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Climate Policy in Republic of Korea (ROK)

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Climate Policy in Republic of Korea (ROK)

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Abstract

Although the Kyoto Protocol enters into force, the Republic of Korea (ROK) doesn't have any quantitative green house gas (GHG) reduction target as its commitment because of its status as a Non-Annex I party. However, the negotiation to formulate the new commitment for next round will start in COP-11 at the end of 2005. Apparently, the main agenda for the negotiation will set a new target for GHG reduction and re-organize responsible members for achieving the goal. Under such conditions, the Korean government may have concerns for deciding whether sharing the burden of GHG reduction because of its current GHG emission level, the industry structure and its energy-intensity. The climate change issues have become one of the main interests of the Korean government, and many efforts to address the United Nations Framework Convention on Climate Change (UNFCCC) and reduce a national GHG emission have been made in this country. However, despite such efforts, it seems not to be successful in showing the increasing trend of GHG emission and lack of public awareness. Hence, this paper will make some proposals to be considered in near future to find appropriate ways to respond to the climate change based on the review of Korea's current situations related to climate change issues.

Keywords: Climate policy, comprehensive national action plan (NAP), GHG emission trend, energy consumption trend

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1. Introduction

Climate change has emerged as one of the important agenda in international community since the United Nations Framework Convention on Climate Change (UNFCCC) came into force in 1994. In addition, the Kyoto Protocol, adopted in the Third Conference of the Parties to the UNFCCC (UNFCCC-COP3) and officially stated greenhouse gases (GHG) reduction target of each developed countries during the first commitment period from 2008 to 2012, entered into force on February 16 of 2005 that was resulted from Russia's ratification in Nov of 2004.

According to the articles of the Kyoto protocol, Republic of Korea (ROK) doesn't have any quantitative GHG reduction target in the first commitment period because of its status as a Non-Annex I country. However, the negotiation to formulate the new mechanism implemented in the next commitment period known as post-2012 or beyond-Kyoto climate regime, will start at COP-11 in late November in 2005. It is supposed that setting up the target for GHG reduction that contributes to reduce the atmospheric GHG concentration level and deciding the burden sharing rule in reducing the GHG emissions reduction among the parities will be crucial in the next negotiation.

In relation to the negotiation process, the Korean government may have concerns for deciding whether Korea should share the burden of GHG reduction with others or not. On one hand, its current GHG emission level is ranked as 9th in the world. On the other hand, its key industries that contribute to the national economic growth are very much energy-intensive, such as steel, chemical, oil refining, automobile and semiconductor manufacturing industries, which are considered to emit huge amount of GHG. Hence it is expected that taking the commitments of GHG reduction in the post-Kyoto period will cause tremendous adverse effect on Korean economy.

Korea is one of the most dynamic countries in the world with high economic growth rates every year despite some negative streams during the economic crisis in the second half of 1990s. In regards to its economic growth, environment issues and sustainable energy use are considered as the most important issues for the country, and the climate change issue has spontaneously become one of the main concerns for the Korean government because the commitment to the UNFCCC involves both environment preservation and limitation of energy use to achieve the sustainable development.

The government has taken many actions to address the challenges for the UNFCCC and the reduction of the national GHG emissions. For example, the government established the Inter-ministerial Committee on the Convention on Climate Change chaired by the Prime Minister in April 1998, and formulated and carried out the First Comprehensive National Action Plan (NAP) that was the first step of introducing the national climate policies and applied from 1999. The NAP has been evaluated every year and re-arranged in every 3 years, and the 3rd NAP is recently prepared to introduce for next 3 years from 2005 to 2007.

Despite of such efforts, the past two NAPs seem not to be successfully implemented in Korea, judging from the increasing of national GHG emission and the lack of public awareness about the climate change. ROK is internationally known as not only economically advanced country in Non-Annex I group but also one of great GHG emitting countries in the world.

This paper will review Korea's current situations that are related to the climate change issues, such as the trends of the national GHG emissions, the current structure of Korea's industry, energy consumption & demand, and relevant policy, and provide some information about main tasks involved in the Korea's 3rd NAP. This paper also will make some suggestions in dealing with possible emerging issues in near future.

2. Current Situations

2-1. National GHG emissions

A. GHG emissions in past

The total GHG emissions of Korea in 2001 were estimated at 148 million tons of carbon (MtC), increased by 2.6% from 144.3 MtC in 2000, as shown Table-1 below. The energy sector was a major contributor to this increase with 3.3% increase from the emissions in the previous year while industrial processes, agriculture and waste contributed minus1.0%, minus 3.3% and 2.0%, respectively. As for the GHG emissions by source in 2001, energy accounted for 83.8%, industrial processes 10.7%, waste 2.9% and agriculture 2.6%. Among the GHG emissions, carbon dioxide (CO2) emitted from energy sources accounted for 82.2% of total emissions in 2001, whereas other sources accounted for only 6.4%.

Since 1990, national GHG emissions have been increasing continuously due to the rapid economic growth and energy-intensive industrial structure. The trend of total GHG emissions between 1990 and 2001 shows an annual increase of 5.2%, with per capita emissions increase by 4.3% per year since 1990, which is equivalent to 3.13 tons of carbon in 2001.

In the energy sector, GHG emissions increased 5.6% per year from 67.6 MtC in 1990 to 123.5 MtC in 2001. After 1990, emissions from industrial processes recorded a dramatically increase of 10.2% per year. The growing trend of GHG emissions in Korea will continue if the proper policies for the industry and considerable efforts to reduce emissions are not implemented.

Table 1. National GHG emissions from 1990 to 2001

(unit: thousand TC)

	1990	1995	1998	1999	2000	2001	Growth % (90-2001)
Total	84,318 (100)	122,854 (100)	123,385 (100)	134,980 (100)	143,722 (100)	147,486 (100)	5.2%
Energy	67,567 (80.1)	101,490 (82.6)	102,335 (82.9)	111,528 (82.6)	119,601 (83.2)	123,540 (83.8)	5.6
Industrial Process	5,428 (6.4)	12,747 (10.4)	12,393 (10.0)	14,933 (11.1)	15,886 (11.1)	15,755 (10.7)	10.2
Agri-culture	4,377 (5.2)	4,327 (3.5)	4,231 (3.4)	4,094 (3.0)	3,982 (2.8)	3,853 (2.6)	-1.2
LULUCF (Sink)	-6,476	-5,793	-9,949	-10,422	-10,156	-9,885	3.9
Waste	6,945 (8.2)	4,291 (3.5)	4,425 (3.6)	4,425 (3.3)	4,254 (3.0)	4,337 (2.9)	-4.2
Net Emission	77,842	117,061	113,436	124,558	133,565	137,601	5.3

