy strategies should seek to improve the affordability of energy services to low-income residents,[29] and acknowledge and seek to take advantage of the fact that after energy consumption reaches a certain level, long since exceeded in the ROK, human welfare, as measured by the Human Development Index, rises very little with increasing energy use.[30] Taking advantage of this pattern, the ROK's green economy strategy should emphasize increasing the availability of energy services to low-income residents, while at the same time aggressively improving energy efficiency overall so that overall national energy use remains stable or even decreases. In this way, green economy benefits can be shared by all.

Existing green growth policies tend to use the types of top-down policy strategies that have been traditional in Korea. Achieving true sustainable energy and economic development, founded on the three goals of economic, environmental, and social sustainability, will require a different approach, one that blends considerations of efficiency and energy supply security with low-carbon and low-pollution systems, as well as a commitment to equity and democratic participation. Energy sector approaches such as efficiency improvement, renewable energy adoption, use of decentralized energy systems, and enhanced participation of residents in energy decisions and the running of energy systems can be combined with other approaches such as changes in land use to promote more balanced and low-impact use of the land, enhanced production and use of local food, and lifestyle transformation.

As part of a sustainable development approach,

expanded local energy use may offer several advantages including:

- **Energy democracy**, providing local residents and citizens' organizations with opportunities (and responsibilities) to participate in production and consumption decisions;
- **A transition to soft path energy**, moving from centralized supply-oriented systems to decentralized, demand management-oriented systems, with expanded use of renewable energy, energy efficiency improvement, and energy conservation;
- **Improving energy security** through efficiency improvement and renewable energy development, thus responding to peak oil and energy resource depletion problems;
- **Improving energy justice** by making local communities more responsible for both the costs and benefits of energy production; and
- **Revitalizing the local economy**, in that money required for energy production and consumption circulates within a community, rather than going out of the community (and often, out of the country).

These approaches to achievement of a green economy by means that emphasize sustainable development by design address issues of energy security, urban security, and climate change.

Sun-Jin YUN, Associate Professor, Graduate School of Environmental Studies, Seoul National University and Editor-in-Chief, Journal of Environmental Studies. She is the author of "Not So Green: A Critique of South Korea's Growth Strategy," Global Asia. Vol. 5, No. 1: 70-74 (2010) and co-author of "Policy Networks Among Actors concerning Introduction of Greenhouse Gas Emission Trading Scheme in Korea: Based on Social Network Analysis," Korean Policy Studies Review*, Vol. 20, No. 2: 81-108 (2011, in Korean).*

Myung-Rae CHO is Professor of Social Sciences at Dankook University and editor of the Quarterly Journal of Environment and Life. He has published on Post-Fordism and Modern Society in Crisis, Searching for a Green Society, Modern Society and City, Development Politics and Green Progress, and Globalization: Looking Back and Getting Beyond.

David von Hippel is a Nautilus Institute Senior Associate based in Eugene, Oregon. His work with Nautilus has centered on energy and environmental issues in Asia, and particularly in Northeast Asia. Current research includes a multi-nation East Asia Science and Security Project, centered around future energy paths, climate change and potential nuclear fuel cycle cooperation. He guest edited and wrote for the "Special Section on Asian Energy Security" of Energy Policy*, (39, 11, November 2011). Other recent publications include the 2011 Nautilus Institute Report* The Path from Fukushima: Short and Medium-term Impacts of the Reactor Damage Caused by the Japan Earthquake and Tsunami on Japan's Electricity Systems*; and "Evaluation of the Energy Security Impacts of Energy Policies", Chapter 3 in* The Routledge Handbook of Energy Security*, edited by B. Sovacool.*

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Notes

[1] This paper is a revised and expanded version of a Nautilus Institute Special Report, "Case Study of Green Economy Policies: Korea." The original report is available on the Nautilus website.

[2] United States Central Intelligence Agency (US CIA, 2011), *The World Factbook*, available here.

[3] Korea Energy Economics Institute (KEEI), *Energy Balances* downloaded from KEEI's energy statistics website.

[4] Korea Energy Economics Institute (KEEI), 2010, *Yearbook of Energy Statistics*.

