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GREEN FINANCE IN THE REPUBLIC OF KOREA: BARRIERS AND SOLUTIONS

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Abstract

The Republic of Korea fully launched its green finance scheme in 2009 and then introduced the environmental information disclosure system and the emission trading scheme in 2013 and 2015, respectively. However, their use has not increased dramatically, as the public sector has taken the major role in green finance. Nowadays, green finance is expanding as the Government of the Republic of Korea is making efforts to change the energy mix by decreasing the share of nuclear energy and increasing that of new and renewable energy. The private sector is also attempting to revitalize the green finance in the Republic of Korea, such as commercial banks, private equity funds, and so forth. Changing the energy mix needs a huge fund, so the government alone cannot be responsible; the government is seeking to reach this goal in combination with private firms. In this context, the motivation of the Korean people to adopt eco-friendliness and energy efficiency through green financing, public or private, is necessary, together with industrial support from the government or financial institutions.

Keywords: renewable energy, energy mix, electricity mix, green finance, greenhouse gas (GHG) emissions, green growth, emission trading scheme (ETS)

JEL Classification: Q40, Q54, Q58

Contents

1. INTRODUCTION

Today, the majority of countries are reducing their greenhouse gas emissions efficiently, following the Paris Agreement, by making more room for nuclear and renewable forms of energy, which produce little carbon dioxide (Kim 2017). The Republic of Korea is the 13th largest country in economy size, while it is 9th in petroleum consumption and 8th in electricity consumption in the world, as of 2014 (Greenhouse Gas Inventory & Research Center of Korea [GIR] 2017; Korea Energy Agency [KEA] 2017).

The Republic of Korea has pursued full-scale green growth since 2008. Green finance newly emerged in 2009, and the development of related policies has involved discussions on how to finance green growth as well as green industry. As green finance policies, the Republic of Korea introduced the environmental information disclosure system and the emission trading scheme (ETS) in 2013 and 2015, respectively. The environmental information disclosure system aims to disclose mainly corporate environmental performance to the public and to enable the public and investors to understand, assess, and invest selectively for effectiveness as well as efficiency. The government introduced the ETS with the purpose of effectively reducing the greenhouse gas (GHG) emissions of companies through the capital market mechanism. In the capital market, it launched the Korea stewardship code to boost the responsible investment of institutional investors in 2016, and it anticipates that it will contribute to the effective GHG reduction of companies through the engagement activities of institutional investors (UN Environment 2017).

Nowadays, the expansion of renewable energy and nuclear-free electric power generation is the subject of debate in the Republic of Korea. The government decided to increase its renewable energy and not to increase the nuclear power generation further (Public Opinion Committee on Shin-Gori Unit 5&6 2017), as the public acceptance of nuclear electricity generation is dropping steadily because of its recent safety issues (Lee and Lee 2017), and it will make efforts to accomplish the 20% share of renewable energy in the total electricity generation in 2030. However, the government decided that the nuclear power generation facility under construction would be completed on schedule because of its high sunk cost. The safety problem is crucial in determining the expansion of nuclear power generation, though nuclear energy is particularly advantageous in the reduction of carbon dioxide: carbon dioxide emissions per capita decrease by 0.26–0.32% as the share of nuclear generation increases by 1%, and the social benefit from one nuclear generation facility is estimated to be KRW 13~20 trillion (Lee and Lee 2016).

Another major concern in the Republic of Korea is fine and ultra-fine dusts. As their concentrations continue to increase and the Republic of Korea records the worst ultra-fine dust among the OECD countries (OECD 2017), the government produced its fine and ultra-fine dust reduction plan (Korean Government, 2016a, 2016b). One of the critical sources is coal-fueled thermal generation facilities: dust that occurs in firing the coal covers the whole territory, worsening the atmosphere (Korean Government 2016a). The social consensus is that the government should diminish the use of the criticized coal-fueled thermal generation. However, coal accounts for the largest portion among the power generation sources in the Republic of Korea now, so the government is considering renewable energy sources as alternatives to coal and has suggested fuel conversion from coal to cleaner sources. In sum, it is necessary to develop technology that can decouple the energy consumption and fine dust occurrence from the mid- to short-term perspective and convert the production system from the

long-term perspective (Lee and Lee 2017). In addition, Korean people need to be energy efficient by strengthening personal norms, such as moral obligation and attitudes toward environmental/climate change issues, which have a positive impact on efficient energy use (Kim 2016a).

In this context, this study will identify the green growth and green finance policies at the country level and provide an understanding of the role of green finance to support low-carbon green growth along with GHG emission reduction.

2. NATIONAL PLAN TO PREPARE FOR CLIMATE CHANGE

The government has tried to prepare for climate change since 1998. It first established a master plan to prepare the climate change agreement in 1998 for the period from 1999 to 2001, and most recently it provided the third plan effective for the period from 2005 to 2007 (KEA 2017). The three plans focused on constructing the infrastructure for GHG emission reduction, and then the master plan, aiming to prepare for climate change, substituted them with the five-year term 2008 to 2012 (Korean Government 2016c). It first released the five-year green growth plan in 2009 as an efficient and systematic approach to the national green growth strategy, and it provided the second plan in 2014. The plan developed most recently is the first climate change preparation master plan, publicly announced in December 2016.

2.1 Second Five-Year Green Growth Plan (Office of Government Policy Coordination [OGPC] 2014)

The first plan focused on the systemization of green growth: it provided laws and policies such as the Framework Act on Low-Carbon Green Growth, Smart Grid Act, Green Building Act, Emission Trading Act, the plan for climate change preparation, and the master plan for sustainable development, established the Green Growth Committee in the government in 2009 to push the governmental driving system for green growth, executed the renewables portfolio standard (RPS) since 2012, and introduced GHG and energy target management in 2010. The reduction of GHG emissions in companies under the GHG and energy target management scheme exceeded the target for GHG emission reduction (Ministry of Environment [MoE] 2014). However, it showed limitations to sound performance improvement for three reasons: 1) the increasing trend of GHG emissions and the inactivation of green industry, 2) government-led and supply-centered policies, and 3) the shortage of stakeholder communication and consideration of social equality.

The second plan aimed to supplement the first plan and to settle the low-carbon economic and social structure under the motto of inclusive green growth, with five policy directions for effective greenhouse gas reduction, the construction of a sustainable energy system, the establishment of a green prosperous industry ecosystem, the embodiment of a sustainable green society, and the reinforcement of global green collaboration.

For effective greenhouse gas reduction, the government set up an industrial GHG reduction rate and provided specific goals for GHG reduction amounts for industries such as steelmaking, cement manufacturing, petrochemistry, electrics and electronics, and electronic display apparatus, as shown in Table 1 below; as steelmaking and petrochemistry industries with high energy consumption introduced or increased their facilities, the energy efficiency worsened (Kim, Lim, and Kim 2015).

Table 1: Principal Industrial Goals of GHG Reduction

Content		Goals per Annum				
		2014	**2015**	**2016**	**2017**	**2018**
Industrial GHG Reduction Rate compared with Business as Usual (BAU) (in %)		**1.7**	**7.9**	**9.7**	**11.6**	**13.7**
GHG reduction amount (in thousand tCO_2e)	Steelmaking	206	2,383	3,313	4,264	5,282
	Cement	206	2,383	3,313	4,264	5,282
	Petrochemistry	408	1,543	2,010	2,628	3,246
	Electrics and electronics	2,356	12,808	15,194	17,595	20,103
	Electronic display apparatus	1,409	7,500	9,986	13,125	17,120

Source: OGPC (2014).

The government planned to reduce the GHG emissions in the transportation sector by constructing a low-carbon green logistics system, reinforcing the manufacturing and consumption of high-efficiency and low-carbon vehicles, improving public transportation, and enhancing power-free and carbon-free vehicle usage.

The government has made efforts to expand the distributed power by inducing the installment of private electric generators in industrial complexes, expanding the community energy supply, and diffusing distributed renewable energies, as the necessity for decentralized electricity power sources is becoming significant for eco-friendly generation as well as the local acceptance of generation and transmission facilities (Ministry of Trade, Industry and Energy 2014, 2015; Park and Jung 2016), and estimates indicate that distributed power will account for at least a 15% share of the total energy in the Republic of Korea, an increase from a 5% share in 2014, which will be able to offset up to 50 million toe, 10% of the annual aggregated emission allowance. The government supports energy investment of which the energy-saving effect turns out to be at least 5% in the energy examination of an energy-saving company (ESCO) project.

As the heavy energy-consuming economic structure is continuing despite the governmental efforts, the Republic of Korea needs a sustainable energy system. The intention of the second plan was to expand the dissemination of renewable energy to 11% in 2035 from 3.18% in 2012, considering the energy safety, GHG emission reduction, and so on; however, the current government declared that the share of renewable energy will be 20% in 2030 (OGPC 2017).

The government introduced new policies, such as the RPS in the utility sector, the renewable heat obligation (RHO) in the building construction field, and the renewable fuel standard (RFS) in the transportation sector in 2012, 2015, and 2016, respectively, in accordance with the second plan. For the dissemination of renewable energy, the government will reform its support policy and expand its investment. It will reform the previous subsidy support policy to incentivize support proportional to the amount of energy generation. It will expand its financial support to technology

commercialization related to energy or renewables as implemented only for production, facilities, and operation.

2.2 Climate Change Preparation Master Plan (Korean Government 2016c)

In June 2015, the Republic of Korea submitted the intended national determined contributions (INDCs) to the United Nations; Table 2 below illustrates the GHG emission reduction goal of a 37% reduction compared with the BAU in 2030 and the GHG emission reduction goals of principal areas (Korean Government 2015). The Republic of Korea first set its national GHG emission reduction goal to reduce GHG emissions by 30% compared with the BAU in 2020 in November 2009, which was the highest level of the Intergovernmental Panel on Climate Change's (IPCC) recommendation for developing countries and represented an expression of strong will regarding GHG emission reduction. Therefore, some argued that it had violated the "no backsliding" principle for the reduction goal: the Republic of Korea had originally planned to reduce its emissions by 30% compared with the BAU by 2020 in its national master plan in 2014; moreover, it used the BAU that most developing countries utilize in setting the reduction goal. Most developed countries set it in comparison with the baseline (Choi 2015; National Assembly Research Service 2017). The INDCs of the Republic of Korea are very ambitious when applying share indicators, such as the share of cumulative emissions or the share of the GDP, while they are less ambitious when applying comparative indicators, such as the per capita emissions relative to the world average (Oh 2016).