Source : Korea Energy Economics Institute (KEEI), 2004

B. GHG emissions in future

The GHG emissions in Korea are closely related to the energy consumption like other developed countries. Therefore, the projection for the GHG emissions should also depend on how much energy will be consumed in future. According to Korea Energy Economic Institute (KEEI), the GHG

emissions will be increased by 70% from the 2000 level in 2020, while the carbon dioxide (CO2) intensity is expected to gradually decrease due to the improvements in the energy efficiency and the energy shift to cleaner fuels which is lower emitting as like natural gas. However, the emissions in energy sector will increase by 2.8% annually from 2000 to 2020, as shown in Table-2, and account for 95.3% of total GHG emissions in 2020 compared to 83.2% in 2000. This figure excludes the industry sector from this projection due to the difficulties to collect relevant data in the situation of currently changing its structure. The energy consumption of the country, which is taken into account the most in this estimation, is detailed in the energy policy of Korea, discussed in later part of this chapter.

Table 2. GHG emissions projection from 2005 to 2020

(unit: million TC)

	2005	2010	2015	2020	Annual growth (%)		
					'00-'10	'10-'20	'00-'20
Total	152.7	180.5	195.3	216.3	3.6	1.8	2.7
Energy	144.3	172.0	186.2	206.2	3.8	1.8	2.8
Agriculture	4.1	3.8	3.5	3.2	-0.9	-1.7	-1.3
Waste	4.4	4.8	5.6	6.8	1.1	3.7	2.4
Sink	-9.3	-8.8	-8.5	-7.6	-1.4	-1.5	-1.4
Net Emission	143.4	171.7	186.8	208.7	3.9	2.0	2.9

Note: The GHG gases from fugitive, industrial process, alternative ones like CFCs are excluded in this figure.

Source : KEEI 2004

2-2. Industry structure

A. Background

Korea has taken aggressive measures for economic development since the 1970s, which prompted high annual economic growth rate, including an annual average growth rate of 8.8% between 1986

and 1995. During that period, main industry in Korea was manufacturing industry, such as shipbuilding, semiconductors, electronics, textiles, automobiles and steels, which required more energy. The economic development plans of Korea, which began in the 1960s and ended in the late 1990s, prompted the expansion of key industries, infrastructure and other industry-supporting facilities, and the establishment of export-oriented strategies.

Among manufacturing industry, the proportion of energy-intensive industries, such as oil refinery, chemical, ceramic and primary metal industries, shows a declining trend while that of technology-intensive industries, such as metal and machinery, is on the rise since the mid-1990s. Focusing on the technology-intensive industries, the annual GHG emissions growth rate during 1996-2000 was more than 3 times less than the rate of 1991-1995, and energy intensive (GHG emission/GDP) was almost a half.

Table 3. National GHG Emissions Trends

	1990	1995	2000	Annual Average Growth Rate(%)		unit
				91-95	96-2000	
GDP(a)	340.0	487.2	614.8	7.45	4.77	bil. USD(a)
Energy Consumption	93.2	150.4	192.9	10.05	5.10	mil. TOE
GHG emissions	83.0	119.5	134.9	7.55	2.46	mil. TC
Energy Consumption. Per GDP	0.046	0.052[a]	0.052	1.349	1.069	TOE/ thousand USD
GHG emissions Per GDP	0.041	0.041[a]	0.037	1.013	0.516	TOE/ thousand USD

(a) in 1995 prices(1USD=774.7 Korean Won)

Source : Yearbook of Energy Statistics, KEEI, 2002

B. Future Profile

Korea will be supposed to make more efforts to keep on its global position and enhance its competitiveness of its basic industries, such as shipbuilding & semi-conductors, automobile &

petrochemicals, textiles and steel materials. These industries have been not only leading Korea's current economic growth but also currently are positioning at a top-level of the world markets. In addition, Korea has a plan to extend its future strategic industry in order to make Korean economic growth more promising.

According to the government visions on industrial development of the country, the increasing trend of the GHG emissions will continued in future even if high technologies for improving energy efficiency will be introduced in these industries. The government is currently trying to change its main industries from basic to future group. However, the basic industry will be kept for longer times than expected because necessary infrastructure for the industry has already been established in the country and such an industry makes Korea's economic growth promising. As a result, it is anticipated that the GHG emissions will continue to increase in the near future.

Table 4. Development visions of Korea industry

Basic Industry	Future Strategic Industry	Service Industry
Shipbuilding, Semiconductors Automobile, Textiles Petrochemicals, Steel Machinery Parts and materials	Digital electronic industry Electronic medical equipment Bio industry, Environment industry, Aviation industry	Business services, e-business

2-3. Energy

A. Background

The Korea's energy policies have been focused on the stabilization of the energy supply and demand in order to support the economic growth and improve the quality of life. The primary energy consumption of the country has been increased rapidly along with the economic growth during the past 10 years. As a result, Korea has become one of the world's 10 major energy consumers.

Since Korea has few natural resources, dependence on overseas energy sources has risen from 87.9% in 1990 to 97.4% in 2001, while its dependence on oil has decreased from 60.4% in 1997 to 50.6% in 2001. As of 2001, Korea is the sixth largest oil consumer and the fourth largest oil importer in the world. Therefore most of energy policies are much connected to the regulation of energy supply, demand and prices.

Table 5. Major Energy Indicators

Indicator	'80	'90	'00	'01
Primary Energy Supply(thous TOE)	43,911	93,192	192,887	198,409
Overseas Dependence(ex. nuclear)	73.5(71.6)	87.9(73.7)	97.2(83.1)	97.3(83.2)
Oil Dependence(%)	61.1	53.8	52.0	50.6
Middle East Dependence(%)	98.8	73.7	76.9	77.0
Rate of Imports to Energy(%)	29.5	15.6	23.4	23.9

Source : KEEI (2003)

Due to the high dependency on overseas energy sources, the government focuses on the efforts to enhance energy efficiency by developing the technologies. The elasticity of energy to the GDP has continuously decreased from 1997, which has dropped below 1 in 1999. The nation's oil dependence is expected to drop below 50% in near future. During the 1990s, the government has also been trying to introduce the competitive conditions in the energy market.

B. Future Profile

B-1. Energy Consumption Trends

In accordance with the rational energy utilization act, the Korean government has been published a National Energy Plan that lasts for 10 years in every 5 years for promoting a stable supply and demand of energy. The second National Energy Plan was presented in Dec of 2002 for next 10 years (2002-2011).

