

# Environmental Policy in South Korea

## Problems and Perspectives



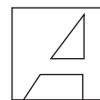


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# Editorial

*Norbert Eschborn*

The environmental policy of a state should aim, among others, to achieve sustainability regarding energy production. Sustainability can be described as the goal to save the capacity of the earth for future generations which includes transnational resources such as water and air. Therefore the effect of environmental policy does not stop at the border of a country, but to the contrary: has an effect on all of us. Although Korea has linked its industrialization to environmental problems such as air pollution and acid rain - sustainable energy systems are not yet integrated in South Korea's economy. Therefore the government's policy needs to create incentives for the economy to create and use sustainable methods of energy production.

The current South Korean Minister of Environment, Yoon Seong Kyu, has stated that it is his first aim to raise Korea's environmental welfare to the level of advanced countries during the period of President Park Geun-hye's administration. He emphasizes that a clean environment is important for the health and happiness of the people and therefore the government has a duty to achieve high ecological standards. This statement sets a focus on an issue that was not dealt with in the first two decades of Korea's rapid industrialization. This issue of the KAS journal analyses the Korean environmental policy within its specific challenges.

In order to build awareness for the issue of environmental welfare it is essential to institutionalize a green movement in a democracy. The Green Party of Korea was established in 2012 after the Fukushima Nuclear Crisis in Japan had occurred. The party has set a political platform aimed at implementing a nuclear-free energy changeover by 2030. Yet in the 19th national parliamentary election in 2012 the party only achieved a result of 0,48% of the votes. This disappointment indicates that it is difficult for a Green Party to establish itself in a democratic system that is still in a state of flux where it has to compete against established parties focusing on other agendas obviously perceived as more

important by the electorate.

Notwithstanding the fact that Korea is a member of the Kyoto Protocol, it has not signed the Annex I of the Protocol which determines binding targets concerning the reduction of CO<sub>2</sub> emission. Korea is the 9th biggest producer of CO<sub>2</sub> of all the OECD countries with an annual emission of 11,8 tons per head. However, Korea has announced to voluntarily reduce its emission of CO<sub>2</sub> by 30% of the business-as-usual level by 2020 at the Climate Change Conference in Copenhagen in 2009 – which is certainly a step in the right direction. However, without binding goals it's a well-intentioned promise but not an international contract. Nevertheless, there is the risk of border tariffs on South Korean exports of the EU and other developed countries in case Korea does not limit greenhouse gas as set out in their reduction goals.

Moreover, Korea is a resource limited region and is therefore one of the top five importers of coal, liquid natural gas and mineral. Therefore, the country's economy is extremely susceptible to changes on the energy market. In order to compensate this dependence Korea still focuses on nuclear power. The capacity of nuclear power plants should be enlarged until 2029, although nuclear power causes the issue of hazardous waste.

Furthermore, the topic of the green energy potential will be discussed in this issue. Korea, as a peninsula, has a great potential to use wind energy through building off shore wind farms. Additionally, Korea has a population over 50 million inhabitants and bio waste could be used to create energy as well. Unfortunately the topic of green energy for energy supply is not a focus of the Park government.

The KAS would like to thank the authors of this issue for their interesting contributions on the topic of environmental policy. We hope to raise awareness on this relevant topic.

# Political Opportunity Structure and the Institutionalization of Green Movements in Korea: The case of the Green Party

*Duchel Shin*

## **I . Background**

This study focuses on the possibilities and limitations of the Green Party in the context of Korea's political regime based on the process and elements of institutionalization of green movements in Korea. The recent green politicization clearly shows that the discourse on environment is going beyond the realm of environmental protection to expand into the discussion on the future development direction of the Korean society. Such green movements are now having an impact on the political circles through civil society, and by analyzing the dynamism and political opportunity structure within the movement itself, which is becoming institutionalized, will allow us to provide an outlook on the limitations and possibilities of institutionalizing Green Party in Korean society.

In Korea, a discourse on green politics, green nation is an initiative to expand public's interest in the environmental movement to the entire society, and the potential for such attempt has been already proven in western European countries like Germany, France etc. After the 1970s, the environmental movement has taken firm root as a strong civic movement in many countries around the world, evolving into a green party that is newly shaping the landscape of human life at the national and international level. Most civic movements do exist outside the institutional politics, however, their evolution into a green party has a great impact not only on the decision making process of the entire

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society but also on the changes in the power structure as they enter the political system. Then, will institutionalization of green movements be also possible in Korea? And is the political opportunity structure in Korea favorable or unfavorable towards institutionalization of green movements?

In Korea, green politics was first discussed with the concept of ecology as a an alternative to avoid the development and growth-oriented social trend, and with the development of the civil society, ecology-based environmental movement defying the development logic was sustained. Specific discussions on the green politics took place starting from the regional elections in 2002, which was after experiencing a minor victory as well as failure during the 1995 local elections. Until then, there had existed times when environmental group candidates won in the local elections, however, even until today, it is difficult to say that an environmental group or the green movement has gained a political empowerment. However, in 2011 occurred a strong initiative to create a new party with green and environment as slogan, and in 2012, the Green Party was finally established, putting forward district and proportionate representative candidates during the general election. The Party also took part in the 2014 local elections, however failed to obtain meaningful election outcome. Meanwhile, prominent environmentalist took the lead to form green political blocks in order to reinforce the environmental agenda within the existing political order or within the business-political realignment structure.

This study aims to explain the possibility and limitations of institutionalizing green movements in Korea with a focus on the forming process and political opportunity structure of the green politics in Korea. The development process of green movements can serve as the basis for establishing the green politics, however, when external factors, including the political opportunity structure is not favorable, institutionalization may not take place properly, despite its historical maturity. Therefore,

it is important to have a look at both the forming process and political opportunity structure. Here, institutionalization is the process by which organizations and procedures acquire value and stability from the public (Huntington 1968). Political institutionalization means securing continuity, passing through the threshold of an institutional system, and in this study, this refers to movement forces gaining independent empowerment in the form of a political party and making inroads into the parliament with a meaningful gain of votes during the elections.

Chapter II focuses on Korea's green movements by period, based on the perspective political empowerment, and in particular, tracks the path of environmental groups becoming politically institutionalized by taking part in the local elections. Chapter III reviews the political opportunity structure and institutional context that allows or limits the political institutionalization of green movements in Korea in order to discuss the potential political institutionalization of the Green Party in Korean society. Based on such discussions, we hope to provide an outlook on the potential, limitations, and sustainability of political empowerment of green movements in Korea.

## **1. Literary Analysis**

A movement party refers to the union of political activists who began as social activists and intend to apply the organization and strategic ability of social movements to the realm of party competition. They barely invest in official and organizational party structure and social choice problem solving process, and is characterized by taking a two-way approach combining activities within the official competition realm with additional institutional mobilization. Such movement parties are believed to have derived from the intensity of the interaction between the official and unofficial barriers to entering into the electoral competition game and the

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intensity of political interests that had not been represented within the scope of existing political parties (Kitschelt 2006).<sup>1</sup>

Most studies on such movement parties focus on Western European cases, (Jang Hoon 1996; Kim Young-tae 2007; Jung Sang-ho 2007; Jin Young-jae. Seo Myung-ho 2008), and there are very few studies dealing with the political institutionalization of green movements in Korea or the green politics of Korea. Insufficient number of studies can be explained by the fact there has almost never been any attempt for political empowerment of environmental movements in Korea, and also very few cases of environmental candidates with green value entering the political institutional circles, thus failing to gain attention from scholars. Studies focusing on Korea were mostly based on political empowerment perspective, and even if a study is themed around environment or the green politics, they tend to call for the necessity for the green politics from a critical and ought-to-be perspective rather than providing objective explanation.

Other than studies with normative, ought-to-be perspectives, there also exist case studies focusing on election participation. Park Jae-mook (2000) analyzed the discussions surrounding the formation of the Green Party in Korea and political empowerment based on the outcome of environmentalist groups' participation in the local elections in 1995 and 1998. Based on the participation in the two elections, Park concluded that environmental movements gaining an independent political

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<sup>1</sup> According to Kitschelt, there is a high chance for social movement parties to emerge in the following cases. First, when collective interests are strongly dominated by massive voters, that is when they voluntarily and clearly express the voters' requirements in a divisive manner, through additional institutional behaviors. Second, when existing parties, for fear of their election voters' division, fail to make any attempt to embrace such interests. Third, when the political representative's official or unofficial limitation or threshold is appropriate or low. (Kitschelt 2006).

empowerment was not a easy task. He interpreted that nominating an “environmental candidate” and “citizen candidate” was due to legal limitations, lack of internal capacity of civil movement groups, limited public support for environmental movement etc. In 2002, Cho Hyun-ok (2002), studied the case of the Korean Federation for Environmental Movement (KFEM)’s participation in the local elections, citing the following as problems: communication of insufficient information to the Federation’s members, insufficient number of candidates, lack of networking activity with other civic groups, lack of specific policy on the green politics, insufficient campaign funding and support for organization. Nevertheless, Cho argued that alternative forces with a focus on the green politics can seize new opportunities when the existing political circle becomes increasingly conservative and fail to address the civic needs.

## **2. Analysis Framework**

This study adopts an approach focusing on social structure and political opportunity structure as an analysis framework to explain the possibilities and limitations of the development and political institutionalization of the green politics in Korea. This approach was presented in the studies of Jang Hoon (1996), Jung Sang-ho (2007), Kitschelt (2006) to present the key to successful institutionalization of green parties in the West and the relationship between civic social movements and political parties. This approach focusing on the structure as a tool to examine the success and failure of the Green Party, is very useful for explaining the kind of context needed for the Green Party to become politically institutionalized.

The socio-structural approach focuses on the process where the social cleavage structure is reflected in the political structure, in particular on the cleavage structure based driven by post-materialistic values. The

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political process-centered approach focuses on the political opportunity structure that promotes or restricts the emergence of new political forces, which includes an electoral system, party system, political coalition, etc.

### **Structural Factor: Post-Materialism**

According to the cleavage theory that explains the party competition structure, a major social group based on the social structure forms a political coalition with a party. That is, the conflict structure or cleavage structure at the social level determines the nature or formation of a party system. The major cleavage that determines the party competition structure in Europe used to be the center and periphery, nation and church, primary industry and secondary industry, capital and labor, etc (Lipset and Rokkan 1967). However, with transition into the post-industrialized society, there have been some changes regarding such cleavage structure. In particular, physical prosperity allows citizens to perceive that their material needs and desires are fulfilled, therefore a new middle class seeking post-materialistic values began to grow. This new middle class became interested in values (self-esteem, quality of life, sense of belonging, will for participation) that they would have never been interested unless their existing physical requirements were fulfilled (Inglehart 1977; 1990). The emergence of people with post-materialistic views can be seen to have lead the conventional cleavage structure to the new cleavage structure of materialism-post materialism. Post-materialistic values piqued high interest for environment, and this in the end led to the political empowerment of green parties which emphasize new political issues and ideologies such as natural protection, protection of minority rights, new political participation, rather than traditional political values such as economic growth or public order etc. That is, transition into the post-materialistic society can become a socio-structural background

of green parties, and post-materialistic values and the growth of green parties can be seen as intimately related.

### **Election System and Party System**

This political process-based approach focuses on how the opportunity structure within the political system impacts and restrains the emergence of new forces. In particular, political institutionalization can be determined by not only the interaction between concentration and salience of voters in seeking movement profit but also by the election laws limiting the growth of new challengers and entry barriers created by official constraints (Kitschelt 2006). Here, institutional mechanisms constitutes the essence of the opportunity structure are an election system and political party system. Studies of green parties in Western Europe found that the growth of new parties under a relatively liberal electoral system such as the proportionate representation system can be much easier, whereas under a closed electoral system such as a simple majority system, it can be quite restricted. Moreover, the composition of the existing political party system is also an important factor that constitutes the opportunity structure, however, if one or many small size parties exist within the existing political system, it is not easy for a new party like the green party to make a new entrance. Yet, if such small size parties already exist, these parties tend to mobilize support by putting forward one issue, therefore, it is not easy for the green party to secure unique differentiation against these small existing parties and mobilize support (Jang Hoon 1996).

### **Structure of Environmental Policy**

For movement parties to enter and grow within the existing party system,

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the policy response of the existing parties, which compete for voters within the same party system, is also a critical political factor. That is, when the political interests that are born by a large number of voters are not represented in the existing political system, it is highly likely that civic movements will join the realm of elections (Kitschelt 2006). In a political system where the existing parties fail to actively respond to the new political requirements such as environmental protection and maintain passive pro-environmental policies or anti-environmental policies, there is a high chance for a green party to seek growth. Moreover, in a closed system, the government's environmental policy structure fails to actively embrace the opinions of its citizens, thus it will be easier for green parties to mobilize citizens' support, than in a system maintaining open environmental policy (Jang Hoon 1996).

### **Political Coalition**

Political coalition is a key element for the continuity and survival of the political empowerment of social movements, in particular. A political coalition between a party and social movement refers to a continued and institutional cooperation for a considerable period of time, which can occur in the areas of election or political fundraising, sharing of information or strategy, e policy collaboration on a case and issue basis etc. In order for a social movement to become politically institutionalized, the reformatory political forces need to assume a certain position or role within the system. The political coalition cases of the Western Europe shows that the new political forces generally formed a coalition and cooperated with the socialist party and new social movements rather than with conservative parties. They, as part of the New Left, developed major forces of the left and the green party in the form "Red-Greens Alliance" in the 1980~1990. That is, in a political coalitions, the existence and status

of a left-wing party is an important factor to assess a stable coalition with movements.<sup>2</sup> In particular, the opposition party status of the left-wing party and a strategic consideration for winning the elections are the main drivers leading to a political coalition. The political empowerment and the sustainability of a new party depends on the existence of left-wing party that can be used as political ally or reformatory party that can integrate the values and requirements of social movements (Jung Sang-ho 2007).

The correlation among the four conditions above-post-materialism, electoral system and party system, structure of the environmental policy, and political coalition-and the political empowerment of green parties is as shown in Table 1. The structural factor called post-materialistic society, the proportionate representative system, the passive and closed nature of environmental policy of existing government and parties, and the existence of political coalition enable political institutionalization of green movements and restrain the oppose.

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<sup>2</sup> Generally, left parties consider labor voters' views as an important barometer when setting their major policy position, and they were not largely favorable towards environmental protectionism that alleviates or refrains from growth-oriented policy (Muller-Rommel 1989). This can be seen as a conflicting structure of human-oriented vs. ecology-oriented. However, exploitation of laborers and devastation of nature are no separate issues, the problem-defining itself should shift from human-oriented vs. ecology-oriented towards the socially privileged vs. socially vulnerable, therefore green politics and left-wing or progressive politics can be connected (Kim Min-jeong 2010).

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Table 1: Correlation between socio-Structural and political Opportunity structural Factors and political Institutionalization of Green Movements

	Post-materialism	Election system	Environmental policy of government or existing parties <sup>3</sup>	Political coalition (left-wing party)
Favorable condition	Post-materialistic society	Proportionate representative system	Passive/closed	Exist
Unfavorable condition	Materialistic society	Simple majority system	Active/open	Does not exist

Source: Excerpt and redrafted from Jang Hoon(1996), Jung Sang-ho(2007)

## II. Process of Formation of Green Politics in Korea

The path of formation towards the political institutionalization of green movements in Korea can be divided into the following periods: pre-political institutionalization, political institutional trial period, transition to party and participation in general elections.

### 1. Pre-Political Institutionalization Period: Environmental Movement as Dissent Movement (1960s–1991)

The history dates back 40 years, with the increasing complaints and claims for compensations from residents affected by frequent environmental damages following industrialization in the late 1960s. However, the environmental problems in Korea suffered setbacks until the late 1980s due to restricted citizens' freedom and political openness

The first environmental movement in Korea was the pollution dispute

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<sup>3</sup> Here "passive and active" means whether the government and existing parties place environmental policy as their priority, and "closed and open" refers to the way they implement policies.

case of the Busan Gamcheon Thermal Plant in May 1966. At the time, the environmental movement was very restricted in that it was carried out to ensure the right to survival of farmers who lost their living space or whose livelihood was affected with the development of environmental facilities including massive plants.

The environmental movement in the 1970s can be defined as “anti-pollution movement.” During this period, it was difficult for the environmental movement to take root because it was perceived as a resistance against the political system, thus difficult to lay the ground to gain public support base. The first environmental group was the “Pollution Research Center” created in the late 1970s. The Pollution Research Center began to inform the public about the environmental problems that were identified through research and data gathering of the environment-affected regions in a limited way.

In the 1980s, the Pollution Research Center that led by Choi Yeol researched and studied the source of pollution with local residents who were suffering from pollution issues caused by industrial activities in Ulsan, Onsan etc. and initiated activities to exert pressure on businesses and the government to provide measures for the victims. The anti-pollution movement was not an anti-capitalistic movement, but was conducted as a way to call for preventive and adequate management of environmental issues arising from industrial process. However, at the time the major forces that led the anti-pollution movement were one faction of the democratic movement forces, therefore anti-pollution movement was perceived as “dissident movement.”

In the mid 1980s, the environmental movement became increasingly generalized and developed into various forms. In 1986, it integrated with the Council for Anti-Pollution Citizens’ Movement to form Association for Anti-Pollution Movement with members from all walks of life with a nationwide network. Furthermore, in 1988, Mokpo Green Research

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Association, in 1989 the Federation of Busan Anti-Pollution Citizens' Movement, the Society for Environment and Pollution, and the Alliance for Ulsan Anti-Pollution Movement were formed. In the 1980s, formation and characteristics of environmental movement organizations were at the stage of informing the necessity of the seriousness and environmental movement of the environment and pollution issues to the citizens driven by activists interested in some environmental and pollution problems, and the size of organization was quite small. In this process, there was a growing awareness on environmental issues and also internal discussions within environmental groups to establish theories and methodologies on the environmental movement. Moreover, environmental groups, through integration and formation, came to take the form of a social movement. It was then that the ability of the environment movement constituted an important part of the social movement. That is, the environmental movement, with the help of private, professional environmental groups, began to evolve into a social movement.

In particular, as democratization took shape with the Democratic Uprising in June 1987, many social issues that converged into democratic movement came to gain public attention, and the civic movement emerged as a new social movement in participation of citizens responding to such issues. With the Federation for Anti-Pollution Movement as a start, followed Citizens' Coalition for Economic Justice in 1989, Green Korea United in 1991, People's Solidarity for Participatory Democracy in 1994 to establish the framework for an integrated citizens' movement to realize economic justice, environmental justice and social justice.

### **2. Attempt for Political Institutionalization: From Environmental Movement to Participation in Local Elections (1991~2002)**

In the 1990s, the environmental movement becomes an important part of

the social movement, and citizens became more keen on environmental issues. Socially, religious groups like Catholic, Christian, Buddhist groups began to take part in environmental movements, and existing citizens' groups once established for other purposes began to develop interest in environment issues to appeal to the public.

During this period, the ecological aspect of environmental movements was highlighted and expanded across the nation, leading to initiatives to establish the mass base. The reason being, there existed public trust in the civic groups than in the government or businesses as problem-solver for environmental issues (Yoon Kyung-hwan 1999, 12). That is, from this period and on, the environmental movement shifts away from its form of the 1980s and undergoes a process of differentiation into the realm of consistently functional movement through the development and integration of organizations to build a nationwide network. Moreover, one of the most politically influential citizen's group actively engaged in environmental movements, the Korean Federation of Environment Movement (KFEM) put forward an environmental candidate during the local elections, thus making inroads into the realm of institution.

The KFEM, since its foundation in 1993, has experienced numerous public office elections to lead an array of activities for political empowerment of environmental movements. Among others, the KFEM's participation in elections took place in multi-faceted ways, however, in almost all elections process, they not only analyzed and announced the electoral promise of each party and individual candidate but also joined together with other civic movement groups especially in the local elections to insist on "citizens' candidate" or independently nominate an "environmental candidate" and lead activities at the organizational level for the election of these candidates (Park Jae-mook 2000).

The KFEM selected "environmental candidates" during the two local elections in 1995 and 1998 and led activities in support of these

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candidates. The reason why the KFEM put forward the so-called “environmental candidates” while going beyond the limitations of the positive law and lead activities for candidates’ success in the local elections was because it wanted to focus its support in the regions with candidates with high chance to be elected in order to create an “exemplary local government.”

During the 1995 local elections, all 46 candidates were selected as “environmental candidates” and were supported and sponsored by the KFEM. More specifically, out of 46 candidates, 4 were for head of local governments, 5 candidates for metropolitan city council members, and 37 candidates for local assembly members. Out of 46 environmental candidates, 31 were selected as members (67.4% of the registered candidates), and they consisted of 2 heads of local government, 4 metropolitan council members, and 25 local assembly members.

During the 1998 local elections, only 39 environmental candidates were nominated including 3 for local government heads, 8 metropolitan council members, and 28 local council members. Out of 39 environmental candidates, 22 were elected as members (56.4% of all candidates). The 22 elected members included 2 local government heads, 6 metropolitan council members and 14 local council members.

The number of environmental candidates and their percentage of election varied according to the timing of the local elections. First of all, the number of environmental candidates decreased slightly in 1998 compared to 1995. Overall, the reason was because the prominent environmental figures’ desire to enter the local politics also slightly decreased. In another word, it can be said that the activists’ desire to enter the institutional political circles was particularly high in 1995 when the local elections revived for the first time after the reestablishment of local governments which had been pending for the past 30 years.

The environmental candidates elected in 1995, especially, many

of the local council members were elected in Korea's highly polluted regions known for active environmental activities such as Ulsan region, Ongjin-gun in Incheon, Gochang in Jeonbuk, Inje in Gangwon, Pohang in Gyeongbuk, Yangcheon in Seoul, and Gunpo in Gyeonggi etc. This clearly shows that local figures who became leaders in their local community through local environmental activities are becoming leaders in the realm of institutional politics (Park Jae-mook 2000).

### **3. Transition to Party and Participation in General Elections (After 2002~)**

It was during the 2002 local elections when the green politics were specifically discussed under the theme of political empowerment of the civil society. The Green Peace Party was established and the Korean Federation for Environmental Movement(KFEM) also established the Green Autonomy Committee to nominate their own green candidates, in order to realize greening of the politics. The Green Peace Party was led by few KFEM management and put forward proportionate representative candidates in 7 cities and provinces including for the Seoul mayoral elections. Its candidates earned many votes in some cities and regions including 4.8% in the Jeonbuk region. Meanwhile, the KFEM also established the Green Autonomy Committee to nominate about 50 candidates nationwide including for the Goyang mayoral election, and 15 of them were elected as local council members in Goyang, Busan and Seoul etc.

Then, the elected local council members took the initiative to establish Greens Korea, and in the 2006 local elections, 21 grassroots candidates were nominated including the ten incumbent local council members. However, only two were elected with the implementation of the party nomination system for the local government election and predominance

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of the Grand National Party (Joo Yo-seob 2007).

During the two general elections that followed the Negative Campaign Against Parliamentary Candidates of Chongsonyondae (Citizens' Alliance for the 2000 General Election), with formation of new party and intervention of the citizens' political movements, a new movement to change the politics was started. This meant shifting from merely excluding bad politicians to placing values of labor, job, welfare, ecosystem and peace at the forefront.

The civil society launched campaigns to stop the Four Major Rivers Restoration Project that continued from 2009, which led to growing public interest. In the 2010 local elections, the environmental groups defined the agenda of the elections as "free meal for in schools and Four Major Rivers Restoration Project", thus supporting and contributing to the election of the local political forces that oppose the Four Major Rivers Restoration Project and support the free-of-charge school meals.

Such political behavior and empowerment of green citizens and the increasing demand for denuclearization around the world following the Fukushima Nuclear Accident in 2010, some prominent environmentalists took the initiative to take part in the 2012 general election by forming the "Green Party." However, it ended up gaining only around 100,000 votes, representing only 0.48% of all party votes, therefore its registration in the National Elections Commissions was revoked. However, they reinitiated the formation of the Green Party and re-registered it as a party the very same year.

The Green Party is the first initiative of its kind in Korean politics to prepare the formation of nationwide party while emphasizing environment as its core value unlike other existing parties.<sup>4</sup>

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<sup>4</sup> This study focuses on the case of the Green Party in Korea which is different from other existing parties, which is based on the ecology that exceeds ideologies and

Political parties that newly emerged in Western Europe pursued specific ideologies, preferred a participative political structure, and were supported by voters who were very different from advocates of other parties (Muller-Rommel 1996). The Green Party of Korea today also share some similarities. First of all, the Green Party was built on a different ideology compared to other existing parties. The Green Party called for the need to address not only environment issues such as denuclearization, environmental degradation but also social issues such as job creation for the youth, reduced working hours, and guarantee of livelihood income. That is, they advocate not only environmentalism, ecology but also an alternative lifestyle, and adopts doctrine and perceptions that are different from the conventional left wing-right wing ideology, but also advocates alternative values that are different from the existing parties. Second, the Green Party is formed as a participatory, decentralized organization that was different from conventional parties. The Green Party has a different culture compared to conventional parties. First of all, women's representation in the Green Party is high, playing key roles within the Party. There is a system called the Gender Equality Representation System ensuring the equal number of men and women's participation. Moreover, the Green Party is the party of youth. A part of its representative body is assigned to youth, so the younger generations can initiate their own organizations and carry out activities aligned with their interest. Meanwhile, the Green Party is a grassroots party. It is not a party led by few elites but by grassroots members and local residents. Policies at local level are created by local people, and nationwide policies are also elaborated based on the party members' participation. In the

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places environment as core agenda. The Green Political Forum did not try to initiate a political party, and the Green Social Democratic Party was more focused on progressive values rather than environment, therefore was not the focus of this study.

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Green Party, at times very heated discussions do occur, but also rational conclusions are made through a horizontal debate culture.” (Ha Seung-soo 2011).

Third, the Green Party’s supporter base is different from the existing parties. The declaration of the party formation committee of the Green Party clearly states that : “we want to seek change in the politics with the power of grassroots people. Until now, we want to seek that change with the power of socially marginalized women, youth, teenagers, minority, non-regular job workers and all ordinary people in this centralized society dominated by the vested interests”. In fact, existing environmentalists, those who returned to the rural area from city, members of the cooperatives, readers of Green Review, local grassroots activists, Chorok Party members, a minority of progressive party members all were engaged with the Green Party. Moreover, young people and women with ecological emotions and preferences, animal protection groups who are not the mainstream among civic social groups, as well as alternative medicine groups are interested in the Green Party. Breaking away from the left wing-right wing spectrum, they are interested in everyday politics, which makes them different from voters of conventional political parties.

### **III. Opportunity Structure of Political Institutionalization of Green Movements in Korea**

During the 19th general election in 2012 and the local elections in 2014, the Green Party in Korea failed to achieve a successful outcome. However, it can be viewed as a meaningful attempt in Korea’s green politics history as it opened up the possibility for a transition into a party with a nation-wide coverage and also took part in the elections. Then, can we say that Korea’s political opportunity structure still restrains political institutionalization of green movements? Is there a political space that

enables such political institutionalization or a potential room for creating such space? These questions can be explained by an approach focusing on Korea's social structure and political opportunity structure

## **1. Structural Factors: Post-Materialism**

Korea has enjoyed economic prosperity driven by its economic growth for the past few decades, and the public's interest in environment has also increased since the 1980s. According to a survey on public awareness on environmental protection conducted by the Ministry of Environment in 2008, 79.0% of Koreans said they are "interested in environmental protection"(Ministry of Environment 2008). A survey on global awareness revealed that Korea, like most countries, ranked high in the number of materialists, and is showing the fastest increase in the number of post-materialists in Asia together with Taiwan (Inglehart 1997). In particular, between 1990 to 2001, the younger the generation, the more they were oriented towards post-materialism. However, generations born after the 1960s who experienced relatively more prosperous economy are at the same time showing a trend of returning to materialism-oriented values, and during this period, the attitude that we should value environmental protection is diminishing whereas the call for prioritizing economic development is increasing (Kim Doo-sik2005).<sup>5</sup> The 2010 study by Na Eun-young and Cha Yoo-ri shows that after the Asian financial crisis in 1997, the percentage of materialists decreased to 46.05% and the hybrid

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<sup>5</sup> With regards to the return to materialism among the youth, Uh Soo-young(2004) explains that it is because they are faced with getting a job after the 1997 Asian financial crisis. The trend for post-materialism on the rise since 1997 has become stagnant and seemed to slightly regress towards materialism, and the change in the opposite direction was much faster in young people (Na Eun-young, Cha Yoo-ri 2010).

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type increased to 43.75%, with a slight increase in post-materialists by 2.35%. This study concluded that there is a decrease in materialism and increase in hybrid type close to post-materialism which was much faster in older generations, and this was also in line with the pace of change in overall values (Na Eun-young, Cha Yoo-ri 2010). This study shows that Korea is gradually undergoing a process of a social transition towards a post-materialistic society.

Nevertheless, evidences exist as to why we cannot define Korea as a post-materialistic society. Inglehart argued that high environmentalism in Korea is not formed because of post-materialistic values in Korea but rather due to the direct environmental pollution and problems, thus cannot be regarded as a true environmentalist attitude (Inglehart 1997). In the 2008 Ministry of Environment's survey, most Koreans were interested in environmental issues, but their level of interest decreased by 9.3%, 9.8% compared to the 1997 and 2000 surveys respectively, and as for the correlation between environmental regulation and economic growth, 59.8% Koreans answered that "there should be deregulations to promote the economic growth" (Ministry of Environment 2008). The survey conducted by the National Election Commission, the Korean Association of Party Studies, and Chosunilbo also revealed that 60% of Koreans were for environmental protection by saying "we have to shut down nuclear power plants" (4.6%) and "we have to shutdown nuclear power plants and transition into renewable energy (57.8%). However, in terms of additional electricity fee, 27.3% answered "electricity tariff increase is unacceptable." and 52.3% responded "10% range increase is acceptable" whereas "5.1% said they were "ready to accept increased electricity tariff to substitute nuclear energy" and only 13.4% answered they "can accept the 20% range increase" (Chosunilbo 2012/3/26). That is, despite Korean people's high interest in environment, they did not agree to tariff increase, which shows that there exists a gap between the

public's interest, awareness and the actual participation.

Moreover, we can also question whether the transition into post-materialism by individual Koreans has something to do with collective environmental action. In a 2010 study, it was found that the impact of age and income on the environmental awareness is minimal, and the younger generations were found to be more passive regarding environmental issues, which shows how environmental awareness has less impact on the collective environmental action. In terms of the level of environmental awareness, no generational gap was found, however, the level of participation of the younger generations in pro-environmental actions was much lower than the older generations, which demonstrates that the gap between awareness and action is much greater among the youth. That is, environmental awareness is not being translated into collective environmental action, and latter in Korean society still remains inactive despite its potential (Park Hee-jae, Huh Joo-young 2010).

## **2. Electoral System and Party System**

Korea has always maintained a plurality-based electoral system however, it also combines the two-ballot system and the proportional representation system to complement the weaknesses of the plurality system. This hybrid electoral system, combining single member district-based simple plurality and proportional representation, was theoretically adopted to reduce the distortion due to the increasing power of the two-party system based on the simple plurality principle, the distortion of representation due to imbalanced proportional representation and also to better represent the minority's public opinion.<sup>6</sup>

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<sup>6</sup> Kim Wang-sik (2006), through his study on the non-proportional representation and intra-parliamentary arrival of minor parties after introduction of the two-ballet system,

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In fact, during the 17th parliamentary elections, the Democratic Labor Party won 2 constituency seats and 8 proportionate representation seats, thereby earning 10 seats to become the no. 3 party in the parliament. The Democratic Labor Party represented ideologies and policies such as issues regarding the socially marginalized including the laborers, farmers who had been under-represented in the National Assembly until then.