Table 2: GHG Emission Reduction Goals of Principal Areas

Area	**Reduction** (in Million tCO_2e)	**Reduction Rate** (%)
Utility	64.5	7.6
Industry	56.4	6.6
Building	35.8	4.2
New energy industry	28.2	3.3
Transportation	25.9	3
Public and others	3.6	0.4
Waste	3.6	0.4
Agriculture and cattle	1	0.1
Domestic reduction	219	25.7
Foreign reduction	96	11.3

Source: Korean Government (2015).

On 3 November 2016, the national assembly passed the proposal to ratify the Paris Agreement, which the COP21 meeting had adopted in December 2015, and the Republic of Korea became the 97th country to ratify the Paris Agreement on 3 December 2016.

In this context, the government established the first climate change preparation master plan for the next 20 years, 2017~2036, in December 2016 according to the Framework Act on Low-Carbon Green Growth. It suggests the mid- to long-term vision as well as the policy direction to prepare for climate change effectively and to convert the economic structure from heavy energy exhaustion to a low-carbon system at the

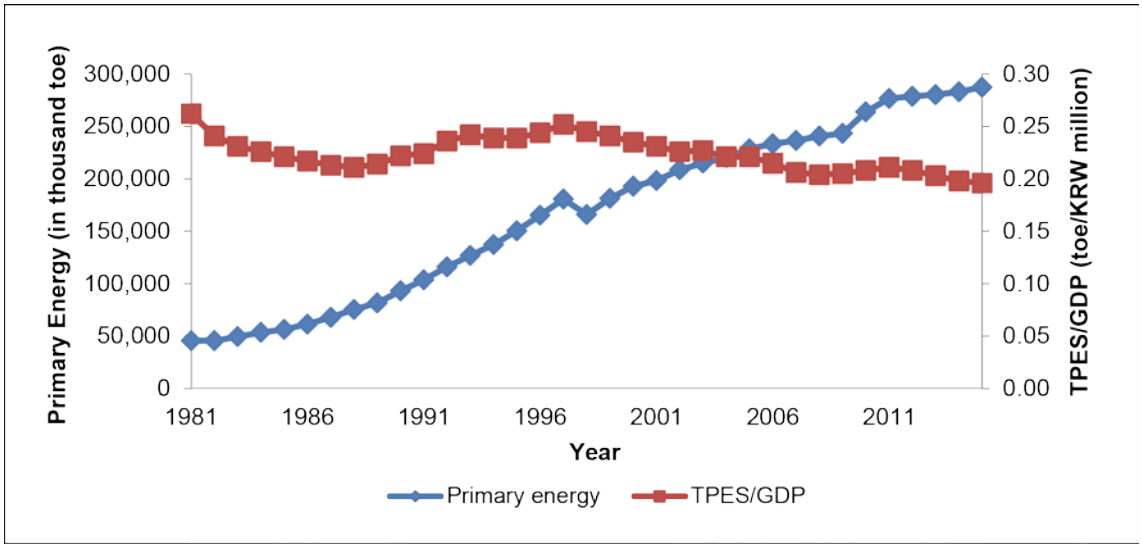
country level, providing for a new climate change regime to function positively in the economy. As companies view the preparation for climate change as a burden and just comply passively with the government's policies, the government will make efforts to support the development of new technologies as well as new industries intensively enough for companies to utilize them as opportunities for market leadership. It will promote the realization of a low-carbon society by inducing companies to develop and invest in technologies through mid- to long-term policies for climate change preparation and expand the public participation.

To achieve the national GHG reduction goal, a 37% reduction compared with the BAU in 2030, the master plan includes an action plan roadmap to accomplish the goal at the country level and to transit to the low-carbon policy: it raised the RPS duty rate to 7% in 2020, and the governmental support will lie in the dissemination of renewable energy; it will financially support renewable energy facilities by lowering the loan interest rate; it will promote eco-friendly fuel usage by reinforcing the duty rate of the renewable fuel mix to 3.0% in 2020 in the RFS; and it will promote the megawatt market in which consumers can sell their saved electric power to induce voluntary energy saving.

3. ENERGY MIX IN THE REPUBLIC OF KOREA

The total primary energy supply (TPES) has increased steadily since 1981, though it decreased in 1998, during the Asian financial crisis, reaching 285,478 thousand toe in 2015, about 6.3 times the amount in 1981 (see Figure 1). In addition, the ratio of the TPES to the gross domestic product (GDP) has been decreasing since 1997, because the increase rate of the GDP is greater than that of the TPES. In addition, estimates show that a 1% increase in energy consumption will increase the economic growth by 0.093–0.104% in East Asian countries, so a reduction in energy consumption may harm the economic growth (Kim 2015b).

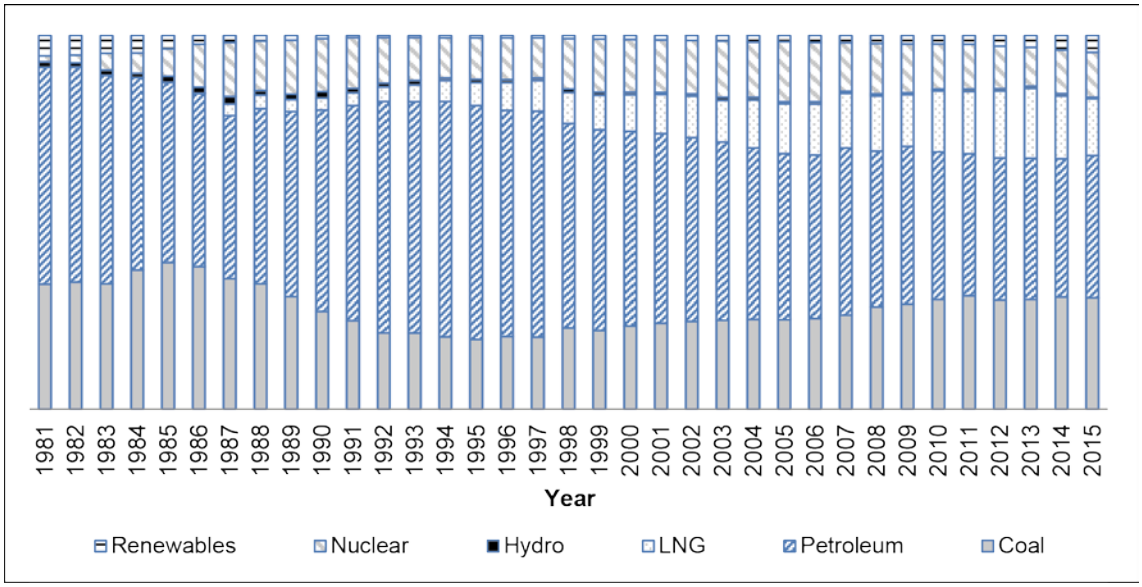
Figure 1: TPES in the Republic of Korea since 1981



Data source: Korea Energy Economics Institute (KEEI) (2017).

Petroleum and coal account for the largest and the second-largest share in the composition of energy sources in the Republic of Korea, though the share of petroleum is decreasing. The share of petroleum recorded a historical maximum of 62.9% in 1994 and then fell to 38.1% in 2015, probably due to its high price. The share of coal has expanded since 1994 and reached 29.7% in 2015, while it was 39.1% at its maximum in 1985. As Figure 2 shows, the share of coal decreased as nuclear power generation became more available in the 1980s. Liquid natural gas (LNG) first appeared as an energy source in 1987, and its share grew steadily to 15.2% in 2015. The share of nuclear energy increased from 1.36% in 1981 to 12.1% in 2015, with a maximum of 16.1% in 2005. As the government makes efforts to reduce the share of coal and promote the use of renewables, it anticipates that the use of coal as an energy source will decline and renewable energy will experience a sudden rise. The government will not add further coal-fueled thermal generating facilities and will convert the existing coal-fueled thermal generating facilities into LNG or other eco-friendlier fuels.

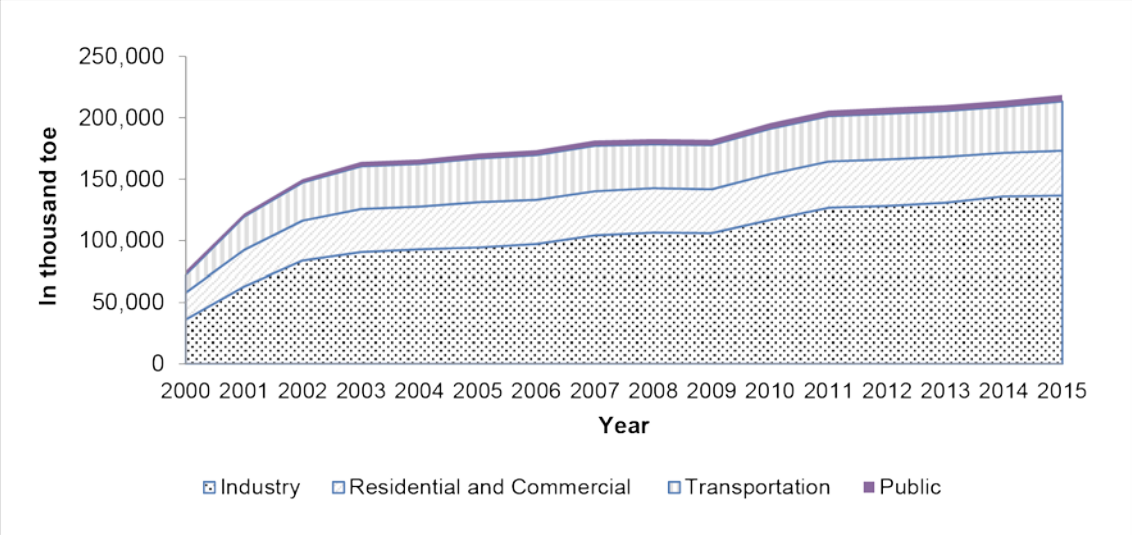
Figure 2: Shares of Energy Sources



Data source: KEEI (2017).