According to the second plan, the total primary energy consumption increased by 4.2 times from 45.7 million TOE (ton of oil equivalent) in 1981 to 192.9 million TOE in 2000, as shown in Table-6. This growth rate was greater than the GDP growth rate in the same period, showing the energy consumption annually increased by 7.5% and the GDP growth rate of 6.1% on average from 1990 to 2000. The energy intensity per unit GDP slightly improved from 0.37 TOE/Million Won in 1981 to 0.35 TOE/Million Won in 1990, however, it increased annually by 1.4% on average in the 1990s, and recorded 0.40 TOE/Million Won in 2000. The nation's energy consumption per capita also increased from 1.2 TOE in 1981 to 4.1 TOE in 2000, which is similar to that of Japan and most countries in Europe where the GDP per capita is 2 to 3 times larger than that of Korea.

Table 6. Trends of Key Energy Economic Indicators

	1981	1990	1995	2000	Annual Growth rate (%)	
					'81-'90	'90-'00
Total Energy Consump (Million TOE)	45.7	93.2	150.4	192.9	8.2	7.5
Energy/GDPb (TOE/'95 Constant Million Won)	0.37	0.35	0.40	0.40	-0.6	1.4
Energy Consump Per Capita (TOE/Person)	1.18	2.17	3.34	4.08	7.0	6.5
GDP ('95 Constant Trillion Won)	122.4	263.4	377.4	476.3	8.9	6.1

Source: Annual Report on Energy Statistics, KEEI, 2002

B-2. Energy Demand Forecasts

< *General Forecast* >

If the energy policies are properly introduced and correctly implemented in the country, the total energy consumption will increase annually by 3.1% on average from 2001 to 2011, and 2.4% until 2020 reaching 311.8 million TOE. The energy demand per capita will increase from 4.2 TOE in 2001 to 5.4 TOE in 2011 and 6.2 TOE in 2020.

Table 7. Forecasts for Key Energy Economic Indicators

	2001	2006	2011	2015	2020	Annual Growth (%)		
						'01-'06	'01-'11	'01-'20
Total Energy Consumption (Million TOE)	198.3	237.6	269.3	288.2	311.8	3.7	3.1	2.4
Energy Demand Per Capita (TOE/Person)	4.19	4.88	5.41	5.72	6.16	3.1	3.6	2.0
Energy/GDP (TOE/'95 Constant Million Won)	0.40	0.37	0.33	0.30	0.27	-1.8	-2.1	-2.2
Energy/GDP Elasticity	-	0.66	0.51	0.39	0.43	(0.66)	(0.59)	(0.52)
GDP ('95 Constant Trillion Won)	490	643	820	975	1,170	5.6	5.3	4.7

Source: The 2nd National Energy Plan, KEEI, 2002

During the time span of the forecasts, the growth rate of the energy demand will be lower than the economic growth rate. Accordingly, the energy consumption per unit GDP (energy intensity) will decrease from 0.40 TOE/Million Won (based on the constant price in 1995) to 0.33 in 2011 and 0.27 in 2020. The improvement of energy intensity will accelerate with time as the average annual growth rate of energy intensity decreases by 2.1% until 2011, and 2.2% until 2020.

The elasticity of energy demand to GDP will decrease to 0.59 during the period between 2001 and 2011, and 0.52 between 2001 and 2020. The energy intensity and GDP elasticity will improve because the production of energy-intensive industries will increase only within a narrow range, and the increasing trends of automobiles and home appliances will be saturated after 2011.

< *Forecasts by Energy Source* >

LNG will lead the increase in the energy demand while the oil dependence ratio will decrease. Even though the share of the oil consumption will continuously decrease from 51% in 2001 to 47% in 2011 and 45% in 2020, oil will remain the main energy source because of the demand for oil in the transportation and industrial sectors. With the increasing preference for clean fuel, the demand for natural gas will grow the fastest, and it will account for 10% of the total energy consumption in 2001, 12% in 2011, and 15% in 2020.

Table 8. Forecasts for Primary Energy Demand by Energy Source

(Unit: Million TOE, %)

Energy Source	2001	2006	2011	2015	2020	Annual Growth (%)		
						'01-'06	'01-'11	'01-'20
Coal	45.7 (23.1)	52.4 (22.1)	60.2 (22.4)	59.1 (20.5)	62.6 (20.1)	2.8	2.8	1.7
Anthracite Bit-s Coal	3.7 42.0	2.8 49.7	2.3 57.7	2.2 56.8	2.3 60.3	-5.6 3.4	-3.5 3.2	-2.5 1.9
Oil	100.4 (50.6)	116.3 (48.9)	125.4 (46.5)	131.8 (45.7)	139.6 (44.8)	3.0	2.2	1.8
Energy Oil LPG Non-Energy	59.1 8.7 32.6	71.0 9.3 35.9	77.1 9.6 38.5	82.0 10.0 39.8	88.3 10.2 41.1	3.7 1.5 2.0	2.7 1.1 1.7	2.1 0.8 1.2
LNG	20.8 (10.5)	31.2 (13.1)	33.2 (12.3)	41.7 (14.5)	48.0 (15.4)	8.5	4.8	4.5
Hydro Power	1.0 (0.5)	1.1 (0.5)	1.2 (0.5)	1.2 (0.4)	1.2 (0.4)	0.8	1.6	0.5
Nuclear Power	28.0 (14.1)	32.6 (13.7)	43.5 (16.2)	47.8 (16.6)	52.0 (16.7)	3.0	4.5	3.3
Firewood and Others	2.3 (1.2)	4.0 (1.7)	5.8 (2.2)	6.8 (2.3)	8.6 (2.7)	11.5	9.6	7.1
Total	198.3 (100.0)	237.6 (100.0)	269.3 (100.0)	288.2 (100.0)	311.8 (100.0)	3.7	3.1	2.4

Source: The 2nd National Energy Plan, KEEI, 2002

Additionally, due to the steady increase in the electricity demand, the demand for nuclear power and bituminous coal, which are fuels for power generation, will also continuously grow. In the final energy demand, the shares of coal and oil will continuously decrease, while the shares of city gas and electricity will keep increasing.

< *Forecasts by Sector* >

In the structure of the final energy demand by sector, the share of the industrial sector will continuously decrease while the shares of the transportation and commercial sectors will increase. The growth rate of the energy consumption in the industrial sector is declining due to the slowdown of energy-intensive industries, such as steels and petrochemicals, as well as the expansion of the high value-added industries such as information and biologic technology industry. As result, its share in the final energy consumption will decline from 55% in 2001 to 51% in 2020.

The share of the transportation sector in the final energy consumption will increase from 21% in 2001 to 23% in 2011 and 25% in 2020, due to the increase of vehicles. Energy consumption in the household will rise due to the trend of enlargement of heating-space and increased number of home appliances following increased income, however, its share in the final energy consumption will remain around 15%. The consumption in the commercial sector will rapidly increase with the high growth rate of the service industries.