However, the hybrid electoral system did not fully address the issue of non-proportion. Today, the electoral system in Korea is still based on plurality, therefore non-proportion is very high. That is, the single-member electorate (constituency) system seeks political stability through plurality, therefore large parties tend to garner more votes and seats, benefitting more, whereas small minority parties are underrepresented, which poses a problem (Kim Yong-ho 2000). However, the seats earned through proportional representation, which was designed to address this problem, is increasingly decreasing in number, and the proportional representatives (including nationwide district) during the 11th, 12th was 33.33%, 25% in the 13th, 20.73% in the 14th, 15.38% in the 15th, 16.48% in the 16th, 18.7% in the 17th, and 18.1% in the 18th National Assembly. For example, the Democratic Labor Party won 10 seats in the 17th National Assembly, but given the 13% party approval rating and the 3.3% of 10 seats, we can see that the non-proportional issue is quite evident. Also, the proportional representation system failed to strengthen the party politics, because it was used as a mean to bring in external figures to enhance the party image and raise political funds (Kim Yong-bok 2009). That is, even though the proportional representation system was introduced to increase representation, the problem seems to persist.

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argued that the two-ballet system did not have a great impact on large parties but helped small sized parties to take part in the parliament, which proved to be effective in addressing to a certain extent the imbalanced proportional representation(Kim Wang-sik 2006).

Unlike other countries, Korea has a very difficult process of forming a party, which serves as a barrier for small parties to enter the political circles. The requirements to form a political party in Korea are as follows: political parties shall be comprised of a central party located in the capital, and City/Do parties located respectively in the Special Metropolitan City, and in each Metropolitan City and Do, must have more than 5 City/Do parties, and the latter should have more than 1000 members residing within the competent district of the City/DO, and shall come into existence when its central party is registered with the National Election Commission. Moreover, as for the members' qualifications, the President, the Prime Minister, State Council members, members of the National Assembly, members of local councils, publicly elected heads of local governments, secretary officials and secretaries of a member of the National Assembly, assistant officers, administrative secretary officials for the representatives of the negotiation groups of the National Assembly, the policy research members and administrative assistants of the negotiation groups of the National Assembly, and presidents, deans, professors, assistant professors, and associate professors can be members, however, public officials, teaching staffs of schools cannot be party members. (The National Election Commission website: [www.nec.go.kr](http://www.nec.go.kr)).

Moreover, if a party fails to obtain more than 2/100 of total number of effective votes, it shall revoke its registration (Article 44 of the Political Party Act), and these provisions combined with the Korea-specific electoral system, serve as an obstacle for new parties to enter the political circles in Korea. The majority of voters supporting the Green Party are teachers, and the Green Party has an electoral strategy centered on citizens' action and proportionate representation. However, Korea's electoral system based on the single-member constituency system and requirements for party establishment and member qualifications seem to restrict the political institutionalization of the Green Party.

### 3. Structure of Environmental Policies

Korea's environmental policies should be viewed in relation to its economic policies and deregulation policies. It was the Lee Myung-bak administration that first placed the green politics on the top national agenda (2008~2012). President Lee emphasized the importance of environmental policies since his speech commemorating Korea's Independence day in August 15, 2008. During his speech, he presented "low-carbon green growth" as the new national development paradigm.<sup>7</sup> Then in February 2009, the Presidential Committee on Green Growth was established and the Framework Act on Low Carbon, Green Growth bill was presented to the National Assembly, in July, the government came up with a national strategy and a five-year plan on green growth, in November set national mid-term goals on the reduction of green house gas emissions, and in December, the Framework Act on Low Carbon, Green Growth was enacted and finally implemented in 2010. This is a comprehensive framework which covers climate change, energy and sustainable development policies, which focuses on the elaboration of the national strategy for green growth and also includes matters on investment in green technologies and green industries, implementation of low carbon society, etc.

However, in major political decision making process, environment

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<sup>7</sup> The Presidential Council for Future and Vision which is assumed to have provided the ideological basis for green growth has rephrased the conceptual definition of the United Nations Economic and Social Commission for Asia and the Pacific(UN ESCAP) to define green growth as the "national development strategy to improve the overall quality of life by taking green industry (based on green technologies in renewable energy, energy resource efficiency, environmental pollution reduction and relevant convergence technologies) as new engine growth to transition the economic/industry structure as well as the life style into low carbon/pro-environmental(Presidential Council for Future and Vision 2009).

is not fully taken into account, and most focus is placed on economic policy, with limited impact of the Ministry of Environment. In particular, the position of the existing parties -especially the Grand National Party and the Democratic Party- around environment policies is that most of these parties did not complete a blueprint on the green politics but placed economy-related development agenda as their core electoral promise whereas the environment-related agenda was suggested as a supplement. Moreover, electoral promises regarding the synergy between economy and environment were in fact intended to view the environment as a new growth engine to seek economic growth, being reflected in the policies of these parties (Cho Myeong-rae 2007).

First of all, the environmental policy of the former Grand National Party (current Saenuri Party)'s environmental policy was based on neo-liberalism, which is a pro-business policy, focusing on harmonizing the environment and the economic development. Moreover, in order to address the socio-economic inequalities, it pursues policy that supports improving individual's competitiveness rather than reducing institutional inequalities. At the time, the Democratic Party (the opposition party), unlike the Grand National Party's economic policy, did not implement pro-business policies outright, however, emphasized the importance of harmonizing growth and distribution with the market economy system as the basis while addressing and adjusting major economic conflicts. Moreover, it proposed a social integration by ensuring health equity and practical gender quality. The two existing parties' environmental policies had similarities in that they both sought to secure opportunities to hit two birds with one stone, that is, to achieve economic growth as well as environmental protection. The two parties did not take issue with the economy system that incurs environmental problems, but only targeted to take measures required to minimize the impact of economy on the Earth's ecosystem (Kim Min-jung 2010).

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Meanwhile, progressive parties criticized the environmental policies of the Grand National Party and the Democratic Party and proposed policies for a sustainable society. The Democratic Labor party proposed to implement a democratic economic system that overcomes the capitalistic paradox as the goal of economic policy, while calling for an all-out transition in all parts of the society towards a sustainable social structure with a goal to achieve pro-environmental alternative society. On the other hand, the New Progressive Party pursues a new economic system that goes beyond the principle of neo-liberalistic capitalism to expand the majority public's democracy in all areas of economic activities. Moreover, from environmental policy perspectives, unlike the Democratic Labor party, the New Progressive Party emphasizes ecologic values and perspectives, which reflect the values of transitioning into an alternative system focusing on the regions that the eco-community movements are advocating. That is, these two progressive parties point out that environmental issues are not only about natural environment but are closely linked to human and social issues. Moreover, they both share a common element in approaching the social welfare policies as the fundamental right of the socially vulnerable (Kim Min-Jung 2010).

The comparison of different positions on environmental policies by political party is summarized as below.

Table 2: Comparison of Environmental Policies by Political Party

	Progressive Party	Democratic Party	Former Grand National Party
Policy Objective	Complete reform of capitalism	Harmonized capitalism	Neo-liberalistic capitalism
Core Values	Equality, democracy, sovereignty, ecology, peace and solidarity, diversity	National integration, practical democracy, strong middle-class nation, fair market economic order	Big market and small government, business-friendly country, value of family

Driver for Economic Growth	Social welfare, green industry	Financial sector, high-tech industry	Construction, engineering project
Environmental Policy	Increased government regulation	In between government regulation and government support	Business-support measures
Social Justice	Inequality perspective	Conflict-based perspective	Equality perspective
Core Supporter Base	Laborers, low income families	Entrepreneurs in SMEs, middle-class	Capitalists centering on large companies

Source: Kim Min-jeong (2010).

With regards to environmental policies of political parties in Korea, the existing progressive parties included environmental agenda, however, today even the conservative parties have come to embrace "greenism", gradually making environmental ideology to become more complex and diversified. Nevertheless, the existing parties in Korea hold a rather passive view on environmental policies, and instead of viewing environmental policies as just environmental policies, they view them as an extension of economic or welfare policies.

The Green Party places nuclear development at the forefront of all environment policy-related issues.<sup>8</sup> For denuclearization, the Green Party established a strategy to first, legislate the "Framework on Denuclearization and Energy Transition" by 2030<sup>9</sup>, second, raise

<sup>8</sup> “Even though the current generations may use electricity at a cheap price, the next generations may need to bear the cost of dismantling nuclear power plants as well as disposing nuclear wastes. However, if there is no political party that raises questions about the expansion of nuclear energy, our future in 20 to 30 years will be gloomy. The Green Party at least thinks about and tries to responsible for our future 20, 30 years after...The goal of the Green Party is to allow our adolescents and youth in the future to not boggle their minds because of climate change or nuclear wastes like the younger generation today, but to enjoy the pleasure of life.”(Ha Seung-soo 2011).

<sup>9</sup> This will include mandatory shut-down of life-ended nuclear power plants, suspension of construction of new nuclear power plants, expansion of energy efficiency and

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denuclearization as an electoral issue to help elect a candidate advocating denuclearization, third pursue energy transition at the regional level, fourth achieve energy supply based on the principles of decentralization, self-supply, autonomy. That is, the Green Party criticizes the current government policy for trying to address climate change issues by building additional nuclear power plants. As such, since the direction that existing parties and the current government take in nuclear issue is different and not of priority, the Green party has a high chance of earning support and mobilization of those who believe in the value of denuclearization.

### **4. Political Coalition**

Until today in Korea, the political institutionalization of environmental movements in Korea failed to take place and existed only as a way to nominate an environment-related candidate for the elections, so there has never been a case of a specific political coalition or union being formed to have an impact on their continuity. However, there was a case when a progressive party formed a coalition with environmental movement forces.

In particular, the political coalition between the Democratic Labor Party and the progressive environmental movement forces is a case in point that linked the two possibly conflicting values, environment and labor. During the 17th National Assembly in 2004, the Democratic Labor Party put forward a slogan “Huge Small Party”, and built a progressive, reformatory network that covered experts and civic groups from all areas.<sup>10</sup>

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renewable energy, etc.

<sup>10</sup> At the time, Dan Byeong-ho, member of the National Assembly who served as the president of the Korean Federation of Trade Union, iconic organization of Korea’s

However, through the attempt to form a coalition among the Democratic Labor Party, civil society, and environmental movement groups, a progressive, reform network was built, which provided the opportunity to include the green values into political parties. For example, Jo Seung-Soo a member of the Democratic Labor Party, said that with regards to the green politics of progressive parties, we should embrace their ecological values. Yet, Jo was critical of the confrontational perspective of mankind vs. ecology and argued that we should approach environmental issues in the context of social inequalities that in human society. "The ecological values that the green politics of the Democratic Labor Party embrace are as follows: we embrace the socialist values that eliminate the destructive attributes of the capitalistic market economy and the socio-economic inequalities that occur in the process and believe that the existing method geared to growth and productivity cannot ensure a sustainable ecosystem." (Jo Seung-Soo 2007).

Since a political coalition can ensure the continuity of political institutionalization, the existence of an experience of green movements forming a coalition with the progressive party in Korea can be a favorable condition for the Green Party to transition into a political party. However, the differences of opinion within green movements can serve as an obstacle to ensure the continuity of the Green Party in the future.

## **VI. Conclusion**

Green movements in Korea began when some democratic forces, driven by their ideological values, began to inform the public of the seriousness of pollution issues, and such movement can be defined as a progressive environmental democratic movement. Above all, following

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labor movement, was assigned to the Environment-Labor Committee.

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the Democratic Uprising in 1987, many social movement forces calling for transformation and democratization under the authoritarian regime were absorbed into the environmental movements. In particular, after the resurrection of the 1995 local elections, environmental movement groups nominated and supported “environmental candidates” to gain their independent political institutionalization, and by forming the Green Party in 2012 also nominated candidates during the general election and the 2014 local elections, however, failed to achieve an independent political institutionalization, with limited effectiveness.

However, the path for historical development of the green movements has served laid the ground for the political institutionalization within the framework of the green politics. The expertise and the network of green movements in Korea have served as the internal driver for the political institutionalization of green movements, which include: solidarity between the central and local organizations who set up a joint committee whenever important environmental issues were raised, securing public support while shifting away from being a movement organization that deals with issues temporarily to become a permanent movement organization that covers overall local environmental issues, and in particular the organizational ability at the local level. Green movements played a role of providing assistance for operation, basic guideline, policy direction as well as well as political resources such as staffing in the process of transitioning into a political party, although not official.

The historical development of green movements in Korea expanded the inner strength of movements and served as the basis for political institutionalization, whereas the social structure and political opportunity structure of Korea had an external impact on the political institutionalization of green movements. The following Table 3 sums up the structural factors of Korean politics and the opportunities and limitations of the political institutionalization of the Green Party.

Table 3: Political Institutionalization Conditions and Possibilities of the Green Party in Korea

Elements for Political Institutionalization	Post-Materialism	Electoral System	Environmental Policies of Government and Conventional Political Parties	Political Coalition
Description	<ul style="list-style-type: none"> <li>• Post-materialism of individuals, Hybrid type of materialism-post-materialism increases</li> <li>• Failed to develop into a collective environmental action. Gap between awareness and action</li> </ul>	<ul style="list-style-type: none"> <li>• Hybrid electoral system of simple plurality based on proportional representation system</li> <li>• Non proportionality of National Assembly</li> <li>• Strict party formation requirements, Political Party Act</li> </ul>	<ul style="list-style-type: none"> <li>• Passive attitude of conventional political parties regarding environmental policies</li> <li>• Environmental policy is not regarded as independent issue, but linked with economic, welfare policies</li> </ul>	<ul style="list-style-type: none"> <li>• Experience of coalition between progressive party and green movements</li> <li>• Difference of opinions among forces attempting political empowerment of environmental movements / → issue of cohesion</li> </ul>
Possibility	Average	Unfavorable	Favorable	Average

Table 3 shows that the absence of a political party, going beyond the existing ideologies, to consider environment as a core issue, is a favorable condition for the Green Party. However, post-materialism values still remain at the periphery, and the closed electoral system, especially, makes it difficult for new parties to enter the political circles, which serve as obstacles for the political institutionalization of the Green Party. Moreover, as for the political alliance that has an impact on the continuity and survival of new parties like the Green Party, there is a chance of a coalition with a progressive party being formed. However, the difference of positions within the environmental movement forces poses a problem of cohesion, which is not a very favorable condition. Korea's political structure has some room for political institutionalization of green movements, and yet restrains their growth, and the foundation for an influential environmental movement to be politically institutionalized still remains weak. However, it should be noted that there exists de-growth, post-materialism-oriented voter base who are not mired in the existing ideological crevice, many voters not supporting any party, and

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also an increasing participation from young generations, all of which create a favorable condition for the Green Party to become politically institutionalized as an alternative party or a niche party.

In the future, in order to review the political institutionalization and sustainability of green movements in Korea, this subject should be linked with other elements such as the Green Party's internal strategy to attract more voters, the relationship between parties and social changes, changes in party organizations, and the relationship between parties and the government. In particular, we are living in a world where daily politics that value specific life such as environment, going beyond the existing ideology-based politics is emerging, and individuals are directly participating in the politics as main actors, and structured organization of political participation through IT and social network development is taking place. This situation is highly likely to have an impact on the political institutionalization and continuity of the Green Party, therefore the relationship of all the said elements need to be addressed in further studies.

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# Korea and the Green Climate Fund: Expectations and Limitations of Seoul's new Role in World Climate Protection

*Sungjin Kim*

## **I . Introduction**

Climate change has been a major issue in the international relations for at least two reasons. First, climate change is a global threat which requires a collective action of the international society. The Intergovernmental Panel on Climate Change (IPCC), the most authoritative epistemic community, in its Fifth Assessment Report published in 2014, found that climate change effects such as rising ocean surface temperature, melting snow and ice, and rising mean sea level are indisputably evident phenomenon, that all substances and processes resulting in the perturbation of the global energy balance are causing climate change, and that increase in CO<sub>2</sub> concentration in particular, is the main culprit. The Earth's mean temperature was highest during the last three decades (1983-2012) than any preceding decade since 1850 and increased by 0.85 °C for the period of 1880-2012. The sea level has risen by 19 cm over the 1901-2010. Therefore, if the current trend of greenhouse gas (GHG) emissions continue without any mitigation, atmospheric concentrations of CO<sub>2</sub> during 2081-2100 will reach 936ppm, causing the Earth's mean temperature to rise by 3.7°C and the sea level by 63cm relative to the 1986-2005 levels. The IPCC expects that an apocalypse will be inevitable if mankind fails to control the atmospheric concentrations of CO<sub>2</sub> under the 550 ppm level (IPCC 2014).

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The apocalyptic risks caused by an increase in GHG emissions cannot be managed with the efforts of few countries alone. Therefore, since the end of the 20th century, the international society has taken a collective action led by the United Nations (UN) to respond to the threats of climate change, which led to the establishment of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 and adoption of the Kyoto Protocol in 1997. The Kyoto regime was greatly restricted in that it defined emission targets based on a top-down approach by making a distinction between countries with or without obligations of GHG limitations. As a result, following many controversies and conflicts surrounding the post-Kyoto regime, a new climate regime is underway based on the concept of “Intended Nationally Determined Contributions (INDC)” focusing on a voluntary participation of individual countries. Going forward, all UNFCCC members including developing countries will need to establish and fully implement measures to reduce the GHG emissions according to their respective capabilities and measures. If not, criticisms from the international society will be unavoidable.

Second, climate change is an area of North-South conflict, where developed and developing countries have long been in fierce opposition. The developing world, emphasizing the historical responsibilities of the developed world, has strongly called on the latter to take innovative measures to reduce GHG emissions and also provide them with financial assistance and technological transfer. Article 3(1) (“common but differentiated responsibilities and respective capabilities”) and Article 3(2) (“specific needs and special circumstances of developing country Parties”) on the principles of the UNFCCC stipulate that primary responsibilities and obligations to climate change lie in developed countries, providing the ground for the claim for “climate justice”. However, for developed countries, mandatory reduction of GHG emissions implied bearing massive costs as well as fulfilling an array of assistance requirements of

developing countries, which was not easy to accept. Moreover, the fact that advanced developing countries like China and India were avoiding reduction obligations and transferring the burden to only developed countries was a serious conflict-causing issue that could undermine the very existence of the Kyoto regime.

In particular, adaptation to climate change in developing countries was an issue that developed countries had long avoided discussing about. Mitigation of massive greenhouse gases emitted by developed countries was the key to responding to climate change, however, if during the UNFCCC COP (Conference of the Parties), the adaptation issue of developing countries like the Least Developed Countries (LDCs), The Small Island Developing States (SIDS) and vulnerable states like African countries was applied to the concept of historical responsibilities of developed countries, the latter would have to assume huge additional costs. As developed countries were already struggling to handle mitigation which was undermining their national interests and competitiveness, the least they wanted was to further develop the issue of adaptation within the framework of “climate justice” and make the financial assistance of developed countries a mandatory measure. However, as it became clear that countries responsible for climate change were avoiding taking adequate measures, ever since the COP13 in Bali in 2007, both mitigation and adaptation became the core agenda items in the UNFCCC discussions (Ciplet, Roberts, and Khan 2013, 51-53).

The Green Climate Fund (GCF) holds both of these two international political issues. Born out of the conflicts and consensus of developed and developing countries at the initiative of the UNFCCC COP, the GCF, on one hand focuses on “institutional cooperation” calling for a collective action of all members of the international society, and on the other hand on “climate justice” calling for developed countries to lead the climate change response of vulnerable developing countries. This

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new organization is drawing much expectation, since its successful operationalization is the key to the global climate change problem solving. Therefore, there is a pressing need to understand the major issues surrounding the GCF operations and discuss measures for its future development. In particular, Republic of Korea, as the host of the GCF Secretariat and advocate of the “Green Growth” concept must not remain complacent with its diplomatic feat but assume a more significant and essential role for the successful operationalization of the GCF. In this regard, this paper will address the different issues regarding the GCF and examine challenges and problems that need to be addressed for Korea to go beyond national centralism and display powerful green leadership.

## **II. Historical Background and Major Issues on Development of GCF**

### **1. Background**

The GCF is a global fund established to support the GHG emissions reduction of developing countries and their adaptation to the negative impact of climate change. Numerous global funds have existed prior to the GCF including the Least Developed Countries Fund (LDCF) and Special Climate Change Fund (SCCF) governed by the Global Environment Facility (GEF), the Adaptation Fund (AF) under the Kyoto Protocol, and Climate Investment Funds (CIFs) established by the World Bank, yet they all had problems in terms of their objectives, governances, and sizes. However, the international society began to take climate change as a serious issue, and as there was a growing need to provide focused and effective support to the most vulnerable states, a large scale fund focusing solely on climate change issue was needed. To this end, active discussions on establishing a new financial mechanism to support

the developing countries have begun since the UNFCCC COP13.

The development of GCF was first documented during the COP15 in Copenhagen in 2009. The establishment of the Copenhagen Green Climate Fund in support of the developing countries was proposed in the Copenhagen Accord. The document stipulated that a short-term fund of USD 30 billion to be raised over the period of 2010 -2012 to help the vulnerable states like LDCs, SIDS, African countries, and a long-term fund of USD 100 billion each year until 2020 through grants from developed countries to support the GHG emissions mitigation and adaptation to climate change in developing countries, and that a significant portion of the fund be raised through the Copenhagen Green Climate Fund (UNFCCC 2009, 3). However, the Copenhagen Accord was not officially adopted due to the deadlock of negotiations among member states and ended up being a document to “take note of.” There was particularly a fierce confrontation between the umbrella group and developing countries regarding the amount of resources to mobilize, actors, nature, governance of the GCF, which did not result in the consensus on the fund.

It was in 2010, during the COP16 in Cancun that the decision was made to establish the GCF. All GCF related matters included in the Cancun Agreements, which is the outcome document of the COP16, corresponded exactly to those in the Copenhagen Accord. That is, it was agreed that over the period of 2010-2012, USD 30 billion would be raised in a new and additional manner to implement a fast start finance in support of mitigation and adaptation, and in the long-term, USD 100 billion would be raised annually until 2020 in support of developing countries, out of which a significant share would be raised through the GCF. In Cancun, the basic framework of the GCF was defined including

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the constitution of the GCF Board<sup>1</sup>, designation of interim trustee<sup>2</sup>, establishment of professional Secretariat<sup>3</sup>, and a Transitional Committee consisting of 40 members was established to explore the Fund's concrete design, with a mission to last until 2011 (UNFCCC 2011, 16-18). Then in 2011 during the COP 17 in Durban, following the opinion raised by the Transitional Committee, the GCF was established in the form of an international organization with juridical personality, and the governance and institutional arrangements of GCF were established (UNFCCC 2012, 55-66).

## 2. Major Decisions of the Board

The GCF held ten Board meetings from August 2012 to July 2015 to finalize the modalities for the operation of the Fund.<sup>4</sup> The 1st Board meeting in Geneva, Swiss in August 2012, discussed additional operational procedures of the Fund and the Board and the selection procedure of observers, and members agreed to continue the discussions on the composition of the Interim Secretariat and Interim Trustee and

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<sup>1</sup> The Board oversees and governs all relevant components of the Fund and has full responsibility for funding decisions. The Board has 24 members with 3 year term (with a possibility for renewal), with an equal representation of 12 developing and 12 developed countries. Developing countries should include the SIDS and LDCs. Each Board member has an alternate member. Alternate members do not have the right to vote, however, in the absence of its Board member, it may hold the right to vote. Decisions are made based on both one vote per one Board member and consensus approach.

<sup>2</sup> Trustee is responsible for managing the GCF funds according to the Board decisions and also assesses and records the financial status of the GCF. The UNFCCC COP decided to designate the World Bank as interim trustee.

<sup>3</sup> The Secretariat supports the Board and is tasked with all administrative affairs for the operation of the GCF.

<sup>4</sup> <http://www.gcfund.org/documents/all-board-documents.html>

budget for the operation. Moreover, an evaluation was conducted on six candidate countries for hosting the Secretariat. During the 2nd Board meeting held in Songdo, Korea in October, Korea's Sondo was selected as the host city of the GCF Secretariat, and the plans for the operational budget of the Fund, composition of the Interim Secretariat and Independent Secretariat were established. Moreover, discussion on the election of the Executive Director was made, and the World Bank was designated as the Interim Trustee.

During the 3rd Board meeting held in Berlin, Germany in March 2013, in-depth discussions took place on the approval on the administrative procedure of the Secretariat, measures to mobilize resources, selection process of the Executive Director, selection of the business model. The 4th Board meeting held in Songdo, Korea elected H la Cheikhrouhou as the Executive Director, and the framework was developed to select the Fund's business model. During the 5th Board meeting in Paris, France, members established performance indicators on mitigation and adaptation programs, led discussions on the plan for the initial operation of the Secretariat, ways to mobilize resources, and officially announced the launch of the Secretariat.

During the 6th Board meeting in Bali, Indonesia in February 2014, the members approved the resource allocation model among the business models and established measures to establish External Audit and guidance on the operation of the Secretariat. The host country, Indonesia, officially pledged USD 250,000 to the GCF, becoming the first country to pledge, other than Korea (USD 10 million) and Germany (Euro 15 million) which had pledged to the GCF during the bidding race to host the Secretariat. In May, during the 7th Meeting of the Board held in Songdo, Korea, members agreed on the GCF business model framework and began discussions on the initial resource mobilization process. During the 8th Board meeting in Bridgetown, Barbados, members decided to select

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a permanent Fund Trustee until the end of 2017 and agreed on concrete measures for the operation of the business required for the initial resource mobilization process agreed on during the previous Board meeting.

During the 9th Board meeting held in Songdo, Korea in March 2015, seven implementing entities (IE) were accredited and the existing business model was improved. Commitments to contribute USD 10.2 billion were received from 34 countries prior to the Board meeting to secure initial resource mobilization, which laid the ground for initiating different projects<sup>5</sup>. Moreover, members further developed the project selection and evaluation criteria. The 10th Board meeting in Songdo, Korea in July, 13, accredited additional 13 IEs, and the business model was further elaborated to solidify the foundation for supporting the developing countries. Prior to 11th Board meeting planned for the approval of projects in support of developing countries, a total of 74 countries have applied for projects and the review of a total of USD 1.9 million has been completed.

Table 1: Major Decisions of GCF's 1st to 10th Board Meetings

No.	Date and Venue	Agenda
1	Aug. 23-25, 2012. Geneva, Swiss	<ul style="list-style-type: none"><li>· Composition and modalities for the operation of the Board</li><li>· Six Candidates for bidding Secretariat begins promotional activities</li></ul>
2	Oct. 18-20, 2012. Songdo, Korea	<ul style="list-style-type: none"><li>· Songdo was selected as host city of Secretariat</li><li>· Elaborated plan for discussing modalities of operation</li></ul>
3	Mar. 13-15, 2013. Berlin, Germany	<ul style="list-style-type: none"><li>· Approved headquarters agreement between GCF and Korea</li><li>· Discussed Business Model Framework</li></ul>

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<sup>5</sup> Through agreement with 21 countries, a total of USD 5.5 billion has been secured. The GCF plans to raise USD 2.5 billion of fund every year over the period of 2015-2018 to secure USD 10.2 billion.

4	June 25-28, 2013. Songdo, Korea	· Elected first Executive Secretary · Developed Business Model Framework
5	Oct. 7-10, 2013. Paris, France	· Selected Initial Result Areas Indicators
6	Feb. 17-21, 2014. Bali, Indonesia	· Agreed to place high-priority on readiness of developing countries
7	May 18-21, 2014. Songdo, Korea	· Confirmed Business Model Framework · Confirmed initial resource mobilization process
8	Oct. 14-17, 2014. Bridgetown, Barbados	· Principles of grant regarding initial resource · Progress on discussing Business Model Framework · Developed implementation strategy on capacity building
9	Mar.24-26, 2015. Songdo, Korea	· Accredited seven IEs · Progress on discussing Business Model Framework
10	Jul. 6-9, 2015. Songdo, Korea	· Accredited additional 13 IEs · Progress on discussing Business Model Framework

### 3. Issues on Modalities of the GCF Operations

There have been conflicts between the developed countries (donors) and the developing countries (beneficiaries) on diverse issues surrounding the modalities of the operation within the GCF, which was established to help developing countries better respond to climate change. The first issue involved defining the relationship between the GCF and the UNFCCC COP. Developing countries were expecting that the COP, with majority of member states to gain more influence, whereas developed countries wished to minimize the influence of the COP and improve the efficiency of the GCF operations. After much controversy, during the COP17 in Durban, a document defining the governing instrument of the Fund was drafted. The relationship between GCF and COP defined in this document is as follows (GCF 2011, 3).

“The Fund will be designated as an operating entity of the financial mechanism under Article 11 of the Convention and will be accountable to and function under the guidance of the Conference of the Parties.”

Here, it is important to note the term “under the guidance.” In Durban,

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developing countries wanted to use the term “under the guidance and authority” to have the GCF under the direct influence of the COP just like the Adaptation Fund (Kim and Kim 2015, 113-114). However, due to the opposition from developed countries, it was decided to keep the phrase as of today (Chung 2013, 217). The developed world believed that when all COP member states intervene in the GCF operations, its efficient operation would be impossible. In the end, it was decided that the GCF Board makes the final decision on the GCF operations, and that the COP would not be allowed to become directly involved with the decisions of the Board and the Secretariat. Therefore, the GCF Board will receive guidance from the COP and only submit an annual report to the COP. Redressing the Board’s decisions will not be done by the COP as in the GEF, but by an internal independent entity within the GCF, which relatively reduces the COP’s authority while ensuring the GCF’s independence.

The second issue surrounding the governance of the GCF was whether to allow the beneficiary countries’ direct access to the Fund. Until now, since the majority of the global funds including the GEF allowed international access through globally specialized entities, the issue of direct access was an important issue to resolve for developing countries, who would generally be beneficiaries of the Fund. The claim of developing countries was adopted in the end, recognizing both direct access and international access to the GCF.

For direct access, the beneficiary country should establish a National Designated Authority (NDA) or a focal point. An NDA is tasked to assess the level of the country’s sustainable development to approve the most suitable project and submit the project proposal to the GCF.<sup>6</sup> Also,

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<sup>6</sup> As of July 31, 2015, 133 NDA or focal point applications were made. The type of NDA can be international, regional or national. For example, Korea’s NDA is under

NDA has the authority to designate IEs accredited by the GCF Board so that the designated IEs can directly receive or spend the fund for the implementation of projects in its country.

Such measure was taken because until now the implementing entities of the GEF were limited to a small number of international organizations, such as World Bank or UNDP, making it impossible for developing countries to directly access the GEF. During the 9th and 10th Board meetings, a total of 20 (seven during the 9th and 13 during the 10th) IEs were accredited (GCF 2015a, 6; GCF 2015b, 6-7), and additional accreditations are expected to follow.

Table 2: GCF Accredited Entities

No.	Accredited Entities
1	Centre de Suivi Ecologique (CSE)
2	Peruvian Trust Fund for National Parks and Protected Areas (PROFONANPE)
3	Secretariat of the Pacific Regional Environment Programme (SPREP)
4	Acumen Fund, Inc.
5	Asian Development Bank (ADB)
6	Kreditanstalt für Wiederaufbau (KfW)
7	United Nations Development Programme (UNDP)
8	Environmental Investment Fund of Namibia (EIF)
9	Ministry of Natural Resources of Rwanda (MINIRENA)
10	National Bank for Agriculture and Rural Development (NABARD)
11	Corporación Andina de Fomento (CAF)
12	Caribbean Community Climate Change Centre (CCCCC)
13	Africa Finance Corporation (AFC)
14	Deutsche Bank Aktiengesellschaft (Deutsche Bank AG)
15	Agence Française de Développement (AFD)
16	Conservation International Foundation (CI)

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the national type, which is the Ministry of Ministry of Strategy and Finance. <http://www.gcfund.org/operations/readiness/designations.html>

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17	European Bank for Reconstruction and Development (EBRD)
18	Inter-American Development Bank (IDB)
19	United Nations Environment Programme (UNEP)
20	World Bank - International Bank for Reconstruction and Development (IBRD) + International Development Association (IDA)

The third issue regarding the operation of the Fund is the modalities for resource mobilization. The financial inputs of the GCF are defined as follows (GCF 2011, 9).

“The Fund will receive financial inputs from developed country Parties to the Convention. The Fund may also receive financial inputs from a variety of other sources, public and private, including alternative sources.”

This agreement, which aims to focus on the paid-in public capital contributions and supplementing the lacking resource from the private sector fails to address the specific measures for resource mobilization. Out of the agreed long-term fund of USD 100 billion, how much should be raised through the GCF? How can such fund be raised through developed countries since they are already feeling the huge financial burden? How to attract the private participation, which is likely to take up the largest share, after the public contributions?