This study investigated the energy consumption in four sectors: industry, residential and commercial, transportation, and public. Industry has consumed the most energy among the four sectors historically, and the transportation sector and the residential and commercial sector have historically shown similar energy consumption amounts. Industry has experienced rapid growth in energy consumption due to the growth of energy-intensive industries, such as steelmaking and petrochemistry (International Energy Agency 2013). In 2015, the energy consumed in the transportation sector amounted to 40.3 million toe and that in the residential and commercial sector to 36.4 million toe. Since 2014, transportation has consumed more energy than the residential and commercial area. Petroleum has been consumed most among the energy sources over all the sectors since 2001, though its share has been chronologically decreasing as electric or hybrid vehicles have been disseminated. The share of the residential and commercial area has declined recently, as its price has been so high that people have selectively consumed other cheaper sources, such as electricity or city gas. The share of petroleum in the transportation sector will diminish with the positive diffusion of electric or hybrid vehicles after all.

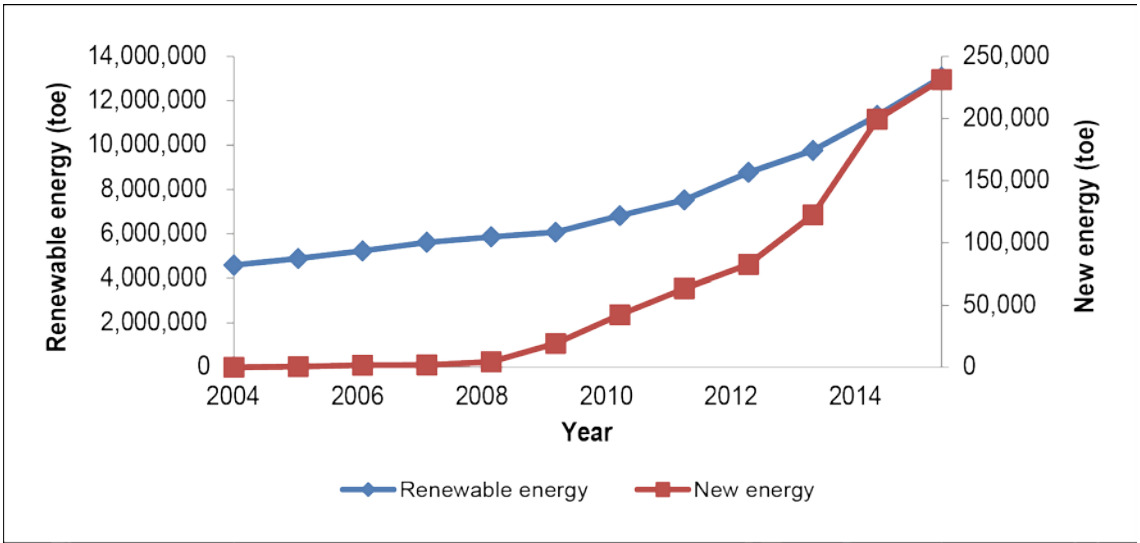
Figure 3: Energy Consumption in Four Areas



Data source: KEEI (2017).

The production amounts of new and renewable energy have been increasing continuously so far, and the production amount of renewable energy is much larger than that of new energy (see Figure 4 below).[1]

Figure 4: New and Renewable Energy Production

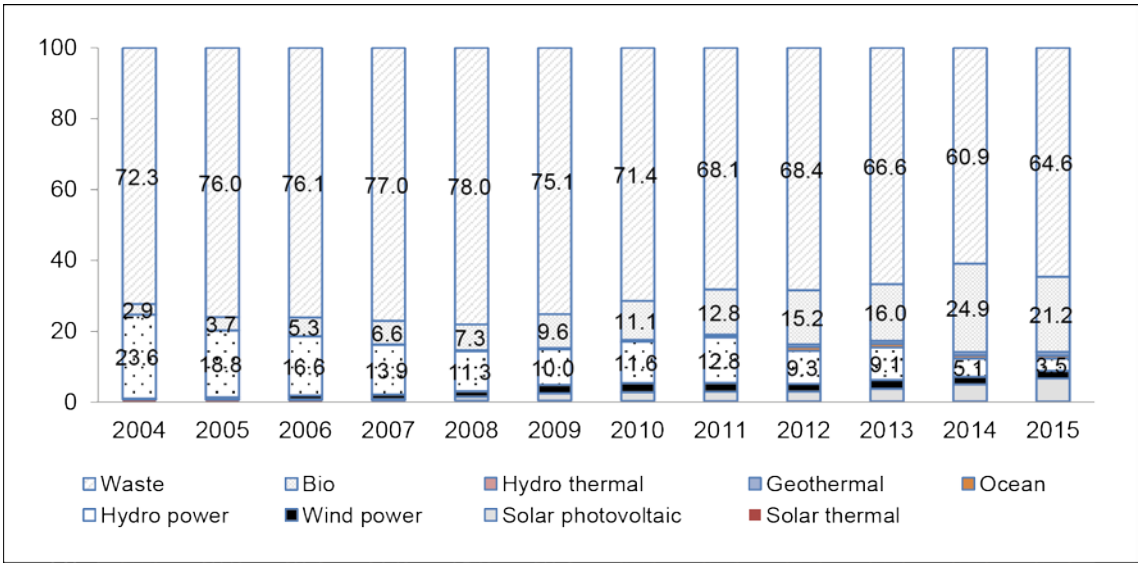


Data source: KEEI (2017).

[1] Renewable energy includes solar thermal, solar photovoltaic, wind power, hydro power, which has included large-hydro (larger than 10 MW) since 2003 and excludes pumped-storage (hydro), ocean, geothermal, bio, which consists of bio gas, landfill gas (LFG), bio diesel, wood chips and pellets, wood briquettes, fire wood, waste wood, black liquor, sewage solid fuel, bio-solid refuse fuel (SRF), bio bunkers, and waste, which includes waste gas, industrial waste, living waste, municipal solid waste, cement kiln fuel, refuse-derived fuel (RDF)/refuse plastic and paper fuel (RPF)/tire-derived fuel (TDF), SRF, refinery fuel oil, and wood waste, by energy source, and new energy includes fuel cells and the integrated gasification combined cycle (IGCC) (KEEI 2017).

Among the renewable energy sources, waste took the largest share of 64.6% in 2015, followed by bio resources, and recorded 78% in 2008 as its maximum. Bio resources increased to 24.9% in 2014. The share of hydro power shrank from 23.6% in 2004 to 3.5% in 2015, because a hydro generating facility had not been developed and other renewably sourced facilities were increasing. Solar photovoltaic power is increasingly being adopted in both industry and houses.

Figure 5: Chronological Shares in Renewable Energy
(%)



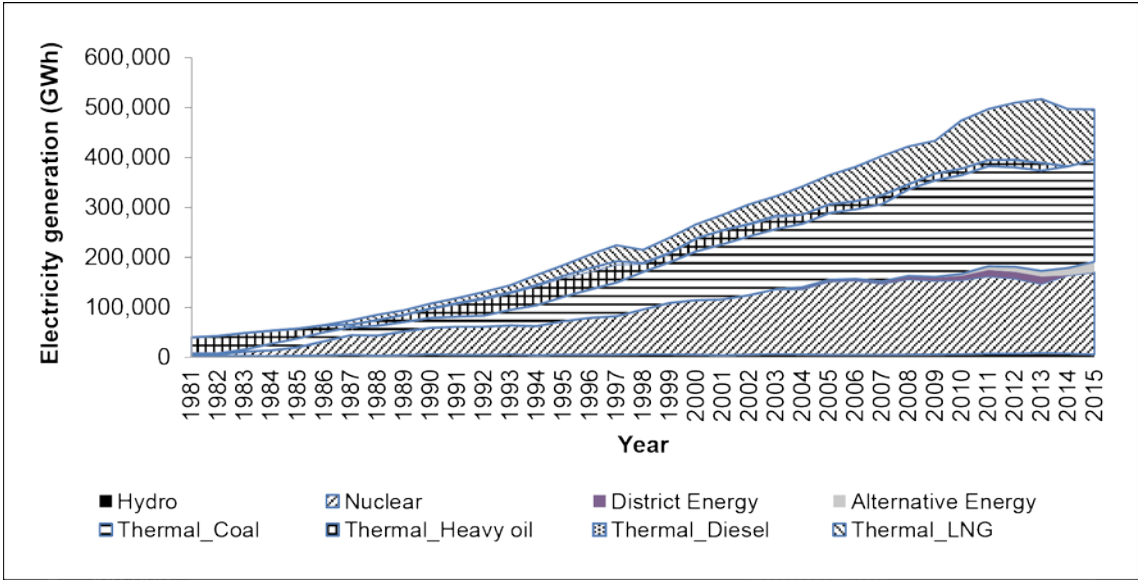
Data source: KEEI (2017).

In particular, the local autonomous bodies and the Republic of Korea's central government offer subsidies for installing small photovoltaic generation apparatus in homes. Hydro thermal, ocean, wind power, solar thermal, and geothermal power do not have meaningful shares now, though the adoption of geothermal power has been increasing.

As far as the electricity mix is concerned, the three major electricity sources are coal, LNG, and nuclear. Their shares in 2013 were 38.8, 24.7, and 26.8%, respectively. The share of coal has increased since 1998 to over 30% and recorded a maximum of 44.6% in 2009. The share of nuclear reached its maximum of 53.1% in 1987 and then gradually declined to 26.8% because of the expansion of the consumption of other sources, such as coal, LNG, and others. Research results imply a 31.1% share of nuclear generation in 2035 on the basis of economic costs (Cho and Park 2015). LNG as an alternative to coal is consumed more than ever. Its electricity generation amount has increased ever since 1981. Alternative energy and district energy have shares of 2.8% and 2.2%, respectively. Incidentally, the share of hydro electricity generation gradually decreased from 6.7 to 1.7% in 2013.

Primary metal and petroleum coal product manufacturing are inefficient sectors regarding electricity, so they have the lowest electricity performance index among the sectors (Ku, Ju, and Jeong 2016).

Figure 6: Electricity Generation by Source



Data source: KEEI (2017).