[5] Korea Energy Economics Institute (KEEI), 2010, *Yearbook of Energy Statistics*

[6] Korea Energy Economics Institute (KEEI), 2010, *2010 Energy Info. Korea*.

[7] Korea Energy Management Corporation (KEMCO), 2010, *Handbook of Energy and Climate Change*.

[8] Korea Energy Management Corporation (KEMCO), 2009, *Handbook of Energy and Climate Change*.

[9] Sources: IEA, 2010, Key World Energy Statistics; National Statistical Office, 2010; Mycle Schneider, Anthony Froggatt, and Steve Thomas, "Nuclear Power in a Post-Fukushima World: 25 Years After Chernobyl Accident," Worldwatch Institute.

[10] Yonhap News, "The Consortium of Korea Electric Power Corporation won a nuclear power contract of 40 billion dollars," 12/27/2009.

[11] Won-Tae Kwon, 2011, "Changes in land use resulting from abnormal climate and natural disaster," *Kugto*, Vol. 353: 18-29. Some of the increase in temperatures measured in Seoul is doubtless due to the increase in the urban "heat island" effect as the city has grown.

[12] Korea Energy Management Corporation (KEMCO), 2010, *Handbook of Energy and Climate Change*.

[13] Korea Energy Management Corporation (KEMCO), 2010, *Handbook of Energy and Climate Change*.

[14] It is possible that this change in the ROK's position was influenced in part by the status of Ban Ki-moon as the Secretary General of the United Nations. Ban began his term as UN

Secretary General in January, 2007.

[15] Office of Prime Minister et al., 2008, *The 1st Basic Plan of National Energy (2008~2030)*.

[16] The authors would like to gratefully acknowledge the assistance of Nyun-Bae Park, Research Professor, Sejong University, ROK, in assembling Table 1.

[17] See, for example, Green Growth Korea (2011), "Greenhouse Gas Reduction Target", available here.

[18] Source: Presidential Committee on Green Growth (PCGG), 2009, "A plan for mid-term National Greenhouse Gas Emission Target Setting" and PCGG website (as above).

[19] The Four Major Rivers project is discussed below.

[20] See, for example, Yale University, "ENVIRONMENTAL PERFORMANCE INDEX 2010, South Korea", Yale University, available here.

[21] Korea Nuclear Energy Promotion Agency, 2010, "Survey Results of People's Nuclear Awareness in 2010."

[22] See, for example, J Wolf, IA Walkington, J Holt, R Burrows (2009), "Environmental impacts of tidal power schemes,"*Proceedings of the Institution of Civil Engineers-Maritime Engineering*, 162 (4). 165-177. Available here.

[23] Though China is rapidly adding to its own nuclear fleet, and will likely soon also be among the top 10 nations as ranked by nuclear capacity.

[24] See, for example, Park Seong-won, Miles A. Pomper, and Lawrence Scheinman (2010), "The Domestic and International Politics of Spent Nuclear Fuel in South Korea: Are We Approaching Meltdown?", Korea Economic Institute Academic Paper Series, March 2010, Volume 5, Number 3, available here.

[25] See, for example, Dennis Normile, "Restoration or Devastation?", *Science* 26 March 2010: Vol. 327 no. 5973 pp. 1568-1570 (available here).

[26] See, for example, Nocut News, 8/23/2011, "Controversy about employment effect of 4 river project" (in Korean).

[27] For a description of the project, see, Kwi-gon Kim (2010?), "Urban Development Model for the Low-Carbon Green City: The Case of Gangneung", available here.

[28] See An Taisce and the Ireland Environmental Protection Agency (2011), "What is Green Home?", available here.

[29] The lowest-income residents of the ROK, the "energy poor", spend a much higher proportion of their income on energy than higher-income residents and tend to use lower-quality fuels (Source: Ministry of Economy and Knowledge, 2008, "Reports of Energy Census")

[30] Source: Martinez and Ebenback, 2008, "Understanding of the role of energy consumption in human development through the use of saturation phenomena," *Energy Policy*, Vol. 36: 1430-1435; UNDP, 2004, "World Energy Assessment"; Amie Gaye, 2008, "Access to Energy and Human

Development," *UNDP's Human Development Report* 2007/2008.