Climate Change Policy in Korea: Challenge and Opportunity for a Sustainable Future

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Korea* is one of the big emitters of greenhouse gases (GHG) in the world. Currently, its total CO_2 emissions is ninth largest (U.S. Department of Energy, 2000). Its per capita emission is 2.6 carbon ton and twenty-fifth in the world. According to recent OECD (Organisation for Economic Co-operation and Development) reports on environmental indicators, Korea recorded the highest increase in per capita CO_2 emissions during the last two decades. And GHG emissions per GDP are increasing. Currently, they stand at 0.49 carbon ton per million won, an increase from 0.46 10 years ago.

The Korean government declared at the Fifth Conference of Parties that the widest possible participation of parties is necessary in order to limit global emissions of greenhouse gases, only if taking such action would not hurt continuous economic growth (Republic of Korea, 1999). It supported an approach to set a target in terms of emissions growth, given a desired rate of economic growth. It further stated that Korea would participate, on a voluntary and non-binding basis, in a regime of limiting greenhouse gases formulated along those lines.

Given the scientific evidence of the global warming and the increasing worldwide pressure for policy responses addressing climate change, the views by the Korean government or any government in a similar situation seem rather weak and confused. This should be understandable because Korea is saddled between its position as a developing country and its status as an OECD member.

What Korea can do in addressing climate change issues depends upon its long-term outlook for greenhouse gas emissions, factors leading to this outlook and the technology available to achieve a desirable level of future emissions. This paper analyzes these elements in order to highlight the constraints and potential for future options. It also reports that economically and technologically feasible responses are available, and Korea should be proactive in utilizing these options.

OUTLOOK FOR GHG EMISSIONS

Korea's high GHG emissions are the result of three decades of rapid industrialization and urban growth. These factors will continue to dominate Korea's economic and social development in the future. Consequently, emissions of GHGs will stay strong.

In the last decade, Korea's total GHG emissions increased at an annual rate of 8 percent, outpacing GDP growth of 7 percent. This was mainly due to the country's energy-intensive industrial structure. The share of steel, petrochemical and cement industries increased despite government's avowed policy of promoting a less-energy-intensive industrial structure. In 1990, the combined share of energy-intensive industries in GDP was 8.4 percent. Recently the share is slightly above 10 percent. The impact on greenhouse gas emissions of a heavy reliance on energy-intensive industries is significant as reflected in the phenomenon that the energy-intensive industries account for 74 percent of greenhouse gas emissions in the manufacturing sector, while their contribution to total manufacturing output is 34 percent.

The energy sector is the main contributor to GHG emissions. About 84 percent of total emissions come from energy sector use. The rest includes emissions from industrial/domestic waste (10 percent), industrial processes such as cement and petrochemical (8 percent), agriculture (3 percent) and absorption by forest (-5 percent). The energy sector is also the leading cause of the rapid growth in total emissions. In the last decade,

*In this article, Korea refers to the Republic of Korea, commonly known as South Korea.

greenhouse gases emissions from the energy sector increased at an annual rate of 8.5 percent, exceeding the total emissions growth of 8 percent. The emissions from industrial operations increased at 7.7 percent per year during the period.

By 2020, the government expects that the energy sector's share in the total emissions will be 82 percent, followed by industrial/domestic waste (11 percent), industrial processes (8 percent), agriculture (2 percent) and absorption by forest (-3 percent). The decline in the energy sector's share reflects an anticipation of a slowdown in energy consumption and increased decarbonization of the energy supply. Overall, the government forecasts a 3 percent annual increase of GHGs by 2010 and thereafter 1.7 percent by 2020. Emissions growth from the energy sector will fall below the total emissions growth rate—2.9 percent by 2010 and 1.5 percent by 2020. The emissions from industrial/domestic wastes are expected to increase at rapid rates of 2.9 percent by 2010 and 3.2 percent by 2020. Total CO_2 emissions will increase to 204 million tons. Carbon dioxide emissions account for 85 percent of total greenhouse gas emissions. Methane accounts for 13 percent, and the rest are nitrous oxides, hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs). The Central Question about future CO_2 emissions is how much further energy consumption can be reduced.

Climate change problems are energy problems (Figure 1). Decisions on energy supply and demand are critical in influencing future emissions of greenhouse gases. Due to the long life of the existing energy infrastructure, options to change energy patterns in the short-term are limited. Opportunities increase when energy infrastructures need replacement or require new investment. Seizing these opportunities is an important aspect of addressing climate change policies and requires a long-term perspective when making energy decisions. The currently available energy outlook for Korea only covers the next two decades. This outlook is reviewed here with a view to highlighting limitations and opportunities for climate change policies.