Table 3: Electricity Generation by New and Renewable Energy
(Unit: MWh)

Year	Total	Renewable Energy	New Energy
2004	4,533,603	4,533,603	–
2005	3,950,000	3,947,897	2,103
2006	3,899,368	3,892,687	6,681
2007	4,394,830	4,386,308	8,522
2008	4,227,477	4,207,167	20,310
2009	4,617,886	4,528,616	89,270
2010	5,889,553	5,692,594	196,960
2011	17,345,647	17,051,026	294,621
2012	19,498,064	19,108,400	389,664
2013	21,437,822	20,859,244	578,578
2014	26,882,190	25,939,134	943,056
2015	37,078,863	35,983,514	1,095,349

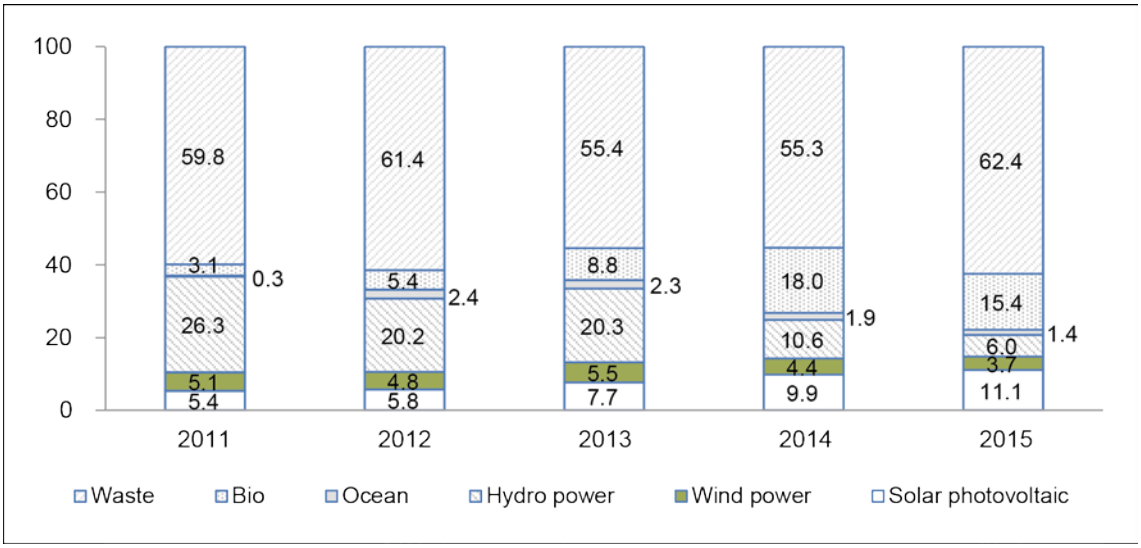
Data source: KEEI (2017).

The electricity generation from new and renewable energies is growing dramatically. The electricity generated from renewable energy was 4,533,603 MWh in 2004 but 35,983,514 MWh in 2015, showing rapid growth. The year 2005 witnessed the introduction of new energy. New energy accounted for the production of 2,103 MWh in the first year, and its consumption expanded to generate 1,095,349 MWh of electricity in 2015. Electricity consumers are the most sensitive to price and prefer to avoid risk, greenhouse gases, and fine dust emissions at the same time, so, for new and renewable forms of energy, which entail no risk and are environmentally friendly, price competitiveness is the most important factor in improving the market acceptance, and the distribution of new and renewable energy will be resolved in the mid to long term rather than in the short term (Lee 2016a). In the long run, a 1% increase in the total electricity consumption will result in a 37.5% increase in carbon dioxide emissions

while a 1% increase in electricity generation through renewable energy will cause a 16.8% decrease in carbon dioxide emissions (Kim and Kim 2015).

The most utilized renewable source to generate electricity has been waste since 2011. It accounted for a share of 62.4% of electricity generation from renewable energy in 2015 and consisted of waste gas, industrial waste, living waste, solid refuse fuel (SRF), cement kiln fuel, and refinery fuel oil. Bio resources, such as bio gas, LFG, wood chips, wood pellets, black liquor, sewage solid fuel, bio-SRF, and bio bunkers, constituted the second-largest share of 15.4% in 2015 and have been more used than ever.

Figure 7: Shares of Renewable Energy in Electricity Generation
(%)



Data source: KEEI (2017).

The presence of RPS works to the advantage of solar power over other sources, though wind power is the optimal source for Korean power producers; furthermore, solar power could become the first choice of Korean power producers if the unit production cost of solar power decreases to 1.5 times that of wind power and the technology investment in solar power increases to 1.2 times that of wind power (Jo, Huh, and Lee 2016).

The plan to substitute nuclear power and coal (bituminous) with LNG and renewable energy increases the cost and risk of the electricity generation mix, so the increase in renewable energy in the electricity mix causes an increase in the cost volatility risk, necessitating a reduction in the manufacturing unit cost (Cha 2017). To keep pace with the increasing trend of renewable energy use, the direction of technology development should be mainly cost reduction in manufacturing: in the photovoltaic power generation industry, core equipment in ingot and wafer manufacturing has shown strong dependency on overseas importation, which has hurt the business profit, so the localization of equipment is necessary to boost business and a reduction in the manufacturing cost of photovoltaic cells and modules is needed through the installation of automated facilities. In the wind power generation industry, core components, such as controllers and power converters, need localization with validated durability and trust; the energy storage system (ESS) requires the localization of core materials and manufacturing cost reduction for promotion (Ahn 2017).

4. GHG EMISSIONS IN REPUBLIC OF KOREA

The Greenhouse Gas Inventory & Research Center of Korea (GIR), established in 2010 under the Framework Act on Low-Carbon Green Growth, manages the national GHG emission amount. The GIR publishes the national greenhouse gas inventory of the Republic of Korea every year to enable the public to understand the national GHG emissions per annum.

The national GHG emissions in the Republic of Korea increased until 2013 but reduced in 2014. The total GHG emissions in 2014 amounted to 690.6 million tCO_2e and declined by 0.8% compared with 2013. It was the first decline in GHG emissions at the country level since 1998, when a big decline occurred due to the Asian financial crisis.

The energy sector played a critical role in the reduction of GHG emissions by showing a 1.2% GHG emission reduction compared with 2013 (for details, see Table 4 below). The GHG emission amount in the energy and industrial process sectors accounted for 94.7% of the total. The GHG emissions in the energy, agriculture, and waste sectors reduced compared with the previous year by 1.2, 2.7, and 3.3%, respectively, while those in the industrial process sector increased by 5.0%. This study calculated the compound annual growth rate (CAGR) of GHG emissions in every sector for the period from 1998 to 2014. The energy sector shows the highest CAGR among the five sectors, 3.4%, and the CAGR of the industrial process sector is the second largest, 2.0%. The GHG emissions in agriculture have reduced with a CAGR of –0.6%. The absorption in land use, land-use change, and forestry (LULUCF) has fallen from 56.1 to 42.5 million tCO_2e because of the reduction of forest land (Korea Forest Service 2014).

Table 4: GHG Emissions by Sector (1998–2014)
(Unit: In Million tCO_2e)

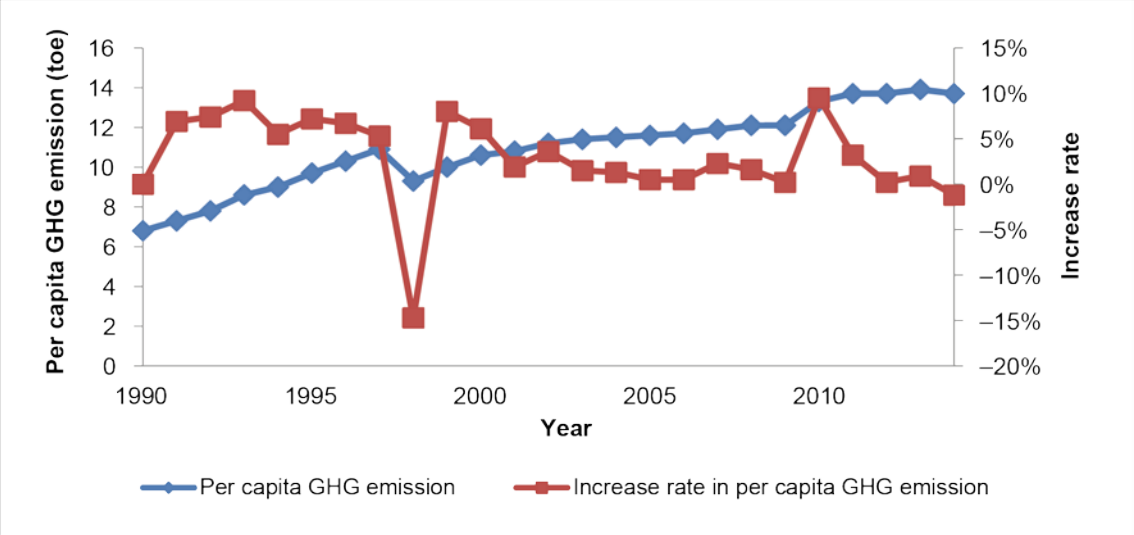
Year	Energy	Industrial Process	Agriculture	LULUCF	Waste	Total GHG Emissions (except LULUCF)
1998	350.4	39.9	23.6	- 56.1	16.1	430.0
1999	381.1	47.3	22.4	- 59.2	16.9	467.7
2000	410.4	49.6	21.8	- 58.8	18.9	500.6
2001	424.4	48.3	21.3	- 56.6	19.7	513.7
2002	443.2	52.1	21.1	- 55.8	18.7	535.0
2003	450.8	55.3	20.8	- 57.0	18.8	545.7
2004	458.4	57.6	20.9	- 55.0	17.7	554.7
2005	466.4	54.3	21.1	- 56.4	16.7	558.5
2006	472.6	52.9	21.2	- 57.1	17.1	563.8
2007	491.6	50.8	21.4	- 57.9	15.7	579.5
2008	505.8	50.0	21.5	- 57.3	15.5	592.8
2009	512.2	47.0	22.0	- 54.5	15.5	596.7
2010	565.2	54.0	22.4	- 54.3	15.1	656.6
2011	593.9	51.7	21.5	- 48.5	15.5	682.6
2012	597.7	51.7	21.9	- 44.7	15.8	687.1
2013	606.7	52.0	21.9	- 42.8	16.0	696.5
2014	599.3	54.6	21.3	- 42.5	15.4	690.6

Source: GIR (2017).

However, the energy sector has emitted the most GHGs among the five sectors. The GHG emissions in the energy sector represented an 86.8% share of the total GHG emissions in 2014. They increased between 1998 and 2013. The industrial process took a 7.9% share of the total GHG emissions in 2014. The largest share was 10.4% in 2004, but it has been following a decreasing trajectory since then. In the energy sector, the three principal industries in GHG emissions are historically energy generation, manufacturing and construction, and transportation. Energy generation accounts for the largest portion among the specified industries in GHG emissions. Its share rose from 29.9% in 1998 to 43.5% in 2014, though it dropped by 1.8%p compared with 2013. Manufacturing and construction followed energy generation with a 32.4% share in 2014. They recorded the smallest share of 26.8% in 2009 and followed a decreasing trend by 2013 but increased by 2.4%p in 2014. The third-largest share is that of the transportation industry: its share declined from 16.4% in 1998 to 14.8% in 2014, increased by 2003, and since then has continued to decrease. As the three sectors mentioned above account for about 79% of the total GHG emissions, the Republic of Korea can achieve a favorable reduction in GHG emissions by focusing on these three industries to achieve greater effectiveness as well as efficiency in the policy.