The amount agreed for the GCF to raise primarily based on the UNFCCC discussions was USD 10.2 billion equivalent, which is likely feasible through the paid-in public capital contributions pledged by 33 countries. The condition for the GCF to become effective is to secure over 50% of the pledged contributions, and in May 21, 2015, 58.5% of the amount pledged to the Fund (USD 5.47 billion) was mobilized for the Fund, allowing the GCF to take effect (GCF 2015d, 1). However, since this amount is far from reaching the goal of long-term finance, there are on-going discussions to seek specific measures for resource mobilization. The GCF Board will continue to discuss ways to receive financial inputs

from the four public sources including: (1) Other developed countries, (2) Developing countries that may be willing to contribute, (3) Sub-sovereign entities/local governments in mostly developed countries, and (4) State-owned entities mostly in developed countries and also from philanthropic foundations and non-public and alternative resources (GCF 2015d, 4). In other word, the possible options are paid-in public capital contributions from developed countries, private fund consisting of private investment and private finance as well as funding from alternative sources such as maritime and aviation shipping sectors, financial transaction taxes, global carbon taxes, etc..

Since bilateral grants between the GCF and countries pose many limitations today, the GCF needs to receive financial inputs from the private sector at least from 2020 in order to mobilize resources at a massive scale. The private fund input has been a hot topic causing divergent opinions to form between the developed and developing countries since the beginning of the GCF (Park 2014, 276-277). Developed countries stressed that in reality, it was extremely difficult to mobilize USD 100 billion solely by contributions and that a significant share of public fund must be mobilized, and wished to establish a separate window for the private sector. On the other hand, the developing countries have argued that the roles of the private sector will be limited due to low predictability of the private fund, distortion of the economic status of the countries due to capital investment, non-activation of financial inputs in low profitable areas, etc. The private fund is highly likely to be concentrated in advanced developing countries (China, India etc.) with relatively low risk and high revenue potential, and not in the LDCs, SIDS, and African countries vulnerable to climate change, ultimately undermining the objective of the GCF. All in all, the proposal to set a separate funding window for the private sector was not adopted, and instead the Private Sector Facility (PSF) to promote private funding

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was established to efficiently and effectively support private investments (GCF 2013c, 6).

Nevertheless, expectations are high for the private sector in raising fund for the GCF, however, without ensuring the cash flow and credibility of the Fund, mobilizing private capital will not be an easy task. Therefore, the initial funding of the GCF will probably depend on contributions from developed countries, and the volume of financial inputs from the private source will be determined by the project success and investment environment of developing countries. Therefore, in the short run, the GCF needs to take differentiated measures to secure the limited resources in the hands of the developed countries and in the long run focus on building the capacity of developing countries by strengthening their NDAs, supporting to fulfill IE accreditation standards, developing local human resources for monitoring and evaluation of project performance in order to attract investments of the public and private sectors of developed countries.

### **III. The GCF for ROK: Korea as the Host Country of GCF Secretariat and Thereafter**

#### **1. Korea's Green Growth Strategy and Selection as Host Country of GCF Secretariat**

Climate change policy and diplomacy in Korea were practically inexistent prior to the Lee Myung-bak administration. The Lee Myung-bak government, inaugurated in February 25, 2008, adopted the "Low Carbon Green Growth (LCGG)" as a national vision of the top priority and implemented many changes home and abroad. First, domestically, Korea established the Presidential Committee on Green Growth, announced the National Green Growth Strategy and Five-Year Plan, enacted the

Framework Act on Low Carbon, Green Growth, the Smart Grid Act, the Green Building Act, and defined the GHG emissions reduction targets by sector. Furthermore, externally, Korea announced its commitment to reduce GHG emissions<sup>7</sup>, established an international organization called the Global Green Growth Institute (GGGI), established a government-initiated green technology research institute, Green Technology Center-Korea (GTC-K), expanded Green ODA (official development assistance), elaborated the G20 Declaration on Green Growth, and proposed Rio+20 Strategy on Green Growth, leading the international society by example in the field of green growth. That is, Korea's climate change diplomacy is characterized by its "me first" attitude of taking the initiative even as a developing country with no binding obligations to cut GHG emissions and the "bridge" role as a middle power liaising developed and developing countries (Kim 2014, 19-25).

Korea, hosting the GCF Secretariat, would naturally serve as the bridge connecting the developed and developing countries, and its success in the bid will be recorded as an important milestone in Korea's climate change diplomacy. When it was decided to establish the GCF in Cancun at the end of 2010, Korea began considering hosting its Secretariat. By hosting the GGGI specialized in strategy, the GTC in technology and the GCF in finance, Korea hoped to realize the vision of the "Green Triangle" (Lee 2015, 597-598). During the 112th International Economic Ministerial Meeting held on November 25, 2011, Korea decided to bid for the GCF Secretariat, and during the COP17 held Durban from November 28, it officially announced its bid to host the GCF. The Korean Minister of Environment who was the chief negotiator was the first among member states to express the intention to bid for the GCF Secretariat in the COP keynote speech, and during informal negotiations, Korea proposed to

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<sup>7</sup> 30 percent cut from the expected 2020 BAU(business-as-usual) level

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hold the 2nd GCF Board meeting, support the operational budget of the Interim Secretariat, and host an international forum on the GCF. Such an active attitude was welcomed by both developed and developing countries, and the United States, Canada, Japan, Australia, Germany, Switzerland from the developed group and Mexico, Saudi Arabia, Philippines, Egypt, Indonesia from the developing group welcomed Korea's proposal (Ministry of Strategy and Finance 2013, 23).

Korea argued that it had ample commitment and ability to host the GCF Secretariat based on the six following grounds. First, Korea understands the concerns of both the developing and developed world, therefore is a nation optimized to serve as the bridge connecting the two groups. Korea's symbolic role as a bridge within GCF is one of Korea's most salient strengths since Korea transitioned from an ODA-receiving developing country to a country having joined the ranks of developed countries. Second, Korea is an exemplary country in responding to climate change since it even adopted "Low Carbon, Green Growth (LCGG)" as its national vision. Third, most of the environment-related international organizations are concentrated in Europe and North America. Even Africa has UNEP, however, there is none of its kind in Asia. Fourth, Korea is recognized as a developing country, but will voluntarily fund USD 40 million to the GCF. Fifth, Songdo, Incheon is a city of outstanding geographical conditions and an eco-system. Sixth, I-Tower (after renamed "G-Tower") is located in Songdo, which can be used for immediate purposes and provided permanently to the GCF free of charge (Ministry of Strategy and Finance 2013, 40-41).

There were six candidates in the race bidding for the GCF Secretariat: Germany (Bonn), Mexico (Mexico City), Namibia (Windhoek), Poland (Warsaw), Switzerland (Geneva), and Korea (Songdo) (GCF 2012a, 6-7). For a successful bidding, the candidate had to win more than 13 votes, which is a majority out of 24 Board members, and since there were nine

European members on the Board (seven EU countries, Norway, and Georgia), the chances of Korea being selected were very slim.<sup>8</sup> Europe decided to endorse Germany, and the votes of developing countries would be distributed among Korea (Asia), Mexico (Latin America), Namibia (Africa) (Ministry of Strategy and Finance 2013, 38). Against this backdrop, the Prime Minister's Office, Ministry of Strategy and Finance, Ministry of Foreign Affairs, Ministry of Environment, Incheon Metropolitan City and the National Assembly focused all their time and efforts in the success of the bid.

Six countries -the United States, Spain, Czech Republic, Belize, Egypt and the Philippines- were selected to sit on the GCF Evaluation Committee. The Board proceeds with the vote based on the report presented by the Evaluation Committee and the evaluation criteria were based on the following four items: (1) legal status, (2) privileges and immunities, (3) financial arrangements, administrative and logistical support, (4) local facilities and conditions. After the evaluation, Mexico received yellow light in (4) and Poland a red light in (2), and Namibia a yellow light in (1) and (4), whereas Switzerland, Korea and Germany received green lights in all items (GCF 2012b, 7, 10, 13, 16, 17, 20, and 23). Then, during the second GCF Board meeting, a secret ballot was held and Korea was finally chosen as the country to host the GCF Secretariat (GCF 2013b, 7).

Reasons for Korea's selection by the GCF Board members are as

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<sup>8</sup> The Board of 24 members (12 developed countries, 12 developing countries) consists of the following: seven EU countries including the U.K, Sweden, Denmark, France, Germany, Spain as well as the United States, Australia, Japan, Russia and Norway in the developed country group and China, Indonesia, India (three from Asia), Mexico, Belize, Colombia(three from Latin America), Benin, Egypt, South Africa (three from Africa), Zambia (one LDC and Africa), Barbados (one AOSIS and Latin America), Georgia (others) in the developing country group.

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follows: First, Korea promised to provide an independent juridical personality to the GCF by through measures of the domestic law. Second, it was the first country with non-binding obligations to pledge a large sum of USD 2 million to the GCF. Third, the UNFCCC Secretariat was based in Bonn, Germany, therefore the predominant opinion was that the GCF Secretariat be located far from Bonn. Fourth, the region, which Korea is part of, would see the highest economic growth in the world, and accordingly the highest increase in GHG emissions. Fifth, the 18 members of the GGGI founded at the initiative of Korea overlapped with the GCF Board members. Lastly, the shift of paradigm of the LCGG that Korea has long advocated was one of the important pillars of the GCF (Schalatek 2013, 14). In other word, it can be said that the commitment to financial contribution, geographical conditions combined with Korea's internal and external efforts were finally recognized in the international diplomatic circles.

### **2. After Selection as the Host Country of the GCF**

Selected to host the Secretariat of a mammoth international organization for the first time in its history, Korea deemed that its internal and external efforts to deploy green growth were finally appreciated by the international society and spared no effort to provide an institutional support for the operationalization of the GCF. It enacted the "Law on Support of Operationalization of the Green Climate Fund" and promulgated and enforced the Act as of July 30, 2013 while signing a headquarters agreement with the GCF, which was ratified by the National Assembly on August 27. All these measures were taken to fulfill its promise made during the bidding process of providing the juridical personality to the GCF or recognizing prerogatives and exceptions, and ensuring diverse assistance. Moreover, Korean government made living

arrangements for the Secretariat which was launched on December 4, 2013 by providing office spaces and equipment within G-Tower for its use (Incheon Metropolitan City 2014, 84).

By hosting the GCF Secretariat, Korea expects to enhance its diplomatic status and benefit from diverse economic effects such as increasing knowledge service industries, boosting consumption, and job creation (Ministry of Strategy and Finance 2013, 99-100). Korea's top social science think tank, Korea Development Institute (KDI), estimated that with hosting of the GCF Secretariat, Korea's annual economic benefit would be KRW 381.23<sup>9</sup> where as the representative think tank of Incheon where the GCF Secretariat is based in, Incheon Development Institute (IDI), estimated the annual economic gain to be KRW 191.7 billion<sup>10</sup>(Kim 2012). Korea is also expected to gain economic benefits by taking the lead in environment-related issues, expanding domestic capital market, revitalizing the local economy and modernizing the service industry (KB Financial Research Institute 2012, 2-3). However, compared to the number of analyses on the GCF's economic impact on Korea, there has not been enough discussions and awareness on the kind of responsibilities and global leadership Korea should demonstrate internally and externally after the hosting the GCF Secretariat to fully operationalize the Fund and address the climate change issues of the

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<sup>9</sup> Consumption expenditure of Secretariat expatriates (KRW 65 billion), consumption expenditure of local workers (KRW 12.5 billion), consumption expenditure of foreign participants international meeting (KRW 34.2 billion), consumption expenditure of foreign tourists (KRW 11.355 billion), impact on GDP (KRW 254.3 billion), job creation (KRW 3.83 billion)

<sup>10</sup> Expenditure on international conference participants (KRW 124.2 billion), consumption expenditure of GCF staffs (KRW 32.5 billion), local consumption of the GCF (KRW 5 billion), local consumption of relevant institution staffs (KRW 25 billion), local consumption of relevant institutions (KRW 5 billion)

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developing countries.

The GCF was created to mobilize massive funds to ensure its adequate allocation in helping developing countries to reduce GHG emissions and adapt to climate change. It also is tasked oversee and evaluate the overall procedure. If Korea as an OECD (Organisation for Economic Cooperation and Development) member, having joined the ranks of advanced countries, continues to merely national interests, rather than seriously thinking about how to take the lead in bridging the developed countries and developing countries as the host country of the GCF, then, it is doomed to face concerns from the international society. Moreover, since Korea succeeded in the bid through its diplomatic efforts, if it fails to ensure the sustainability of green growth within its own country, a bumpy road lies ahead for Korea to display its leadership within the international society.

The issue at hand is that the commitment of the current administration lags far behind that of the former government, and that the current government tends to not follow in the footsteps of its predecessors' accomplishments with regards to climate change issues and matters. Park Geun-hye administration having inaugurated in February 25, 2013, has maintained the stance that Korea needs to respond to energy security and climate change issues by promoting energy related new industries as part of the government's core strategy of "Creative Economy." President Park seems to have avoid the burden of directly inheriting the symbolic rhetoric of "Green Growth" of her predecessor who used to be her political rival, although from the same party, and decided to continue on with the green growth at the "at a necessary level" by implementing energy policies as part of realizing her vision of "Creative Economy."

Therefore, green growth which was the former government's first and foremost national strategy has become just one the many themes required to implement the creative economy, and this massive-scale

issue of climate change adaptation at national and global level has been incorporated in the overall national energy policy. Moreover, the Presidential Committee on Green Growth which was the control tower of the former administration's green growth policies, was downgraded to a prime minister's committee level, losing its influence, and the Green Growth Planning Division within the Committee tasked to establish the LCGG strategies was abolished. The scope of activities and roles in the field of "green" was drastically reduced in major ministries including the Ministry of Environment, Ministry of Trade, Industry & Energy, Ministry of Strategy and Finance, Ministry of Foreign Affairs. The Image of the Korean government preaching the importance of the LGCC in all international conferences was no longer to be found. Korea has managed to host the GCF Secretariat after relentless efforts, however, ever since, has failed to provide any specific plan regarding the country's role. After all, Korea is now faced with the possibility of being degraded into a "Green Wash" country which puts forward only short-term international rhetoric without sincere commitment and any major internal changes. Therefore for Korea to secure its leadership as a middle power, playing the bridge role in different climate change issues, it must go beyond the diplomatic rhetoric to develop and implement a strong plan and accordingly focus first on enhancing its global reputation.

Korea is also making efforts for the fully operationalization of the GCF as the host country of its headquarters and is aware that the most essential matter to this end is securing sufficient funding. Therefore, the Park Geun-hye administration seems determined to lead by example by providing preemptive grants and persuading complaining countries to help facilitate the expansion of assistance coming from other developed countries. Since 2013 and till now, the focus of President Park's official address has been on securing long-term finance of the GCF.

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Table 3: GCF Comments in President Park Geun-hye's Remarks

Date	Event	Comment
Dec. 4, 2013	Opening Ceremony of the Headquarters of the Green Climate Fund	Emphasized the goal implementation of Korea, support for climate change response of developing countries, assistance for the successful operationalization and development of the GCF
Sep. 23, 2014	Keynote Speech at the UN Climate Summit	Reported the development of Korea's new energy industries and ETS(emissions trading system) implementation, pledged up to 100 million which is an increase from existing pledge of 50 million
Sep. 25, 2014	Keynote at the 69th UN General Assembly	Will work for the full and early operationalization of the GCF and for the expansion of the GGGI's assistance to developing countries
Oct. 17, 2014	Summit Remarks during the 10th ASEM Summit Meeting	Confirmed the pledge up to 100 million

\*source: Cheongwadae, Republic of Korea. President Speech. <http://www1.president.go.kr/president/speech.php>

During the UN Climate Summit held in September 2014, President Park called on the developing world to make efforts for adaptation to climate change and the developed world to provide financial assistance and technical transfer to this end. Also, as the leader of the host country of the GCF Secretariat, she emphasized the importance of securing funding for the GCF to implement its roles and promised to double its pledge to the Fund up to USD 100 million.

“First, we need to see climate action not as a burden, but as an opportunity... Investing in the chance to unlock new energy industries and jobs can ignite fresh engines of future growth. Second, technology and market-based solutions should be at the center... To encourage the private sector to lead, markets should reward carbon-cutting innovations. Third, all countries need to be on board. For developing countries, however, cutting CO<sub>2</sub> can be a burden. To help them invest in needed capabilities and build markets, the developed world should transfer technology and know-how... The early capitalization of the GCF is vital to

the launch of a new climate regime next year... The Korean Government pledges up to 100 million dollars to the GCF, including the 50 million we are currently paying.”

In June 2015, Korea, by signing a payment agreement with the GCF, fulfilled this promise (GCF 2015d, 6). However, Korea needs to go further than paying the pledged amount to the Fund and assume a bigger leading role in the international society as the host country of the GCF headquarters, which requires commitment to identify channels to mobilize resources and make proposals to the GCF as a way to contribute to responding to climate change in developing countries.

## **VI. ROK for the GCF: Korea’s Action Plan for the Successful Operationalization of the GCF**

### **1. Internally: Ensure Sustainability of Green Growth and Develop Climate Finance Cluster**

The Park Geun-hye administration, while announcing the National Greenhouse Gas Emissions Reduction Roadmap in January 2014, declared that the government would send “clear signals to the industry as a way of expressing firm commitment to reductions” (Joint Statement of Relevant Ministries, ROK 2014, 1). The Roadmap includes the GHG emissions reduction targets set by the Lee Myung-bak administration and reconfirms the government’s commitment to cut the level by 30% relative to the BAU level by 2020. To this end, the Roadmap proposes the vision of implementing the ETS, Renewable Portfolio Standard (RPS), Bonus-Malus system<sup>11</sup> and developing new energy technologies based on the

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<sup>11</sup> Bonus-Malus System which was expected to be implemented from January 2015 was delayed to post January 2021 due to opposition from the industry.

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creative economy strategy to achieve low carbon society in all areas. The current green growth strategy of Korea, however, has failed to enrich its substance and seems to remain as mere political rhetoric.

There are two evidences that support this argument. First is a matter of “behavior”, and second, a matter of the “will”. The former is associated with the current status of GHG emissions. As of today, Korea is the world’s 7th largest emitter of GHG, 8th largest energy consumer, 9th oil consumer, and the total GHG emissions in 2012 recorded around 688.3mtCO<sub>2</sub>, representing about an 133% increase compared to 295.5mtCO<sub>2</sub> in 1990 (GIR 2014, 31). The year-on-year decrease of the GHG emissions decreased occurred only once in 1998 when the country suffered from economic downturn due to the Asian financial crisis. Other than that, there has always been on upward trend. The same goes for energy consumption, except for the one-off slight reduction in 1998 due to the Asian financial crisis, over the past three decades from 1981 to 2013, energy consumption was on constant increase. Korea consumed 46 million toe of energy in 1981, which increased to 280 million toe in 2013, showing a six-fold increase for the past three decades (International Energy Agency 2014, 183).

With Korea relying heavily on fossil fuels, increased consumption in energy naturally leads to increased GHG emissions. As of 2013, Korea’s primary energy mix consisted of oil (37.8%), coal (29.2%), natural gas (18.7%) with fossil fuels representing 86%, and the reliance on oil and coal was at 67%, which was higher than the developed world’s 60% (Korea Energy Economics Institute 2014, xxi). The share of non-fossil fuel energy sources remained at relatively low with nuclear (10.4%), hydro (0.6%) followed by the renewable energy (3.2%). Moreover, as for the energy sources for generating electricity whose 75% of primary energies are converted or lost, coal represented 38.8%, natural gas 24.7%, followed by oil 6.1%, showing that fossil fuels accounted for a high share of some

70%. Given Korea's energy-intensive industrial structure focused on steel, petrochemical, and cement sectors, innovation of its industrial structure is essential, if not, the GHG emissions limitation will be a distant future.

Second, Korea indicated in its INDC report submitted to the UNFCCC that it “plans to reduce its GHG emissions by 37% from the BAU level by 2030 across all economic sectors” (UNFCCC 2015b). In numbers, it means that Korea will cut the GHG emissions from 850.6mtCO<sub>2</sub> (BAU level) to 536mtCO<sub>2</sub> by 2030. In 2009, the Lee Myung-bak administration pledged to cut the GHG emissions by 30% compared to BAU level by 2020, which meant reducing the BAU level of 813mtCO<sub>2</sub> to 543mtCO<sub>2</sub> by 2020. The plan was applying the maximum level of the IPCC recommendation to developing countries, which was “15-30% of BAU”, and Korea's decision was considered as the best practice in the international society as it had shifted its direction from the “me first” behavior towards an “early mover”. However, the INDC proposed by Korea in 2015 showed that the emissions reduction target was changed from 543mtCO<sub>2</sub> in 2020 to 536mtCO in 2030, indicating that only 7mtCO<sub>2</sub> emissions would be cut over the period of 2020-2030. The international society expressed concerns over Korea's proposed INDC, which was also rated “inadequate” by the Climate Action Tracker (CAT), a consortium of renowned climate change research institutes.<sup>12</sup>

Measures to achieve reduction target also involves many problems. Korea proposed in the INDC report it would use international market mechanism (IMM), however, domestically, it reported using statistics, that out of the 37% mitigation target, 25.7% would be achieved through domestic policies and 11.3% through IMMs (Joint Statement of Relevant Ministries, Republic of Korea 2015, 4). However, with the

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<sup>12</sup> Climate Action Tracker. “South Korea.” <http://climateactiontracker.org/countries/southkorea.html>

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imminent adoption of the post-Kyoto climate regime, it is yet unclear how such mitigation of 11.3% will be possible through IMM. Internally, many policies are planned including the reform on the electricity policy, implementation of the ETS and RPS, and further deployment of the renewable energies, however, in most cases, Korea is extremely dependent on imported fossil fuels and is centered on energy-intensive manufacturing industries. Therefore, achieving the target of 25.7% GHG emissions reduction does not seem easy. Moreover, the fact that 11.3% will be mitigated through IMMs and 25.7% through domestic measures, implies that although Korea is not in outright violation of the “No Backsliding” principle<sup>13</sup> agreed in the COP20 in Lima it is hardly in line with the spirit of the principle, which could undermine its reputation in the world.

As a result, in terms of the “behavior” and the “will”, Korea has failed to implement the vision that it once proposed to the international society. As many countries around the world are preparing the transition into a low carbon society with the upcoming adoption of the new climate regime in COP21 in Paris in 2015, Korea, as a country that first advocated for the green growth and made successful diplomatic outcome as middle power in climate change issues by becoming the host of the GCF recognized for accomplishment, needs to first and foremost focus on the following: adhering to the norms and values that it once proposed to the international society and enriching their substance. If Korea wishes to take the initiative and demonstrate leadership in climate finance as the host country of the GCF Secretariat, it needs to implement a practical strategy as an “early mover” and a “norm diffuser” by defining first a

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<sup>13</sup> “The Conference of the Parties agrees that each Party’s intended nationally determined contribution towards achieving the objective of the Convention as set out in its Article 2 will represent a progression beyond the current undertaking of that Party (UNFCCC 2015a, 3).”

clear national vision to improve its fundamentals and diffuse it to its neighboring countries.

Together with enriching the substance of the green growth, the Korean government needs to focus its energy in successfully developing a climate finance cluster in Songdo to seek further development of the GCF. With the full and early operationalization of GCF, Songdo is expected to become the hub gathering global experts on climate change issues from all over the world. The Korean government but also the Incheon city housing the GCF, have taken note of this and are determined to make Songdo as the world's leading climate finance hub, but a specific road map is yet to be developed. Incheon has provided guidelines for development such as fostering Korean consulting experts on climate change, supporting Korean firms hoping to enter the green sector, building green finance capacity of Korean financial institutions, and improving the living conditions of Songdo (Incheon Metropolitan City 2014, 85-86), however these plans merely focus on Korea's utilization of the GCF for the capacity building of domestic actors. However, if Korea wishes to show true leadership on climate change issues in the world, it should stop thinking of taking advantage of the GCF for the benefit of its national interests but seriously think about how it can contribute to the successful operationalization of the GCF. Such change in the way of thinking will serve as a win-win strategy benefitting both Korea and the GCF as a whole in the long run.

For this, above all, strong development assistance policies of the Korean government are required. Different policy measures need to be designed and implemented based on firm commitment, including: allocation of special budget for developing Songdo as knowledge-sharing platform and cluster in climate finance; creation of a government organization tasked with the mission to develop and expand transport infrastructure to ensure increased access to and from Seoul and Incheon;

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development of communications & energy infrastructure within Songdo; creation of the R&D complex specialized in low carbon technologies; development of support mechanisms for training on climate finance; development of incentives such as tax favor for relevant industries; and establishment of laws and regulations to control speculations in the property market, etc. In particular, full implementation of institutional frameworks through enactment of laws will add credibility to the Korean government's firm commitment and facilitate attracting massive internal and external financial and human resources to Songdo.

## **2. Externally: Demonstrate Leadership of Middle power through Readiness**

In order to limit the global temperature rise to 2 degrees relative to pre-industrial levels and minimize the impact of climate change, it is crucial to secure a massive funding of USD 900 billion every year until 2050, of which USD 531 billion (59%) needs to be used for adaption of climate change in developing countries (Polycarp, Brown, and Fu-Bertaux 2013, 12). However, the amount of contributions pledged by developed countries is only USD 100 billion each year, and it is uncertain whether such target can be met. With such a huge gap between the amount required and that can be mobilized in reality, there is a growing awareness on the need to support the readiness of developing countries to address the current issues.

What is “readiness” in terms of climate finance? UNDP defines readiness as “the capacities of countries to plan for, access, deliver, and monitor and report on climate finance, both international and domestic, in ways that are catalytic and fully integrated with national development priorities and achievement of the MDGs (Vandeweerd, Glemarec, and Billett 2012, 4).” In climate finance terms, readiness refers to developed

countries supporting the developing countries to create a more favorable environment for the latter so that the former can provide more financial and technical investments to the latter to better respond to climate change. For example, readiness activities would include all activities to support developing countries in assisting the elaboration of strategies including national plans, establishment of mechanisms (laws, polices, organizations, etc.), feasibility studies, pilot projects, capacity building of the banking sector for financial assistance, capacity building in operation and governance of projects, etc.

The GCF has been aware from the beginning that the efficient use of the Fund would also require capacity building of the developing countries so that the latter would be ready to make use of the Fund. The 3rd Board meeting made a reference to the experience of the existing CIFs and GEF, analyzing that, “a lack of focus on readiness activities can delay and reduce the effectiveness of larger-scale investments in climate change mitigation and adaptation (GCF 2013a, 2).” That is, even the existing international funds relatively overlooked the readiness activities for creating investment-friendly environment for developing countries, which resulted in lesser efficiency of the carried out. In this regard, developing countries need to attain a certain level of capacity in order for massive investments from developed world flow in. Therefore, the Board has been very aware of the fact that readiness activities in support of developing countries to build capacity to elaborate adequate strategies, mobilize and operate massive funds from different sources, monitor the progress of projects and evaluate their impact are one of the important pillars that underpin the GCF activities. Consequently, the 5<sup>th</sup> Board meeting proposed five modalities<sup>14</sup> of readiness activities that could be

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<sup>14</sup> (1) Assessment of readiness and support needs, (2) Country programming and portfolio development, (3) Communication, outreach and knowledge sharing, (4) Advisory

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implemented by the GCF (GCF 2013d, 5-7), and five pillars of readiness activities<sup>15</sup> to be supported by the Secretariat with high priority (GCF 2014, 12-18) were selected during the 8th Board meeting. According to the four reports on readiness activities submitted to the 10<sup>th</sup> Board meeting, some progress has been made for modality (1) and (5). With regards to (1), USD 1.9 million was allocated to seven countries (Comoros, the Dominican Republic, Ethiopia, the Federated States of Micronesia, Rwanda, Thailand and Togo) to establish NDAs, focal points or delivery partners, and in the future some USD 0.89 million is scheduled for allocation in four countries (The Plurinational State of Bolivia, Cook Islands, Gabon and Mali). Moreover, regarding (5), the Secretariat carried out various activities such as holding regional workshops and webinars, launching websites and providing relevant information, to name a few (GCF 2015c, 1-7).

Until now, the GCF's focus of readiness programmes has been supporting the institutional framework setting of developing countries for increasing their access to the GCF such as establishment and reinforcement of NDAs. Of course, readiness in such a limited sense may be needed in the beginning, however, the ultimate goal of readiness activities is to develop laws and policies, train human resources, raise awareness on climate change response, and build capacity of the banking sector and businesses in order to create an environment for developing countries to attract massive green investments. Therefore, the GCF is now faced with the task of developing readiness programmes to seek a fundamental change from developing countries in the long-term while

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service, and (5) Training, mentorship and twinning arrangements

<sup>15</sup> (1) Establishing and strengthening NDAs/focal points, (2) Strategic frameworks, including the preparation of country work programmes, (3) Selection of intermediaries or implementing entities and support for accreditation, (4) Initial pipeline of programme and project proposals, and (5) Information, experience and learning

implementing at the same time the initial model of readiness activities, namely providing assistance in setting up institutional mechanisms to establish and reinforce NDAs. In the end, without creating an investment-friendly environment in developing countries, it is impossible to attract massive grants from developed countries and private funds which are the key to securing long-term finance.

Further development of readiness programmes serving as the basis for securing the GCF's long-term finance can be the role assumed by a middle power state like Korea. Given the governance of the GCF entitled to all rights and responsibilities of the Fund's operations, it is in fact difficult for Korea to take the initiative as a leader in the decision-making process of the GCF as it is not part of the 24 Board members<sup>16</sup>. In fact, it seems appropriate for Korea needs to focus on fulfilling its role as the bridge connecting the developing and developed world, which it had underscored during the bidding for the Secretariat, in order to enhance its global reputation as the host country of the GCF Secretariat. Readiness is a domain optimized for Korea to transfer its know-how to developing countries based on its experience of having transitioned from a developing country into a developed one. Therefore, Korea is required to continue to assess the requirements of developing countries vulnerable to climate change and provide relevant technologies, resources and labor related to meet such demand, thus their investment conditions and identifying projects to support the climate change adaptation in these nations. Readiness activities will allow Korea to showcase its commitment to support the green growth strategies of the developing nations and will invite active participation from many countries around the world to fully operationalize the GCF. And this is the type of leadership and accountability that country like Korea, as the host of the GCF Secretariat,

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<sup>16</sup> Korea is an alternate member to China which is the Board member.

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can pursue.

Furthermore, the Korean government needs to collaborate with AEs with vested experience when identifying projects. As of now, Korea has proposed the Export-Import Bank of Korea(Korea Exim Bank)and Korea Development Bank(KDB) as the implementing entities. Out of the two, since the Economic Development Cooperation Fund (EDCF) of Korea Exim Bank is responsible for providing bilateral concessional ODA of Korea and has extensive experience in implementing diverse green ODA projects, it is highly likely to be chosen as an AE. However, it is not desirable for the Korean government to cooperate solely with the EDCF. To have a clear understanding of the demand and identify new creative ideas to enhance project effectiveness, the Korean government will need to seek active cooperation from the world's specialized institutions including the UNDP, UNEP, World Bank, and ADB, etc. The GGGI, a Korea-based international organization specialized in developing green growth strategies, also has a high potential to be chosen as an AE. The international society expects that Korea makes responsible efforts, as the permanent board member to GGGI and host country of the GCF, so that the GGGI's strategies and the GCF's funds are ideally utilized to support developing countries (O'Donnell 2015, 73).

## **V. Conclusion**

The GCF announced that it would hold its 11th Board meeting to initiate programs in support of developing countries, during the COP21 to be held in Paris from November 30 to December 11 prior to the launch of the new climate regime. The programs of highest priority for the GCF will be in readiness of developing countries which include strengthening their ownership to enhance direct access to the Fund, supporting micro-, small- and medium-sized enterprises (MSMEs), and building the capacity

of NDAs (GCF 2015e). When the GCF readiness programs kick off smoothly with the launch the post-climate regime, it is expected to send a positive signal to the international society. As a results, it will serve as the turning point for other countries who have not yet pledged to pledge contributions, attract more financial inputs from those who have already pledged to the Fund, and secure more funds from the private sector to be channeled into responding climate change issues.