Korea's energy is driven by fossil fuels and nuclear power. This energy structure has nothing to do with the country's energy resource endowment. Korea's only commercially available indigenous fossil energy resource has been low-grade anthracite coal, which was the major energy resource before the country's industrialization but not suitable for industrial use. When Korea's industrialization programs were launched some 40 years ago, one of the planners' first projects was petroleum refining despite the fact that the country had no domestic oil resources. The energy market in the early periods of industrialization was dominated by two fuels: domestic coal for residential and commercial use and foreign oil refined for industry and electric power plants.

The first oil crisis in 1973 was a blow to Korea's energy system and prompted an all-out drive for fuel diversification for power generation. It convinced planners that oil use in electricity generation should be minimized, and nuclear and imported coal should take a leading role. As a result, Korea's first nuclear power plant began operation in 1977, and its first bituminous coal power plant started up in 1983. By 1985, oil's share in electricity generation was reduced to 33 percent, while new fuels such as nuclear occupied 30 percent and imported coal 24 percent. Ten years earlier, oil supplied 85 percent of electric generation and the rest was domestic coal (6 percent) and hydro (8 percent).

The second oil crisis in 1979 dealt another shock to the energy system. Stunned by oil's instability, planners were convinced that the non-electric sector should also minimize oil dependency. As a result, Korea's natural gas import project was conceived. In 1986, the liquid natural gas (LNG) receiving terminal was completed and Indonesian LNG became available. The government also launched an infrastructure investment for a national pipeline grid. Policies promoting fuel substitution in residential and commercial sectors also were implemented.

Currently, oil accounts for 55 percent of total energy consumption in Korea. Coal occupies 21 percent, nuclear 13 percent, LNG 9 percent, hydro and renewables 2 percent. Most coal is imported bituminous coal. Fossil fuels amount to 85 percent of the country's energy requirement. For electricity generation, fossil fuel

dependency is 50 percent owing to the large nuclear contribution amounting to 47 percent. The rest is shared by coal 33 percent, LNG 11 percent, oil 6 percent and hydro 3 percent.

Much of Korea's energy (84 percent) is for stationary use; mobile use is 16 percent. Industry is the largest stationary energy user (44 percent), with electricity generation (21 percent) and residential/commercial (19 percent) taking up the rest. Oil is the most important fuel in both stationary and mobile use.

Oil demand consists of petrochemical feedstock (29 percent of total oil consumption), transportation use (27 percent), industrial use (15 percent), residential and commercial use (13 percent) and electric generation (4 percent). Coal demand consists of electric generation (52 percent of total coal consumption), coking (32 percent) and cement industry (9 percent). LNG demand consists of cooking and heating in residential and commercial sectors (46 percent), electricity generation (35 percent) and industrial fuels (15 percent). Electricity demand consists of industrial use (56 percent) and residential and commercial sectors (37 percent).

Industrial energy use is highly dependent upon oil (60 percent), with coal supplying 22 percent, electricity 13 percent and LNG only 3 percent. Energy for transportation is almost entirely dependent upon oil (99 percent). Oil is again the dominant fuel in residential and commercial energy use (49 percent), with LNG and electricity providing 24 percent and 21 percent respectively.

In projecting a Business-As-Usual (BAU) official energy outlook, government planners assumed: (1) a slowdown in the annual growth of GDP to 4-5.5 percent range during next two decades; (2) a slowdown in population growth to 0.4-0.7 percent per annum; (3) decline in the energy-intensive industries' contribution to GDP from 30 percent to 25 percent; and (4) overall energy efficiency improvement at an annual rate of 1.8 percent.

On the basis of these assumptions, total energy consumption is projected to increase at an annual rate of 3 percent during the next 10 years, and 1.7 percent during 2010-20. The energy mix in 2020 will still be dominated by fossil fuels despite reduced growth in oil and coal consumption. The share of fossil fuels in the total energy requirement in 2020 will be 80 percent. This consists of oil's share of 49 percent¯a reduction of 6 percentage points from 2000, coal's share of 18 percent¯a reduction of 3 percentage points and LNG's share of 14 percent¯an increase of 5 percentage points. Other sources of energy will increase their share: nuclear from 13 percent to 18 percent and new and renewable energy from 1.5 percent to 1.8 percent.

In electricity capacity investment, nuclear remains supreme. Its share in total power capacity will increase 5 percentage points to 33 percent. The government plans to build approximately 17 new nuclear power plants by 2020. As a result, the share of fossil power capacity will decline: coal by 2 percentage points to 27 percent, LNG by 3 percentage points to 24 percent and oil by 2 percentage points to 8 percent. Renewable power capacity will increase 3 percentage points to 9 percent.