The GDP has the largest effect on the gross GHG emissions (Kim 2015c). The per capita GHG emissions followed an increasing trend, except for 1998, during the period from 1990 to 2013. From 1998, they increased until 2013; however, they first reduced by 1.2% in 2014. The rate of increase has been decreasing overall since 1998, though there was a sudden rise in 2010. It fell to –14.7% in 1998.

Figure 8: Per Capita GHG Emissions in the Republic of Korea



Data source: GIR (2017).

5. GREEN FINANCE IN REPUBLIC OF KOREA

5.1 Green Management Company Finance Support System, enVinance

The purpose of enVinance is to promote the green financing of commercial banks through preferential treatment of companies with outstanding environmental management activities by collecting and analyzing the corporate environmental

information that the government owns according to the Framework Act on Low-Carbon Green Growth and the Act on Support of Environmental Technology and Industry. In January 2017, the government amended the enforcement regulation of the Act on Support of Environmental Technology and Industry to provide the legal ground for the enVinance system.

The system provides environmental performance evaluation reports to individual companies, and commercial banks utilize them to assess and include the environmental risk in the loan evaluation process. Companies can understand their environmental risk state and find ways to overcome it via the evaluation report, and the system defines companies with outstanding environmental management as those with an outstanding grade in enVinance or those that have received the grand prize in environmental management; they are treated preferentially and awarded extra points in the policy correspondence area in the environmental policy fund evaluation process.

The operator, the Korea Environmental Industry & Technology Institute (KEITI), aims to expand the usefulness of enVinance for financial institutions. It is favorable for financial institutions to make investment decisions utilizing enVinance rather than decisions on corporate loans. Seven Korean commercial banks among the Korean financial institutions have joined enVinance as of 2017 and have made efforts to utilize it in financial products. The KEITI will expand the participation of financial institutions to insurance companies, as until now only commercial banks have joined. The enVinance system will be utilized by insurance companies for environmental liability insurance, which has been obligatory for companies with heavy environmental loads since 2014.

5.2 Environmental Information Disclosure

The aim is to construct the nationwide environmental management infrastructure and establish voluntary environmental management by enhancing the voluntary will to promote environmental management at the corporate level and promoting the environmental communication with the public and to contribute to the green loans and investment of financial institutions by providing them with verified environmental information. Disclosure object institutions should submit the environmental information of the previous year to the website (www.env-info.kr) by June every year, and the submitted information will become available to the public every March following validation. Disclosure items are categorized into mandatory and voluntary disclosure and vary by industry sector.

As of 2015, the number of registered institutions is 1,383, composed of 624 manufacturers, accounting for 45% of the total, 410 public administration bodies, 26 hygiene service institutions, 74 educational service institutions, and so on; 100% of the mandatory disclosure and 25.3% of the voluntary disclosure have been implemented so far based on the number of voluntary disclosure items (KEITI 2017).

However, some researchers have stated critically that manufacturers in various industries have different features economically as well as environmentally, so it would be better to be more specific regarding environmental characteristics. Some have also suggested that the system needs to transform certain voluntary disclosure items into mandatory items and proposed the adoption of the “comply or explain” principle whereby, if an item is not related to a company, it can just explain the irrelevance.

Table 5: Mandatory and Voluntary Disclosure Items by Industry Sector

Content	Items	Manufacturer	Public Administration	Education service	Hygiene	Other services	Other industries
Corporate overview	Business status	●	●	●	●	●	●
	Environment-related awards and agreement	○	○	○	○	○	○
Green management system	Vision, strategy, direction, and goal	○	●	○	○	○	○
	Organization in full charge, training and education, internal assessment, etc.	●	●	●	●	●	●
Resources/ energy	Investment in reduction and technology adoption	●	○	○	○	○	●
	Material usage	●	–	–	–	–	●
	Water consumption	●	●	●	●	●	●
	Energy consumption	●	●	●	●	●	●
	Renewable energy investment and technology adoption	○	○	○	○	○	○
GHG/ environmental pollution	Investment in GHG emission reduction and technology adoption	○	○	○	○	○	○
	GHG management level and emission amount	○	○	○	○	○	○
	Investment in environmental pollution reduction and technology adoption	●	○	○	○	○	●
	Environmental pollution management facility and monitoring system	●	○	○	○	○	●
	Air pollution material emissions	●	–	–	–	–	●
	Water pollution material emissions	●	○	○	○	○	●
	Waste generation and recycling	●	●	●	●	●	●
	Hazardous material usage	●	○	○	●	○	●
	Management of land, noise and vibration, and odors	○	–	–	–	–	○
Green products and services	Investment in green product and service development and technology adoption	○	–	–	–	–	○
	Eco-friendly design	○	–	–	–	–	○
	Third-party certification and type II certified products	○	–	–	–	–	○
	Green purchase direction and operation	○	●	○	○	○	○
	Management of environmental information of subcontractors and environmental performance evaluation	○	–	–	–	–	○
	Support for environmental technology and education	○	–	–	–	–	○
Social and ethical responsibility	Environment law violation (domestic/overseas)	●	●	●	●	●	●
	Environment (sustainability) report publication	○	○	○	○	○	○
	Correspondence with stakeholders following requests for environmental information	○	○	○	○	○	○

"●" denotes a mandatory disclosure item, "○" denotes a voluntary disclosure item, and "–" denotes no relevance.

Source: www.env-info.kr (accessed on 12 December 2017).

5.3 Loans from the State-Owned Environmental Fund

The MoE provides a loan service from the state-owned environmental fund for environmental industry, separate from the utility sector, in particular new and renewable energy. The loan area, loan period, and upper limit of loans per company vary according to the purpose of the loans. However, they are very attractive to companies, as the loan interest rate is lower than the commercial loan interest rate. They can apply online via a website (http://loan.keiti.re.kr). The due diligence process is essential after document examination. Companies that qualify can borrow money from the fund. Unfortunately, the financial support from the government mainly consists of loans, not investments. The ministry should promote investments to reinforce the corporate environmental management.

Table 6: Loans from the State-Owned Environmental Fund

Content	Area	Specified Area	Loan Interest Rate	Load Period	Upper Limit per Company (KRW Billion)
Fund to nurture the environmental industry	Facility	Facility fund	Fixed	3-year deferment 4-year redemption	3
		Developed technology commercialization fund			1
	Operation	Growth base fund		2-year deferment 3-year redemption	0.5
		Foreign base fund			0.5
		Distribution and sale fund			0.2
Environmental improvement fund	Facility	Pollution prevention facility fund		3-year deferment 4-year redemption	5
		Hazardous chemicals facility fund			
Fund to nurture the recycling industry	Facility	Facility fund	Floating for every quarter	3-year deferment 7-year redemption	2.5
		Developed technology commercialization fund			1
	Operation	Growth base fund		2-year deferment 3-year redemption	0.5
		Emergent business stability fund			0.5
Fund to install a natural gas supply facility	Facility	Facility fund		5-year deferment 10-year redemption	3

Source: loan.keiti.re.kr (accessed on 12 December 2017).

5.4 Financial Support from the Government for Renewables

The government provides financial support for entities that are willing to install and utilize renewable energy facilities and entities that manufacture renewable energy equipment as a separate loan from the state-owned environmental fund. It offers a low-interest loan for facilities, manufacturing, and operation. The size of the support was KRW 100 billion in 2016: KRW 92.2 billion for facilities and KRW 7.8 billion for production and operation. The total government subsidies for renewable energy cumulatively amount to KRW 1.8 trillion for 55,084 cases (KEA 2017).

The government also financially supports green homes or buildings. It defines a green home as a low-energy eco-friendly home that minimizes the use of fossil fuels and the emission of GHGs as well as air pollution materials through the adoption of new and renewable energy, such as solar photovoltaic, solar thermal, geothermal, and so on, and the use of high-efficiency lights and boilers and eco-friendly insulating materials.

Table 7: Financial Support for Renewable Energy

Purpose	Upper Limit (KRW Billion)	Loan Period	Support Rate
Production and facility	10	Five-year deferment Ten-year split payment	SME: 90% Intermediary company: 70% Large company: 40% (maximum)
Bio and waste	10	Three-year deferment Five-year split payment	
Facilities for homes	0.1		
Operation	1	One-year deferment Two-year split payment	

Source: http://www.knrec.or.kr/knrec/12/KNREC121915.asp (accessed on 12 December 2017).

Table 8: Financial Support Performance for Renewable Energy

Year	~2010	2011	2012	2013	2014	2015	2016	Total
No. of cases	54,354	43	40	52	245	252	98	55,084
Subsidies (KRW billion)	1,143	112	89	84	128	135	100	1,791

Source: KEA (2017).

The state of historical support since 2011 shows that the support for production has reduced while the support for facilities has grown fast. Since 2013, the political support for facilities has increased substantially: solar photovoltaic facilities account for the largest share in the support for facilities, followed by waste and wind facilities in turn. The researchers understand that the current policy is to support the installation of facilities rather than production to reduce the GHG emissions directly as well as effectively.

The utilization of social financing, such as crowd funding, is an alternative method to promote the diffusion of new and renewable energies by providing a social fund (Jung 2016).

Table 9: Financial Support Amount per Renewable Energy Source
(Unit: KRW million)

Year	2011	2012	2013	2014	2015	2016	Total
Facility fund	26,668	45,498	57,218	103,367	119,000	92,157	443,908
Solar thermal	–	224	–	–	200	–	424
Solar photovoltaic	–	–	–	45,637	49,737	34,841	130,215
Bio	3,733	15,305	23,667	11,920	16,593	2,363	73,581
Waste	2,935	13,454	12,683	32,572	15,602	13,668	90,914
Small hydro	1,087	2,730	3,150	2,444	804	751	10,966
Geothermal	–	477	868	794	–	–	2,139
Wind	8,154	13,208	2,955	10,000	26,885	17,174	78,376
Fuel cell	10,759	100	13,895	–	1,339	8,360	34,453
ESS	–	–	–	–	7,840	15,000	22,840
Production fund	79,238	40,842	23,988	22,033	13,000	4,843	183,944
Operation fund	5,894	3,000	3,000	3,000	3,000	3,000	20,894
Total	111,800	89,340	84,206	128,400	135,000	100,000	648,746

Source: KEA (2017).