However, such blueprint is the most idealistic one. As aforementioned, the GCF is a newly established organization that has just made a first step, without any long-term solutions to many of the challenges it faces. The GCF needs to mobilize massive resources from both developed and developing countries, and more sustainable resource mobilization inevitably requires engagement of the private sector. The Fund has many goals to achieve: creating investment-friendly conditions for developing countries, supporting readiness of the most vulnerable countries to climate change, reducing global GHG emissions, and ultimately transitioning into the low carbon world.

This presents both opportunities and challenges for Korea in demonstrating its middle power leadership in the field of climate change. Cooper, Higgott and Nossal referred to the typical behavior of the middle powers, the “middlepowermanship” as “[the] tendency to pursue multilateral solutions to international problems, [the] tendency to embrace compromise positions in international disputes, and [the] tendency to embrace notions of ‘good international citizenship’ to guide its diplomacy (Cooper, Higgott and Nossal 1993, 19).” Moreover, due to such middlepowermanship, middle powers take three forms of identity as catalysts, facilitators, and managers: catalysts tend to highlight the importance of issues, facilitators create associations through cooperation and managers establish formal institutional frameworks and develop them into norms. Cooper believed these three behavioral patterns of

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middle powers are associated with the niche diplomacy, “concentrating resources in specific areas best able to generate returns worth having (Cooper, Higgott and Nossal 1993, 25-26).”

Until now, Korea has advocated the concept of green growth and diffused it to the international society, developing it as a national brand. However, for Korea to display true leadership as a middle power, it needs to go beyond the diplomatic rhetoric, work hard in seeking substance of the green growth at the national level and act befitting its middle power status vis-a-vis the international society. That is, as the host country of the GCF Secretariat, Korea needs to assume the three aforementioned roles: catalyst by promoting diverse ideas through raising awareness on the threats of climate change and importance of the GCF, facilitator by encouraging engagement of many different countries in GCF activities, and manager by contributing to developing the green finance cluster as the knowledge-sharing platform centered on the GCF and leveraging it as a hub to diffuse green norms worldwide. Moreover, it should be stressed one again that Korea needs to go beyond the nationalistic approach of merely focusing on calculating the economic impact of hosting the GCF Secretariat and seek to comply with the values and objectives of the GCF and leverage its experience for the full operationalization of the Fund. This will certainly be a wise approach for Korea to adopt to maximize its national interests while addressing the global challenges of climate change.

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# Low Carbon and Green Growth in South Korea

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## **Abstract**

In 2011, the Republic of Korea, an energy and CO<sub>2</sub>-intensive OECD member state, initiated the National Greenhouse Gas Emissions Reduction Roadmap 2020 in order to mitigate climate change. In 2015, South Korea implemented the first domestic emission trading scheme in East Asia in order to support this process. In an attempt to fulfill the allocated domestic emission reduction targets for each sector, the South Korean economy has increased investments into low carbon and green growth. However, to date greenhouse gas emissions remain on the rise and the sectors are failing to reach their emission reduction targets. This article assesses the question pertaining to how much additional investment is required in order to realize the government's commitment to the 2020 roadmap.

Central to this assessment, an econometric greenhouse gas emission model for South Korea was developed that was mainly driven by macro-economic investments. Results obtained from this model indicate that the GDP-share of investments will need to increase by 9.1% p.a. in order to generate sufficient capital to realize the National Greenhouse Gas Emissions Reduction Roadmap2020. Due to different marginal abatement costs, however, the induced greenhouse gas emission reductions are not evenly distributed among each sector of the South Korean economy. Prominently, power generation, oil and gas, and transport are likely

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to over-fulfill their emission reduction targets, while manufacturing industries will come up short on their targeted emission reductions. By 2020, the manufacturing industries and construction would be short about 70 Mt CO<sub>2</sub>-equivalents, while power generation, oil and gas would possess excess emission reductions in about the same amount. In this case, the proposed domestic emission trading scheme would be able to efficiently allocate the necessary capital for greenhouse gas emission reductions and support the sectoral emission reduction efforts. Sectors with high marginal abatement costs such as manufacturing industries could buy emission allowances from the power generation or transport sectors. Hence, additional investments and the trading scheme would work hand in hand together.

### I . Introduction

According to the International Energy Agency (IEA), the Republic of Korea has the thirteenth-largest economy and is the seventh-largest exporter in the world. South Korea is an energy-intensive economy, at number eleven in the world in terms of energy consumption, and is the world's fifth-largest oil importer (IEA, 2012). Between 1990 and 2013, its primary energy supply and CO<sub>2</sub>-emissions grew by 200% (BP, 2014), governed by the Kyoto Protocol under the United Nations Framework on Climate Change (UNFCCC), its greenhouse gas emissions (i.e., CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, PFCs, HFCs, and SF<sub>6</sub>) grew by 134% between 1990 and 2012 (UNFCCC, 2015).

South Korea does not have a quantitative obligation towards the Kyoto Protocol. However, in order to mitigate climate change, in 2008 the “Low carbon, Green growth” movement was proclaimed by the South Korean President Lee Myung-bak, as a national vision to guide the nation's long-term development (YOO, 2012). In 2009, at the 15th Conference

of the Parties of UNFCCC (COP 15) in Copenhagen, the Republic of Korea announced its national GHG emission reduction goal of 30% below the business as usual (BAU) projection by 2020 (The Republic Of Korea, 2011). In 2011, the South Korean government also issued the National Greenhouse Gas Emissions Reduction Roadmap 2020, which included a national emissions reduction target and action plans for each sector. Disaggregated by sectors, the following greenhouse gas emission reductions were envisaged: transportation -34.3%, buildings -26.9%, power generation -26.7%, public sector -25.0%, industry -18.5%, waste -12.3%, and agriculture and fisheries -5.2%. According to the National Greenhouse Gas Emissions Reduction Roadmap 2020, the total emission reduction of 30% would be equivalent to a 233 million tons of CO<sub>2</sub>-equivalent (CO<sub>2e</sub>) greenhouse gas emission reductions on a national level compared to the predicted business as usual emission of 776.1 MtCO<sub>2e</sub> (Ministry for the Environment, 2011). On 1 January 2015, a national emissions trading scheme came into force to support the Korean government pledge for a 30% greenhouse gas emission reduction, down to 543 Mt CO<sub>2e</sub> (ICAP, 2015).

Between 2008 and 2012, South Korea's economy grew by 20.5% (IMF, 2014). According to existing data from the UNFCCC (2015), during that period, however, greenhouse gas emissions in South Korea increased by 15.6% instead of decreasing by 1.6% as scheduled in the National Greenhouse Gas Emissions Reduction Roadmap 2020. To counterbalance this issue, in 2009, South Korea initiated a Five-Year Plan for Green Growth that contained a comprehensive set of projects worth KRW 108.7 trillion (USD 96 billion) in total investments (Fekete et al., 2013). In 2013, investments accounted for 27.4% of the GDP (IMF, 2014). However, these investments seem to be not sufficient as greenhouse gas emissions are still on the rise. Against this background, this article assesses the question: how much additional investments have to be made

to realize sufficient greenhouse gas emission reductions in South Korea until 2020 in order to fulfil the government pledge.

In the following, Section 2 describes the development of South Korea's greenhouse gas emissions between 1990 and 2012, as well as the current greenhouse gas emission reduction policies. Section 3 provides an econometric estimation and forecast of greenhouse gas emissions in South Korea required to reach the targets of the National Greenhouse Gas Emissions Reduction Roadmap 2020 under different scenarios of the increase of investments relative to the GDP (increase of 8.1% p.a., 9.1% p.a. and 10.1% p.a.). It also analyses to which extent the greenhouse gas emission reductions would be realized in the different sectors of the South Korean economy. The summary in Section 4 concludes the article.

## **II. Development of South Korea's greenhouse gas emissions 1990–2012 and current greenhouse gas emission reduction policies**

South Korea is a member of the Organization for Economic Co-operation and Development (OECD) and is a fast growing economy in the G-20 group. Between 1990 and 2013, its gross domestic product (GDP) increased by 13.3% p.a. With its low population growth (1.0% p.a.), the GDP per capita increased by 12.2% p.a. during the same period (Table 1). In 2013, by purchasing power parities, South Korea was recognized as the 12<sup>th</sup> largest economy in the world; its GDP per capita was about USD 34,800, similar to that of Japan (USD 36,900) (IMF, 2014). Between 1990 and 2013, investments increased by 5.8% p.a. from USD 127.6 bn. PPP to USD 464.1 bn. PPP. During the same period of time, the GDP-share of investments, however, decreased by 1.4 % p.a. (Table 1).

Table 1: Basic socio-economic and environmental indicators of South Korea (1990–2013)

	1990	1995	2000	2005	2010	2011	2012	2013	1990–2013, in % p.a.
Population (Mill.)	43.0	44.7	46.0	47.0	48.2	48.4	48.6	48.8	1.0
GDP (USD bn. PPP)	334.9	552.3	773.4	1094.8	1473.7	1559.4	1623.8	1697.0	13.3
Investments (bn. USD PPP)	127.6	204.0	236.4	325.0	435.1	459.3	449.1	464.1	5.8
Investments (% of GDP)	38.1	36.9	30.6	29.7	29.5	29.4	27.7	27.4	-1.4
Primary energy supply (Mtsce)	128.6	210.2	270.6	315.5	363.8	382.6	387.0	387.6	8.9
CO <sub>2</sub> -emissions (Mt)	252.8	386.1	442.3	494.8	594.0	623.4	625.7	NA	7.2 <sup>a</sup>
GDP per capita (USD PPP)	7,792	12,366	16,817	23,271	30,584	32,226	33,420	34,792	12.2
PES/GDP (t SKE / 1000 USD PPP)	0.38	0.38	0.35	0.29	0.25	0.25	0.24	0.23	-3.9
CO <sub>2</sub> /PES (t CO <sub>2</sub> / t PES)	1.97	1.84	1.63	1.57	1.63	1.63	1.62	NA	-1.5 <sup>a</sup>
CO <sub>2</sub> /GDP (t/USD 1000 PPP)	0.75	0.70	0.57	0.45	0.40	0.40	0.39	NA	-5.0 <sup>a</sup>
CO <sub>2</sub> per capita (t)	5.88	8.65	9.62	10.52	12.33	12.88	12.88	NA	6.2 <sup>a</sup>

Source: BP (2014), UNFCCC (2015), IMF (diff. issues). NA = Not available in UNFCCC data. a) Annual growth rate 1990-2012.

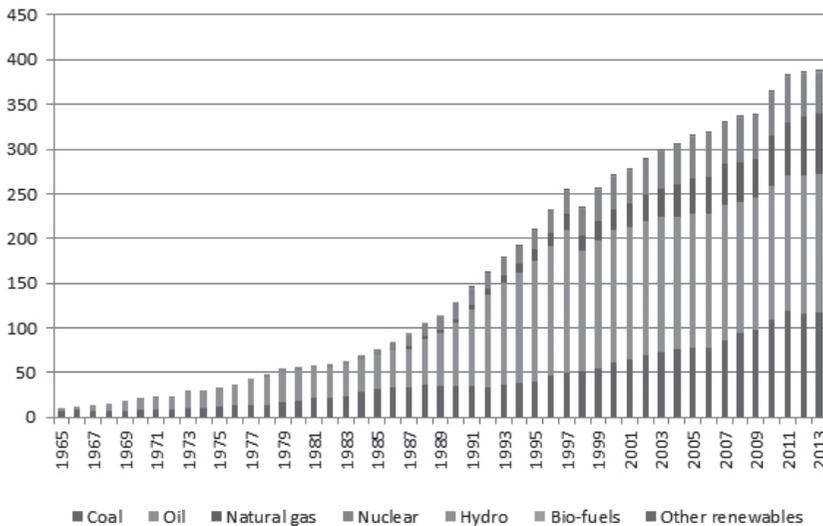
With a growing economy, and as one of the “four tigers” in Asia (South Korea, Taiwan, Hong Kong and Singapore), the energy demand in South Korea has increased considerably since the mid 1960’s, at 8.1% per annum between 1965 and 2013. As South Korea’s economy is dominated by heavy industries such as iron and steel, the chemical industry, ship-building and automotive manufacturing industry, etc. by large industry conglomerates (chaebols) (OECD, 2014), the country has long been very energy intensive. The main fuels used in the South Korean economy are oil and coal (Figure 1).

Although South Korea was hit by the 1997 financial crisis and

## Low Carbon and Green Growth in South Korea

had to be bailed out with IMF loans, the country succeeded to partly restructure its economy by promoting the information technology and communication (ITC) sector. In 2012, South Korea spent 4.4% of its GDP on research and development, the highest share among OECD countries (OECD, 2014). The restructuring also helped, together with efficiency gains in industry, to realize a decrease in the energy intensity on the GDP (only about 4% p.a. between 1990 and 2013), allowing the economic growth and primary energy demand to decouple. After this consolidation, South Korea managed to recover from the global financial crisis of 2008 and the following years much better than neighboring countries such as Japan (IEA, 2012). The new South Korean growth strategy aims at fostering a “creative economy”, in which venture businesses play a vital role (OECD, 2014).

Figure 1: Primary energy supply in South Korea (1965-2013, in Mtsce)



Source: BP (2014).

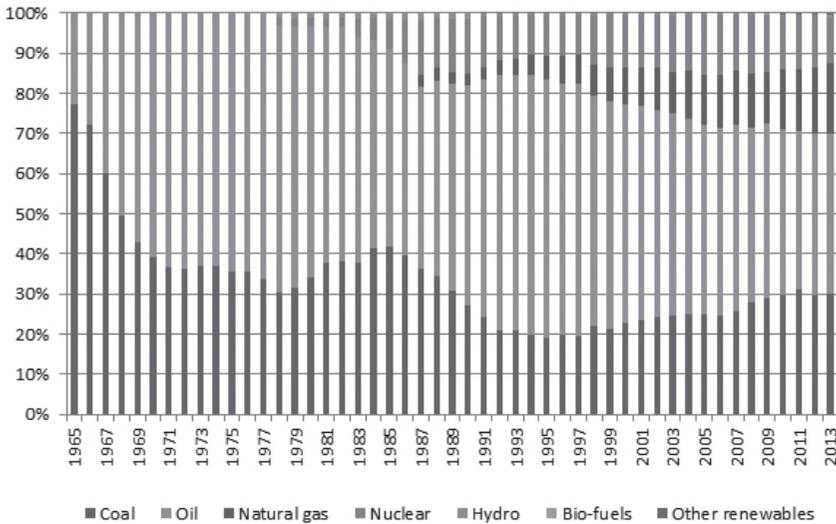
South Korea does not have significant domestic fossil energy resources: no oil resources, only very limited reserves of natural gas, and small amounts of indigenous anthracite (IEA, 2012). Hence, the country is largely dependent on imports of oil, gas, and coal. South Korea is the third-largest crude oil importer in Asia after China and Japan, and the Korea Gas Corporation (KOGAS) is the largest single buyer of liquefied natural gas (LNG) in the world (IEA, 2012).

Nuclear energy was developed in the early 1980's in attempts to improve energy security in the production of electricity for its fast growing economy. Although nuclear energy represents about 30% of power generation and 12% of the total primary energy supply, the CO<sub>2</sub>-intensity of the primary energy supply only decreased by about 15% until 1990, and has remained more or less constant ever since (Table 1).

Compared to the situation until the mid 1990s, the structure of the primary energy supply in 2013 is more balanced, especially as the share of gas (LNG) in the total primary energy supply is continuously increasing. However, renewable energies (hydro, bio-fuels, and other renewables) still only count for 1% of the total primary energy supply in South Korea (Figure 2). As such, the promotion and increase of renewable energies is obviously a task that remains for the South Korean government, especially for the future implementation of the 2020 National Greenhouse Gas Emissions Reduction Roadmap.

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Figure 2: Structure of primary energy supply in South Korea (1965–2013, in Mtsce)



Source: BP (2014).

The high energy intensity of the GDP, high CO<sub>2</sub>-intensity of the primary energy supply, and slow population growth rate in South Korea have led to a considerable increase in the CO<sub>2</sub>-emissions per capita of about 6% p.a. between 1990 and 2012. In 2012, the CO<sub>2</sub>-emissions per capita was already 12.9 tons (Table 1).

Thus, South Korea has already surpassed Germany (2013: 10.9 t) and Japan (11.2 t) and is starting to catch up with the high per capita CO<sub>2</sub>-emissions in the US (2013: 19.0 t) (BP, 2014). According to BP (2014), the per capita CO<sub>2</sub>-emissions in 2013 are already 16.0 t; however, the two data sets have differed since 1990. Therefore, in order to be able to compare the emissions of CO<sub>2</sub> and the other five greenhouse gases in South Korea, in the following, the UNFCCC data is used.

Table 2 shows the development and structure of the six Kyoto greenhouse gases (carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide

(N<sub>2</sub>O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF<sub>6</sub>) between 1990 and 2012. In 2012, CO<sub>2</sub> made up about 90% of the six Kyoto greenhouse gas emissions in South Korea, followed by methane (4%), and nitrous oxide (2%). Hence, the main focus of the climate change mitigation strategy in South Korea is the reduction of CO<sub>2</sub>-emissions.

Table 2: Structure of greenhouse gas emissions in Korea (excl. LULUCF)(1990–2012, in Mill. t CO<sub>2e</sub> and %)

Greenhouse gas	1990	1995	2000	2005	2010	2011	2012	Annual growth (1990–2012, in % p.a.)
Total	294.6	436.5	503.0	559.9	657.2	685.7	688.4	7.3
CO <sub>2</sub>	252.8	386.1	442.3	494.8	594.0	623.4	625.7	7.8
CH <sub>4</sub>	32.0	29.6	29.3	28.7	29.3	29.6	29.8	-0.6
N <sub>2</sub> O	9.6	14.4	18.3	22.1	13.3	13.9	14.2	3.4
HFCs	0.9	5.0	8.5	6.6	8.1	7.9	8.7	20.5
PFCs	NA	NA	2.2	2.7	2.3	2.0	2.3	0.2 <sup>a</sup>
SF <sub>6</sub>	0.2	1.4	2.4	5.0	10.3	8.8	7.6	33.5
in %	1990	1995	2000	2005	2010	2011	2012	Difference 1990–2012. in %-points
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0
CO <sub>2</sub>	85.8	88.5	87.9	88.4	90.4	90.9	90.9	5.1
CH <sub>4</sub>	10.8	6.8	5.8	5.1	4.5	4.3	4.3	-6.5
N <sub>2</sub> O	3.2	3.3	3.6	3.9	2.0	2.0	2.1	-1.2
HFCs	0.3	1.2	1.7	1.2	1.2	1.2	1.3	1.0
PFCs	NA	NA	0.4	0.5	0.3	0.3	0.3	-0.1 <sup>a</sup>
SF <sub>6</sub>	0.1	0.3	0.5	0.9	1.6	1.3	1.1	1.0

Source: UNFCCC Data Interface (2015).<sup>a)</sup> Annual growth rate resp. deviation 2000–2012.

In absolute figures, between 1990 and 2012, the total greenhouse gas emissions in South Korea (excluding land use and land use change

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(LULUCF)<sup>1</sup> grew by 7.3% p.a. from 295 Mt CO<sub>2e</sub> to 688 Mt CO<sub>2e</sub> (Table 3). The main sectoral sources of greenhouse gases were energy industries (38.9%), manufacturing industries (26.2%), and transport (12.5%), together accounting for 77.6% of the total greenhouse gas emissions in South Korea (688.4 Mt CO<sub>2e</sub>). Including LULUCF, greenhouse gas emissions in 2012 were 637.5 Mt CO<sub>2e</sub>.

Although a member of the OECD, South Korea does not have a quantitative obligation for reducing greenhouse gas emissions with respect to the Kyoto Protocol under the United Nations Framework Convention on Climate change (UNFCCC). When the UNFCCC was adopted in 1992, the Republic of Korea was still regarded as a developing country, and did not join the OECD until 1996 (OECD, 2015).

Table 3: Development of total greenhouse gas emissions in Korea (1990–2012, in Mill. t CO<sub>2e</sub>)

in Mill. t CO <sub>2e</sub>	1990	1995	2000	2005	2010	2011	2012	Annual growth (1990–2013, in % p.a.)
Total emissions excl. LULUCF	294.6	436.5	503.0	559.9	657.2	685.7	688.4	7.3
Power generation, oil and gas	53.0	94.6	138.9	182.6	263.2	271.7	275.9	14.7
Energy industries	47.6	91.5	134.8	177.1	256.0	264.0	267.5	15.5
Fugitive emissions from fuels	5.4	3.1	4.1	5.4	7.2	7.7	8.3	3.7
Transport	35.5	64.7	69.9	81.8	85.3	85.0	86.4	7.7
Other sectors (buildings, public sector)	76.5	78.5	73.3	69.6	58.9	58.3	58.0	-2.3
Industry	96.0	159.4	179.3	188.7	213.6	234.3	231.4	7.6

<sup>1</sup> Increasing the removal of greenhouse gases from the atmosphere (e.g., by afforestation or forest management), or by reducing emissions (e.g. by reducing deforestation) (UNFCCC, 2015a).

Manufacturing industries and construction	76.5	116.9	129.8	134.9	161.2	182.6	180.0	7.4
Industrial processes	19.5	42.6	49.5	53.8	52.4	51.7	51.4	8.4
Waste	9.9	14.8	17.8	15.7	14.1	14.6	14.8	3.4
Agriculture	23.8	24.5	23.7	21.5	22.0	21.9	22.0	-0.6
Landuse change and forestry (LUCF)	-34.4	-35.4	-58.9	-56.6	-54.9	-51.3	-50.9	3.3
Total emissions incl. LULUCF	260.2	401.1	444.1	503.2	602.3	634.4	637.5	7.8

Source: UNFCCC (2015).

In 2008, the South Korean government introduced “Low carbon, Green growth” as the new goal of its long-term economic policy. A 50 member Presidential Committee on Green Growth (PCGG) was subsequently established in February 2009, to coordinate and evaluate the green growth policies of the different ministries and to undertake consultations with private-sector stakeholders. It is co-chaired by the Prime Minister and a chairman from the private sector (IEA, 2012). In 2009, South Korea also initiated a Five-Year Plan for Green Growth that contained a comprehensive set of projects worth KRW 108.7 trillion (USD 96 billion) in total investments, and planned to increase the share of public investment in basic research to 35% in order to become competitive with other leading countries (Fekete et al., 2013).

Implementing this strategy and contributing to climate change mitigation, the South Korean government in 2009 proclaimed its national GHG emission reduction goal of 30% below the 2020 business as usual projection of greenhouse gas emissions. The 30% emission reduction represents an ambitious pledge in the 15% to 30% range based on the IPCC’s recommendation for a substantial deviation below baseline for developing countries (Fekete et al., 2013; IPCC, 2007). Table 4 shows the forecasted greenhouse gas emissions in the 2020 business

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as usual projection. For 2015, the South Korean government assumes the total greenhouse gas emissions to be in the range of 707 Mt CO<sub>2e</sub>, and 776 Mt CO<sub>2e</sub> for 2020 (The Republic of Korea, 2011). As no other data is available and it is not clear which measures have already been implemented by the Korean government and taken into account in the BAU scenario (Fekete et al., 2013), the sectoral structure in Korea is assumed to be constant, and as such the average annual growth rate of total greenhouse gases was applied for each year between 2012 and 2015 and between 2016 and 2020. For the GDP, an annual growth rate of 5.5% is assumed; South Korea's economy grew by this rate during the past five years.

Table 4: Development of total greenhouse gas emissions in Korea-Business as usual (2013–2020, in Mill. t CO<sub>2e</sub>)

in Mill. t CO <sub>2e</sub>	2013	2014	2015	2016	2017	2018	2019	2020
Total emissions excl. LULUCF	719	714	709	722	735	749	762	776
Power generation, oil and gas	288	286	284	289	295	300	306	311
Energy industries	280	278	276	281	286	291	296	302
Fugitive emissions from fuels	9	9	9	9	9	9	9	9
Transport	90	90	89	91	92	94	96	97
Other sectors (buildings, public sector)	61	60	60	61	62	63	64	65
Industry	242	240	238	243	247	252	256	261
Manufacturing industries and construction	188	187	185	189	192	196	199	203
Industrial processes	54	53	53	54	55	56	57	58
Waste	15	15	15	15	16	16	16	16
Agriculture	23	23	23	23	23	24	24	25

Source: The Republic of Korea (2011), own calculations.

In 2011, the South Korean government issued the National Greenhouse Gas Emissions Reduction Roadmap 2020. It included both the sectoral emissions reduction target as well as action plans for each

sector. Based on this roadmap, the following greenhouse gas emission reductions until 2020 are planned (Ministry for the Environment, 2011):

- Transportation: -34.3%
- Buildings: -26.9%
- Public sector -25.0%,
- Power generation, oil and gas: -26.7%
- Industry: -18.5%
- Waste: -12.3%
- Agriculture and fisheries: -5.2%.

The 30% target represents a total greenhouse gas emission reduction of 233 Mt CO<sub>2e</sub> from the current 776 Mt CO<sub>2e</sub> by 2020 in the business as usual scenario, down to 543 Mt CO<sub>2e</sub> in the same year, by having implemented these emission reduction measures. Yoo (2012) presents a disaggregation of the emission reduction paths for each sector. Table 5 shows the planned greenhouse gas emission reductions of each sector according to the National Greenhouse Gas Emissions Reduction Roadmap 2020 and the disaggregation shown in Yoo (2012).

UNFCCC does not provide disaggregated South Korean GHG emission data for buildings and the public sector, only its sum under the item “1.A.5 Energy-Other”. As the public sector only has a share of less than 1% of the total greenhouse gas emissions in South Korea (2007 data, Oh, 2011), its emission reduction impact is very small. As for power generation, oil and gas disaggregated data is available as “1.A.1 Energy industries” and “1.B. Fugitive emissions from fuels”. The same is true for industry, which can be disaggregated into “1.A.2 Manufacturing industries and construction” and “2. Industrial processes”. Note that as waste (2012: 2.2% of total GHG-emissions) and agriculture (2012: 3.2% of total GHG-emissions) are very small sectors, for reasons of simplicity

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no disaggregation of their sub-sectors is made here, even though data is available.

Table 5: Development of total greenhouse gas emissions in Korea-Planned reduction according to the National Greenhouse Gas Emissions Reduction Roadmap 2020 (2013–2020, in Mill. t CO<sub>2e</sub>)

	2013	2014	2015	2016	2017	2018	2019	2020	Emission reduction vs BAU (2020)
Total emissions excl. LULUCF	695	667	638	618	598	579	561	543	-30,0
Power generation, oil and gas	280	273	267	258	250	243	235	228	-26,8
Energy industries	271	265	259	251	243	236	228	221	-26,7
Fugitive emissions from fuels	8	8	8	7	7	7	7	7	-30,0
Transport	86	83	80	77	73	70	67	64	-34,3
Other sectors (buildings, public sector)	58	56	54	53	52	50	49	48	-26,8
Industry	234	217	201	193	185	178	172	166	-36,5
Manufacturing industries and construction	180	164	148	139	131	124	116	110	-46,0
Industrial processes	54	53	53	53	54	55	55	56	-3,2
Waste	15	14	14	14	14	14	14	14	-12,3
Agriculture	23	23	22	23	23	23	23	24	-5,2

Source: The Republic of Korea (2011), Yoo (2012), own calculations.

South Korea has developed a comprehensive set of strategies, broken down into policies and measures for all sectors to fulfil their pledge. The government developed 14 different strategies to support its overarching Low Carbon, Green Growth vision, including the reduction of industrial energy demand, promotion of renewable energies, energy efficiency improvements in buildings, public transport, policies of land use change

and forestry as well as waste reduction. Most importantly, South Korea is implementing an emissions trading system which has started operation in January 2015 (Fekete et al., 2013).

The South Korean national emission trading scheme is the first nationwide cap-and-trade program in operation in Asia. With a cap of 573 Mt CO<sub>2e</sub> in 2015, it is the second largest emission trading scheme (ETS) worldwide, after the EU ETS. This system covers about two-thirds of the country's total emissions and has three implementation phases (ICAP (2015)):

- Phase I (2015–2017) has a cap of 1687 Mt CO<sub>2e</sub> including a reserve of 89 million t CO<sub>2e</sub> in order to ensure market stabilization measures, early action, and new entrants. In this phase, 100% of the certificates will be issued for free. In Phase I, 23 sub-sectors including steel, cement, petro-chemistry, refinery, power, buildings, waste sectors, and aviation will participate in the trading scheme. In total, 525 companies that emit more than 125,000 t CO<sub>2</sub>/year are included.
- In Phase II (2018–2020), there will be 97% free allowances and 3% auctioning.
- In Phase III (2021–2025), less than 90% of the certificates will be freely allocated and more than 10% auctioned.

Energy-intensive and trade-exposed sectors such as iron and steel will receive 100% of their allowances for free in all three phases. Banking, i.e., saving of emissions rights for later, is allowed without any restriction. Borrowing, i.e., using future emission rights, is allowed only within a single trading phase. Annual reporting of emissions per year (t) must be submitted by the end of March of the following year (t+1). Emissions must be verified by a third-party verifier. Penalties for non-compliance

shall not exceed three times the average market price of allowances of the given compliance year or KRW 100,000/ton (EUR 70) (ICAP, 2015).