Table 9. Forecasts for Energy Demand by Sector

(Unit: Million TOE, %)

Sector	2001	2006	2011	2015	2020	Annual Growth rate (%)		
						'01-'06	'01-'11	'01-'20
Industry	84.5 (55.0)	97.9 (53.8)	107.4 (52.6)	113.1 (51.6)	120.2 (50.8)	3.0	2.4	1.9
Transportation	32.2 (21.0)	40.5 (22.3)	47.3 (23.2)	52.7 (24.0)	58.3 (24.6)	4.7	3.9	3.2
Household	24.1 (15.7)	27.7 (15.2)	30.9 (15.1)	33.1 (15.1)	35.6 (15.0)	2.8	2.5	2.1
Commercial	9.6 (6.3)	12.2 (6.7)	14.2 (7.0)	15.9 (7.2)	17.8 (7.5)	4.9	4.0	3.3
Public & Others	3.0 (2.0)	3.6 (2.0)	4.2 (2.0)	4.5 (2.1)	4.9 (2.1)	3.6	3.3	2.6
Total	153.5 (100.0)	181.9 (100.0)	204.0 (100.0)	219.4 (100.0)	236.8 (100.0)	3.5	2.9	2.3

Source: The 2nd National Energy Plan, KEEI, 2002

< *Comparisons with Business as Usual (BaU)* >

The forecasts case for the primary energy demand for 2020 was 6.7% point lower than the BaU as being shown in Table-10 simulated by KEEI. This is because the improvement rate of the energy intensity (TOE/GDP) in the forecasts case is faster by 0.4% on annual average than the BaU for the time span of the projections. In addition, compared to the BaU, the consumption of coal and oil will decrease further, and the consumption of LNG, nuclear power and new and renewable energies will increase further[3].

Further, the oil dependence ratio in the forecast is projected to be 44.8% in 2020, 2.4 % point lower than that of the BaU, which is 47.2%. In addition, the share of LNG is projected to be 15.4%, 1.7% point higher than that of the BaU, which is 13.7%. These differences derive from the improved energy efficiency in the final demand sector, as well as the more environment-friendly mix of fuels in the energy transformation sector.

Table 10. Comparisons of Forecasts for Primary energy Demand (Forecasts/BaU)

(Unit: %)

Energy Source	2006	2010	2020
Petroleum - Oil - LPG	-6.4 -8.1 -2.5	-8.3 -10.7 -5.5	-11.5 -14.6 -9.5
LNG	6.7	6.7	4.7
Coal - Bituminous Coal - Anthracite	-1.7 -1.8 0.2	-8.0 -8.3 0.2	-13.1 -13.5 0.1
Hydro Power	0.0	0.0	0.0
Nuclear Power	0.0	5.6	2.9
New and Renewable	8.0	13.0	23.6
Total	-2.7	-4.1	-6.7

Source: The 2nd National Energy Plan, KEEI, 2002

[3] The consumption of coal and oil will decrease by 13.1% and 11.5% more, respectively, in 2020 than that of the BaU. The consumption of LNG, nuclear power, and new and renewable energy increased by 4.7%, 2.9%, and 23.6% more, respectively, than that of the BaU

2-4. Relevant Policies

Most of the energy policies in Korea are related to the energy security in its supply and the improvement of its efficiency in energy consumption in achieving the sustainable development. However, about 84% of the total GHG emissions in 2001 came from the energy sector, such as fuel consumption and fugitive emissions. Hence, the reduction of the GHG emissions in the energy sector is of utmost importance so that , as countermeasures to the UNFCCC, diverse policies and measures in relation to existing energy policies to attain a primary goal, are being developed and promoted.

A. Environmentally-friendly energy system

To achieve the primary goals, such as the stabilization of the energy supply and the protection of air pollution, the government has introduced the environmentally-friendly energy system, as the means to encourage domestic consumers, such as local policy makers, industries, and households, to diversify the energy sources. For example, the government has been carrying on switching the energy source from oil to clean energy sources. In this regard, petroleum-centered heating system has been replaced by district-heating or gas heating system in households & commercial sectors; alternative fuels for transportation has been developed and disseminated; and the oil demand for industry has been stabilized or decreased by expanding integrated energy supply system utilizing the combined heat & power (CHP) and waste-incinerating heating.

In addition, the use of clean and low-carbon energy sources in the country will be expanded throughout nationwide, and observing that there are many works in progress, such as constructing the gas network system, maintaining the share of nuclear energy in power sector to a certain level, and developing clean coal technology.

B. Strengthening policy for enhancing energy efficiency

It is known that the energy efficiency of Korea is relatively higher than that of the other developing countries. However, there are still possibilities to increase energy efficiency. The average energy productivity was about $2,400 per TOE in 1998, which is below the level of the advanced countries ($3,200~6,600), while the Energy/GDP elasticity of Korea was 0.7~0.8 between 1999 and

2000, which was close to the average of the OECD countries (0.7).

Therefore, the government has introduced more aggressive policies to enhance the energy efficiency, particularly in terms of the energy use. The government believes that the energy consumption can be rationalized by through price adjustments, and continue to enforce more effective energy efficiency and technology development programs in Korea.

C. Promotion of Renewable Energy

Renewable energy emerges as a new future energy source as the international environment regulations have been tightened. Until 2001, the share of renewable energy in Korea was slightly over 1% of total energy supply, which is at very low level compared to other developed countries. The government understands that more efforts should be made in order to establish the institutional foundation and provide financial support for increasing the use of the renewable energy. Of course, there still exists some problems and obstacles to promote the distribution of the renewable energy in Korea, such as insufficient technology development for commercialization and low profitability for the investments. However the government should look over the long-term strategy in terms of the energy supply and various environmental issues.

Table 11. Electricity-Generating Cost (won/kWh)

Oil	Bituminous	Nuclear	Photovoltaics	Wind	Wastes
60	38	34	700	103	150

Source : KEEI, 2002

The government is currently processing the preferential purchase of the electricity produced by renewable energy sources in order to facilitate the market to function well. However, it does not seem that the renewable energy market is active in Korea because of the low profitability for the investments. Hence, the government should be more concerned about this matter in terms of providing more financial incentives to investors who may be willing to put some money to generate electricity from renewable energy sources.