5.5 Emission Trading Scheme

The government launched the emission trading scheme (ETS) in January 2015 for effective as well as efficient GHG reduction in the industry sectors. The Framework Act on Low-Carbon Green Growth legislated in 2009 stipulates the introduction of the "cap and trade" ETS. The government implemented the ETS act in 2012. Companies with 3-year average GHG emissions of over 125,000 tCO_2e or facilities with 3-year average GHG emissions of over 25,000 tCO_2e are designated ETS objects. There were 525 companies in 25 industry sectors[2] as ETS objects in January 2015 and 549 in January 2017 (Kim and Shim 2017). Offset credit is available so that entities can offset the emission amount as much as their overseas carbon emission reduction. In 2015 and 2016, the scheme certified 100 offset credits.

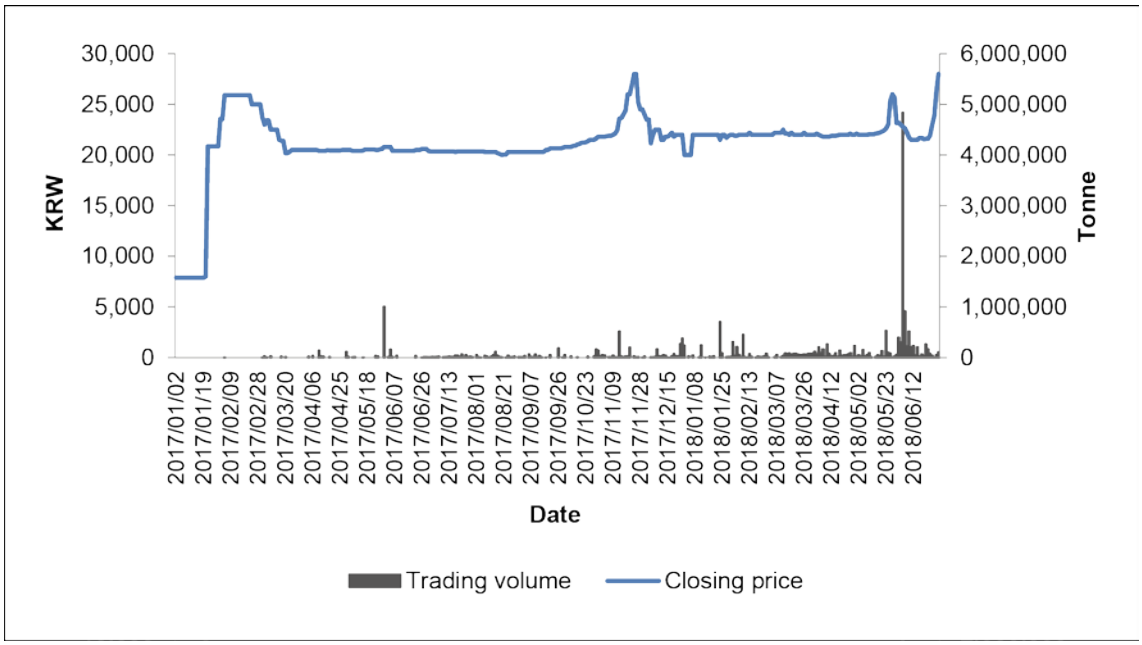
The Ministry of Strategy and Finance (MoSF) reallocates the GHG emissions to entities participating in the ETS every 5 years based on the 5-year GHG emission amounts, but it planned the second allocation 3 years after the ETS's launch, that is, in 2017 (MoSF 2014). It publicly announced the reallocation of the emission amounts on 30 November 2017 (MoSF 2017). The total allocated emissions increased by 17,631,757 Korean Allowance Units (KAUs), consisting of the increase in the preallocated emissions of 17,014,932 tCO_2e and the reserved emissions of 616,825 tCO_2e; more specifically, the industry has the largest increase rate of 4.7%, much larger than 1.08% for energy and 1.96% for transportation (MoSF 2017). However, the Ministry excluded the city gas industry, which is a substitute for district heating, from the emission trading, equal to allocating unlimited emission credits free of charge to the city gas sector, which will not only be a matter of equity but will also hinder the efficient allocation of resources in the heating market (Oh 2017).

The closing price of the KAU has risen rapidly to about 3.6 times its initial price, from KRW 7,860 in February 2015 to KRW 28,000 in June 2018. It rose from KRW 8,000 to 20,850 in January 2017 and from KRW 23,900 to 28,000 in June 2018, though there were few transactions by 2016. As time passes, the pressure to reduce the GHG emissions will become more intense and the price will rise more than ever. Figure 9 below illustrates the closing price and trading volume of the KAU since 2017. As shown, the price of the KAU has been over KRW 20,000 since February 2017, and a large demand emerged recently.

The Korean Credit Unit (KCU) has been transacted since April 2017 with the price of KRW 19,600, and its price is KRW 21,800 as of 29 June 2018, which is much more static than the price of the KAU (see Figure 10). The transaction of the Korean Offset Credit (KOC) started on 23 May 2016, at the price of KRW 18,500, and its recent price was KRW 26,000. As shown, the KOC has achieved more transactions than the KAU and KCU so far.

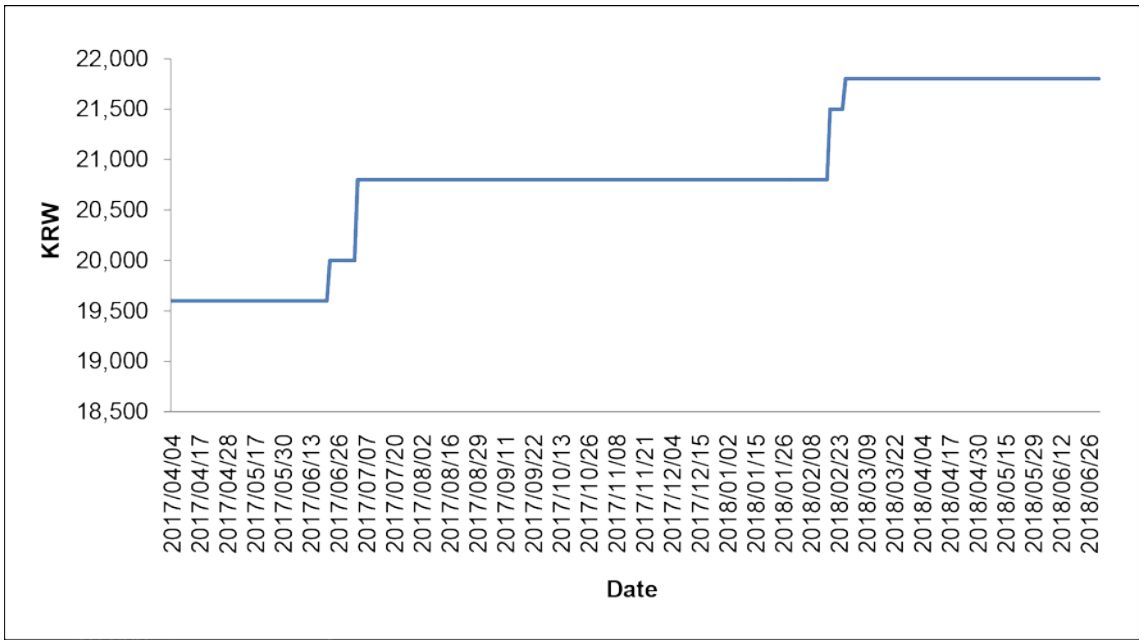
[2] These classified in accordance with the second-highest level of the Korean Standard Industrial Classification (KSIC).

Figure 9: Closing Price of KAU17[3] since 2017



Data source: www.krx.co.kr.

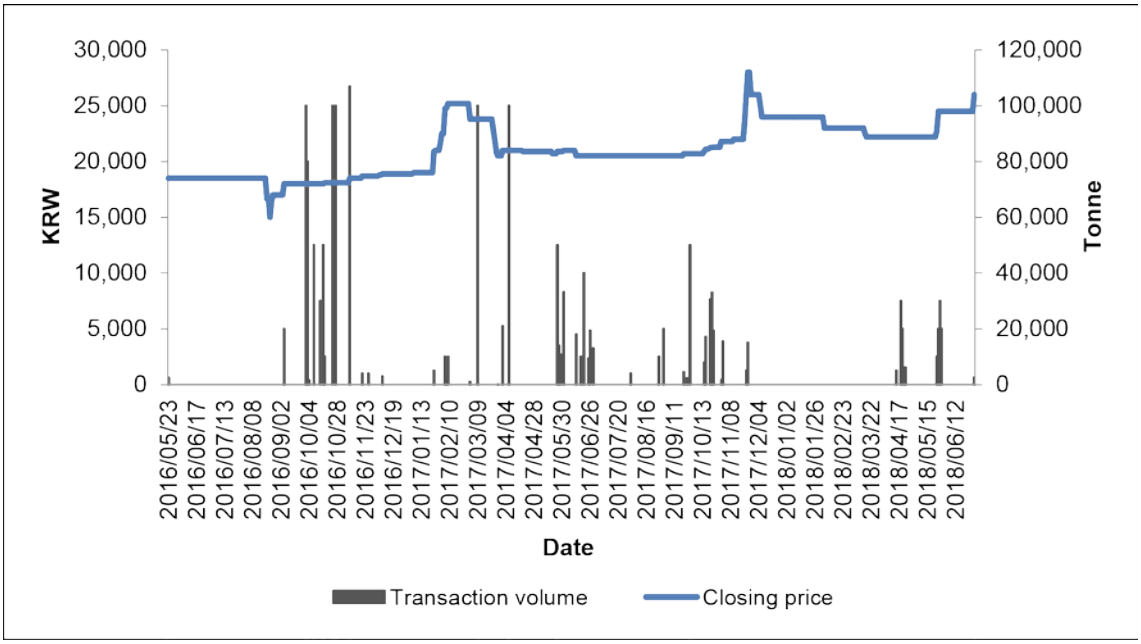
Figure 10: Closing Price of KCU17 (since 14 April 2017)



Data source: www.krx.co.kr.

[3] KAU17 denotes the KAUs allocated by 2017 and transacted by June 2018.