### III. Econometric estimations and forecasts of greenhouse gas emissions to reach the targets of the National Greenhouse Gas Emissions Reduction Roadmap 2020

In order to estimate the impact of additional investments to reduce greenhouse gas emissions and to reach the targets of the National Greenhouse Gas Emissions Reduction Roadmap 2020, an econometric greenhouse gas emissions model for South Korea is applied to cover the sectors mentioned in the Roadmap. In detail, the model equations are as follows:

Energy industries: (1)  $GHG\_ENERGYIND\_KS_t = C + \alpha \cdot GHG\_ENERGYIND\_KS_{t-1} + \beta \cdot CO2\_KS_t + \varepsilon_t$

Fugitive emissions from fuels: (2)  $GHG\_FUGITIVE\_KS_t = C + \alpha \cdot GHG\_FUGITIVE\_KS_{t-1} + \beta \cdot CO2\_KS_t + \varepsilon_t$

Transport: (3)  $GHG\_ENTRANSP\_KS_t = \alpha \cdot GDP\_KS_t / POP\_KS_t + \beta \cdot CO2\_KS_t + \gamma \cdot D112_t + \varepsilon_t$

Other sectors (buildings, public sector): (4)  $GHG\_ENERGYOS\_KS_t = \alpha \cdot CO2PES\_KS_t + \beta \cdot GHG\_ENERGYOS\_KS_{t-1} + \varepsilon_t$

Manufacturing industries and construction: (5)  $GHG\_ENMANUF\_KS_t = C + \alpha \cdot GHG\_ENMANUF\_KS_{t-1} + \beta \cdot CO2\_KS_t / GDP\_KS_t + \gamma \cdot T_t + \zeta \cdot D111_t + \varepsilon_t$

Industrial processes: (6)  $GHG\_INDPROC\_KS_t = \alpha \cdot GHG\_INDPROC\_KS_{t-1} + \beta \cdot CO2\_KS_t + \gamma \cdot D97_t + \zeta \cdot D99_t + \varepsilon_t$

Waste: (7)  $GHG\_WASTE\_KS_t = \alpha \cdot GHG\_WASTE\_KS_{t-1} + \beta \cdot INV\_KS_t / POP\_KS_t + \gamma \cdot D98_t + \zeta \cdot D101_t + \eta \cdot D107_t + \varepsilon_t$

Agriculture: (8)  $GHG\_AGRIC\_KS_t = C + \alpha \cdot GDP\_KS_t / POP\_KS_t + \beta \cdot T_t + \gamma \cdot INVSH\_KS_t + \zeta \cdot CO2\_KS_t + \varepsilon_t$

With:  $GHG\_ENERGYIND\_KS_t$  = Greenhouse gas emissions from energy industries in year t (Mt CO<sub>2e</sub>)  
 $GHG\_FUGITIVE\_KS_t$  = Fugitive greenhouse gas emissions from fuels in year t (Mt CO<sub>2e</sub>)  
 $GHG\_ENTRANSP\_KS_t$  = Greenhouse gas emissions from energy for transport in year t (Mt CO<sub>2e</sub>)  
 $GHG\_ENERGYOS\_KS_t$  = Greenhouse gas emissions from energy for other sectors in year t (Mt CO<sub>2e</sub>)  
 $GHG\_ENMANUF\_KS_t$  = Greenhouse gas emissions from energy for manufacturing industries and construction in year t (Mt CO<sub>2e</sub>)

GHG\_INDPROC\_KS<sub>t</sub> = Greenhouse gas emissions from industrial processes in year t (Mt CO<sub>2e</sub>)  
 GHG\_WASTE\_KS<sub>t</sub> = Greenhouse gas emissions from waste in year t (Mt CO<sub>2e</sub>)  
 GHG\_AGRIC\_KS<sub>t</sub> = Greenhouse gas emissions from agriculture in year t (Mt CO<sub>2e</sub>)  
 CO2\_KS<sub>t</sub> = CO<sub>2</sub>-emissions in South Korea in year t (Mt CO<sub>2e</sub>)  
 CO2PES\_KS<sub>t</sub> = CO<sub>2</sub>-intensity of primary energy supply in year t (t CO<sub>2</sub>/t sce PES)  
 INVSH\_KS<sub>t</sub> = GDP-share of investments in year t (%)  
 GDP\_KS<sub>t</sub> = GDP in year t (bn. USD PPP)  
 POP\_KS<sub>t</sub> = Population in year t (million)  
 T<sub>t</sub> = Linear technological trend  
 D109<sub>t</sub> = Dummy variable for the year 2009 (1 for 2009, 0 otherwise)  
 D112<sub>t</sub> = Dummy variable for the year 2012 (1 for 2012, 0 otherwise)  
 ε<sub>t</sub> = Error term

The emissions from power generation, oil and gas (GHG\_ENPOWERGEN\_KS<sub>t</sub>), and from industry (GHG\_INDUSTRY\_KS<sub>t</sub>) in Mt CO<sub>2e</sub> in year t are defined as:

$$(9) \text{ GHG\_ENPOWERGEN\_KS}_t = \text{GHG\_ENERGYIND\_KS}_t + \text{GHG\_FUGITIVE\_KS}_t$$

$$(10) \text{ GHG\_INDUSTRY\_KS}_t = \text{GHG\_ENMANUF\_KS}_t + \text{GHG\_INDPROC\_KS}_t$$

In year t, the total greenhouse gas emissions in South Korea (GHG\_TOTAL\_KS<sub>t</sub>) in Mt CO<sub>2e</sub> are defined as:

$$(11) \text{ GHG\_TOTAL\_KS}_t = \text{GHG\_AGRIC\_KS}_t + \text{GHG\_ENPOWERGEN\_KS}_t + \text{GHG\_ENERGYOS\_KS}_t + \text{GHG\_ENTRANSP\_KS}_t + \text{GHG\_INDUSTRY\_KS}_t + \text{GHG\_WASTE\_KS}_t$$

Before being able to run the models, the question of stationarity of the time series has to be addressed. Estimating the OLS, including variables that follow a random walk, may yield spurious results, i.e., the regressions present a relationship between these variables which in reality do not exist (Granger and Newbold, 1974). In order to assess the existence of a random walk of the variables in the single models, a unit root test

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introduced by Dickey and Fuller (1979) was applied. The augmented Dickey-Fuller (ADF) test results indicate that all variables applied above are non-stationary. Therefore, all variables could be converted into a stationary time series by taking their first differences (Table 6), i.e., they are integrated at order 1 [I(1)].

Table 6: Stationarity of the model variables

Variable	Specification	Order of integration
GHG_ENERGYIND_KS <sub>t</sub>	Greenhouse gas emissions from energy industries	I(1)
GHG_FUGITIVE_KS <sub>t</sub>	Fugitive greenhouse gas emissions from fuels	I(1)
GHG_ENTRANSP_KS <sub>t</sub>	Greenhouse gas emissions from energy for transport	I(1)
GHG_ENERGYOS_KS <sub>t</sub>	Greenhouse gas emissions from energy for other sectors	I(1)
GHG_ENMANUF_KS <sub>t</sub>	Greenhouse gas emissions from energy for manufacturing industries and construction	I(1)
GHG_INDPROC_KS <sub>t</sub>	Greenhouse gas emissions from industrial processes	I(1)
GHG_WASTE_KS <sub>t</sub>	Greenhouse gas emissions from waste	I(1)
GHG_AGRIC_KS <sub>t</sub>	Greenhouse gas emissions from agriculture	I(2)
CO2_KS <sub>t</sub>	CO <sub>2</sub> -emissions	I(1)
CO2PES_KS <sub>t</sub>	CO <sub>2</sub> -intensity of primary energy supply	I(1)
INVSH_KS <sub>t</sub>	GDP-share of investments	I(1)
GDP_KS <sub>t</sub>	GDP	I(1)
POP_KS <sub>t</sub>	Population	I(1)

Source: Own calculations.

No spurious regressions will occur if there is a stable-long-term economic relationship between the variables in the single models, i.e., if the linear combination of the variables are co-integrated (Engle and Granger, 1987; Granger, 1986). Applying ADF-tests to the OLS-residuals shows that the residuals of Equations (1)–(8) are stationary (Table 7). This then means that the linear combination of the variables in the single model equations appear to be co-integrated.

Table 7: Co-integration of the model variables

Nr.	Model equation	Stationarity of residuals, significance level (%)
(1)	$GHG\_ENERGYIND\_KS_t = C + \alpha \cdot GHG\_ENERGYIND\_KS_{t-1} + \beta \cdot CO2\_KS_t + \varepsilon_t$	I(0), 5%
(2)	$GHG\_FUGITIVE\_KS_t = C + \alpha \cdot GHG\_FUGITIVE\_KS_{t-1} + \beta \cdot CO2\_KS_t + \varepsilon_t$	I(0), 1%
(3)	$GHG\_ENTRANSF\_KS_t = \alpha \cdot GDP\_KS_t / POP\_KS_t + \beta \cdot CO2\_KS_t + \gamma \cdot D112_t + \varepsilon_t$	I(1), 1%
(4)	$GHG\_ENERGYOS\_KS_t = \alpha \cdot CO2PES\_KS_t + \beta \cdot GHG\_ENERGYOS\_KS_{t-1} + \varepsilon_t$	I(0), 1%
(5)	$GHG\_ENMANUF\_KS_t = C + \alpha \cdot GHG\_ENMANUF\_KS_{t-1} + \beta \cdot CO2\_KS_t / GDP\_KS_t + \gamma \cdot T_t + \zeta \cdot D111_t + \varepsilon_t$	I(0), 1%
(6)	$GHG\_INDPROC\_KS_t = \alpha \cdot GHG\_INDPROC\_KS_{t-1} + \beta \cdot CO2\_KS_t + \gamma \cdot D97_t + \zeta \cdot D99_t + \varepsilon_t$	I(0), 5%
(7)	$GHG\_WASTE\_KS_t = \alpha \cdot GHG\_WASTE\_KS_{t-1} + \beta \cdot INV\_KS_t / POP\_KS_t + \gamma \cdot D98_t + \zeta \cdot D101_t + \eta \cdot D107_t + \varepsilon_t$	I(0), 1%
(8)	$GHG\_AGRIC\_KS_t = C + \alpha \cdot GDP\_KS_t / POP\_KS_t + \beta \cdot GHG\_AGRIC\_KS_{t-1} + \gamma \cdot D102_t + \zeta \cdot D103_t + \varepsilon_t$	I(1), 5%

Source: Own calculations.

Table 8 shows the estimated coefficients and t-values of the model equations. The coefficients of the variables are all significant on the 1% and 5% levels, with one on the 10% level. In many cases, the dependent variable, e.g., for the energy industry in South Korea ( $GHG\_ENERGYIND\_KS_t$ ), is estimated using its lagged value ( $GHG\_ENERGYIND\_KS_{t-1}$ ). The lagged value represents the inertia in the development of the greenhouse gas emissions in the energy industry in South Korea. Based on long-term investment cycles, e.g., of power plants, the energy industry capital stock only slightly changes from year to year (Oberheitmann and Frondel, 2006).

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Table 8: Estimated coefficients and t-values of the single model equations

(1) GHG_ENERGYIND_KS <sub>t</sub>		
Variable	Coefficient estimates	t-Values
C	-46.61990***	-2.722994
GHG_ENERGYIND_KS <sub>t-1</sub>	0.698244***	6.903920
CO2_KS <sub>t</sub>	0.217275***	3.233993

adj. R<sup>2</sup>: 0.99; DW: 1.21 \*\* denotes significance on the 1% level.

(2) GHG_FUGITIVE_KS <sub>t</sub>		
Variable	Coefficient estimates	t-Values
C	-1.432551***	-4.842208
GHG_FUGITIVE_KS <sub>t-1</sub>	0.843527***	13.13292
CO2_KS <sub>t</sub>	0.005053***	5.901041

adj. R<sup>2</sup>: 0.97; DW: 2.51 \*\*\* denotes significance on the 1% level.

(3) GHG_ENTRANSP_KS <sub>t</sub>		
Variable	Coefficient estimates	t-Values
GDP_KS <sub>t</sub> /POP_KS <sub>t</sub>	-0.403116*	-1.573401
CO2_KS <sub>t</sub>	0.174324***	15.42488
D112 <sub>t</sub>	-9.245889*	-1.896528

adj. R<sup>2</sup>: 0.93; DW: 0.75 \*\*\* denotes significance on the 1% level, \* on the 10% level, respectively.

(4) GHG_ENERGYOS_KS <sub>t</sub>		
Variable	Coefficient estimates	t-Values
CO2PES_KS <sub>t</sub>	14.72552**	2.324540
GHG_ENERGYOS_KS <sub>t-1</sub>	0.634950***	4.185995

adj. R<sup>2</sup>: 0.65; DW: 2.33 \*\*\* denotes significance on the 1% level, \*\* on the 5% level, respectively.

(5) GHG_ENMANUF_KS <sub>t</sub>		
Variable	Coefficient estimates	t-Values
C	-11920.41***	-4.672114
GHG_ENMANUF_KS <sub>t-1</sub>	0.263566**	2.037152
CO2_KS <sub>t</sub> /GDP_KS <sub>t</sub>	188.0280***	3.940516

$T_t$	5.953036***	4.693031
$D111_t$	***13.81251	2.619214

adj.  $R^2$ : 0.99; DW: 2.31\*\*\* denotes significance on the 1% level, \*\* on the 5% level, respectively.

(6) GHG_INDPROC_KS <sub>t</sub>		
Variable	Coefficient estimates	t-Values
GHG_INDPROC_KS <sub>t-1</sub>	0.696398***	5.600262
CO2_KS <sub>t</sub>	0.031102***	2.542187
D97 <sub>t</sub>	4.685690*	1.342788
D99 <sub>t</sub>	6.767519**	1.945576

adj.  $R^2$ : 0.99; DW: 2.31\*\*\* denotes significance on the 1% level, \*\* on the 5% level, \* on the 10% level, respectively.

(7) GHG_WASTE_KS <sub>t</sub>		
Variable	Coefficient estimates	t-Values
C	3.683228***	3.602659
GHG_WASTE_KS <sub>t-1</sub>	0.827210***	11.14885
INV_KS/POP_KS <sub>t</sub>	-0.130989*	-1.602772
D98 <sub>t</sub>	-1.684783**	-2.321687
D101 <sub>t</sub>	0.947806*	1.320349
D107 <sub>t</sub>	-1.211179*	-1.773914

adj.  $R^2$ : 0.91; DW: 1.62\*\*\* denotes significance on the 1% level, \*\* on the 5% level, \* on the 10% level, respectively.

(8) GHG_AGRIC_KS <sub>t</sub>		
Variable	Coefficient estimates	t-Values
C	3.651516**	2.045979
CO2_KS/ GDP_KS <sub>t</sub>	1.910334**	2.051441
GHG_AGRIC_KS <sub>t</sub>	0.794318***	8.400914
D103 <sub>t</sub>	-0.563931*	-1.695974
D103_KS <sub>t</sub>	-0.535149*	-1.591395

adj.  $R^2$ : 0.81 DW: 0.80\*\*\* denotes significance on the 1% level, \*\* on the 5% level, \* on the 10% level, respectively.

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Every model equation directly or indirectly ( $CO2PES\_KS_t = CO2\_KS_t / PES\_KS_t$ ) contains the variable  $CO2\_KS_t$ , i.e., the amount of  $CO_2$ -emissions in South Korea. As  $CO_2$  by far is the most important greenhouse gas in South Korea (2012: 90.9%, Table 2), the reduction of  $CO_2$ -emissions in South Korea is the main driver of greenhouse gas emission reductions required to realize the National Greenhouse Gas Emissions Reduction Roadmap 2020. The  $CO_2$ -emissions in South Korea ( $CO2\_KS_t$ ) can be estimated using the following model equation:

$$(12) CO2\_KS_t = C + \alpha \cdot INV\_KS_t / GDP\_KS_t + \varepsilon_t$$

$INV\_KS_t$  are the investments in Korea (in bn. USD PPP),  $GDP\_KS_t$  is the South Korean GDP (in bn. USD PPP), and  $\varepsilon_t$  is the error term. Table 9 shows the estimated coefficients and t-values of the  $CO_2$ -emission model.

Table 9: Estimated coefficients and t-values of the  $CO_2$ -emission model

(12) $CO_2\_KS_t$		
Variable	Coefficient estimates	t-Values
C	1097.531***	11.15841
$INV\_KS_t / GDP\_KS_t$	-2016.798***	-6.684553
$D98_t$	-214.4554***	-3.481461
$D111_t$	119.8539**	2.060217

adj.  $R^2$ : 0.76; DW: 1.22\*\*\* denotes significance on the 1% level, \*\* on the 5% level, respectively.

The time series of  $CO_2$  and the GDP-share of investments are both non-stationary, but are integrated at order 1 (I(1)). As the residuals are stationary, these variables can be co-integrated and hence do not yield spurious results when using the OLS estimator.

In order to assess the validity of the model, the business as usual (BAU) path until 2020 was estimated (Table 10) and compared to the

assumed business as usual development of greenhouse gas emissions provided by the South Korean government as a benchmark for the planned greenhouse gas emission reductions in the National Greenhouse Gas Emissions Reduction Roadmap 2020 (Table 4). As Table 10 shows, the deviations of the estimated development of greenhouse gas emissions are acceptable. The total emissions excluding LULUCF only differ from the official BAU-scenario by -0.5%. The deviation of power generation, oil and gas is even less (-0.2%). Minor emission sources such as waste or agriculture are more difficult to estimate. However, the absolute deviations (-2.7 Mt CO<sub>2e</sub> resp. -4.1 Mt CO<sub>2e</sub>) are small compared to the total emissions of 776 Mt CO<sub>2e</sub> in the official BAU scenario (Table 10).

Table 10: Econometrically estimated BAU-scenario of greenhouse gas emissions in South Korea (1990–2012, in Mill. t CO<sub>2e</sub>)

	2013	2014	2015	2016	2017	2018	2019	2020	BAU official 2020
Total emissions excl. LULUCF	667	672	684	699	716	734	753	772	776
Power generation, oil and gas	267	265	268	274	281	290	300	311	311
Energy industries	259	257	259	265	272	281	290	300	302
Fugitive emissions from fuels	8	8	9	9	9	10	10	10	9
Transport	81	84	86	88	90	92	94	95	97
Other sectors (buildings, public sector)	59	59	60	60	60	60	59	59	65
Industry	224	228	234	242	250	258	265	273	261
Manufacturing industries and construction	171	173	179	184	191	197	203	208	203
Industrial processes	53	54	56	58	59	61	63	64	58
Waste	15	15	14	14	14	14	14	14	16
Agriculture	22	22	21	21	21	21	21	21	25

Source: Own calculations.

In 2009, the South Korean government initiated a Five-Year Plan for Green Growth with green investments in the amount of KRW 108.7 trillion (USD 96 billion) (Fekete et al., 2013). In 2013, the total

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investments accounted for USD 464 bn. (PPP), or 27.4% of the GDP (IMF, 2014). In order to reduce the greenhouse gas emissions in South Korea according to the 2020 roadmap, investments in low-carbon green growth have to be increased. Table 11 shows the development of greenhouse gas emission reductions due to three scenarios of annual growth relative to the total investment share of the GDP in the South Korean economy.

From Table 11, it is clear that the 2020 government pledge can only be fulfilled with a 9.1% annual growth of the GDP-share of investments. An 8.1% p.a. growth rate would only reduce the total greenhouse gas emissions by 25.2% in 2020 compared to the business as usual development assumed by the South Korean government. A 10.1% annual growth would lead to a 35% reduction of greenhouse gases in South Korea. Correspondingly, the total investments in South Korea would have to increase up to USD 798 bn. PPP (8.1% p.a. growth), USD 851 bn. PPP (9.1% p.a. growth), and USD 907 bn. PPP (10.1% p.a. growth) in 2020.

Table 11: Estimated greenhouse gas emission reduction scenarios in South Korea for different annual growth rates of GHP-share of investments (2013–20202, in Mill. t CO<sub>2e</sub>)

+8.1% p.a.											
	2013	2014	2015	2016	2017	2018	2019	2020	Emission reduction vs official BAU (2020)	Target Emission reduction vs BAU (2020)	Emission reduction vs govt. planned scenario (2020)
Total emissions excl. LULUCF	667	655	643	631	619	607	594	581	-25.2	-30.0	6.9
Power generation, oil and gas	267	258	249	239	230	220	209	199	-36.1	-26.8	-12.7
Energy industries	259	250	241	231	222	212	202	192	-36.5	-26.7	-13.3
Fugitive emissions from fuels	8	8	8	8	8	8	7	7	-25.5	-30.0	6.4
Transport	81	78	75	72	68	65	61	58	-40.9	-34.3	-10.0
Other sectors (buildings, public sector)	59	59	59	59	58	58	57	57	-13.2	-26.8	18.6
Industry	224	223	225	227	229	231	233	236	-9.7	-36.5	42.2
Manufacturing industries and construction	171	170	171	174	177	180	183	187	-7.9	-46.0	70.5
Industrial processes	53	53	53	53	52	51	50	49	-15.8	-3.2	-13.1
Waste	15	14	14	14	13	13	12	12	-27.9	-12.3	-17.8
Agriculture	22	21	21	21	21	21	20	20	-18.7	-5.2	-14.2
+9.1% p.a.											
	2013	2014	2015	2016	2017	2018	2019	2020	Emission reduction vs official BAU (2020)	Target Emission reduction vs BAU (2020)	Emission reduction vs govt. planned scenario (2020)
Total emissions excl. LULUCF	667	652	636	620	602	583	564	543	-30.0	-30.0	0.0
Power generation, oil and gas	267	257	246	233	220	207	192	177	-43.1	-26.8	-22.2
Energy industries	259	249	238	226	213	199	185	171	-43.4	-26.7	-22.8
Fugitive emissions from fuels	8	8	8	8	8	7	7	6	-32.1	-30.0	-3.0
Transport	81	77	73	69	64	60	55	50	-48.6	-34.3	-21.8

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Other sectors (buildings, public sector)	59	59	59	59	58	58	57	56	-13.9	-26.8	17.7
Industry	224	223	223	224	225	226	227	228	-12.4	-36.5	37.8
Manufacturing industries and construction	171	169	170	172	174	177	180	183	-10.0	-46.0	66.6
Industrial processes	53	53	53	52	51	49	48	46	-21.0	-3.2	-18.5
Waste	15	14	14	14	13	13	12	11	-30.1	-12.3	-20.3
Agriculture	22	21	21	21	21	21	20	20	-19.0	-5.2	-14.6
+10.1 % p.a.											
	2013	2014	2015	2016	2017	2018	2019	2020	Emission reduction vs official BAU (2020)	Target Emission reduction vs BAU (2020)	Emission reduction vs govt. planned scenario (2020)
Total emissions excl. LULUCF	667	649	629	608	584	559	532	504	-35.0	-30.0	-7.2
Power generation, oil and gas	267	256	242	227	211	193	174	154	-50.4	-26.8	-32.2
Energy industries	259	248	234	220	204	186	168	149	-50.7	-26.7	-32.8
Fugitive emissions from fuels	8	8	8	8	7	7	6	6	-39.0	-30.0	-12.9
Transport	81	76	71	66	60	54	48	42	-56.8	-34.3	-34.2
Other sectors (buildings, public sector)	59	59	59	58	58	57	57	56	-14.6	-26.8	16.7
Industry	224	222	221	221	221	221	221	221	-15.4	-36.5	33.2
Manufacturing industries and construction	171	169	169	170	171	173	176	178	-12.2	-46.0	62.5
Industrial processes	53	53	52	51	50	47	45	43	-26.4	-3.2	-24.1
Waste	15	14	14	14	13	13	12	11	-32.4	-12.3	-23.0
Agriculture	22	21	21	21	21	20	20	20	-19.4	-5.2	-15.0

Source: Own calculations.

The required greenhouse gas emission reductions in South Korea, however, would not be among single sectors of the economy. In the scenario of a 9.1% p.a. growth of investment share of the GDP, Table

11 shows that the increase of investments into low carbon green growth would especially trigger greenhouse gas emission reductions in power generation and transport (-43.1% resp. -48.6% in 2020), but only a reduction of 10% in manufacturing industries and construction, and 13.9% in buildings and the public sector. By 2020, in absolute terms, this means that manufacturing industries and construction would be short about 70 Mt CO<sub>2</sub>-equivalents, with power generation, oil and gas having emission reductions in about the same amount. Greenhouse gas emission reductions from waste and the agricultural sector would decrease by 27.9% resp. 18.7%, but on a very low absolute value level. This means that power generation, oil and gas sector, especially, as well as the transport sector is likely to over-fulfill their pledges while manufacturing industries and construction as well as buildings and the public sector will not reach their greenhouse gas emission reduction targets in 2020.

The different speeds of greenhouse gas emission reductions across the sectors of the economy reflect the different marginal abatement costs in these branches. For example, the marginal abatement costs in power generation sector or the oil and gas sector seem to be lower than in other industry sectors. Hence, the same amount of investment leads to smaller greenhouse gas emission reductions in other industries compared to the power generation sector. Against this background, in the installed domestic cap-and-trade emission trading scheme, especially power generation, oil and gas, are in a seller position of greenhouse gas emission allowances, other South Korean industry sector are very likely to be in a buyer position. However, as the emission trading scheme has only been in place for a few months, the success of this system is still undetermined and is indeed subject to further research. Importantly, the considerable spread of marginal greenhouse gas abatement costs between the sectors, however, is a positive framework condition for creating a significant greenhouse gas emission allowance for trading turnover in South Korea.

### IV. Summary

The Republic of Korea is a developed OECD member state with a per-capita income comparable to Japan. Over the past decades, after the Korean War, the South Korean economy has grown quickly. Inter alia, by largely investing into research and development and promoting the information and telecommunication sector since the 1990s, it has succeeded in diversifying its economic structure, allowing it to overcome the international financial crisis in 2008 and the following years much better than many of its neighboring countries, especially Japan.

On average, South Korea is still an energy intensive economy that is dominated by large industry conglomerates. With 12.9 t CO<sub>2</sub> per capita, the country is one of the most carbon intensive economies in the OECD, being more carbon intensive than either Germany (2013: 10.9 t CO<sub>2</sub>) or Japan (11.2 t CO<sub>2</sub>). Between 1990 and 2012, greenhouse gas emissions in South Korea grew by 7.3% p.a., with 90% of these emissions being CO<sub>2</sub>. However, although it is a member state of the OECD, South Korea does not have a quantitative greenhouse gas emission reduction obligation towards the Kyoto Protocol under the United Nations Framework Convention on Climate Change. When the UNFCCC was signed, the Republic of Korea was still regarded as a developing country. Nevertheless, in 2009, the South Korean government committed itself to reduce domestic greenhouse gas emissions by 30% in 2020, compared to its current business as usual path.

In 2011, the National Greenhouse Gas Emissions Reduction Roadmap 2020 was issued, including quantitative emissions reduction targets for transportation (-34.3%), buildings (-26.9%), the public sector (-25.0%), power generation, oil and gas (-26.7%), industry (-18.5%), waste (-12.3%), and agriculture and fisheries (-5.2%). In order to support the sectoral greenhouse gas emission reduction efforts, in January 2015, a

domestic cap-and-trade emission trading scheme was installed, being the first of its kind in East Asia. However, even though South Korea has invested into low carbon green growth, to date its greenhouse gas emissions are still growing. Obviously, the capital that has been invested was insufficient. Hence, the question that now arises pertains to how much investment would be necessary to fulfil the National Greenhouse Gas Emissions Reduction Roadmap 2020 in the remaining years.

In this report, by applying an econometric greenhouse gas emission model, the National Greenhouse Gas Emissions Reduction Roadmap 2020 was estimated and the related emission reductions forecasted. The main driver of the greenhouse gas emission reduction is the GDP share of macro-economic investments and the underlying investments in South Korea. Results from this model indicate that the GDP-share of investments would have to be increased by 9.1% p.a. until 2020 in order to fulfill the greenhouse gas emission reduction pledges of the South Korean government. Overall, annual investments would have to almost double from USD 465 bn. PPP in 2013 to about USD 850 bn. PPP in 2020 in order to achieve these goals.

The induced greenhouse gas emission reduction paths, however, are different across the South Korean economy due to different sectoral marginal greenhouse gas abatement costs. By 2020, the largest impact of the increased investment will be seen in power generation, oil and gas as well as in the transport sector (-43.1% resp. -48.6%), over-fulfilling their national targets (-26.7%, resp. -34.3%). In other sectors, most prominently in the manufacturing industry (-10.0%), greenhouse gas emission reductions are rather small compared to their emission reduction target (-46.0%). Here, however, the installed domestic emission trading scheme would be able to support the emission reduction efforts, as the manufacturing industry could buy emission allowances and thus be able to fulfill its emission reduction targets at a lower cost than its

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marginal abatement costs. In particular, the low carbon investments in the power generation and transport sectors could be rewarded with back-flowing capital from the sales of their excess allowances.

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# Korea's Nuclear Policy - Past, Present, Future

*Sun-Jin Yun*

## **I. Introduction**

This year marks the 70th anniversary of Korea's independence from Japanese colonial rule. Ever since its liberation, Korea has experienced many changes on political, economic, social and cultural fronts. Korea's energy production and consumption have also transitioned greatly with economic growth and people's evolving lifestyles in the process of industrialization. Rather, inversely, it was transition in energy production and consumption which led to the economic growth and transformation of life styles. Electricity, as a secondary energy, especially became increasingly relevant as high-level energy, driving economic development while adding convenience and comfort to our daily lives. In the wake of Korea's liberation in September 1946, the nuclear power installed capacity of South Korea was only 199 MW (Kang Myungng-jang, 1990). However as of 2013, it increased more than 437times to 86,969 MW. In 1945, the electricity generation output was 711,327 MWh, which increased 727 times to 517,148 GWh in 2013. Such change in South Korea is extremely remarkable when compared to its North counterpart. The power installed capacity of North Korea in 1945 was 1,524 MW, which increased 4.8 fold to only 7,243 MW (Statistics Korea, 2015), and this is in stark contrast of South Korea whose power installed capacity is 12 times greater than North Korea as of 2013.

Many changes also occurred in terms of the final consumption

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energy sources in Korea in the course of industrialization. In Korea, oil accounts for the largest share (almost half) of final energy with 48.4%. Even until the beginning of the 1960s, wood and coal represented 50% of energy sources in Korea (Ryu Ji-cheol, 2013). As for households, fuel used for heating is extremely important, however, in the past firewood was generally used as fuel. In 1950s coal briquettes were deployed to become the most widely used domestic fuel for heating and cooking until the 1980s. In the 1990s, kerosene became prevalent by installing oil boilers. In 1998, affordable kerosene for boilers emerged for everyday use, however, as it began to be used as the primary ingredient for fake petrol, boiler kerosene has been completely banned from sale since July 2011 (SK Energy, 2015). Today, the most commonly used fuel for heating and cooking in Korea is urban gas but electricity is increasingly gaining relevance as well. Such transition in final energy sources could be profoundly felt by average citizens in their daily lives. However, it was not the domestic sector but the industrial sector that has driven the consumption of energy in our society. As of 2013, the industrial sector consumed 62.3% of the overall final energy and 54.1% of power.

The fuels used for power generation have also evolved. A large scale of bituminous coal and nuclear energy has become the major source of fuel for power generation going from hydro-electricity to coal and to petrol. Recently new and renewable energy has emerged as a sustainable alternative; however, it still remains at a standstill. The most controversial energy in Korea nowadays is nuclear energy, representing 23.5% of the generation installed capacity and 31.1% of all power generation output. Nuclear power which did not exist in Korea at the time of independence, has now become the major power source together with bituminous coal, and unlike the bituminous coal which is declining, nuclear energy is being expanded regarded as the “economic and ecological energy” to adapt to climate change.

Korea is the major world nuclear energy country. After constructing the first nuclear reactor Kori 1 in 1972 which began commercial operation in 1978, as of today 2015, Korea has become the 6th largest powerhouse in terms of nuclear capacity and the number of reactors. A total of 24 reactors with 21.6GWe capacity are currently operating, 4 reactors (1.4GWe each) are under construction and additional 8 reactors are scheduled for construction. Moreover, Korea has gone beyond its borders to export nuclear generation abroad. In 2009, Korea signed a \$20 billion contract with the UAE and is currently building 4 reactors. Korea has continued to achieve economic development by supplying abundant, stable and affordable power by consistently expanding nuclear reactors. Then, to where is Korea's nuclear development policy headed? and is it sustainable?

Korea liberated itself from the Japanese imperialism with the atomic bombings of America and achieved modernization, however its nuclear energy which had been adopted and expanded in the course of modernizing the country has led to numerous problems, reinforcing risks inherent in society. Korea is currently standing at the crossroads of having to decide whether to continue relying on nuclear energy or opt for denuclearization. Based on this historical background, this paper aims to examine the past, present and future of Korea's nuclear policies. It also aims to study how nuclear power plants have expanded in Korea according to the evolution of nuclear policies and the social response thereof. Korea's nuclear policies are not merely an issue regarding Korea. Chances are high that Korea, as the world's major nuclear energy country, will have a great impact on other countries such as developing ones seeking to achieve substantial economic growth. Moreover, as seen from the 1986 Chernobyl incident of the Soviet and the 2011 Fukushima nuclear accident in Japan, since the consequences of a nuclear accident go beyond the boundaries of the affected country, nuclear safety of Korea

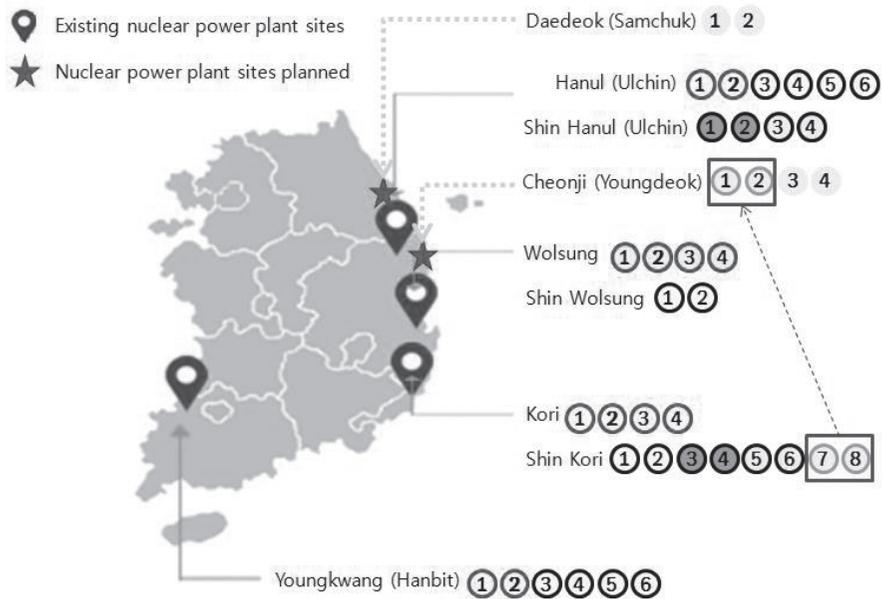
## **Korea's Nuclear Policy**

is not just confined to Korea but goes beyond its borders, therefore it is quite relevant to examine the present and future of Korea's nuclear energy policy focusing on continuous expansion.