D. Privatizing energy suppliers

Privatizing the energy industry is one of the ways to increase efficiency in generating electricity. The government is establishing the relevant policy step-by-step base. According to the last step of the policy guideline, every consumer can choose the power supplier directly under the system that encourages the competition among the power companies. The policy may enhance the energy market's transparency and efficiency. However, the government should be concerned about the consumer preferences in choosing the power supplier, because the electricity price will be remained as a key factor when consumers choose the power supplier. Therefore, there still remain possibilities that the use of the fossil fuel keeps expanding because the price of the electricity generated from fossil fuel in current Korea's electricity supplying system which is not completely privatized is much cheaper than the electricity generated from other sources, including renewables.

E. Supply of CNG (Compressed Natural Gas) Buses

Large diesel vehicles like buses and trucks are the main cause for the air pollution and the GHG emissions in large cities. Large diesel vehicles account for only 4% of the total vehicles but the pollutants emitted from these vehicles take up to 47% of the total pollutants. To improve the situation, CNG buses, which emit no exhaust gases and 70% less ozone pollutants, have been utilized since 1998.

Initially, as pilot cases, nine cities of the country introduced some 3,000 CNG city-buses and 98 refueling stations until 2002. By 2007, approximately 20,000 CNG city buses will be supplied and 400 refueling stations be established, replacing all city-buses in major cities with CNG buses. In addition, the government has the plans to convert garbage trucks in urban residential areas from diesel which give adverse impact on human health, to gas engine which lower emitting air-pollutants. Depending on the vehicle type, garbage trucks will be transformed into either CNG garbage trucks, or trucks equipped with post-treatment devices.

F. Expand energy efficiency standards & labeling program

Since 1992, the energy efficiency standards (grade 1 to 5) and labels indicating the level of the energy efficiency have been put on the products to encourage consumers to purchase high efficiency products that will reduce energy consumption as well as the GHG emissions. Initially, the program

was implemented on 5 items including refrigerators and automobiles in 1992. By 2001, 5,294 models for 11 items were classified and registered. 3,849 models, equivalent to 73% of the total number of models, were evaluated as highly energy efficient products, which are categorized as grade 1 and grade 2.

Furthermore, the minimum energy performance standard, which restrains the distribution of low efficiency products and promotes the technical development of manufacturers by setting up and controlling the minimum required efficiency standard, will be implemented. The products registered as grade 1 and grade 2 that are currently occupying 90% of the market but difficult to differentiate among grades will be converted as subject items for the minimum energy performance program.

G. Promote landfill gases as resources

As of 2002, 242 municipal waste landfill facility sites were functional in Korea. There are 1,400 sites, including the completed and closed landfills. In total, 31 operating sites with over 1 million tons of landfill capacity are selected as the targets for the landfill resources business. The amounts of the organic wastes among the collected wastes brought to the landfill facilities are high in Korea. Hence, the ratio of the generation of the methane for being utilized to the energy source is known to be higher than that of the developed countries. Therefore, the landfill gas resources business, coupled with the development of alternative fuels, will greatly contribute to the nation-wide efforts on reducing the GHG emissions.

Table 12. Status of landfills operated in Korea

Classification	Total	Landfill Volume (1,000 tons)				
		Over 15,000	5,000～15,000	3,000～5,000	1,000～3,000	Under 1,000
No. of Sites	242	1	4	8	18	211

Source: Ministry of Environment, 2002

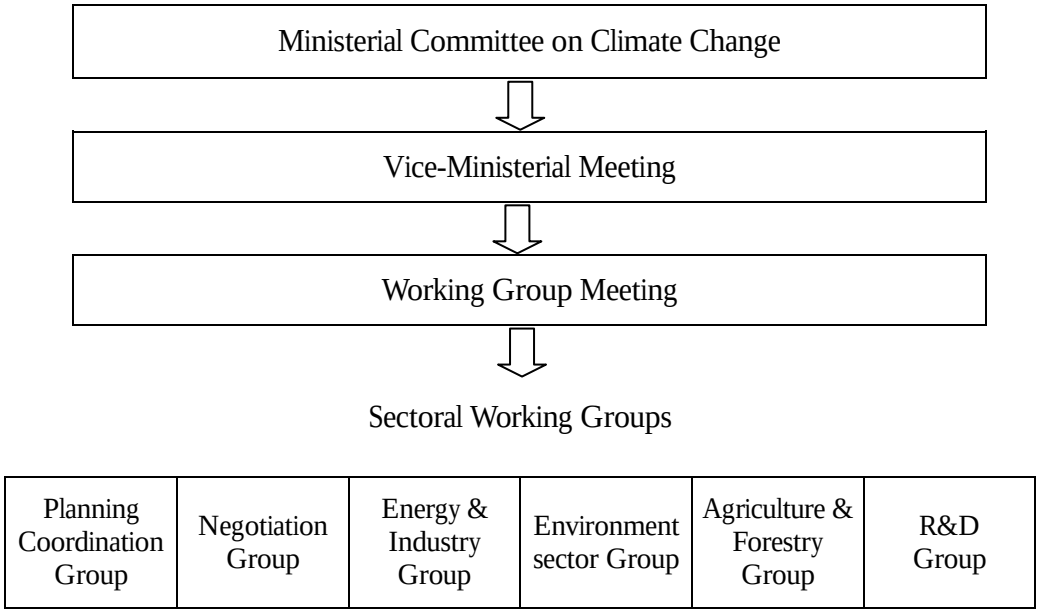
3. Comprehensive National Action Plan

3-1. Organizational Structure

The policies and measures related to the UNFCCC in Korea are established and promoted through the Inter-Ministerial Committee headed by the Prime Minister that consists of specialists, members of various ministries and government agencies as well as the industrial sector. The inter-ministerial committee launched in April 1998 devised the systematic measures, named as Third comprehensive national action plan (NAP) in Feb. of 2005.

The committee consists of a vice-ministerial level working group chaired by the Deputy Minister of Government Policy Coordination, a coordination working group of director generals chaired by the economic policy coordinator of the Office for Government Policy Coordination, six task forces for each major field, and five research teams staffed with experts. In addition, the need to ensure continuous economic development and environmental protection in balance and to actively respond to international environmental issues such as the UNFCCC, led to the establishment of the Presidential Commission on Sustainable Development.

Figure 1. Organization chart of the Inter-governmental Committee of the UNFCCC



Meanwhile, efficient measures related to the UNFCCC have been devised and are being enforced by the Special Committee on Countermeasures for Climate Change at the National Assembly in March 2001 in the government sector and the Task Force on UNFCCC at the Korea Chamber of Commerce and Industry established in March 2001 for the private sector.

3-2. The NAP (National Action Plan)

Generally, the NAP consists of 5 subjects, namely the measures for international negotiation processes, technology development, the measures for GHGs reduction, the measures for Kyoto Mechanism and public awareness. Each subject has relevant tasks that most of them are already introduced in the country, and implements in a certain period (3 years) and focused on the purpose of the subject. There were 84 tasks in total under the second NAP implemented from 2002 to 2004.