Figure 11: Closing Price of KOC



Data source: www.krx.co.kr.

Along with the launch of the ETS, the government will assist industries through tax deduction and subsidies. The investment in environmental conservation facilities will be deducted from the tax amount, and the government will support 50% of the cost of the installation of best available technology (BAT) facilities or manufacturing process improvements.

The Korea Exchange is making efforts to develop the emission trading market information platform to provide integrated emission information that it will distribute to several agencies in 2018. SK Securities contracted a business collaboration to disseminate high-efficiency stoves to Bangladeshi households as a Clean Development Mechanism (CDM) project and import the certified emission reduction (CER) in 2018 (Green Economy Daily 2018c). The expectation is that this will save 2.4 million tCO_2e of GHG over five years. It became possible as the government regulation has changed to let domestic companies import the CER of their foreign GHG reduction projects.

The ETS is known as a political means to accomplish the given GHG reduction goal in the most cost-efficient manner; however, it is possible in ideal market conditions with no market distortion, and estimates indicate that the Korean ETS is weak, with transaction costs, market dominance, and price risk as market distortion factors (Shim and Lee 2015). The Green Growth Committee has suggested that companies can purchase cheap reduction means through the market mechanism in the ETS, saving the cost of 32% to 56% compared with target management (Choi 2011). It has suggested the differentiation of criteria for companies or places of business considering industrial features rather than the current uniform criterion regardless of the industry sector and free allocation of certified emission reduction (CER) with the benchmark approach to efficiency (Kim 2015a). The petroleum industry has improved the efficiency of its GHG reduction since 2013, more through the ETS than through target management (Kim and Noh 2016). The ETS can also affect the electricity market under the 7th electricity supply and demand master plan: coal generation will fall if the CER price rises, but, if the CER price is too high, it will cause an increase in the electricity

price (Lee 2015a). The voluntary participation of companies is essential for the successful settlement of the ETS, and it is necessary for them to make investors aware of their activities toward climate change through effective publicity about climate change response activities, which may lead to a positive effect on corporate value (Kim 2016a). It is important to include the basic directions for the reduction using the international carbon market in the preparation of the roadmap for GHG reduction in the Republic of Korea in the future (Lee 2016b).

Table 10: Industry Sectors of the KAU Allocation with Payment

No.	Industry Sectors
1	Electric Power Generation
2	Slaughtering of Livestock, Processing, Preserving of Meat and Meat Products
3	Manufacture of Dairy Products and Edible Ice Cakes
4	Manufacture of Other Food Products
5	Manufacture of Alcoholic Beverages
6	Manufacture of Ice and Non-alcoholic Beverages, Production of Mineral Waters
7	Dyeing and Finishing Textiles
8	Manufacture of Wood Products
9	Manufacture of Plastic Products
10	Manufacture of Articles of Concrete, Cement, and Plaster
11	Cast of Metals
12	Manufacture of Other Fabricated and Processed Metal Products
13	Telecommunications
14	Computer Programming, Consultancy, and Related Activities
15	Information Service Activities
16	Retail Sale in Non-specialized Stores
17	Accommodation
18	Insurance
19	Real Estate Activities with Own or Leased Property
20	Administration of Industrial and Social Policy of Community
21	Universities
22	Hospital Activities
23	Amusement and Theme Park Operation
24	Air Transport (Domestic)
25	Sewage, Wastewater, and Human Waste Treatment Services
26	Water Supply

Source: MoE (2018).

In 2018, the management authority of the ETS changed from the MoSF to the MoE, and the MoE announced the 2nd KAU allocation plan on 12 July 2018. The major changes are 1) allocation with payment for 26 industry sectors, 2) expansion of the application of the BM method in allocating the KAUs, and 3) more specified industry sectors from the 2nd level to the 3rd level of the KSIC. The industry sectors are more detailed because several companies appeared to be disadvantaged (MoE 2018). Some had criticized the class cation of the manufacturing of cement, lime, and plaster and the manufacturing of articles of concrete, ready-mixed concrete, and other cement and plaster products in the 3rd level of the KSIC but the manufacturing of cement, lime,

plaster, and its products in the 2nd level, so they were originally among the industries for KAU allocation with payment; with the application of the 3rd level of the KSIC, the manufacturers of cement will receive their allocation of the KAU with no payment.[4] To resolve this unfair problem, the MoE specified industries further from 25 to 63 sectors; it selected 26 sectors according to the 3rd level of the KSIC as the objects of the KAU allocation with payment, as Table 10 illustrates. The companies in the 26 industry sectors should purchase 3% of the allowance, and it is estimated that an additional cost of KRW 4.5 trillion will occur for 3 years (MoE 2018).

In addition, public financial institutions, such as the Korea Development Bank, the Korea Exim Bank, and the Industrial Bank of Korea, will take the role of market provider, 5 and 14 million tCO_2e are set as slack for market liquidity and for market stability, respectively, and the application of the benchmark allocation method is expanding to increase the allocation of more KAUs to high-efficiency facilities, as the grandfathering method is disadvantageous to high-efficiency facilities (MoE 2018).

5.6 Green Bonds and Funds

A green bond is differentiated from a regular bond by its label, that is, its designation as green from the issuer or another entity, which involves a commitment to use the proceeds or green bonds in a transparent manner and to finance or refinance exclusively green projects, assets, or business activities with an environmental benefit (OECD 2015). Another entity can apply a green bond label to a bond via its inclusion in a green bond index, such as the Bank of America Merrill Lynch Green Bond Index, Barclays MSCI Green Bond Index, S&P Green Bond Index and Green Project Bond Index, and Solactive Green Bond Index, or through a tag on analytical tools that are widely used in financial markets, such as the Bloomberg Terminal (OECD 2015).

Different from other countries, green bonds in the Republic of Korea are not sovereign bonds but a kind of public or corporate bond to invest in environmental projects or renewable energy, so the fund size is relatively small. The MoSF has announced that it has no plan to issue sovereign green bonds yet, as of March 2018 (Etoday 2018).

Green bonds in the Republic of Korea are booming again. They boomed as the government announced the reduction of the share of nuclear power generation as well as the increase in the share of new and renewable energy in 2017. The expectation is that a large amount of funds will be necessary to expand the share of new and renewable energy for several years, as the government will increase the power generation by new and renewable energy from 17 GW in 2017 to 67 GW in 2030 (Construction Economy News 2017).

Korean public institutions have played an important role in issuing green bonds. The Korea Exim Bank created a green bond of USD 500 million to invest in environmental improvement projects as well as renewable energy in 2013 (Green Economy Daily 2013). The Korea Exim Bank also issued a green bond of USD 400 million in March 2018, and the Korea Development Bank, which subscribed to the Equator Principle in January 2017, issued and listed a green bond of KRW 300 billion on the KOSPI, which is the first Arirang green bond (Green Economy Daily 2018b; Korea Exchange 2018). The Korea Exchange is making efforts to list the Arirang green bond in the stock market. The Korea Water Resources Corporation issued a water bond, a kind of green bond, of USD 300 million, which is the first water bond in Asia, in 2017 (Green Economy Daily 2018a).

[4] http://news1.kr/articles/?3358778.

Table 11: Green bond Issuance in Republic of Korea

No.	Issuer	Issue Date	Size	Listing
1	Korea Exim Bank	20 February 2013	USD 500 million	SGX
2		2 February 2016	USD 400 million	SGX
3	Hyundai Capital	7 March 2016	USD 500 million	SGX
4	Korea Development Bank	27 Jun 2017	USD 300 million	SGX
5	Hanjin International	25 September 2017	USD 300 million	SGX
6	Korea Exim Bank	8 March 2018	USD 400 million	TPEx, SGX
7	Korea Water Resources Corporation	8 May 2018	USD 300 million	SGX
8	Korea Development Bank	29 May 2018	KRW 300 billion	KRX

SGX denotes the Singapore Stock Exchange, TPEx denotes the Taipei Stock Exchange, and KRX denotes the Korea Exchange.

Source: Korea Exchange (2018).

Recently, the Korea Land & Housing Corporation obtained certification as a qualified social green bond issuer by Sustainalytics in 2018 and made efforts to issue a social green bond (Dailian 2018). The Korea Electric Power Corporation (KEPCO) and the East and West Power Corporation (EWPC) will try to create green bonds of USD 500 million each. The KEPCO and EWPC will issue green bonds to invest in the new and renewable energy and ESS (Korea Economic Daily 2018). Furthermore, the Industrial Bank of Korea is now seeking to issue a social bond of USD 500 million (The bell 2018).

In the private sector, Hyundai Capital first created a green bond of USD 500 million to support hybrid vehicle purchases financially in 2016, and it received the award from *The Asset* for the best Korean green bond in 2017 (Climate Bonds Initiative 2018; Dongailbo 2017). The Hanjin International Corporation issued a green bond of USD 300 million to invest in its own eco-friendly building in 2017 (Climate Bonds Initiative 2018).

Estimates indicate that the green bond size will be about KRW 2.67 trillion in 2018, which is larger than the total ESG bond size, KRW 2.15 trillion, issued by 2017 (Korea Economic Daily 2018). In addition, green bonds are following the trend to expand their coverage to the environment to environmental, social, and governance (ESG), so some refer to ESG bonds. Thus, the green bond market is spreading very fast to keep pace with the domestic policy to reduce the nuclear and enhance the new and renewable power generation and the global trend of increasing ESG bonds.

As far as green funds are concerned, the National Pension Service (NPS) invested KRW 200 billion in two green private equity funds (PEFs) to invest in the domestic green infrastructure, such as renewable energy electricity generation, waste facilities, and so forth, in 2017 (Chosunilbo 2017), and the Korea Scientists and Engineers Mutual-Aid Association (SEMA) invested KRW 40 billion in a green fund in which largest investor is the NPS (The bell 2017). Financial institutions, in particular domestic institutions, have been making efforts to create funds related to new and renewable energy, as the government has been trying to increase the share of new and renewable energy power generation to 20% of the total power generation: the Shinhan Financial Group and the KB Financial Group created new and renewable energy blind funds with sizes of KRW 100 billion and 150 billion in 2017, respectively, and KDB Infra Asset Management is managing a solar photovoltaic investment fund sized KRW 350 billion (Construction Economy News 2017).