POLICY ACTIONS TO REDUCE GHGS

Against the backdrop of these BAU outlooks for greenhouse gas emissions and energy, Korea's policy actions are aimed at improving energy and materials efficiency in various sectors of the economy and stimulating fuel substitution in the energy system. In 1998, the Korean government has established an "Inter-agency Committee to Combat Climate Change" in the Prime Minister's Office to develop a "National Action Plan to Mitigate Climate Change." The government's official position on the climate change treaty negotiations was based on the recommendation made by this committee in 1998: Korea would consider a mandatory commitment for the 2018-2022 period, and for the interim period would consider establishing and achieving a non-binding voluntary target.

The Inter-agency Committee has drawn up a comprehensive response strategy to climate change, with input from various ministries and research institutions. It covers policy actions designed to reduce future emissions of carbon dioxide from various sectors, including industry, transportation, residential and commercial, electricity generation, agriculture and waste management.

INDUSTRIAL SECTOR

A "Voluntary Agreement" system was established in 1998, which stipulates voluntary targets in excess of 8 percent for carbon dioxide reduction or energy efficiency increase for a five-year period. Participating firms receive subsidized financing from public funds for investment necessary to achieve the targets.

Subsidized financing is also available to promote the dissemination of energy efficient equipment. The financing covers both the initial cost of purchase and ensuing operating costs. To lower the barrier to purchases of high energy efficient equipment, the entire purchase cost receives subsidized financing. The government also created publicly funded risk capital, specially earmarked to provide financing to venture firms developing high energy efficient equipment. Technology R&D for energy efficiency improvement also receives public funding.

In addition, some sectors are subject to mandatory use of energy efficient equipment. All government buildings, since 1999, must use energy efficient equipment. In 1999, the government also issued "Energy Conservation Construction Design Standards for Multi-unit Residential Structures" under which apartment buildings with more than 50 housing units must use energy efficient equipment. The government plans to increase the types of equipment certified for high energy efficiency and streamline the qualifying process. At the same time, it plans to toughen energy efficiency standards for a number of home appliances. In addition, many government-sponsored technology seminars and awareness campaigns promote energy efficient technologies.

TRANSPORTATION SECTOR

Policy actions include measures to promote fuel efficient vehicles—the manufacture of light weight sub compact vehicles, research support for increasing fuel efficiency and development of alternative fuels vehicles—and improve overall efficiency through the development of an environmentally friendly transportation and distribution infrastructure.

Purchasers of light passenger vehicles (engine size less than 1000cc) pay lower taxes on vehicle ownership and less on auto insurance, and they receive discounts on highway tolls and parking. The government plans to tighten automobile fuel efficiency standards to stimulate technology development. It provides R&D funds to private automobile makers and research institutions for technology to improve fuel efficiency and develop low/zero emission vehicles. The government also provides funds for deployment of the compressed natural gas (CNG) bus—both the purchase of buses and installation of CNG distribution networks.

To improve the efficiency of the national transportation infrastructure, the government enacted the "Transportation System Rationalization Law" in early 1999. A year later, it adopted a "National Transportation System Plan, 2000-2019" and established a "Transportation Policy Council" chaired by the Prime Minister. These policy initiatives are designed to establish better investment priorities for the transportation infrastructure, appropriate transport load distribution and improved connectivity within the nationwide transportation system.

RESIDENTIAL AND COMMERCIAL SECTORS

Policy actions in these sectors include measures to improve energy efficiency in buildings and the dissemination of district heating and small co-generation. Regulations and standards are critical factors in achieving energy efficiency in commercial buildings and residential structures. Through a tightening of the "Construction Design Standards for Energy Conservation in Buildings," the government expanded the mandated adoption of energy efficient equipment. The government provides R&D funds for energy conservation technology development. It plans a labeling system for building energy efficiency. Two ministries, Energy and Construction, work closely to expand the district heating system to new housing development projects.

ELECTRICITY GENERATION

In addition to increases in nuclear- and LNG-powered electricity generation, the government also plans to increase renewable-based electricity generation. For the most part, this will be for remote area power service through wind power or photovoltaics. R&D for alternative energy technology has been conducted in accordance with the National Ten-year Plan for Energy Technology Development, established in 1997. Its goal is to supply 2 percent of

Korea's total energy requirement through alternative energy technology by 2006.