Recently, the inter-ministerial committee published the third NAP introduced in Korea for next 3 years. The first aim of the third NAP is to contribute to the global efforts to mitigate climate change and actively participating in international negotiation processes, taking into account existing trends in domestic energy consumption. Secondly, it establishes a less energy-intensive economic structure by stimulating energy conservation in all sectors, including industry, transport, and residential sectors, while accelerating the development of less energy-intensive industries. Finally, it plans to prepare an adaptation measures for minimizing the adverse effects by climate change on Korea's ecosystems and communities. To achieve these goals, the government will approve the budget of 21.5 trillion Won for the third NAP, which consists of 90 tasks for the next 3 years.

A. Active participation in international negotiation processes

Most of the tasks included in this subject are related to the commitments under the UNFCCC and the utilization of the Kyoto Mechanisms as a method for developing negotiation strategies, improving national GHG inventory, developing new technology, and raising public awareness.

A-1. Developing negotiation strategies

The government is now considering the possibility of accepting the GHG emissions reduction target from the 2nd commitment period (known as post-2013 climate regime) because the

negotiation for formulating a new round mechanism to reduce the GHG concentration in the atmosphere begins in 2005. Korea is not only known as one of big GHG emitters but also perceived as one of the most economically developed countries among developing countries. Therefore, it is necessary for Korea to prepare the negotiation strategies for the next commitment period.

A-2. Improving national GHG inventory

Every UNFCCC member country should estimate its annual GHG emissions as its one of the basic commitments under the UNFCCC. The accuracy of the calculation of the GHG emissions heavily depends upon its ability in collecting relevant data. However, most of the countries have difficulties with collecting the data because the process is quite complex and the date should cover vast range of areas. Therefore, as a solution, the government decided to designate an institute in each GHG emission sector[4], and encourage the institute to collect detail data from its target area and to calculate the GHG emissions by using the high method of IPCC for more accurate national GHG emissions.

A-3. Developing new technologies

The government believed that the R&D of new technologies is essential for promoting economic development as well as tackling with the climate change. Therefore, the national programs for research and development of innovative technologies are key elements for implementing policies and measures for keeping on economic growth. Especially, with the growing concern on climate change, the R&D strategies have played a leading role in developing a less energy-intensive and environmentally sound economic structure. The promotion of new innovative technologies including renewable energy such as hydrogen and ocean energy is another challenge to the government. In particular, it is necessary to develop integrated approaches for the research, development, and deployment of new and renewable technologies, introducing them to an increasingly liberalized market.

[4] According to the Annex A of the Kyoto protocol, there are 4 sectors and each sector has relevant sub-categories which should be considered to set the national GHG emissions, and the 96 Revised IPCC guideline indicates, there are two types of calculation methods such as high and low and the high method is more accurate but more data are required.

A-4. Raising public awareness

In order to improve public awareness about the global warming (or climate change), the government is considering various measures, such as implementing climate change/environment education for students, establishing a graduate school specialized in the climate change, and building partnerships with the private sector to acquire the distribution channels and to train for experts. Textbooks covering climate change issues have been developed and distributed nationwide for school students. Education on climate change will be included in elementary, middle and high school curriculums in order to enhance the awareness of climate change related issues. A graduate school specialized in climate change was designed and is currently operating to improve the awareness among academics on the climate change issues and train experts in this field.

In addition, collaborative efforts with the private sector to address climate change issues will be pursued by building partnerships between the industrial sector and the municipal governments. Local Agenda 21, a unique partnership program among local governments, residents, companies and private organizations, is now in process in 223 municipalities, which accounts for 90% of total municipalities as of June 2002.

A-5. Facilitating the Kyoto Mechanisms

< Clean Development Mechanism: CDM >

To set up the legal and systemic framework for CDM projects, the Government has already established the CDM Designated National Authority (DNA) as a part of the Government Policy Coordination. The CDM DNA has the authority to approve the CDM project implemented domestically, according to its internal guideline regulating the detail procedure and criteria for reviewing, which have already set by related expert institutions. In order to expand the CDM activities in the country, the government has been put in its efforts to induce foreign investment for CDM, promoting Korea's attractiveness for its stable financial and political environment and excellent business infrastructure. As the results, one CDM project is already implemented and some others are ready for implementation.

< Domestic Emissions Trading Scheme: DETS >

The government has made efforts to design its domestic emissions trading scheme for the demonstration phase experiment while many Korean research institutions have been analyzing the effects of various potential trading mechanisms. The domestic emission trading system (DETS) is considered that the system could induce in GHG reduction activities for the Korean GHG emitters by providing them with some financial incentives, even if the DETS will not directly reduce the GHG emissions. The government has a plan that the DETS in Korea will be introduced in the near future, and currently, the establishment of the operational mechanisms such as an electric tool for exchanging allowances, monitoring guidelines and verification procedures are being considered.

B. Reducing GHG emissions in all sectors with a less energy-intensive economic structure stimulating energy conservation

B-1. Industry sector

Traditionally, one of the big problems of the Korea in terms of the GHG emissions reduction is its industrial structure that keeps relying on energy-intensive methods. With such a condition, 34% of CO2 emissions derive from energy consumption of the industrial sector. However, the financial crisis in 1997 and the restructuring of the Korean industry have brought gradual changes in the traditional atmosphere, with the growth of new technology businesses such as information technology (IT), biologic technology (BT), and environment technology (ET) which are recognized as a less GHG emitting. These businesses are growing in scale and playing an increasingly important role in Korea's industrial sector for reducing GHG emissions.

In addition, the Korea's energy rationalization policy has begun to change the basis of the energy management system. In the area of the industrial policy, there are two major challenges - how to accelerate the de-carbonization of the industrial structure, and how to ensure the protection against the early action of Korean companies.

The Integrated Energy Policy (IEP) program, which is a new system that integrates energy auditing, financial/technical support, and the national registry system into a policy package, was designed to tackle these risks. During the period of the third NAP, the major industrial emitters will face the

energy auditing in order to identify what kind of the GHG emissions reduction projects are suitable for them.

B-2. Transportation sector

The transportation sector in Korea is now the most rapidly growing sector in terms of the GHG emissions, accounting for 20% of total GHG emissions by fuel combustion in 2001. The transportation program focuses on the enhancement of the public transportation. The expansion of the urban subway system can be a useful and effective tool to reduce the GHG emissions in this sector, as well as the effective management of the road system. The various and active support measures to increase CNG (Compressed Natural Gas) vehicles was also a major measures for GHG emissions reduction in the transportation sector.