### **II. Situation of Nuclear Power Generation in Korea**

Nuclear energy is the major source for power generation in Korea. Ever since the commercial operation of Korea's first 587MW nuclear reactor in 1978, nuclear generation facilities and total output in Korea have achieved a constant growth. Nuclear energy with a total output of 3.5GWh in 1978, representing 8.5% of all installed capacity and 9.4% all power output increased to 20,716MW and 156,407GWh respectively in 2014, each representing 22.2% of the total installed capacity and 30.0% of the total power output. There are currently a total of 24 nuclear reactors in operation as of September 2015, with 4 under construction and planned for construction. Among the operating reactors, 20 are pressurized light water reactors with Wolsong 1& 4 being the only pressurized heavy water reactors. Nuclear power plants and reactors in Korea are located as seen in Image 1.

Image 1: Existing and Planned Nuclear Power Plant Sites in Korea



Note: Site indicated in parenthesis is where each reactor is located.

Nuclear reactors indicated in light yellow circle are currently operating, and dark yellow represents pressurized heavy water reactors. And the circles with red borders indicate reactors whose design life will expire in 15 years in 2015.

Reactors in dark grey are those under construction and in light grey are planned for construction.

Shin Kori 7 & 8 are planned for construction as Cheonji 1, 2 in Youngdeok, yet it is difficult to ascertain that the site has been confirmed as Youngdeok.

Reactors in light grey without borders are whose site has not been yet confirmed. Additional 2 reactors planned for construction will be either built in Youngdeok or Samcheok

Korea consists of 17 metropolitan local autonomous groups, and nuclear plants are located in the Busan Metropolitan City Kijang-gun, Ulsan Metropolitan City Ulju-gun, Gyeongsangbuk-do Gyeongju-si, Gyeongsangbuk-do Ulchin-gun, and Cholla-namdo Youngkwang-gun. The Wolsong Nuclear Power Plant and Shin Wolsong Nuclear Power Plant border Yangnam-myeon and Yangbuk-myeon respectively, therefore together are referred to as the “Wolsong Nuclear Power Plants.”

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Hanul Nuclear Power Plant and Shin Hanul Nuclear Power Plants are both located in Gyeongbuk Ulchin-gun, both referred to as “Hanul Nuclear Power Plants.” Kori Nuclear Power Plant located in Busan-si Kijang-gun and Shin Kori Nuclear Power Plant located in Ulsan City Ulju-gun do not belong to the same administrative district, however, since they share administrative borders are referred to as “Kori Nuclear Power Plants.” The “Hanbit Nuclear Power Plant” is located in Chonnam Youngkwang-gun. Hanul Nuclear Power Plant and Hanbit Nuclear Power Plant were referred to as “Ulchin Nuclear Power Plant” and “Youngkwang Nuclear Power Plant” based on their geographical location, however, with the general perception that nuclear power plants revealing the same name as the administrative district they belong to would have a negative impact on the local economy and image, local residents demanded that the name of the nuclear plants be changed, thus was adopted the current name in May 2013. Four reactors were planned for construction in Shin Kori and 2 in Shin Ulchin, however, 2 units (no. 7 & 8) out of 4 planned for the Shin Kori site were decided to be built in Youngdeok as Cheonji 1 & 2. By 2022, when construction of the currently planned nuclear reactors will be completed, there will be 10 units operating in Kori (4 in Kori + 6 in Shin Kori), 6 in Wolsong (4 in Wolsong +2 in Shin Wolsong), and 10 in Hanul (6 in Hanul) + 4 in Shin Hanul, 6 in Hanbit, and 2 in Cheonji, Youngdeok. Moreover, 2 additional units will be constructed either in Youngdeok or Samcheok, however, the site is yet to be confirmed due to resistance from local residents.

With 24 nuclear reactors under operation, Korea holds a significant position in terms of nuclear development. Table 1 ranks Korea as the world's 6th in terms of nuclear installed capacity and the number of reactors and 4th in terms of the installed capacity and nuclear power generation of the reactors under construction. Above all, Korea ranks no.1 in terms of nuclear generation density which is derived by dividing

the total nuclear installed capacity with the land surface area. This indicates that many nuclear power plants are concentrated in such a small territorial space. Since Belgium, Taiwan, Japan, France and Switzerland ranking from 2nd to 5th place in nuclear density have either abandoned their pro-nuclear policies or will not expand their nuclear policy, Korea is expected to continue to top the list. High nuclear density means that the nuclear reactors are concentrated in a small area of land, thus in case of a nuclear accident, the entire territory is subject to contamination. Korea also ranks high in the number and capacity of reactors under construction, which probably will increase the nuclear density. As of August 2015, a total of 72 nuclear reactors with 76.3 GWe capacity are under construction globally, and Korea ranks 5th (4 under construction) following China (24), Russia (8), India (6), and US (5) whereas in terms of installed capacity it ranks 4th (5.6GWe) following China (27.4GWe), Russia (8.0GWe), and the US (6.3GWe). Going forward, Korea is expected to continue to rank high globally in nuclear energy generation.

Table 1: The World Major Nuclear Power Countries

	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	6 <sup>th</sup>	World
Installation capacity (GWe (#))*	US	France	Japan	Russia	China	<b>S. Korea</b>	380.8 (437)
	98.8 (99)	63.1 (58)	40.5 (43)	25.3 (34)	23.1 (26)	<b>21.7 (24)</b>	
Reactors under construction (GWe (#))*	China	Russia	US	<b>S. Korea</b>	India	UAE	76.3 (72)
	27.4 (25)	8.0 (9)	6.0 (5)	<b>5.6 (4)</b>	4.3 (6)	4.2 (3)	
Nuclear generation (TWh)**	US	France	Russia	<b>S. Korea</b>	China	Canada	2,461
	798.6	418	169.1	<b>149.2</b>	123.8	98.6	
Nuclear density (kW/km <sup>2</sup> )**	<b>S. Korea</b>	Belgium	Taiwan	Japan	France	Swiss	-
	<b>216.5</b>	194.3	139.8	117.0	115.3	78.8	

Note: \* As of August, 2015; \*\* 2014 statistics

Source: World Nuclear Association Homepage.

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Not only are nuclear power plants in Korea quite densely located compared to the national land surface, they are concentrated in specific areas of the country, primarily in a limited number of regions. As of April 2015, a total of 443 nuclear reactors are located in 187 nuclear power plant sites around the world. Among them, there are only 11 sites which have more than 6 reactors, accounting for only 6% of all cases. As for Korea, all 4 nuclear power plant sites fall under this category. Overall, the nationwide density is not only high but also site-specific density is very high in the world. Ulchin ranks number 2 in the number of reactors it accommodates and installed capacity per site with six 6216MW Hanul reactors, and Youngkwang the third place with six 6193MW reactors in the Hanbit Nuclear Power Plant, and Kori (six, 5107MW) ranking 6th and Wolsong (six, 4809MW) the world's 7th. Moreover, since Shin Kori 3 & 4, Hanul 1&2 are under construction, and Shin Kori 5&6, Shin Hanul 3 & 4 are planned for construction, Korea's density per site ranking will soon go up again. (See Table 2). The high population density surrounding the sites is another issue. There are 3.4 million residents living in the vicinity of the Kori Nuclear Power Plant, which makes it one of the most densely populated regions in the world. A total of 10 nuclear reactors are planned for construction, which will eventually operate in these densely populated regions. Then nuclear centralization of multiple nuclear reactors being concentrated in one site will incur risks for the surrounding environment, and in case of accidents due to human error or terror, it will be difficult for these reactors to ensure power supply, triggering serious problem by disrupting stable supply of electricity throughout the country.

Table 2: Global Nuclear Reactors by Nuclear Power Plant Site

(As of April 2015)

	1 unit	2 units	3 units	4 units	5 units	6 units or more	Total (443 units)
No. of sites	53	77	18	28	0	11	187 sites
Share (%)	28	14	10	15	0	6	100%

Source: See IAEA and WNA websites; compilation of Green Peace website data

The total installed capacity of nuclear power plants operating in Korea is 20.7GW as shown in <Table 3>. The total power output from nuclear energy increased 11,200 times from 2,324GWh in 1978 to 138,784GWh in 2013. As for the lifespan of Korean nuclear reactors, the first reactor Kori 1 and 4 pressurized heavy water type units in Wolsong Nuclear Power Plant are 30 years, and the rest are all 40 years. Kori 1 and Wolsong 1 have extended their licenses after going through a safety inspection and are currently in operation. Kori 1 which reached mass criticality in 1977 and went into commercial operation from 1978 reached the end of its 30 year license in June 2007, however after undergoing a safety inspection, it was authorized for extension by 10 more years until June 2017, and is currently operating.

In Korea, to extend the license of nuclear reactors whose design life has expired, it is required to file an application 2 years before the license ends. As for Kori 1, with the deadline for license extension drawing near in June 2017, the application for extension should have been submitted by June 2015. However, despite growing social concerns over the safety of outdated nuclear power plants following Japan's Fukushima nuclear accident and controversies and social protests thereof, the Nuclear Safety and Security Commission (NSSC) decided to extend the license of Wolsong 1 for another 10 years in February 2012. However, due to the aggravated public opinion, the operator KHNP gave up on applying to extend license, accepting the recommendation of the Energy Committee

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under the Ministry of Trade, Industry and Energy. As a result, in June 2017, Korea's first nuclear reactor will be shut down due to the expiration of design life. The 30 year life of Wolsong Nuclear Reactor Unit 1 expired in November 2012, and an application was made to extend its license in November 2010. However, with the stress test following the Fukushima accident, the deliberation for extension was delayed. Despite the social controversies that will be addressed later on in this paper, the NSSC approved extending the license of Wolsong 1 in February 27, 2015, which went into extended operation since June 23, 2015. In Korea, nuclear power plant construction in the 1980s took place at a rapid pace, thus added to the Kori 1 and Wolsong 1, there are 10 other units, thus 12 in total which will have their license expire before 2030. These reactors are indicated in red borders in Image 1. The details of reactors by site are as seen in Table 3.

Table 3: Current Status of Nuclear Power Plants and Characteristic of Reactors by Site in Korea

Category	Installed capacity (MW)	Reactor Type	Design Life	Site	Date of Commercial Operation	Expiry of Design Life	Accumulated Generation since Commercial Operation(MWh)		
Kori	#1	587	30+10	Busan-si, Kijang-gun, Jangan-eup	'78. 04. 29	'07. 06. 18 ( '17. 06. 18)	139,100,959		
	#2	650			40	'83. 07. 25	'23. 04. 08	152,662,105	
	#3	950	'85. 09. 30			'24. 09. 28	211,557,529		
	#4	950	'86. 04. 29		'25. 08. 06	210,994,714			
Shin Kori	#1	1,000	40	Ulsan-si, Ulju-gun, Seosaeng-myeon	'11. 02. 28	'50. 05. 18	17,547,481		
	#2	1,000			PWR (OPR 1000)	'12. 07. 20	'52. 07. 00	7,810,602	
	#3	1,400				PWR (APR 1400)	Under construction(began installing reactors: '10.7.15/'11.7.18)		
	#4	1,400			Planned for construction (completion expected in '19.12/'20.12)				
	#5	1,400							
	#6	1,400							
	#7	1,500			APR 1500	Will be changed to Youngdeok 1 & 2 for construction (completion expected in '23.12/'24.12)			
	#8	1,500							

Wolsong	#1	679	PHWR	30+10	Gyeongbuk Gyeongju- si Yangnam- myeon	'83. 04. 22	'12. 11. 20 ( '22. 11. 20)	139,044,905
	#2	700				30	'97. 07. 01	'26. 11. 01
	#3	700		'98. 07. 01			'27. 12. 29	91,999,136
	#4	700		'99. 10. 01		'29. 02. 07	85,378,185	
Shin Wolsong	#1	1,000	PWR (OPR 1000)	40	Gyeongju- si Yangbuk- myeon	'12. 07. 31	'52. 01. 26	7,175,956
	#2	1,000				'15. 07. 24	'55. 02. 08	-
Hanbit	#1	950	PWR	40	Chonnam Youngkwang- gun Hongnong- eup	'86. 08. 25	'25. 12. 22	206,208,737
	#2	950				'87. 06. 10	'26. 09. 11	195,768,235
	#3	1,000				'95. 03. 31	'34. 09. 08	149,470,395
	#4	1,000				'96. 01. 01	'35. 06. 01	147,372,010
	#5	1,000				'02. 05. 21	'41. 10. 23	93,569,055
	#6	1,000				'02. 12. 24	'42. 07. 30	91,150,817
Hanul	#1	950	PWR	40	Gyeongbuk Ulchin-gun, Buk-myeon	'88. 09. 10	'27. 12. 22	186,904,472
	#2	950				'89. 09. 30	'28. 12. 28	182,779,731
	#3	1,000				'98. 08. 11	'37. 11. 07	128,103,642
	#4	1,000				'99. 12. 31	'38. 10. 28	101,810,665
	#5	1,000				'04. 07. 29	'43. 10. 19	80,141,450
	#6	1,000				'05. 04. 22	'44. 11. 11	74,483,497
Shin Hanul	#1	1,400	PWR (APR 1400)	40		Under construction(groundbreaking: '10.4.30; began installing reactor in: '14.7.20)		
	#2	1,400				Planned for construction (completion expected in '20.6/21.6 )		
	#3	1,400						
	#4	1,400						
Total	20,716							2,796,645,746

Note: Reactors whose license will expire by 2030 are indicated in gothic, those under construction or planned for construction in shade.

### III. History and Policy of Nuclear Development in Korea

Then, how did Korea come to expand its nuclear development? This chapter aims to examine the policies and social context of nuclear development in Korea.

#### 1) Beginning and Expansion of Nuclear Development

## Korea's Nuclear Policy

Nuclear development in Korea first began at the request of the US government. In 1953, then US President Eisenhower advocated for “Atoms for Peace” and proposed to stop the competition for developing nuclear weapons and to use nuclear weapons technology for peaceful ends to generate nuclear energy. Then in 1954, the US government requested the Korean government to send Korean scientists to the Atomic Research Institute in the US. (Yun Sun-Jin·Oh Eun-jeong, 2006). As such, nuclear energy was generated in Korea with the support of the US government, and in 1955 both countries signed the bilateral atomic energy agreement. In 1958, the Atomic Energy Act was enacted in Korea and in 1959 the Atomic Energy Institute, an independent agency under the Presidential Office was established (Yun Sun-Jin·Oh Eun-jeong, 2006). In the beginning in Korea, nuclear energy was evaluated as not viable, because it was deemed too costly to be used for commercial purposes (Yun Sun-Jin·Oh Eun-jeong, 2006). However, in the 1960s, with the establishment of the five-year economic development plan and with Korea's economic development, power demand increased by 15% every year. As a result, from the mid-1960s, discussions on building nuclear power plants began to emerge and the policy direction was set to adopt nuclear energy. (Nuclear Energy Agency, 1969; Jin Sang-hyeon, 2009).<sup>1</sup> In the

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<sup>1</sup> The Korean government pursued nuclear energy development not just for economic reasons. There were also political and military reasons involved as the country wanted to possess nuclear weapons manufacturing technology by acquiring and accumulating nuclear development technologies (Yun Sun-Jin·Oh Eun-jung 2006; Yun Sun-Jin 2015). Moreover, many developing countries tend to consider nuclear technologies as cutting edge technologies and that having nuclear capacity is the barometer for national power. Moreover, since Korea as a divided nation is faced with ideological and military confrontations, holding cutting edge technology like nuclear energy was a means to flaunt its national power. There were also US interests involved. At the same time the US felt the tension from the Soviet which was its competitor developing nuclear weapons (1949), therefore it wanted to manage and control the nuclear industry by providing nuclear development technologies and have its liberal

1960s, Korea came to consider nuclear energy as an important source of energy for the economic development through its long-term nuclear development plan and established plans to build nuclear power plants.

As a result, in 1972, Kori 1 began its construction, which became commercially operational in April 1978, making Korea the 21st nuclear power country in the world. Following the two oil crises in the 1970s, nuclear energy began to be considered as an alternative option to oil and coal, which led to the rapid expansion of nuclear power plants. There was only one reactor operating up until 1980, however the number increased to 9 units in 1989. In 1983, 8 units were under construction at the same time. With the expansion of nuclear energy, the Korean government also planned to introduce a nuclear fuel cycle program. According to the Korea-US Atomic Agreement, Korea needs approval or consent from the US to reprocess the spent nuclear fuel. However, with the signing of the Nuclear Non-Proliferation Treaty (NNPT) in 1970 and strengthening of the NNPT following India's atomic bomb in 1974, it had become challenging to seek America's consent. With the reinforced NNPT, efforts to complete the nuclear fuel cycle by reprocessing spent fuel were foiled.

In the 1980s and 1990s, the nuclear development saw a slowdown due to the Three Mile Island accident in 1979 and the Soviet's Chernobyl accident in 1986. Most developed countries failed to go ahead with their new nuclear plant construction plans. However, at this time Korea continued to expand its nuclear power generation. In fact, Korea used the global nuclear slowdown as the means to take another leap forward in the nuclear sector. As the global nuclear energy market declined, nuclear technology firms that dominated the market came to face management

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democratic allies under its nuclear umbrella (Lee Pil-ryul 1999). Moreover, the sales strategy of large multinational companies trying to gain profit by selling largely invested nuclear generation facilities came into play (Yun Sun-Jin, Oh Eun-jung 2006; Lee See-jae 2005).

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issues, which served as the chance to further develop Korean-type reactors built on our proprietary technology. By signing a contract with America's Combustion Engineering (CE, present Westinghouse), Korea was transferred the right to improve and produce technologies independently. As for the nuclear power plants commissioned for construction before the Chernobyl accident, all the rights and obligations from design, planning, and construction to pilot operation were delegated to foreign companies as a turnkey project. However, as for the construction of Youngkwang 3 & 4 commissioned in 1987, a Korean company was selected as the main contractor with the goal of achieving 95% technological autonomy pursuant to the "Plan for Achieving Nuclear Technological Autonomy", and relevant technologies were introduced from abroad. The Korea Heavy Industries and America's ABB-CE jointly constructed the Hanbit Nuclear Reactor 3 & 4, which eventually became the Hanul 3& 4, the first Korean standard reactor (Optimized Power Reactor 1000, OPR-1000), which began commercial operations in August 1998 and December 1999 respectively. And based on the transferred technology, Hanbit 5 & 6 and Ulchin 5 & 6 based on the OPR-1000 model were constructed in the beginning of and mid-year 2000. Moreover, Shin Kori 3 & 4 and Shin Hanul 1& 2 which are currently under construction through technological innovation are the Advanced Power Reactor 1400 (APR-1400) type.

With growing global interest in climate change in 2000, pro-nuclear camps including the IAEA and the WNA advocated the nuclear renaissance, presenting nuclear energy development as a means to cope with climate change (Yun, 2012). In Korea, the former president Lee Myung-bak advocated low-carbon green growth as the new development paradigm in August 2008, defining nuclear energy as low-carbon green energy and actively seeking its expansion. Deeming that the nuclear energy as a green energy or environment-friendly energy producing low

carbon, the Lee administration announced that it would increase the nuclear energy's share in the energy mix to 59% by 2030 through the first National Energy Basic Plan published in 2008. Moreover, it was active in exporting nuclear energy technologies to the overseas market. In December 27, 2009, the Korea Electric Power Corp. (KEPCO) signed the main contract to build four APR1400 reactors with the Emirates Nuclear Energy Corporation (ENEC). The UAE 1 & 2 are currently under construction scheduled for completion in May 2017. As such, the ambitions to expand Korea's nuclear energy are not limited to Korea but reaching out to the world.

## **2) Developments and Characteristics of Energy Policy and Nuclear Development Policy in Korea**

Energy and power consumption of a country are greatly impacted by the government policies. Not only are energy and power closely linked with economic growth, but also diverse needed facilities are generally massive in scale and require high investment costs. From generation, transmission, distribution to the downstream process, power generation and consumption are closely linked with diverse environmental and health issues, therefore it is highly likely that diverse social conflicts will occur surrounding the sites of the relevant facilities. Therefore, at times, government intervention is inevitable to address these issues or policies are established and implemented to move things towards the government-desired direction. This chapter aims to have an overall look at the past journey of nuclear energy policies in Korea and examine the meaning and the details of the National Energy Basic Plan and the Basic Plan on Electricity Demand and Supply which are closely connected to the nuclear development policy covered in this paper.

The first and foremost priority of Korea's energy policy has been the

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stable supply of energy to achieve country's economic growth. "The role of energy and the energy sector was to support economic growth by ensuring its sustainability." (Korea Energy Economics Institute, 2000). However, the direction of such energy policy is understandable to some extent when overcoming poverty was the biggest social goal after the liberation. However, even today – even though it has been already 20 years since Korea joined the OECD nations coming out of poverty – such policy direction has still been maintained. This can be also seen in the 7th Basic Plan on Electricity Demand and Supply announced in July 2015, which provides that "stable supply and demand of power is the first and foremost priority". In Korea, the Ministry of Commerce, Industry and Energy establishes and implements the energy-related policies and governs relevant administrative matters. However, the fact energy affairs are governed by the ministry in charge of industry-related affairs implies that energy is considered as an element for economic growth and as a subordinate means to economic or industrial policies.

The trends and characteristics of Korea's energy policy can be categorized in the following periods. From the establishment of the first 5 year economic development plan in 1962 until the oil crisis in 1973, with the rapid development of mining and the light industry sector, economy expanded significantly in size, achieving an annual growth rate of 8.9%. From 1962 to 1973, energy consumption increased 8.4% annually, and as a result energy consumption in 1973 was 2.4 times higher than 1962 (Korea Energy Economics Institute, 2000). With accelerated industrialization, oil became the mainstream energy, leading oil dependency to grow from 9.8% in 1962 to 53.8% in 1973, whereas the share of firewood and anthracite was halved, dropping from 88.5% to 44.9%. Moreover, believing that the sufficient supply of power is a must to run factories and that energy demand will continue to grow in the future, the government established and implemented the

Generation Expansion Plan. In 1961, the government grouped together the three existing power generators, Namsun, and Chosun, to form a single entity KEPCO and expanded investments in power generation development. In the beginning, the investments were primarily focused on coal-fired power plants with relatively shorter construction period at lesser construction costs. However, with the increasing power demand, ever since 1974, the number of oil-fired power plants expanded, and thus the decision to build nuclear power plants, which explains the excessive supply of power in the 1970s. In 1971, the electricity power reserve reached 34.6%, which further grew to 55.6% in 1972, triggering campaigns on promoting the power sales (Korea Energy and Economics Institute, 2000).

After the main energy source is changed to oil, Korea undergoes the first oil crisis and comes to grasp the importance of energy saving. However, this did not translate into systematic and structural changes. With increasing need to take long-term and proactive measures regarding energy issues at the national level, the Ministry of Energy and Resources was newly established in 1978. However, Korea suffered relatively less compared to other countries during the first oil crisis due to the special procurement boom in the Middle East, therefore it promoted growth-oriented policy by rather expanding investments in the energy-intensive heavy chemical sector. And in this situation, the unit price of imported crude oil due to the second oil crisis more than doubled, leading to twice more oil import payments, which in turn resulted in accumulated external debt and high inflation between 1979 and 1981. As a result, in 1980, Korea recorded a negative economic growth for the first time in its history.

Leveraging such experience, from the 1980s, a plan to diversify channels for oil imports going beyond the Middle East and stockpiling oil were added to Korea's energy policy. Moreover, as part of the

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policy to reduce oil use, projects to construct bituminous coal-fired power plants, introduce natural gas, and build nuclear power plants were carried out. In 1986, the Pyeongtaek LNG Tank was completed to deploy LNG in earnest. As for the coal, which is the only fossil fuel produced in Korea, small mines were shut down because they had lost competitiveness due to the declining demand since consumers with higher income preferred high-end energy, and the coal mines became larger in size and mechanized. However, in the 1980s, non-OPEC countries that experienced oil crisis began to develop and sell crude oil, which led to fierce price competition, making oil prices to plummet or to be maintained at very low level. Due to falling global oil prices, Korea's energy consumption picked up constantly, making the economy to grow all the more rapidly. The two oil crises taught Korea the importance of energy demand management and development of new and renewable energies. As a result, the Energy Use Rationalization Act was enacted and the Korea Energy Agency was launched. Moreover, for the development and use of new and renewable energy, the Alternative Energy Development Promotion Act was enacted in 1987. However, such policy failed to gain momentum due to constant low oil prices.

In the 1990s, energy prices including oil were stabilized, and with economic development and increasing income accordingly, energy consumption also recorded high growth. Moreover, during this period, power consumption growth rate exceeded that of the GDP, such trend continued to persist. During the 1997 Asian financial crisis, the GDP decreased by 3.5%, energy consumption by 0.2%, and power consumption by 8.1%. This period was quite an exception in Korean history, since in the 1990s, energy consumption grew almost two fold and power consumption 2.3 times more. However, it was also in the 1990s that the international community began to take interest in climate change, giving rise to relevant negotiations. In 1992, the UN Framework

Convention on Climate Change was adopted, and the Kyoto Protocol with the detailed action plan was adopted in 1997. Korea having joined the OECD in 1996, was classified as the Non-Annex I country of developing countries, and not the Annex I countries with the mandatory obligations to reduce greenhouse gas emissions. As a result, energy policies mitigating climate change failed to become the mainstream in Korea. In the 1990s, the hottest issue in Korea's energy policy was the introduction of a competitive scheme in the energy sector. With the wind of neo-liberalism blowing around the world at the time, the political agenda in the energy sector also included deregulation, efficiency improvement and privatization of public companies and introduction of competitive scheme. Consequently, deregulation measures regarding the export and import, distribution, and pricing of oil businesses were implemented, and KECPO divided its generation division into 6 affiliates. It was then that the mandate on nuclear power generation was transferred to the Korea Hydro & Nuclear Power Corporation (KHNP).

In 2000s, with climate change causing many disasters gaining more and more global attention, there also were growing interests in the low carbon energy sources. Many developed countries including Germany implemented measures to save energy to adapt to climate change, improve energy efficiency, foster demand management, and expand renewable energies, and Korea while deeming nuclear energy as low-carbon producing ecological energy source redoubled its efforts to seek further development. In particular, as aforementioned, the Lee Myung-bak government, while presenting low-carbon green growth as the new national paradigm, expanded nuclear power plant constructions and exported nuclear technologies abroad to seek economic growth. As a result, policy to expand nuclear energy gained more momentum, and despite the 2011 Fukushima accident, not many changes have occurred in Korea's overall nuclear policy.

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The nuclear energy sector in Korea has grown over the years as seen in Image 2. In the 1980s, with Korea constructing 8 nuclear reactors simultaneously at one point, the number of operating reactors increased from 1 unit in 1980 to 9 units in 1989. As a result, due to the over-supply of power, the electricity tariff was cut by 9 times. Moreover, with stable supply of affordable electricity, it was possible to develop the energy-intensive heavy chemical sector. Since the mid-1990s, 4 nuclear reactors were built every year on average with increasing installed capacity and total power output. However, in the late 1980s, nuclear generation share was quite high, representing 36.3% of generation installed capacity (1989) and 53.1% of total power output (1987), whereas nowadays there is a slight declining trend of nuclear power generation.

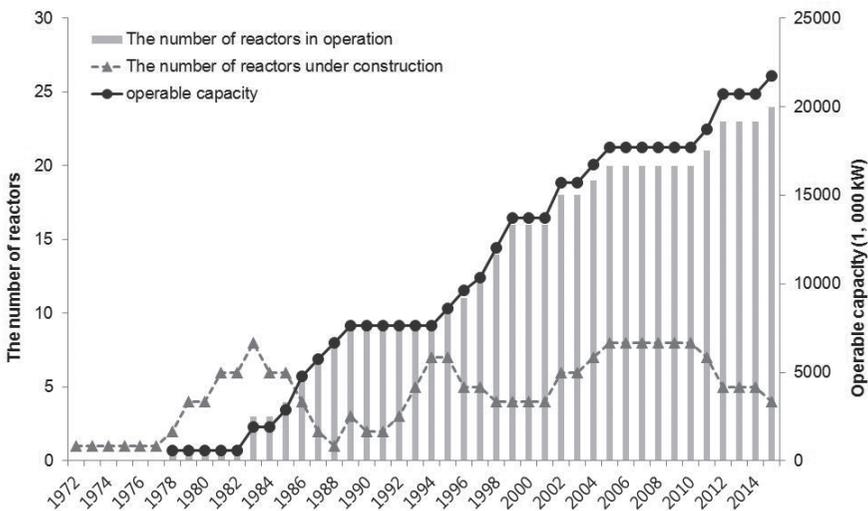


Image 2: Annual Installed capacity and the Number of Nuclear Reactors under Operation and Construction

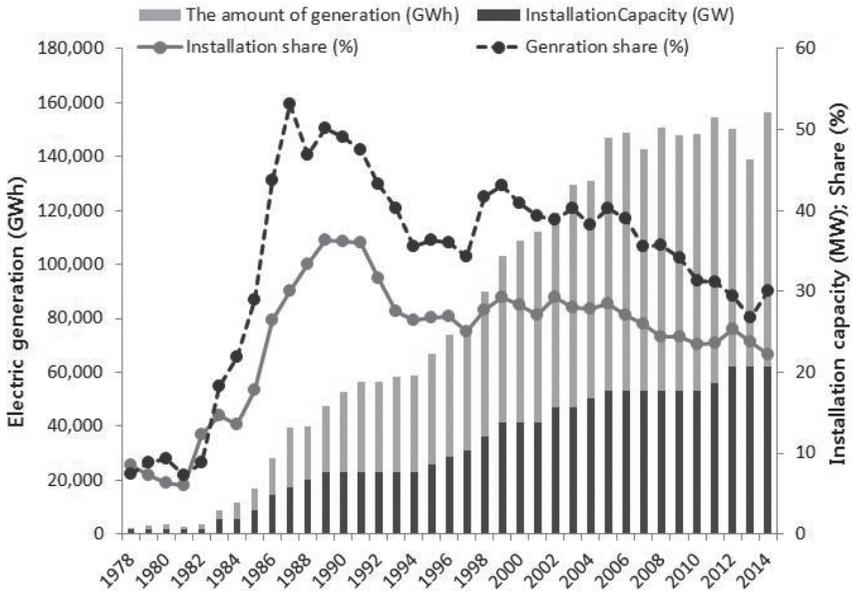


Image 3: Share of Annual Nuclear Installed capacity and Generation

### 3) Introduction to Energy Policy and Nuclear Policy in Korea: the National Basic Energy Plan and the Basic Plan on Electricity Demand and Supply

The basic direction of energy policy, power policy, furthermore the nuclear policy in Korea is well defined in the National Basic Energy Plan (NBEP) and the Basic Plan on Electricity Demand and Supply (BPEDS). The NBEP is the most superior national plan on energy policy which covers all areas related to energy and defines the basic direction of mid to long term energy policy while providing principles and direction on other energy plans. Furthermore, it aims to adjust the direction of individual energy plans based on macro-perspectives by seeking systematic integration of other energy plans. As of today, as part of the 20 year plan based on the Framework Act on Low Carbon, Green Growth,

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the NBEP is renewed every 5 years whose draft is prepared the Ministry of Trade, Industry and Energy, which then goes through consultation with the heads of competent central administrative body and a public hearing before being finally confirmed through the deliberation of the Commission for National Energy, Committee on Green Growth and the Cabinet Council. The NBEP shall include the following items as indicated in Table 4: the trends and outlook in energy demand and supply in Korea and abroad, measures for stable deployment and supply, and energy management, etc. The first NBEP was established in 1997 (1997~2006) based on the Energy Use Rationalization Act (Article 4) to last for 10 years and renewed every 5 years. In 2002, the second National Basic Energy Plan (2002~2011) was established pursuant to the Energy Use Rationalization Act (Article 4). The changed applicable act in 2008, the Energy Act provided that the Plan be established every five years over a period of 20 years, and during the Lee Myung-bak administration, due to the change in the applicable law, it was renamed as first the National Basic Energy Plan (2008~2030), and the current Park Geun-hye government established and announced the second National Basic Energy Plan (2013~2035) in January 2014 pursuant to the Framework Act on Low Carbon, Green Growth.