IMPACT OF POLICY ACTIONS

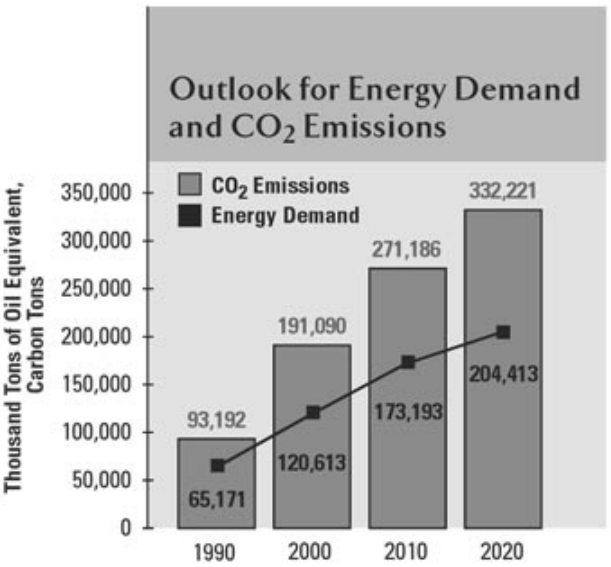
The combined effect of these policy actions is estimated to reduce CO_2 emissions by 27 percent relative to BAU in 2020. This reduction reflects energy saving (23 percent) and fuel substitution (4 percent). The total reduction, according to government assessments, is judged to be on the high side due to possible double counting (Republic of Korea, 2000). More important, however, is the cost of this reduction in CO_2 emissions. The cost of achieving energy savings and fuel substitution—the cost of policy actions—is not presented in the government study. We cannot know if the array of policy actions and measures would be cost-effective.

Several research results show the impact on the economy of a domestic carbon tax, designed to achieve hypothetical domestic targets for CO_2 emissions, or the impact of the Kyoto Protocol on the domestic economy. These studies suffer the usual shortcomings of the top-down macro economic methodology: structural adjustment inherently responding to policy measures is not well analyzed.

A comprehensive bottom-up engineering study on climate change policy and its relations to the Korean economy is rare. However, one recent study by a University of Delaware research team is worth noting (John Byrne, 2001). It evaluates potential energy savings and CO_2 emissions reductions. The unique aspect of this study is its construction of an energy efficiency database, reflecting Korea's energy end-use characteristics on the basis of, among others, comprehensive technology assessments conducted by U.S. Department of Energy and its five national laboratories. From the pool of available technologies, only cost-effective efficiency technologies were selected and run through a scenario of energy efficiency improvement. Cost-effective criteria differed for each sector. Selection in the industrial sector was based on energy savings greater than 10 percent and a payback period of less than seven years. The criteria for residential and commercial building technologies were based on a cost of conserved energy of less than 5 cents/kWh. In the case of the transportation sector, a payback period of less than five years was required.

The study found that if all the selected cost-effective energy saving technologies were implemented, the resulting reduction in CO_2 emissions in 2020 would reach 29 percent. Compared to the government study, the CO_2 reduction potential in this independent study is much higher, and this potential is based only on cost-effective energy saving options, without considering fuel substitution options. The magnitude of 29 percent energy saving by 2020 would translate to no new nuclear power plants beyond those already under construction and as a result, release capital amounting to US$ 25 billion from would-be nuclear investment.

Figure 1. Outlook for Energy Demand and CO_2 Emissions



CONCLUSIONS

Korea's policies in response to climate change problems are for the most part old energy policy that has existed for the last two decades. Policies are now merely packaged and labeled as climate change policy. Existing energy policy is aimed at bolstering industrial activity, which has been the backbone of Korea's export-driven economic development. Energy prices for industry are set to be the lowest for all consumers, and

the energy conservation subsidy is given most generously to energy-intensive industries that have improved energy efficiency on their own anyway, without the subsidy, given the competitive pressure they face in the domestic and world market. The subsidy merely replaces private funds and does not induce additional investment for efficiency improvement. These policies are inappropriate as measures for addressing climate change problems.

New initiatives are very few. This passive response reflects a low level of understanding of the problems and priorities. Consumer surveys found that only 2 percent of the general public recognizes global climate change as a problem the Korean government must address. The concern for local environmental degradation overwhelms the concern for global environmental issues among both policy makers and the consumers. This dichotomy misses the larger picture.

The energy sector in Korea has been modernized by the two external shocks arising from oil supply and price instability. New fuels were introduced in response to these shocks, and the result has been positive throughout the economy. Global climate change problems and policy responses—future external shock—have the potential to revolutionize the energy system in Korea. The new system based on climate friendly technologies will provide a platform for sustainable development for Korea. The challenge is to recognize the availability of cost-effective technology options that the country can utilize immediately and improve further through technology development. In this way, Korea can realize a future of cost-effective, clean development.

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