B-3. Residence and commercial sector

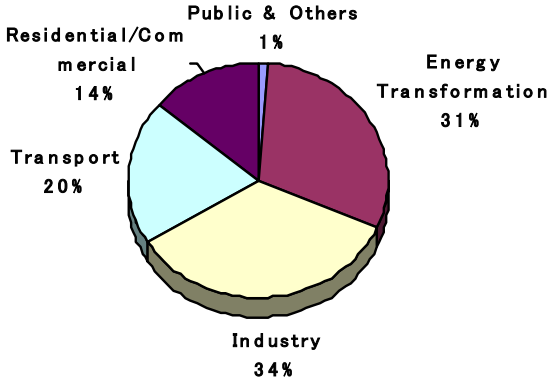
The emissions in the residential sector accounts for about 13.8% to the total GHG emissions by fuel combustion in 2001. The basic approach for this sector is the introduction of the energy-saving and environment-friendly guideline for buildings. Since 2002, it has become mandatory to include insulation in the design of new buildings under certain criteria. In addition, a 'Green Building Certificate' verifying the energy saving level of the building, to encourage the construction of more energy efficient buildings was put in force in 2002. The Certification for Energy Efficiency in Buildings, which supports the funding for buildings that conform to energy conservation standards, was introduced in 2001, and the category will be broadened further. Furthermore, the energy efficiency rating program for home appliances which is marked of its energy efficiency level began in 1992. This program will help consumers choose more energy efficient appliances and at the same time, bring the growth of the market for high energy efficiency appliances.

B-4. GHG reduction project

LFG (Landfill Gas), mainly composed of methane, comprises 4.8% of the total GHG emissions in 2001. It is thus a promising area for GHG reduction projects. Methane recovery and reuse projects will contribute to environment protection and energy conservation at the same time. As the result of these efforts, a LFG power plant with 50MW capacity and other small scale LFG power plants have been constructed and operated in the vicinity of Seoul. Among all, 15 of such sites are built in

residential areas nationwide. The government makes more efforts to promote this area domestically and provide its experience and know-how to other developing countries.

Figure 2. Greenhouse Gas Emissions from Fuel Combustion by Sector (2001)



C. Preparing adaptation measures for minimizing the adverse effects by climate change

Climate change is projected to have serious impact on various sectors, such as agriculture, forestry and fisheries, the coastal and marine environment, terrestrial ecosystem, natural disasters, and human health in Korea. Therefore, the government will establish and carry out monitoring system to collect and analyze data that are necessary for predicting various climate change symptoms in Korea.

In Korea, there are currently various facilities, including 89 observatories, 435 sites with automated meteorological observational instruments, 5 meteorological buoys, 2 light beacon stations for weather equipment, and 1 meteorological observation ship to survey the climate through earth, ocean, upper air, satellite, radar, aviation, and earthquakes. At the 89 observatories, 79 synoptic, 6 upper air, 7 radar, and 9 aviation meteorology observations have been deployed. To observe the anthropogenic causes of global environmental changes and protect the ozone layer, the "Law on the Restriction of Manufacturing Specific Materials for the Protection of Ozone Layer" was enacted in January of 1991. Furthermore, in December 1993, the law was amended as a preliminary legal basis for gaining membership into the UNFCCC, and for monitoring of GHG as well as the ozone layer.

4. The main issues in Korean Policy

At the time of accession to the OECD in 1995, the Korean government was considering the feasibility of taking a voluntary reduction target from the third commitment period (2018 to 2022), and accepting the status of a Non-Annex I party within the global climate change discussion. The reason for such an intention to wait until the third commitment period relates to the fact that Korea has only 30 years of history in its economic development, with conditions vastly different from other advanced industrial countries and their relatively stable economies.

However, the government is now currently encouraged to consider the possibility of joining with countries taking the GHG reduction target from the second commitment period (2013 to 2017) even though there have been few changes in Korea's economic situation in the last ten years. This option is promoted by some because the negotiation for formulating the new round to reduce the GHG atmospheric concentration will begin in this year, and Korea is known as not only one of the big GHG emitters but also one of the most economically developed countries among the developing countries.

Korea Energy Economics Institute (KEEI) has conducted a feasibility study to determine what level of the GHG reduction target would be acceptable to Korea, should it join the second GHG reduction commitment. The results of the study indicate that a reduction to 3% of total GHG emissions during the second period will allow positive economic growth to continue. However, a reduction to more than 3% of the total emissions for that period will negatively influence economic growth in Korea.

This scenario is based on the assumption[5] that every country of UNFCCC is classified into one of the three groups; developed, developing and least developed groups, depending on its economic facts, such as its GDP. Each group has a different level of the GHG reduction target based on its economic condition. The scenario also assumes that the target of GHG reduction is related to the size of its economy, known as the GHG intensity, how much it emits per unit of its economic activity.

[5] This assumption is also including all of UNFCCC member taking the GHG reduction target and discarding the base year only considering the 2nd period from 2013 to 2017

Closer examination of the study reveals that Korea would have to reduce its total predicted GHG emissions in the year 2015 by 7.63% and 16.71% to meet the 3% and 5% reduction targets respectively for the second commitment period. Korea may acquire a certain amount of emission credits from other countries, to lighten the burden of Korea's industries and therefore, the real amount to be reduced in the country, according to the study, would be 3.31% and 4.87% of the total emission amount of the year, to meet the targets under this scenario.

As the result, in order to contribute towards burden sharing in the second commitment period, Korea may accept the target of 3% reduction during the period while maintaining positive growth in GDP's. However in case of the 5% target, it is very difficult to accept the target without a incurring a negative impact on economic growth. Of course, there still reminds a lot of uncertainty in the model simulation, the scenario and related assumptions, and also the study is ongoing. It is believed that the government is going to concentrate on this matter as a main issue for setting up the policy in response to the UNFCCC.

5. Conclusion

The second NAP aimed at the establishment of the "Energy-Saving Economic Structure" by accelerating the shift to less energy-intensive industries and strengthening energy-saving measures across all sectors. At that time, the main goal of the second NAP was to create a turning point of the GHG emission structure and to design a long-term strategy for a sustainable energy system to harmonize national economic growth and global needs for the environment. The government recently published the third NAP, implemented for the next 3 years, 2005 to 2007. With implementing the tasks of the NAP, the government should review the results of the last two NAPs and the relevant internal policies, and consider the effectiveness of introducing the policies in terms of their implementation costs and their effects.