Table 4: National Basic Energy Plan and Basic Plan on Electricity Demand and Supply

	National Basic Energy Plan	Basic Plan on Electricity Demand and Supply
Applicable Act	Framework Act on Low Carbon, Green Growth (Article 41)	Electric Utility Act (Article 25)
Governing Entity	Government	Minister of Trade, Industry and Energy
Duration	Established every five years over a span of 20 years	Established and implemented every 2 years

Procedure	Deliberation by Commission for National Energy → Committee on Green Growth → Cabinet Council	Consultation with competent central administrative body, public hearing → electric power policy council deliberation
Description	<ul style="list-style-type: none"> <li>• Trends and outlook on energy demand and supply in Korea and abroad</li> <li>• Matters on stable introduction, supply and management of energy</li> <li>• Goals on energy demand, energy mix, energy saving and energy efficiency improvement</li> <li>• Measures on supply and use of eco-friendly energy including new and renewable energy</li> <li>• Measures on energy safety management</li> <li>• Energy-related technology development and deployment, development of professional human resources, international cooperation, natural energy resource development and use, energy welfare etc.</li> </ul>	<ul style="list-style-type: none"> <li>• Basic direction of electricity demand &amp; supply</li> <li>• Long-term outlook on electricity demand &amp; supply</li> <li>• Plan on power facilities and equipment</li> <li>• Power demand management</li> <li>• Other matters required for power demand &amp; supply</li> </ul>
Park Geun-hye administration	<ul style="list-style-type: none"> <li>• Officially announced the Second National Basic Energy Plan (2013~2035) in January 2014</li> </ul>	<ul style="list-style-type: none"> <li>• Officially announced the seventh Basic Plan on Electricity Demand and Supply (2015~2029) in July 2015</li> </ul>

The Basic Plan on Electricity Demand and Supply (BPEDS) to be established by the Minister of Industry, Commerce and Energy every two years pursuant to Article 25 of the Electric Utility Act shall include the basic direction of power supply & demand, long-term outlook of power supply & demand, plan for power installations, management of power supply & demand, and other matters related to the supply & demand of power. (See Table 4). According to Article 25.1 of the Electric Utility Act, the BPEDS aims to ensure the “stable supply of electricity.” The Korean government, ever since it published the first BPEDS in 2002, has established a 15 year plan every two years. Similar plans to BPEDS had existed before, that is, 1985~1989 prior to 1991,

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the exclusive utility KEPCO had established and implemented the “long-term power development plan.” However with the complete amendment of the Electric Utility Act in 1991 and until 2000, it was the government which established the long-term power supply plan every two years with KEPCO as the implementation body. However, up until then, KEPCO, the exclusive utility in generation, transmission and distribution had been in charge of establishing the plan itself, which was subsequently approved by the government. But after implementing the utility sector reform in 2001 which divided KEPCO into six generation companies with an attempt to introduce competition into the power sector, the Basic Plan on Electricity Demand and Supply has been established by surveying KEPCO subsidiaries and private companies on their intent to build power generation facilities and incorporating the feedback in the business plan of the utility providers. The most recent BPEDS was the 7<sup>th</sup> edition confirmed and published in July 2015.

In the 2<sup>nd</sup> NBEP, the government defined the top 5 priorities which include transitioning into policy centered on demand management, building decentralized power generation system, improving sustainability in terms of safety and environment, strengthening energy security and implementing policies together with the people. To meet such policy objectives, the government planned to expand the share of nuclear energy to 29% and new and renewable energies to 11% until 2035.<sup>2</sup> The

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<sup>2</sup> In Korea, we do not use the term “renewable energy” but “new and renewable energy” a combination word for “new energy” which is different from the term “renewable energy” used by the IEA. The new and renewable energy in Korea refers to energies that are neither coal nor oil, nuclear energy nor natural gas, and new energies include hydrogen, fuel cell, coal liquefied/gasified energy and heavy oil residue, and renewable energy include solar, photovoltaic, biomass, wind, small hydro power, geothermal, ocean energy, waste energy. The definition of the IEA’s renewable energy does not include the new energies included in the categories of Korea’s “new and renewable energies”, and unlike Korea, the IEA’s definition includes inflammable and

second NBEP was quite a progress compared to its previous approach, as in shifted towards demand-centered policy or building decentralized generation system. Yet, it did not differ much in that it still projected a consistent and sharp increase in energy demand, especially in power demand, and plans to constitute energy to meet such demand. The plan should have been made after considering the peak of the energy demand in order to reduce energy demand in times of different energy crises including climate change, however, this was not the case. The total energy demand will increase 1.32% annually until 2035 to become 37.1% higher compared to the 2012 level, the electricity would increase by 79.5%, that is, 2.47% every year. As a result, it was projected that the share of electricity out of all energies would increase from 19.0% in 2012 to 27.6% in 2035, and the goal in terms of demand management was set to reduce the electricity demand by 15%. Despite demand management, the electricity demand will continue to grow, therefore, nuclear energy was chosen as an alternative to deal with climate change as it emitted lesser greenhouse gases. Such approach still remains very much supply-oriented. Compared to the first NBEP, even though the nuclear energy share was reduced from 41% to 29%, this means expanding the nuclear installed capacity (20,716MW) which represented 26.4% all installed capacity in 2020 to 29% in 2035 (42,705MW), whose goal can only be achieve through an additional construction of 5 ~ 7 nuclear reactors, excluding those planned for and construction. And the installed capacity needs to be more than doubled.

The core of the seventh BPEDS which was confirmed and published in July 2015 is to build additional two new nuclear reactors. After projecting

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biodegradable wastes as waste energy, which is a different scope from Korea which does include industrial waste gas. Korea uses new a broader term of renewable energy compared to the IEA, which explains the gap between Korean and global statistics.

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that the electricity demand will increase by 2.1% ever year for 15 years from 2015 to 2029, the government established the following basic direction for power generation facilities: expansion of generation facilities for stable supply of electricity (securing proper reserve rate of 22%), low carbon energy mix to reduce greenhouse gas emissions, balanced consideration of economic and environmental viability and acceptance in defining energy mix, and expanded deployment of decentralized energy (12.5% in 2029). In order to achieve these goals, the plan to build 4 coal-fired power plants was removed from the 6<sup>th</sup> BPEDS and replaced by building 2 additional nuclear reactors. The hottest issue today surrounding energy consumption is the government's intention to expand nuclear power generation following the Fukushima nuclear accident.

## **IV. Future of Nuclear Energy in Korea**

What will be the future of nuclear energy in Korea? It depends on what principles the government serves to establish its policies, and the latter depends on how the diverse issues faced by nuclear energy are resolved and how they are embraced by the civil society. The most important issue in the wake of the Fukushima accident was not just about ensuring nuclear safety but about whether nuclear was economically viable or whether nuclear energy could be considered low-carbon across all cycles. More specifically in Korea, there were a pile of pending issues that involved construction of new nuclear plants, extension of the design life of outdated nuclear power plants, installation of high-voltage transmission lines to transport nuclear energy, and treatment of spent fuel, etc. The way we address these issues and how proactive post-nuclear movements are in providing alternatives while voicing against Korea's pro-nuclear development policies will determine the future path of nuclear development in Korea. This chapter aims to provide an

outlook for the future of nuclear energy in Korea by briefly examining the major issues that fuel social controversies and studying the post-nuclear movements' struggle against nuclear development policies.

### **1) Life Extension of Outdated Nuclear Power Plants**

As aforementioned, 12 out of the 24 existing operating reactors, will see their design life expire in 15 years in 2030 (See Image 1 and Table 3). Kori 1 operation will be permanently halted for the first time in Korea history in 2017, however, 11 reactors including Wolsong 1 whose one-time life extension will expire in 2022 will need to undergo an inspection to extend its life in 2020.

To extend the life of an outdated nuclear power plant (in Korean legal terms “continuous operation”) in Korea, the Nuclear Safety and Security Commission (hereinafter “NSSC”) determines, based on a set of safety criteria, whether the reactor in question can be operational until 10 years after the end of the design life. The requirements include periodic safety test on equipment, life test for equipment whose safety performance vary with time, and evaluation on the radiation impact on the environment following continuous operation, etc. All in all, 134 items need to meet the evaluation criteria. In 2013, in addition to the existing requirements for continuous operation, requirement for “stress test”, which was President Park Geun-hye’s electoral promise, was newly adopted. The stress test aims to verify whether nuclear power plants can remain stable under extreme conditions, and major items for evaluation include earthquake, tsunami, other natural disasters, loss of safety function in electricity system, management of sever accident, and emergency response, etc. According to paragraph ④ of Article 36 of the Nuclear Safety Act Enforcement Decree, in order to extend the lifespan of a reactor, the nuclear reactor operator, Korea Hydro & Nuclear Power (KHNP) shall

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submit a written assessment within two to five years before the record date of assessment which is the date on which the lifespan of design comes to an end (including the dates on which ten years elapse every ten years thereafter). Once the KHNP submits application to the NSSC, Korea Institute of Nuclear Safety (KINS) initiates evaluation, then an evaluation report approved by the expert committee is submitted to the NSSC. As for the stress test, the stress test report submitted to the NSSC by KHNP undergoes an expert group review, and verification technical consultation group consisting of 4 members from the KINS and 4 private independent members will draft and disclose a relevant comprehensive report. Then the expert committee reviews this comprehensive report and submits it to the NSSC.

The NSSC was launched with the growing need for safety regulations on nuclear energy after the 2011 Fukushima accident. Since then, the role of the existing nuclear commission on use and promotion of nuclear energy was left to the realm of the Atomic Energy Promotion Council, and the nuclear safety management issues were to be separated and governed by the NSSC. The NSSC first began as an independent central administrative agency under the Presidential office in 2011, given the importance of nuclear matters. However, after President Park Geun-hye was elected, the Presidential Transition Committee wanted to make the NSSC an umbrella organization of the Ministry of Science, ICT and Future Planning just like in the past. However the civil society and the opposition party opposed to this proposal and pursuant to Article 2 of the Government Organization Act, the NSSC became an independent central administrative agency under the Prime Minister's Office, and the chairman of NSSC was deemed as vice minister. The NSSC consists of 9 members including the chairman: that is 1 chairman and 1 secretary general who are standing members and 7 other non-standing members. The chairman is appointed by the President of Korea recommended

by the Prime Minister. The four members including the permanent member are recommended by the chairman and the other four members are appointed by the President of the Republic at the recommendation of the National Assembly. After consulting with the government, the National Assembly decided that from the second term of the NSSC, the ruling party and the opposition party would recommend two candidates respectively. After facing public criticism that that first term of the NSSC included solely pro-nuclear members, the opposition party, taking note of the public opinion, proposed that both the ruling and the opposition party recommend the same number of candidates, and as a result, two anti-nuclear members could be included in the commission. The second term of the NSSC is on-going, and excluding the two members of out nine recommended by the opposition party, the other members consist of scholars and government officials who endorse nuclear development. (See Table 5). Such constitution of members undermines the civil society's trust vis-à-vis the objectivity and fairness of the NSSC decisions.

Table 5: Constitution of Members of the Second Term of the Nuclear Safety & Security Commission

Title	Type of Recommendation	Affiliation (Position)
Standing member	Ex-officio (2)	Chairman (honorary professor, department of nuclear engineering, Seoul National University)
		Secretary General (former director of the nuclear energy bureau, Ministry of Science and Technology)

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Non-standing member	Ruling party recommended (2)	Chair professor at safety school, Korea Institute of Nuclear Safety (KINS), Inviting professor department of nuclear engineering, KAIST)
	Opposition party recommended (2)	Professor of microbiology at Dongkuk University of Medicine, chairman of energy and climate committee of the Korean Federation of Environmental Movement
	Government recommended (3)	Attorney at law firm Logos, professor at Bangmok College in Myongji University, Professor at college of mechanical engineering at Sungkyunkwan University

Source: Compiled from the Nuclear Safety and Security Commission

The second term of the NSSC reviewed the application for extending the license of Wolsong Reactor 1 and approved an extension of 10 years. The design life of Wolsong 1 is 30 years, which expired in November 20, 2012, 30 years after November 21, 1982 which was the initial criticality day. The operator KHNP filed an application for the continuous operation of Wolsong 1 in December 30 in 2009 and received the NSSC's green light for the continuous operation in February 27, 2015. Today, Wolsong 1 will be operational until November 20, 2022.

However the NSSC's decision to extend the lifespan of Wolsong 1 failed to earn social support and trust. Of course, member constitution was the source of controversy but also its decision-making process. An expert group and private independent group conducted a review on the stress test results submitted by the KHNP, and their opinions were divergent. The expert review group consists of KINS specialists whereas the private independent group consists of local autonomous and environmental groups. The independent group provided a negative review that continuous operation would not ensure safety whereas the KINS review group evaluated that the stress test guidelines satisfied the evaluation criteria. The independent group identified 32 items of improvement and provided the opinion that safety operation of Wolsong 1 is only possible when all of these improvements are made. The KINS

group identified and proposed 19 items of improvement, which were not mandatory improvements before the re-activation but rather tasks to be dealt with in the future. On the other hand, the independent group focused on securing public acceptance before applying for the continuous operation which was a newly included provision in the amended Nuclear Safety Act and stressed that when deciding the continuous operation of Wolsong 1, it was crucial to actively incorporate the opinion on the public acceptance of local residents. This is because when the public hearings on the stress test results were held in June 2014 and December 2014 for the Gyeongju Wolsong residents where Wolsong 1 is located, the local residents voiced against expanding the lifespan of the outdated Wolsong 1, and yet their views were completely ignored during the decision-making process.

The decision-making process per se of the NSSC was also under criticism. The NSSC held three meetings in January 15, February 12, and February 26 in 2015. The members engaged in intensive discussions from 10 am on February 26<sup>th</sup> to 1 am until the next day. The members not only disagreed on the 32 improvements identified by the independent review group but also on how to interpret the mandatory provision on securing the public acceptance before the application for the continuous operation.<sup>3</sup> The amended Nuclear Safety Act mandatorily required public

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<sup>3</sup> The revised Nuclear Safety Act included a new provision on mandatorily securing public acceptance before applying for a continuous operation. Article 103 stipulates that “each person wanting to receive approval for modification....to continue to operate generational reactors or relevant facilities even after the end of their lifespan” shall seek public consensus by “disclosing the draft of the radioactive environmental impact report or holding a public hearing”, and attach it to the radiation impact evaluation. The opposition party-recommended members argued that result of the public acceptance through public hearing should be included in the deliberation of the NSSC incorporating the founding vision of the Nuclear Safety Act, however, the government-recommended members argued back that the public acceptance can be

acceptance not only for constructing new nuclear plants but also for obtaining approval for changes such as extension of lifespan of outdated power plants. However, the NSSC argued that the amended law could not be retroactively applied with the application review pending, since the application dossier for Wolsong 1 had been submitted back in 2009. The NSSC proceeded with vote after 1am on February 27, and with 7 pros and 2 blank ballots, it was decided to extend the lifespan of Wolsong 1. The two opposition party recommended NSSC members voiced that the safety issues raised by the independent review group had not been addressed, therefore refused to proceed with the vote. When the chairman went ahead with the vote anyway, they walked out as a sign of protest. Therefore the voting was held without these two members present. Despite the much conflicts and controversies surrounding the extension of the life of Wolsong 1, the application for extension was finally approved. According to the NSSC rules, an application for deliberation can be passed when the majority (5 out of 9 ) votes saying "yes", therefore the walk-out of these two members did not have any impact on the vote outcome. As of today, and a network for lawyers advocating democratization (Minbyeon) has already filed a suit regarding this issue, claiming that the NSSC's decision was unconstitutional.

Other than Kori 1 whose permanent life end is confirmed for 2020, 11 other reactors will also need to apply for extension according to the aforementioned procedure. Therefore, it is highly likely that the same conflicts and controversies will be repeated with much intensity. In particular, if the NSSC members mostly with pro-nuclear inclination continue to make decisions on the deliberation of applications, without securing any channel to embrace the views from the local residents

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incorporated just before the actual operation by the KHNP after deciding first on the lifespan extension by the NSSC.

and the civil society, then it will become more difficult to seek a social consensus and support on the deliberation outcome. Moreover, another issue for Korea to resolve is that there is no specific plan after the nuclear power plants permanently halt operations.

## **2) Construction of New Nuclear Power Plants**

Another heated debate involves building new nuclear power plants. In the beginning of the 1980s, the Korean government designated and announced nine regions as candidate sites for new nuclear power plants. However with the 1986 Chernobyl accident and protests against nuclear waste treatment facilities, residents living in the candidate sites strongly opposed to the government's plan, and potential sites near the existing nuclear power plants such as Ulchin-gun Geunnam-myeon Sanpo-ri were partially delisted from the candidate site list whereas plans for the 8 remaining sites were completely cancelled in December 1999 (Hankyoreh Newspaper, 1999/12/30). As for the Gyeongbguk Ulchin-gun Geunnam-myeon Sanpo-ri, the Ulchin-gun went ahead and proposed to have its name taken off the potential site list once it finds a replacement site in the vicinity of the existing Ulchin Nuclear Reactor 3 & 4 until January 2000. Delisting of Ulchin-gun was possible because the Ulsan Metropolitan City's Ulju-gun, which was not originally included among the 9 candidate sites, announced that it would accommodate nuclear reactors in its region by bidding for the project under the name of the district head in November 1999. Ulsan city's Ulju-gun Seosaeng-myun is referred to as the Shin Kori region, and Shin Kori 1 & 2 are currently operating as of September 2015, and Unit 3 & 4 are under construction with 5 & 6 planned for construction.

Until now, Korea constructed 5 units in 1970s, 6 in 1980s, 9 in the 1990s and 6 more after 2000. (See Table 3 above). Also commercial

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operations of 8 reactors began in the 1980s, 7 in the 1990s, 4 in the 2000s and 4 in the 2010s. Since it became difficult to attract nuclear power plants in new sites, the government adopted the approach of adding new ones in the existing regions. As a result, from minimum 6 reactors up to 10 reactors were built in one nuclear power plant site, which gave rise to the development of a nuclear power plant complex (Yun Sun-Jin, 2015). However, such complex means concentration of risky facilities, which may give rise to safety issues. Multiple reactors are exposed to the same natural disasters or terror attacks, making problems in one single reactor to have a great impact on other reactors in case of accidents or emergencies. This can pose a serious threat to the stable supply of electricity.

The nuclear reactors that the Korean government and KHNP intend to additionally construct can no longer be built in existing sites since the sites are limited in space. The KHNP intends to secure two new sites by 2012 to build over 4 APR1400 type reactors and began the search in earnest since November 26, 2010. The KHNP planned that, after receiving voluntary applications, it would review the safety, public acceptance, environmental impact, and construction feasibility through the Site Selection Committee and based on the results select two candidate sites by June 2011 and designate the sites as the Energy Development Business Zone pursuant to the “Energy Development Promotion Act” until 2012 for final confirmation.

Consequently, the KHNP commissioned a project to implement the policy to secure the sites for new nuclear constructions in 2009, and based on the results, identified Gangwon Samcheok-si, Chonnam Goheung-gun and Haenam-gun and Gyeongbuk Youngdeok-gun as the four sites with the potential to host the new nuclear power plants, thus requesting these sites to file an application. As for Samcheok-si, Geunduk-myeon Deoksan-ri area was selected as the candidate site

in 1999 for nuclear reactors, and Wondeok-eup Yicheon-district was chosen as the candidate site for nuclear waste treatment facility in 2005, however, with fierce opposition from the local residents, the projects were completely cancelled. (Yonhap News, 2010/12/16). In case a local government wishes to apply for the nuclear power plant site, its chief head must submit an application dossier to the KHNP by attaching the approval document of the local council. That is, the supporting document is not the public referendum results but the city council approval. Moreover, if there are regions other than these four wishing to additionally accommodate nuclear power plants, their inclusion would be determined after reviewing the site feasibility study. As of February 28, 2011, Samcheok and Youngdeok had submitted applications. The Samcheok city council was pressed for time to meet the deadline, so they passed the nuclear power plant site application with unanimous decision on condition of holding the public referendum later on, which was a request made by then Anti-Samcheok Nuclear Power Plant Committee.

However, not long after filing the applications, the Fukushima accident occurred, aggravating concerns over nuclear safety issues. Nevertheless, the KHNP selected Samcheok and Youngdeok as the candidate sites for the new nuclear power plants in December 23, 2011, and the government designated and announced these two sites as the candidate sites for new nuclear constructions in September 14, 2012. However, Samcheok residents strongly opposed and refused to accept the government's decision, claiming that the public opinion should be considered by holding a referendum as had been requested by the local council. Moreover, when it was found that the document on the referendum results indicating 96.6% agreement by the local residents submitted by the former Samcheok mayor actually included false signatures of residents, the Anti-Samcheok Nuclear Project Citizens' Alliance called on the government to cancel the designation of the

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Samcheok region as candidate site. Samcheok residents conducted a referendum to vote on the subpoena of the former mayor who did not keep promise on the referendum and the referendum with new nuclear construction with the new mayor. However, due to the obstructions from the Samcheok city, the voting rate turned out to be 25.9%, failing to get 1/3 votes required for subpoena, thus neutralizing the plan. However, during the regional elections held in June 2014, mayoral candidate Kim Yang-ho won the elections with 62.4% of votes, becoming the first candidate in Korean regional elections history to promise a fight against construction of nuclear power plants. After his inauguration, the Samcheok mayor requests the National Election Commission to oversee the referendum asking residents' opinion on the new power plant, however, the Commission refused to do so saying that nuclear power plant site selection is a national affair and therefore not subject to referendum. Therefore, the referendum was held by the private sector led by the "Commission on Referendum on Samcheok Nuclear Power Plant" in October 9, 2014. As a result, 68% (48% of the total voters) of those listed on the register voted, with 85% voicing against the nuclear power plant in their region. Based on the referendum results, the current Samcheok mayor requested that the designation of the Samcheok site to be cancelled. However, the government argued back saying that application was made legitimately by the Samcheok-si and that the referendum of Samcheok was legally invalid. The government still presents Samcheok as the new candidate site for the nuclear power plant in the 7th Basic Plan on Electricity Demand and Supply, however, Samcheok continues to strongly disagree with such plan.

The referendum in Samcheok also had an impact on Youngdeok. There is a chance that Shin Kori 7 & 8 planned for construction in Ulju-gun and 2 additional reactors will be constructed in Youngdeok. However, it was found that the application of Youngdeok-gun filed

in 2010 did not include any public hearing or public meeting results, seeking no consensus from the public, and it too is gaining strong protest from the residents. With the initiative of Anti-Youngdeok Nuclear Power Plant Construction Committee, Youngdeok residents are strongly requesting that the decision should be made based on a referendum, which deserves the public's attention. As such, building new nuclear power plants accompanies serious social conflicts, which cannot guarantee the continuity of Korea's current pro-nuclear development policies.

### **3) Construction of Massive High-Voltage Transmission Lines Essential for Nuclear Generation**

Social conflicts surrounding the Miryang transmission tower has been a hot issue in Korea for the past few years. In fact, this incident dates back to the beginning of the year 2000. In January 2000, the government announced the fifth long-term plan for demand and supply of electricity, and in May 2001, KEPCO selected the sites where the 756 kV Shin Kori Nuclear Power Plant-North Gyeongnam transmission line (to build 161 transmission towers spanning 90.5km across 5 sis and guns including Ulsan Ulju-gun, Busan Kijang-gun, Gyeongnam Yangsan, Miryang-si and Changnyeong-gun) would pass through and commissioned a study on its environmental impact. In August 2005, KEPCO completed the environmental impact study and conducted a public hearing in Miryang regarding the project to install transmission lines. By the beginning of 2006, there was a growing opposition movement in Miryang, and an Anti-Transmission Line Committee was launched in Miryang, where the transmission tower was originally scheduled to be built. In July 2007, Miryang city council called for the complete cancellation of the project on transmission lines, however, in November the same year,

the government approved the project which intend to connect lines from Shin Kori to North Gyeongnam. Despite the opposition from local residents, the KHNP began the project in August 2008. Ever since, the local residents continued to voice their opposition through the anti-project committee and waged diverse protests from hunger strikes and through demonstrations in Seoul, and numerous law suits between the constructor KEPCO and local residents were also filed.

However, despite such wrangling, the project was carried out as planned, and many conflicts surrounding the construction of high-voltage transmission towers in Miryang failed to gain sufficient public attention. However, when a 70 year old resident Lee Chi-woo committed suicide by setting himself on fire in January 2012, in February 2012, a special task force was launched bringing together a coalition of nationwide civil society associations and the political circles, place this issue on the list of national agenda. In September 2012, as the National Assembly requested to stop the construction of Miryang transmission tower, the project came to a halt. However, in May 2013, KEPCO announced that it would resume the project, attempting to resume construction, which led to physical fights with the local residents who were in confrontation, aggravating the situation. In the end, in May 29, a consensus was made between KEPCO and the Miryang residents to temporality stop the construction and seek an alternative study through an expert consultation group. Therefore, in June 5, expert consultation body was launched with three members recommended from KEPCO members and the resident group respectively. In July 8, however, the chairman, without seeking any consensus from members, submitted a consultation report indicating that there was no alternative but to build the transmission tower in Miryang, which was finally not adopted with the resistance from the opposition party. Ever since, the project constantly faced fierce protest from Miryang residents, however, in June 11, 2014, the government, through its

administration execution proxy, pulled down the anti-transmission line protest sit-in sites and KEPCO initiated the construction on all 69 areas for Miryang transmission tower, thereby completing the construction by the end of September, with the tower going into pilot operation from December 28, 2014.

These transmission lines were built to transfer electricity generated from Shin Kori 3 to consumers and are especially related with the nuclear reactor construction project commissioned by the United Arab Emirates. Shin Kori 3 is the first commercialized model of Korea's independently developed APR1400 type pressurized water reactor. The contract with the UAE signed in 2009 provided that Shin Kori 3 (the same as the UAE model) undergo a commercial operation until September 2015 to prove its safety and in case Shin Kori 3 is not operational after the completion date, a penalty equivalent to 0.25% of the monthly construction fee will be charged for the period of delay. It was due to this reason that the project to build Miryang transmission tower was enforced without seeking proper consensus from residents by giving an excuse that it was actually to transfer electricity produced from Shin Kori 3. However, with scandals surrounding the falsification of the quality control certificates of power plant parts, replacement of cables and death of workers, the construction of Shin Kori 3 itself was postponed. And through the transmissions lines connecting Shin Kori and North Gyeongnam currently under test, the electricity produced from Shin Kori 1 & 2 and not Shin Kori 3 & 4 will be transferred.

As a result, the social conflicts surrounding the Miryang transmission tower resulted from not only the compelled execution of the project without seeking public consensus but also fundamentally due to the mismatch between the power production site and consumption site under the centralized system extremely dependent on massive coal-fired or nuclear power generation. Without the structural change of the

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power system, another struggle just like that of Miryang transmission towers can occur anywhere in the country. Nuclear generation produces massive electricity, however, the fundamental risks that it holds make it difficult to locate nuclear generation facilities around the sites where many consumers inhabit. That is why, nuclear generation requires large scale transmission facilities. The utility provider KEPCO wants to increase the voltage up to 765kV in order to minimize the energy lost in transmission, however, any site or region concerned will very likely refuse to accommodate such facilities due to economic, environmental and health reasons. As such, nuclear-centered power system is regenerating social conflicts and with chances of these social conflicts aggravating will be high, which makes it unclear whether Korea's pro-nuclear policies will be successfully implemented.

### **4) Processing of Spent Nuclear Fuel**

Nuclear generation holds a very huge challenge that cannot be addressed with the current technology: processing of spent nuclear fuel. For the spent nuclear fuel to become completely harmless to human body and the environment so that the radiation toxicity will not be an issue, it should be safely managed and preserved for at least 100,000 years. However, as of today, Korea does not have the technology to process or the place to store spent nuclear fuel and still lacks proper policies on the management of spent fuel. The only approach until now had been the "wait and see" approach. However, with the increasing volume of spent fuel stored within power plants, we have now arrived at a saturation point. Initially, the Korean government announced that the Kori Plant will be saturated starting from 2016, Hanbit and Wolsong by 2019 and Hanul Plant in 2026. However, with the saturation drawing nearer, the government, through an externally commissioned study, announced that

it would be possible to prolong the saturation time as seen in Table 6 through high density storage of cross-reactor transfer. Given the extended storage capacity, as of June 2015, the saturation rate for Kori is 84.4%, Hanbit 61.6% and Hanul 67.7% respectively, and 79.2% for the heavy reactor and 24.7% for the light reactor, respectively.

Table 6: Spent Fuel by Nuclear Power Plant (2Q, 2015)

		Storage Capacity (Bundle)	Total Accumulation (Bundle)	Saturation Rate (%)	Rescheduled saturation time	Original saturation time
	Kori	6,494	5,478	84.4	2028	2016
	Hanbit	9,017	5,551	61.6	2024	2019
	Hanul	7,066	4,786	67.7	2026	2021
Wolsong	PHWR	499,632	395,801	79.2	2026	2019
	PWR	523	129	24.7	2038	2020

Source : excerpt from KHNP website

However, the prolongation of saturation time by expanding the storage capacity cannot be the real solution to the problem. The Korean government launched the Public Engagement Commission on Spent Nuclear Fuel Management from October 2013 to bring the issue to the public's attention and focused on seeking solutions to properly manage spent fuels by the end of 2014. However, the Commission failed to come up with measures within the given time and extended the duration of its mandate until June 2015, and in June 2016 submitted a report entitled "Recommendations on Spent Fuel Management" before completing its mandate. In this report, the Commission suggested "principles of public safety as the first and foremost priority" and suggested to move the spent fuel currently stored in the in-house temporary storage sites to more safe storage facilities before the storage capacity becomes

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saturated or before the reactor operation license expires. Moreover, the Commission recommended that the disposal facilities be operated by the government until 2015 and proposed that the Underground Research Laboratory (URL) site be selected until 2020 in the existing treatment facility site or sites with similar conditions, and that an empirical research be initiated from 2030. The Commission also proposed that the construction of the pre-disposal storage facilities should begin from 2020 on the URL site even before operating the disposal facilities so that spent fuel can be stored until disposal, and in inevitable cases, that temporary storage facilities be installed within each power plant and temporarily store the spent nuclear fuel.

However, despite the Commission's recommendations, no decisions have yet been made regarding the management of spent nuclear fuel. Moreover, there have not been any social discussions on the feasibility of the Commission's proposals. Nuclear energy continues to produce spent nuclear fuel, however, Korea only focuses on expanding nuclear energy and has failed to come face to face with the issue of how to manage spent nuclear fuel. This issue will serve as the detonator for the government's pro-nuclear development policy.

### **5) Post-Nuclear Movements**

Above all, the future of Korea's nuclear development policy depends on the post-nuclear movements. According to the technological system or socio-technical system advocated by Thomas Hughes (1984, 1987), the socio-technical system does not exist only as an artificial object or technical element related to the outcome of technology or technologies but encompasses organizations including producers, installations providers, investment banks, scientific elements including books, theses, university lectures and research plans as well as social elements including

laws, regulations and policies. The socio-technical system is formed as technical elements are formed in a given social context and as new social organizations, systems and structures required to develop these elements are formed. As such, nuclear energy generation, since it constitutes specific energy technologies, also shows characteristics of a socio-technical system (Yun Sun-jin et al., 2011). Since the socio-technical system is not only based on the physical structures and social elements that have been long maintained and that the relevant stakeholders also have interest in maintaining that specific system, it tends to be continuously sustained, preserved and strengthened. Such tendency is referred to as “momentum” (Hughes, 1984). However, this momentum of socio-technical system does not last forever. As one socio-technical system is expanded and reinforced, there are critical problems that impede the system’s maintenance and growth and also other elements that lag behind or fail to interact with other elements tend to occur. And if these problems are not addressed within the socio-technical system itself, it is very difficult to preserve this momentum. Hughes dubbed such critical problems the “reverse salient.” As seen from Hughes’ example, anti-nuclear movement can indeed serve as the most powerful reverse salient (Yun Sun-Jin, 2015a).