5.7 Incentives for and Barriers to Green Financing in the Republic of Korea

Since the government declared the decrease in nuclear energy and the increase in new and renewable energy in 2017, green finance has progressed more than ever, focusing on new and renewable energy. The government has actively implemented project financing in large-sized solar photovoltaic energy generation facilities to achieve stable profitability. The KEPCO will purchase the electricity generated in the facilities under the preannounced unit price within the given years; although the unit price is experiencing a downturn, it does not greatly affect the profitability.

Along with the private sector's green financing, the government is seeking to support companies or facilities related to the environment and energy financially through loan programs with a low interest rate. The public loan program is suitable for firms or facilities that find a way to become eco-friendly or energy efficient. The current mainstream in green financing is still loans with a lower interest rate in the Republic of Korea. Though it can offer economic benefits as much as the difference between general and preferentially treated loan interest rates, it might enable rich companies to become richer, because only rich companies can drive environmental projects and receive financial support from the government. The government focuses on stability rather than risk taking, so it never invests in companies with potential ability but lends money to financially stable companies with preferential treatment and a lower interest rate. However, the government should adopt a risk-taking position to invest in companies with potential business ability, despite the fact that they are not financially stable now.

The largest barrier to green financing in the Republic of Korea is the lack of public interest in green growth. People have little interest in the environment but think that economic growth or profit is more important for now. The lack of public interest does not cause a significant increase in corporate value as well as market efficiency in the capital market. Furthermore, companies participating in the ETS have urged the MoSF to extend the allocated amount before launching the ETS. Korean companies with heavy GHG emissions, which have participated in the ETS or GHG emission target management system, should willingly make efforts to reduce the GHG emissions under their own plans, which are stricter than the national plan. The MoE (2018) recently announced the KAU allocation plan for 2018 to 2020, including the allocation with payment. However, in the meantime, it cautiously anticipates opposition from industries regarding the allocation with payment in particular. Public interest in the environment or energy can heal this phenomenon by allowing companies with outstanding environmental performance or GHG emission reduction to enjoy corporate value enhancement in the capital market. Private companies pursuing profits will seek to enhance their corporate value by positively improving and disclosing their eco-friendliness or energy efficiency.

The OECD (2015) illustrated the advantages as well as the disadvantages of green bonds, as Table 12 below shows. As investors are requested to be sustainable, that is to say, to meet the ESG requirements, it is possible to achieve that via green bonds, which provide a fixed income, so it is necessary to facilitate the development of environmental projects and the creation of a green bond base for them (OECD 2015).

Table 12: Advantages and Disadvantages of Green Bonds

Advantages	Disadvantages
– Investors can balance risk-adjusted financial returns with environmental benefits. – Satisfy ESG requirements and green investment mandates. – Improved risk assessment in an otherwise opaque fixed-income market through the use of proceeds reporting. – Potential use of pure-play, project, and ABD to hedge actively against climate policy risks in a portfolio that includes emission-intensive assets. – Recognized by the UNFCCC as a non-state actor: "climate action."	– Small and nascent (and potentially less liquid) market with small bond sizes. – Lack of unified standards can raise confusion and the possibility of reputational risk if the green integrity of a bond is questioned. – Limited scope for legal enforcement of green integrity. – Lack of standardization can lead to complexities in research and a need for extra due diligence that may not always be fulfilled.

Source: OECD (2015).

The Climate Bonds Initiative (2018) summarized the strength and barriers to the growth of the green bond market in the Republic of Korea, as Table 13 shows. The capital market in has strength in the system, and the government's strong drive toward green growth is a good investment opportunity now. It should sustain this growing interest in green bonds continuously and eliminate the barriers to the growth of green finance.

Table 13: Strengths and Barriers in the Korean Green Bond Market

Strength	• Strong and functioning bond market • Bankable projects and robust project pipeline • Strong investor base • Supportive policy on climate change
Barriers to Growth	• Lack of market awareness from issuers • Lack of awareness among investors • Lack of market guidance or standards, which can cause confusion in the local market around the types of assets or projects that can be considered green. Globally accepted standards, such as the Climate Bonds Standard, can help in this regard • Slightly higher transaction costs for green bond issuers • Barriers to issuing internationally are present for all bond issuers in Korea

Source: Climate Bonds Initiative (2018).

However, the small green bond market size is the most disadvantageous aspect in the Republic of Korea. Green bonds require further facilitation, because a large amount of funds is needed to accomplish the national goal of an increase in new and renewable energy. It is necessary for the government to support the infrastructure of green bonds and to promote their issuance by financially sound companies. In addition, it is important to foster domestic agencies to appraise green bonds according to the global standard, and this will ease the access to the issuance of green bonds.

5.8 Impact: Financing Flows and the Diffusion of Renewables

The government is making efforts to disseminate renewable energy by financially supporting it through loans and subsidies. It will sustain this effort in the future, as the economic profit from renewable energy is one of the most critical factors in the renewable energy business. For home use of renewable energy, subsidies are a particularly influential and important component in determining the installation of

renewable energy apparatus. A cautious estimate is that the subsidies will rise more than ever to boost the installation and achieve the GHG reduction goal in a shorter period than predicted.

Project financing has been popular for renewable energy, particularly large solar photovoltaic power generation, due to KEPCO's stable purchase of electricity for the next 20 years. The major participants in project financing are financial institutions such as banks, insurance companies and securities companies, and PEFs. As far as distributed solar photovoltaic power generation for homes is concerned, the principal financial supporter is the government, both centrally and locally. The government supports a maximum of about 90% of the total installation cost. However, more renewable energy generation plants are needed to meet the demand without additional construction of nuclear power generation facilities, so public and private investment in renewable energy will be more active than ever.

In addition, the government will enhance the investment in renewable energy technology development. The yield rate is critical, as it determines the economic profit level. A 50% improvement in the yield rate can create a larger economic profit than before, and the economic profit will make people and companies competitively adopt renewable energy apparatus or facilities. The development of highly energy-efficient technology is also a field that will receive subsidies. Products with low electricity consumption reduce the total electricity consumption and decrease the necessity of additional power generation facilities. In the transportation sector, electric or hybrid vehicles will be disseminated more to the public to diminish the petroleum dependency. It is widely known that the petroleum dependency in the transportation sector is the greatest among the industry sectors. A decrease in the petroleum dependency directly causes a GHG emission reduction. Therefore, the government will make efforts to promote the adoption of electric or hybrid vehicles by offering larger subsidies.

6. CONCLUSIONS AND POLICY RECOMMENDATIONS

The Republic of Korea is the 7th-largest emitter of GHGs in the world; however, the Korean environmental and energy policies are not well motivated to reduce the GHG emissions and to prepare for climate change. GHG emissions have been increasing proportional to economic growth, and the per capita GHG emissions are still increasing. It is time to provide a direct policy to reduce the GHG emissions. Korean people need to be energy efficient by strengthening personal norms such as moral obligation and attitudes toward environmental/climate change issues, which have a positive impact on encouraging people to use energy efficiently (Kim 2016b). Various supportive plans should be provided for the energy efficiency improvement, which the government can emphasize as a means to reduce the GHG emissions in the Republic of Korea's industrial and power sector (Lee 2016c). In addition to energy efficiency R&D investment, a well-balanced combination of relevant technology diffusion and well-designed R&D programs is necessary to obtain the real effect of R&D investment in energy efficiency (Shim 2016). It is also necessary to expand the dissemination of renewable energy apparatus for home use to meet the goal of a 20% share, though this requires substantial funding. It is important to enable every home to be independent from the national electricity distribution. Every entity in the Republic of Korea should have energy independence at a certain level, including persons, companies, buildings, facilities, and so forth.

Green finance is very conducive to accomplishing the national goal, in particular the dissemination of renewable energy. Until new and renewable forms of energy attain a certain level of economic feasibility, efforts are needed from the government, the market participants, and the public (Lee 2016a). Public financial support from the local and central government aims to diffuse the use of renewable energy at home, hybrid and electric vehicles, and renewable energy facilities for existing companies. Mainly PEFs and green bonds have provided new renewable energy facilities. To spur the dissemination of renewable energy, the expansion of public financial support is crucial. Green bond issuance of private companies has emerged and needs expansion. The government will provide the supportive infrastructure for the issuance of green bonds, such as guarantees of public financial institutions and tax incentives. It should foster green bond appraisal agencies. As far as the ETS is concerned, it should avoid a change in the competent authority to allow successful and stable settlement. Since 2018, the MoE has taken charge of the ETS again, instead of the MoSF. This affects the consistency of the policy. The KAU allocation plan of the MoE (2018) revealed the allocation with payment and mentioned that it estimates it to be about KRW 4.7 trillion at its maximum and that it will utilize it to support financially the GHG emission reduction activities of companies participating in the ETS. In addition, the role of the government is crucial, as it allocates the credit allowance to companies. Proper allocation can lead firms to reduce their GHG emissions effectively. However, loose allocation decreases their efforts to reduce their GHG emissions, so it is important to identify the appropriate allocation amount to induce firms to reduce their GHG emissions with no resistance. The government should use “carrots and sticks” appropriately to achieve sound congruence between the government and the firms.

Furthermore, it is necessary to improve the public interest in green finance. “Go green” needs green finance as well as green purchases. Green finance is the first move toward a green public. It is necessary for the public to understand that their green finance activities can change the society and to participate in various green finance activities. In particular, investors will change the environmental or energy efficiency performance of listed firms if they tend to invest in listed firms with outstanding environmental performance or energy efficiency or to withdraw their investment in listed firms with poor environmental performance or energy efficiency. Financial institutions should make efforts to provide the public with various green finance options, and the government should provide green finance participants with more incentives. The government had provided a tax exemption incentive for qualified green deposits, bonds, and funds; however, no financial institutions have offered the public green financial instruments with tax exemption. If there are problems in resolving in the policy, the government should improve the policy enough for green financial instruments to be implemented effectively. If financial institutions are not willing to become involved in green finance, it is necessary to provide incentives for the financial institutions that introduce the best green finance. It is time to improve the green finance policy for better implementation, as people consider green finance in the Republic of Korea to be more socially important to keep pace with the national energy mix plan.

The government declared that it would achieve a 20% share of renewable energy in electricity generation by 2030, though it has not provided and publicly announced the action plan yet. The gist is that it will not construct additional nuclear generating facilities, although it will complete facilities that are currently undergoing construction, and that it will not add more coal-fueled thermal generating facilities and will change the fuel from coal to other cleaner resources. However, the national plan for green finance is not available yet either, as the specific action plan is not complete. If the government provides a specific action plan, it will cover the structure of the support function of green finance and its implementation in detail.

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