The government's efforts on the past two NAPs should be commended for facilitating a lower rate of increase in the GHG emissions than the rate of energy consumption increase over the last 10 years. Despite the growing consumption of energy by the industry, transportation and residence sectors, the ratio of the GHG emissions has not increased proportionately. This is primarily due to that the government's energy and environment policies and the proper introduction and

implementation of the NAPs in the country. However, much GHG are still emitted in the country and the ratio of renewable energy to the total energy resource is only 1%[6]. The government should make more effort to reduce GHG emissions, especially by increasing the energy efficiency in all sectors and distributing renewable energy sources in the country.

The government should be concerned about comprehensively and systematically promoting measures to prevent global warming. In accordance with the bill for the promotion of measures to cope with global warming, observation and monitoring of changes in concentrations of GHGs and sea level rising by adverse effect of climate change shall be conducted. Such monitoring is important because the adverse effects of climate change, such as sea level rise, will have severe impacts on countries like Korea where the land area is small, the altitude is lower, and the country has many peninsulas and coastlines. In addition, the government should provide supporting measures to the local governments for limiting the GHG emissions, such as technical advice, and promote the activities of business, citizens and non-governmental organizations relating to the limitation of the GHG emissions. These kinds of the integrated concepts should be run in parallel with the third NAP, to ensure the national comprehensive plan.

One of the main streams of the third NAP, the same one as the second NAP, was a change of industrial structure from energy-intensive to less energy-intensive by stimulating the energy conservation. These actions will produce results on the UNFCCC matters over the long-term. However the NAP is only a short-term plan that is reviewed every 3 years. Thus, the long term activities should be supplemented by short-term goals, which can be implemented during the life span of the NAP. Short-term goals that could be given more focus include promoting a more environmentally-friendly lifestyle by encouraging the citizens to recycle energy-intensive raw materials, to use public transportation and to participate in car pools. The government could also make an effort to develop new technologies such as absorption and removal of GHGs and increase in energy efficiency.

In addition, the adoption of the LCA (Life Cycle Assessment) could be considered as a task of the third NAP. The system is very useful to understand the bases of the GHG emissions and environmental information of a product by monitoring its life cycle from the raw material extraction

[6] The ratio number is also included the energy generating from the solid waste disposal such as incineration.

phase to the product-manufacturing phase, and finally the use and disposal phase. It also generates environmental information on each product which enables customers to select environmentally-friendly purchases.

The government should be more concerned about the transportation sector as it has high GHG emissions levels and is predicted to increase GHGs emissions significantly in the near future. In order to organize a transportation system that has low carbon emissions, the policies for promoting use of public transportation should be included in the NAP. In addition, the policies for reducing traffic congestion should be considered.

Furthermore, the government should improve environmental education activities and learning on global warming and energy saving in every day life, to promote actions to all generations of citizens, with whom the future rests. The government should develop an annual plan for community based activities connected to global warming abatement, and expand public relations activities through a broad range of media. These public relation campaigns should be informed by behavior change research to ensure they go beyond simply awareness raising and catalyze action from the general public. In order to enable citizens to properly evaluate the energy saving capability of housing and building options, the government should introduce systems for identifying energy efficient housing materials. Then, consumers can select low carbon emitting and energy saving products by using the information on the carbon emission and energy efficiency rating of household appliances. Automobiles should also be marketed in a way that helps consumers to understand their energy efficiency.

Lastly, we recommend some proposals for the climate policy in Korea.

● Win-Win Strategy by CDM

The Korean government should take part in the utilization of CDM, that is, it should identify ways of assisting the Non-Annex I parties in achieving sustainable development and contributing to the ultimate objective of the Convention. The government should recognize that Korea doesn't have any further potential to reduce its own GHG emissions domestically within the short term because of the current energy-intensive industries and high-level of energy efficiency. Therefore, the government

should give more consideration to international cooperation activities, both to acquire more emission credits for Korea and to assist efforts to reduce the GHG concentrations in the atmosphere externally.

● Develop a negotiation strategy for next round commitment

The government is currently considering whether to commit to a reduction target for the second commitment period, starting in 2013, but has no confirmed negotiation strategy. The government should develop a negotiation strategy for the next commitment. This strategy should recognize Korea's situation as a country with only thirty years of history in economic development with conditions vastly different from advanced industrial nations with relatively stable economies. Most advanced industrial countries, for example, had already reached more than 10,000 USD per capita GDP in the 1970s, while Korea still remains below that level today. It is anticipated that Korea will reach the OECD average of the 1990s only after 2010. Therefore, given Korea's lower GDP and shorter economic history, it seems Korea should have lesser responsibility for the current global atmospheric GHG concentration levels compared to the industrialized countries, who have produced increasing levels of GHG emissions over the last 100 years. The strategy should reflect this reality.

However, despite Korea's history with respect to GDP and economic development, it may become necessary for Korea to participate in the second commitment period. Therefore, a second part of the proposed strategy should outline acceptable national options and commitment levels for this period. To develop this part of the strategy, the government will need to acquire information including the level of its reduction target in next round, preferable base year and the scope of targeted countries. Korea should also actively participate in the negotiation process to ensure favorable results.

● Utilizing the existing infrastructures

The policies should be based on cost effectiveness and integrated with existing policies. For example, while Korea has been struggling with improving air quality of metropolitan area where almost 50% of Korean people live, many measures and tools for responding to its challenges have already been implemented in the country areas. Therefore, there are already many effective energy and environment regulations and policies for limiting the energy use and monitoring pollutant emission by Korean emitters. In addition, one of the Korean environmental research institutes

reported that about 100 key emitters in Korea are creating more than 90% of the national GHG emission. CEM (Continuous Emission Monitoring) to monitor pollutant emissions are currently installed in the exhausting pipe lines and smoke stacks of each key emitters. Furthermore, the government is currently collecting all data related to the key emitters' operations like annual energy consumption and applied exhausting system in the factory.

The CEMs and government data could be utilized to calculate highly accurate national GHG emission levels as one of measures for the convention of climate change. They could also be applied in the operation of domestic emission trading schemes to be introduced in the future, as a verification tool for checking the GHG emission reported by the emitter. The government should consider more effective ways to achieve positive outcomes with respect to GHGs and identify best practices to include in the NAP by comprehensively reviewing existing policies and measures.

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The Institute for Global Environmental Strategies (IGES) was established in 1998 as a non-profit organization to conduct strategic research on global environmental challenges and develop innovative policies for sustainable development innovative policies for sustainable development in the Asia-Pacific region. Currently IGES carries out research on themes such as climate policy, urban environmental management, forest conservation, business integration, IGES also hosts the Technical Support Unit of the National Greenhouse gas Inventories Programme under the auspices of the Intergovernmental Panel on Climate Change (IPCC).

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