The construction of the first reactor for each site began in fact before the 1986 Chernobyl accident for all nuclear generation sites in Korea, therefore back then, people did not know much about nuclear development, and nuclear power plant construction projects were considered as a means to seek local development, thus facing not much resistance from local residents (Lee See-jae 2005; Yun Sun-Jin, 2015b). In fact, there was a prevalent perception that nuclear development would ensure stable supply of affordable electricity, fostering development of industries and progress of civilization. According to a survey on the awareness of Hanbit nuclear power plant site residents, at the time of

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building Hanbit, majority of people were not aware of the risks associated with nuclear energy development and merely thought a “plant generating electricity” was going to be built in their region and expected that their local economy would grow once the power plant is put in place (Yun Sun-Jin et al. 2013). The same was for Youngkwang. Residents in other nuclear sites also showed similar awareness, which resulted in no anti-nuclear organizations being formed by residents at the construction of initial nuclear power plants. Moreover, at the time, the Korean society was under military dictatorship, thus the social conditions were not met to form an anti-nuclear organization. However, with the Chernobyl accident in 1986, questions surrounding nuclear safety were raised, and with the democratic uprising in June 1987, the conditions for political opportunities were created. Moreover, as thermal discharge issues due to nuclear operation aggravated and many cases regarding radiation damages were reported, anti-nuclear movements began to take shape. As Youngkwang residents in 1987 greatly suffered from the thermal discharge, they fought hard to receive compensation for their affected fishery business.

After the 2011 Fukushima nuclear accident, anti-nuclear movements became the mainstream, as there were calls for compensations in the existing nuclear sites and protests against building new nuclear power plants. These included compensation for the damages due to thermal discharge, resistance to accommodate new nuclear power plants and nuclear waste treatment facilities, etc. The anti-nuclear movements mostly occurred in the sites where nuclear generation facilities were located or sites planned to build nuclear waste treatment facilities, and mostly the relevant site residents and environmental groups took part in the anti-nuclear movements. Through such protests, there was a slight delay pursuing the construction of new nuclear power plants and the attempts to locate nuclear generation facilities in new sites were foiled, however,

in 2005 since the low to intermediate radioactive waste treatment facility was finally built in Gyeongju, Korea's anti-nuclear movement entered a quiet stage. Until 2005, protests against nuclear waste treatment centers were at the core of Korea's anti-nuclear movements. As it became difficult to build nuclear power plants in a new site, the government decided to build additional facilities in the existing sites whose reactors had already been installed before the Chernobyl accident. This allowed the continuous construction of nuclear power plants. Attempts to build nuclear waste treatment facilities were made after the 1986 Chernobyl accident however, the plan had been cancelled 9 times until 2004. In 2005, the government newly designed the policy regarding the site selection process, and the nuclear waste treatment center became the subject of bidding competition among different sites. Since then, the anti-nuclear movements went into a quiet stage again (Yun Sun-Jin 2006). When selecting the site for the nuclear waste treatment facility in 2005, the Special Act on Assistance to the Locations of Facilities for Disposal of Low and Intermediate Level Radioactive Waste aimed to limit the scope of waste to low and intermediate level radioactive wastes, increase more assistance to the host site and also hold referendum to seek public consensus. As a result, radioactive waste treatment facility was no longer subject to avoidance, but to competition. As a result, four sites applied to host the facility, and following a referendum, Gyeongju was finally selected. Since the anti-radioactive waste treatment center was at the core of anti-nuclear movements, following 2005 when the risks were mitigated through financial assistance, the anti-nuclear movement relatively lost its ground and declined again.

However, after the Fukushima nuclear accident, in Korea, the term anti-nuclear movement was replaced with post-nuclear movement, and the latter became very diverse and rich in both quantitative and qualitative terms. "Verwandlung, metamorphosis" through "emancipatory

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catastrophism” proposed by Ulrich Beck (2015) can be found in many places of the Korean society. The movement is seeing a shift where unlike in the past merely opposing to host a certain facility, now it has transitioned into providing alternatives. And it has evolved from a movement taking the intermittent and explosive forms of protests and resistance towards a movement that is consistently taking place in our daily lives seeking changes. Moreover, it does not stop at merely criticizing the power demand and supply scenario presented by the government, but goes further to present an alternative energy scenario. The number of experts actively engaged in post-nuclear activities by forming “post-nuclear energy professors group” “post-nuclear legal experts group, sunflower” and “post-nuclear doctors’ group” is on the increase. Some national assemblymen have organized “parliamentarians’ group for post-nuclear energy transition” or “parliamentarians’ study group for nuclear-free world for our children”. The mayor of Seoul is implementing a policy on “reducing one nuclear power plant by Seoul” since April 2012, and 46 local government heads have endorsed the “Municipal Declaration on Post-Energy Transition” in February 2012 and have implemented many activities to this end. In the past, the post-nuclear movements were perceived to be in the realm of environmental groups, however nowadays, many civic groups and religious groups are also taking part. Moreover, average citizens are also making meaningful changes in their lives. (Yun Sun-Jin, 2015b).

Despite all that, the post-nuclear movement still lacks power to neutralize the pro-nuclear development policies. In Korea, even though the public’s support for nuclear energy has slightly decreased, it still remains relatively high. According to a national survey on the nuclear awareness conducted by the Korean Nuclear Energy Foundation as seen in Table 7 in July 2015, 82.9% of respondents answered that nuclear

energy generation was still needed.<sup>4</sup> Less people agreed to nuclear power generation than the 89.4% of the 2010 survey however, 8 out of 10 agree to it, which is relatively high. The percentage still remains high even though only 32.8% respondents consider nuclear energy to be safe. Regarding nuclear safety, still even to this day 50.1% of people believed that nuclear energy generation was not safe but necessary, which is lower than the 53.1% before the Fukushima accident. Moreover, 72.4% of respondents answered that the nuclear generation capacity should be either increased (29.5%) or maintained as status quo (42.9%). 24.9% agreed to the reduction of capacity which was twice higher than 11.1% before the Fukushima accident, however, 2.5 times the number of those agreed to reduction supported expansion and maintenance. The survey findings compared to the initial ones of October 2011 illustrate that there was a growing perception regarding the need for nuclear development from 78.3% to 82.9% whereas as the perception that we should reduce nuclear development remained quite similar at 24.2% and 24.9% respectively.

Table 7: Trends of Public Awareness on Nuclear Development

(Unit: %)

Year	'95	'00	'08	'09	'10	'11.10	'12.11	'13.10	'14.11	'15.7
Need for nuclear energy generation	85.5	84.4	89.8	83.7	89.4	78.3	87.8	83.5	81.7	82.9
Safety on nuclear energy generation	30.5	33.6	58.3	61.1	53.3	48.8	34.8	31.2	26.2	36.2
Safety on nuclear waste management	22.8	23.4	64.6	59.6	53.1	29.5	24.2	25.6	27.6	32.8

<sup>4</sup> Korea Nuclear Energy Foundation conducts a national awareness survey three to four times a year. About 1000 people of 19 years of age or older are surveyed through mobile/fixed-line phones or individual interviews. The confidence level is 95%±3.1%.

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Construction of nuclear power plant	For expansion	55.5	48.3	41.4	50.6	45.9	37.4	39.5	40.3	31.5	29.5
	Maintain status-quo	27.1	34.0	51.2	39.7	43.0	38.4	47.8	34.9	39.4	42.9
	For reduction	17.4	17.7	7.4	9.7	11.1	24.2	12.7	21.7	24.9	24.9
Acceptance on hosting nuclear power plants		12.4	10.9	23.7	26.9	27.5	21.0	18.4	35.7	36.0	31.3

Source: Korea Nuclear Energy Foundation 2013, 2014, 2015.

The trend of survey findings can be explained by Anthony Downs (1972)'s "Issue-Attention Cycle", which consists of 5 stages. The first stage is the pre-problem stage. During this stage, some undesirable social situations exist and few experts and small group stakeholders are already aware of these issues, yet not the general public. The second stage is the phase full of alarmed discovery and euphoric enthusiasm. As the aggravated social problems are revealed dramatically, the public becomes aware of these issues and feels alarmed. In this stage, the general public becomes passionate and confident that such impending issues can be resolved by mobilizing social strength. The third stage is when realizing the cost of significant progress. In this stage, we realize that the costs of addressing the problems are quite high. We come to realize that problems actually occurred in the process of benefitting so many people, and the resolution of those problems is only possible through the sacrifice of the population and restructuring of the social structure. The fourth stage involves the gradual decline of intense public interest. Transition from the third stage to the fourth stage takes place unnoticed, and in this period, the public interest in the problem gradually decreases. As growing number of average citizens begin to realize that resolving such problems is very difficult and incurs huge costs, three types of reactions can be found. Some become low-spirited or discouraged. Others feel threatened by thinking about these problems, thus try to suppress those thoughts.

There are also those who feel tired about all these issues. The majority of people experience a combination of these three. And in this stage, other important issues have already entered the second phase, newly attracting the public's attention. Lastly, the fifth stage is the post-problem stage. In this stage, the issues are no longer at the center of the public's attention and move into the limbo stage, thus entering into the less important realm and intermittently re-emerging at the center of the public's interest. However, this problem compared to the pre-awareness stage, has formed another relationship with the public, therefore new systems, programs or measures have been already established to address this problem. These tools persist even after the public's interest has moved elsewhere.

The Korean public has passed the euphoric enthusiasm to address issues through the Fukushima nuclear accident; however, as they realized that addressing these problems cost a lot, they may have stopped being interested in these issues. Therefore it is important to make the public realize that the costs associated with nuclear plant reduction are much less than those associated with nuclear accidents and that post-nuclear world is indeed possible. The future developments of post-nuclear movement will definitely determine the future direction of the pro-nuclear development policy in Korea.

#### **IV. Concluding Remarks**

The nuclear development policy in Korea is being implemented without much change despite the nuclear accident in the neighboring country Japan, which used to have a global reputation as a safe nuclear country. In Korea, social acceptance on nuclear energy has declined somewhat compared to pre-Fukushima accident, despite the intensifying social conflicts surrounding the construction of new nuclear power plants or high-voltage transmission lines, these trends fall short of undermining

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the policy oriented towards expanding nuclear energy. Nevertheless, since the wave of changes has begun, we cannot ascertain that the Korean government's nuclear expansion policy will remain unwavering. Korea is indeed standing at the crossroad. And all the aforementioned issues - including construction of new nuclear power plants, construction of high-voltage transmission lines, management of spent fuels, and life extension of outdated reactors - depend on how we address the impending issues and also how the post-nuclear movements provide active solutions to change the course of the current situation. These problems are closely linked to how we will ensure the nuclear safety.

The Korean nuclear development policy is not just a matter of Korea. The impact of Korea's nuclear policy will go beyond its borders to have ramifications around the world. Many developing countries consider Korea as a benchmark case, and Korea has the ambition to expand into the global market by presenting the nuclear development technologies as the new growth engine for the future economic growth. Moreover, if Korea experiences a nuclear accident just like the one in Fukushima, radiation risks may cross the national administrative borders and spread.

As of September 2015, Korea ranks the 6<sup>th</sup> in terms of nuclear installed capacity and the number of nuclear reactors. It ranks no.1 in nuclear generation density and plans to seek further expansion of its nuclear power plants, which will naturally lead to more risks inherent in nuclear development. In this situation, there is a growing number of citizens transitioning into energy producers while fostering energy citizenship, politicians providing relevant support and experts adding expertise to these efforts in achieving energy transition. However, such changes are yet to become the mainstream in Korean society. Small cracks are being formed to the existing powerful energy regime overly dependent on nuclear energy, however it is difficult to determine whether such cracks will become closed with time or drive the fall or decline of the existing

energy regime.

When nuclear development is accepted as a risk-bearing technology that is inevitable for the economic growth and the immediate convenient and easy use of energy, even though it is not safe, and especially when the majority of the population agrees to or supports this idea, then post-nuclear movement and energy transition will be difficult to realize and Korea will be locked up in its existing pro-nuclear expansion policy. To achieve post-nuclear stage and energy transition, we need more and more direct stakeholders making a living with the changed energy regime and citizens with energy citizenship. When they all successfully implement and expand the transition strategies in their regions, chances for realization will be high. Furthermore, more in-depth discussions and practice are needed to identify who are the groups advocating the status quo amidst the current nuclear-dependent energy regime that fails to ensure sustainability and what should be done and how to transition to a new energy regime. Individual members of the society seeking change and improving systems and structures that prevent such change...these are the two keys to success.

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# Korea's Green Energy - Potential

*Gi-Eun Kim*

To more effectively utilize its existing green energy resources in the future, Korea needs greater contributions and efforts at a national level. These efforts can include growth-engines for economic development that also induce CO<sub>2</sub> reductions for the next generation. Korea owns a considerable magnitude of green energy treasures, but the government seems unwilling to exploit its most obvious and economic feasible resources-in both the short and long term.

Here, some considerations concerning the current political strategies described in the 2nd Korea Master Plan, January 2014 are presented.

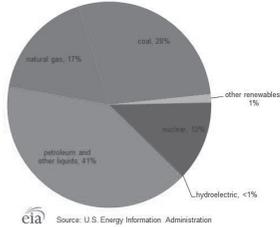
In the past decades, Korea's economy has made considerable steps ahead, as macroeconomic data show a very positive development, the trade balance is ever increasingly positive, and the economic growth ranges 2% to 3% ahead of German figures. Globally, Korea has attained the 14th largest national economy, with a GNP per capita in 2014 amounting to ca. US\$ 35,000 (according to the World Economic Outlook Database 2015).

Korea however has one particular Achilles' heel, i.e., its almost complete dependence on imported energy sources; crude oil and gas are predominantly imported from the Middle East. Korea was the 9th largest energy consumer in 2011. In 2013, Korea was the 4th largest importer of coal and the 2nd largest importer of LNG. In response to this situation, oil and gas companies are aggressively seeking to improve the national energy security by increasing overseas exploration and exploration in the

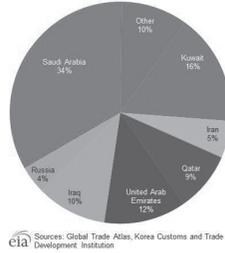
## Korea's Green Energy

### Yellow Sea.

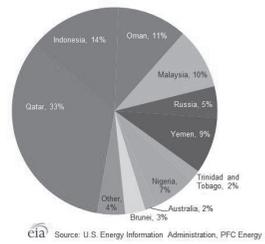
South Korea total primary energy consumption by fuel type, 2012



South Korea crude oil imports by source, 2013



South Korea LNG imports by source, 2013

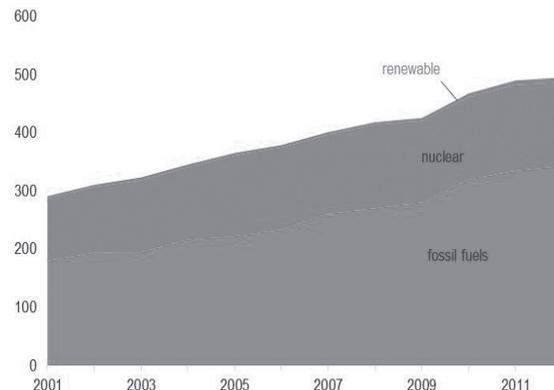


## U.S Energy Information Administration

Prior to 2012, and indeed to date, green energy has yet to play a key role in providing electricity, heat, or biofuel to Korean consumers.

South Korea's net electricity generation by type, 2001-12

billion kilowatt hours



## U.S. Energy Information Administration

(For comparison, selected countries and their renewable energies as % of end energy consumption in 2012: Sweden 52%, no nuclear; Finland 34%, no nuclear; Latvia, with capital Riga as one of three Baltic nations 35%, no nuclear; Austria 32%, no nuclear; Denmark 26%, no nuclear;

Greece 15%; Spain 14%, nuclear exit; Germany 12%, nuclear exit; and France 13%, reduction of nuclear.)

According to the Korea Energy Management Corporation (KEMCO) website, the governmental agency responsible for the implementation of energy conservation, policies, and energy efficiency, improvements in the development of green energy production in Korea can be described as follows.

The role of green energy has improved marginally from 2008 to 2015 in relation to conventional primary energy forms. Given the fact that these numbers include energy from waste treatment and hydro power, in terms of overall energy production, Korea's green energy was only 0.3% in 2008 and < 2% in 2015.

Status NRE acc. KEMCO				
		2008	2010	2015
Classical Green Energy	Thou. TOE	725	1498	4343
Solar thermal		33	40	63
PV		59	138	313
Wind		106	220	1084
Bioenergy		518	987	2210
Geothermal		9	43	280
Marine		0	70	393
Additional Korean count				
Hydro		946	972	1071
Waste		4688	5097	6316
Total Korean Count		6359	7567	11730
Primary Energy	Thou. TOE	247000	253000	270000
Classic Green Energy Share %		0.29	0.59	1.61
Green Energy Share Korean Count %		2.57	2.99	4.34

KEMCO Presentation

The overall energy situation of Korea is less than promising, especially

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with respect to energy security and CO<sub>2</sub> reduction activities.

The World Energy Council (WEC) published an index (Energy Trilemma Index) comparing the sustainability of the energy supply in 129 countries; Korea ranked 54th overall in 2014. However with respect to energy safety Korea ranked 98th (below Armenia, Latvia, and Thailand), and with respect to sustainability Korea ranked 85th (below Greece, the US, and Nigeria).

ENERGY TRILEMMA INDEX RANKINGS					
South Korea					
	2011	2012	2013	2014	TREND
<b>ENERGY PERFORMANCE</b>	73	72	85	70	↑
 Energy Security	92	89	103	98	↑
 Social Equity	39	32	49	25	↑
 Environmental Impact Mitigation	81	86	85	85	→
<b>CONTEXTUAL PERFORMANCE</b>	22	21	16	22	↓
 Political Strength	41	41	37	40	↓
 Societal Strength	27	26	26	31	↓
 Economic Strength	12	11	9	13	↓
<b>OVERALL RANK</b>	55	54	64	55	↑
Copyright World Energy Council 2015					

With respect to carbon dioxide emissions (2013), in a per capita emissions survey of over 200 nations, Korea place 22nd at ca. 12.3 t CO<sub>2</sub> and displayed a strong increasing tendency (Germany placed 36 with ca. 9.4 t CO<sub>2</sub> per capita with a tendency for reduction).

In 2008, low carbon green growth was proclaimed by former president Lee Myung Bak and in 2009 the target to reduce greenhouse gas emissions by 30% until 2030 was pronounced, and in the “Act on Low Carbon Green Growth” three main objectives were described:

- effectively deal with climate change and attain energy independence
- create new engines of green growth
- improve the quality of life in Korea

The succeeding president Park Gun Hye (February 2013) outlined major changes in the energy policy during the WEC that was held in Daegu in October 2013, and in stating that she acknowledges the challenge of the energy trilemma, she outlined ideas reflecting a move towards a creative economy, which means energy conservation and environmental protection by using ICT and new technologies.

A creative economy is a model that combines creative ideas, science, technology, and IT to achieve economic growth.

How is the present (i.e., Park Gun Hye) government dealing with this situation? Here is an outline of some of its more important aspects and measures. Notably, however, green energy as a means for energy supply and energy safety is not a focus of the government, as other issues play a more dominant role.

It is the present political strategy to accept a rise in overall yearly energy consumption.

Given the expectation of a annual economic growth rate of 2.8%, a sharp increase in single households from 24% to 34%, and a small growth in population of 0.17% p.a., the government expects a “business as usual scenario” with an increase in total primary energy of only 1.32% or of only 0.88% end energy (all consideration were made on oil prices of US\$ 100/barrel and higher). The highest increases are expected in electricity demand and heat energy, followed by city gas. The government explains that their measures and targets include how to moderate the yearly increase of energy consumption to less than 0.3% p.a. The government does not intend to reduce primary energy consumption, and no attempt has been made to find a solution for reaching an energy peak point.

The final value for green energy portion in the end energy is not explicitly expressed, though it can be estimated by adding the two values

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of 10% green electricity production (= ca. 6.0 Mio Toe) with 8.8 Mio Toe from other renewables. This total of ca. 14.8 Mio Toe should then be corrected by a significant portion of energy that is gained through energy processes.

The final order of green energy in the year 2035 will presumably range between 5% and 6% in terms of the end energy form.

Korea Energy Master Plan outlook and policies January 2014 (MOTIE)							
Business as Usual Model						Demand target	
Total Primary Energy (Mio Toe)			End Energy (Mio Toe)			in End Energy	
	2011	2035		2011	2035		2035
Coal	83.66	112.4	Coal	33.5	38.6	Political agenda: improved demand, management, price, tax adjustment, R&D expansion	34.4
Oil	105.1	101.5	Oil	102	99.3		80.3
Natural gas	46.3	73.3	City gas	23.7	35.3		33.8
Hydro	1.7	2	Electricity	39.1	70.2		59.9
Nuclear	32.3	70	Heat energy	1.7	3.3		3.2
Renewables	6.6	18.8	Renewables not electricity	5.8	7.4		8.8
Total	275.7	378.0	Total	205.8	254.1		Total
1.32% yearly increase			0.88% yearly increase			0.29% increase relative to 2011	

### Korea Energy Master Plan Outlook and Policies January 2014 (MOTIE)

On the supply side, Korean energy policies are almost fully focused on conventional energy sources and atomic power. An ever increasing demand is accepted and supply quantities will be increased with an increasing gap.

Consequently, for future developments the main focus is on the self-sufficiency rate for LNG (natural gas) and crude. Korea strongly supports overseas exploration activities through the Korea National Oil Corporation, the Korea Gas Corporation, and private companies. There is a strong regional focus on North East Asia, America, and Europe.

Dependency on the Middle East will be decreased. Efforts are also on ways to obtain a gas pipeline from Russia through North Korea to South Korea.

To motivate private investments in overseas resource developments, the government provides strong incentives and a fund that exceeds EUR 3 billion until 2017.

On the demand, side Korea has undertaken numerous actions to increase supply security by strongly increasing capacities in all disciplines, i.e., thermal/coal power plants, atomic power plants, LNG powered plants. To further increase the security and public acceptance for atomic power (electricity production and atomic power technology as a core business for the export of atomic power plant technologies) more efforts and resources will be allocated to this task.

## Electricity Supply

The key roles for electricity generation shall be played by coal and nuclear power plants. Interestingly, however, though no detailed discussions about the future role of coal-fired power plants are given in the 2nd master plan, the 6th plan can serve as a rough guideline.

The high proportion of green energy (20%) given in the 6th plan in 2013 is overruled by the new policy.

C. Generation Mix Outlook Installed capacities in MW, (6th basic plan for long-term electricity supply and demand, 2013)				
	2012	%	2027	%
Coal	24534	30	45444	28.7
Nuclear	20716	25.3	35916	22.7
LNG	20116	24.6	31794	20.1
Oil	4888	6.0	1249	0.8

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Pump Hydro	4700	5.7	4700	3.0
Renewables	4084	5.0	32014	20.2
RCS	2768	3.0	7434	4.7
TOTAL	81806		158551	

(6th basic plan for long-term electricity supply and demand, 2013)

At present in the US and China, there has been a strong decline in the use of coal as an energy resource between 2005 and 2013, about 10.0% of the power market. In the US, natural gas has become comparatively inexpensive and energy from wind and solar installations is gradually getting cheaper, and as such several major coal-related companies went bankrupt in 2013 and 2014. The US government is planning to further reduce the capacities of coal power plants in 2015 by 13 GW. China has also achieved a major step towards a more sustainable future, and its proposed increase of electricity consumption of over 7% coal consumption was reduced by nearly 3%. Worldwide, a decline in use of coal is expected as coal-fired power plants will no longer be deemed cost-effective. However, the measures for CO<sub>2</sub> storage described in the 2nd master plan are not yet commercially viable.

### Examples for intended new power plants

Coal-Fired Power Plants According to		Capacity in MW
Dangjin 9, 10	12/2015 – 6/2016	2 × 0.020
Samcheok 1, 2	12/2015 – 6/2016	2 × 1,000
Bukpyeong 1, 2	2/2016 – 6/2016	2 × 595
Taeon 9, 10	6/2016 – 12/2016	2 × 1,050
Yeosu 1	02/2016	350
Dongbu Green 1, 2	6/2016 – 12/2016	2 × 550
Sinboryeong 1,2	6/2016 – 6/2017	2 × 1,000
Yeongheung 7	12/2018	870
Sinseocheon 1, 2	12/2018 – 9/2019	2 × 500
G-project 1, 2	4/2019 – 10/2019	2 × 1,000

Tongyangpower 1,2	12/2019 – 7/2021	2 × 1,000
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(6th basic plan for long-term electricity supply and demand, 2013)

The intensive and aggressive increase of installed capacities (coal, LNG, atomic power) aims at providing for future summer and winter peak demands and the creation of sufficient reserve capacities.

To moderate the effects of greenhouse gas emissions by coal-fired power plants, the government intends to implement the latest power plant technologies, i.e., ultra-supercritical technologies (USCs), which is ultimately more a question of economics than of environmental protection and carbon capture storage technologies (CCSs).

In terms of CCSs, no data are provided in the 2nd master plan concerning the implementation of CCSs in Korea.

LNG Power Plants		Capacity in MW
Jangmun 1, 2	3/2015 – 5/2015	2 × 900
Dangjin 5	12/2015	950
Yeongnam	6/2016	400
Seoul 1, 2	9/2016	2 × 400
Daewooipocheon 1	10/2016	940
Yeoju	6/2017	950
Sinpyeongtaek 3	11/2017	900

Atomic Power Plants		Capacity in GW
Shin Kori 5, 6	12/2019 – 12/2020	1.4
Shin Hanul 3, 4	6/2021 – 6/2022	1.4
Shin Kori 7, 8	ca. 12/2023	1.5

(6th basic plan for long-term electricity supply and demand, 2013)

Despite the disaster at Fukushima, and the exit from atomic power of countries such as Germany, Switzerland, etc., the importance of atomic power remains strong. Indeed, Korea will increase its capacity by ca. 29%

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until 2035; in terms of total end energy consumption, the ratio will be about the same as today.

Numerous actions will be taken to improve the public image of nuclear power. In particular, investment into safety and safety related R&D will be continuously increased by 60% until 2023.

The safety first policy also applies to nuclear power plant (NPP) operation systems to improve planned preventive maintenance, the preemptive replacement of parts, the number of monitored items, and increase the standard maintenance period from 30 days to 35 days.

As an NPP exporter, Korea intends to develop world's highest security level NPPs, using relevant quality tests and verification procedures. To this end, new APR 1400 reactors are now being constructed and next generation reactors (APR+) will be developed.

A number of measures have been outlined in order to enhance the transparency and safety in state-owned organizations

A major aspect in the policy is the shift from feed-in tariffs to a renewable portfolio system (RPS-System) by which major suppliers (at present, 13 companies having installed capacities over 500 MW) of energy are obligated to provide a portion of green energy. A company can comply by the generation of green energy, buying green energy, or by acquiring green energy certificates. At the moment, however, some companies prefer to pay moderate penalties rather to comply with this regulation.

In dealing with the rising future demand in electricity, the Korean government intends to build numerous new coal-fired power plants based on latest technology; these high efficiency plants will be able to moderate CO<sub>2</sub> impact considerations and CO<sub>2</sub> storage capacities in line with how Canadian power plants are made, and efforts will be undertaken to develop a smart grid.

NRE Development According to 4th basic plan for NRE September 2014						
	2012	2014	2020	2025	2030	2035
NRE as % of total primary energy	3.2	3.6	5.0	7.7	9.7	11.0
Solar thermal	0.3	0.5		3.7		7.9
Solar PV	2.7	4.9		12.9		14.1
Wind	2.2	2.6		15.6		18.2
Biomass	15.2	13.3		19.0		18.0
Hydraulic	9.3	9.7		4.1		2.9
Geothermal	0.7	0.9		4.4		8.5
Offshore	1.1	1.1		1.6		1.3
Energy to waste	68.4	67.0		38.8		29.2
6th basic plan 2012 NRE share			8.4	11.3	12.3% (2027)	

4th basic plan for NRE, September 2014

By comparing the 4th basic plan for new and renewable energies September 2014 and the prior 6th basic plan for long-term electricity supply and demand (2012) it becomes clear that the present government has given up the target of green growth (compare differences in table above). At current rates, a major portion (67% in 2014) of the so-called green energy in Korea will be provided through waste to energy processes; hereafter, the role will be still significant. By correcting the target value of 11% by the portion provided through waste to energy, the final target value for green energy will be below 8%, and in the coming 20 years Korea will actually increase its greenhouse gas emissions.

### **Moderation of annual energy demand**

The government is essentially attempting to maintain a cheap energy policy in combination with moderation of imparities between different kinds of energy sources by using new taxation principles, while also trying to moderate the increase of negative environmental effects by using a number of measures. In addition to the RPS, among the most note-

worthiest include the following:

- a. Enhancing the distributed power generation, replacement of aged CHP, and installing large-scale facilities in suburbs of the capital, and improving the heat and electricity ratio. No considerations have been made to promote ORC processes that could effectively utilize waste heat in existing facilities.
- b. Launching new R&D initiatives, identifying more commercially viable R&D projects having a high potential for commercialization, cost-reductions, and diversification in the areas of geothermal, solar, and off-shore energies. Especially in the EU, technologies in these areas have already been developed, thus programs for effective cooperation would have a more immediate impact; for example, the development of large-scale biogas plants.
- c. To moderate the effects of climate change, the government intends to deploy the most efficient power plant technologies available. In the case of coal power plants, ultra-supercritical technologies shall be utilized, with carbon dioxide storage technologies (CCS) mentioned as a real future possibility; presumably, however, much higher costs for generation (+100%) must be envisioned.
- d. Fuel in Korea shall contain a minimum of bio fuel (2%), though it is questionable whether Korea can provide the necessary quantities by using national agriculture initiatives, or whether large quantities of biofuel will have to be imported.
- e. Under the expressed ROH renewable heat obligation, requirements shall be set for new buildings to use a share of heat from renewable sources. A first requirement (10%) for buildings with more than 10,000 m<sup>2</sup> in total floor space (except for residential and public buildings) will be set. (comment: no measures below 10.000 m<sup>2</sup>)

Produced by the Ministry of Trade, Industry and Energy (MOTIE), the english.motie.go.kr website states the following: the use of zero-energy buildings, which minimize power consumption through maximum insulation and achieve energy sufficiency by producing renewable energy, will be mandated for market-based public enterprises from 2017. This requirement will be extended to small administrative organizations such as community centers and post offices from 2020 for all public buildings, and from 2025 all private buildings shall be integrated. However, this is a very slow approach to an old and existing technology, and it remains to be seen whether these standards for the construction of zero-energy houses will provide advantages in the overall economics of buildings and whether public acceptance will create a higher standard of living in combination with reasonable costs for construction.

- f. In 2015, the MOTIE will implement a program to expand the market for eco-friendly vehicles and EV-related services. At present, the overall infrastructure for charging stations (**EV charging station, electric recharging point, charging point**) in Korea is absent; the MOTIE intends to install 5000 more charging stations in Seoul and Jeju Island. A total of 500 cars p.a. shall be sold to the public sector.

Subsidies will be available to private owners (ca. EUR 8000 / KRW 10 Million), with further tax reductions of up to KRW 4 Million.

- g. An interesting aspect of future energy policies is the intention of the government to introduce a customized electric rate system for the promotion of energy storage systems (ESS) and EV industries. An example is given for rate discounts during times of lowest power consumption.
- f. Finally, the government intends to install a demand management

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system. Among other features, electricity savings will be treated as resources, which will allow management firms to participate in the electricity bidding process. Under this proposal, buildings and factories can generate income by selling conserved energy to demand energy companies, inducing savings in the electricity market.

All intended measures have only been described in brief, no quantified data have been provided concerning the effects on CO<sub>2</sub> emissions or on energy savings potential.

Despite its numerous activities and programs, and given the target values of Korea's energy policies, it becomes clear that neither energy reductions nor CO<sub>2</sub> reductions can be expected. The main target has been to increase energy security, but this target will only be achieved by accepting higher CO<sub>2</sub> emissions in the future-Korea's position in terms of international rankings will most likely worsen in the coming years.

Korea, however, has not made effective use of existing opportunities, which include the aggressive use of thermal solar energy in existing buildings and the use of private initiatives to upgrade the energy levels of existing apartments or buildings. Another area of particular need and urgency is the utilization of the huge amounts of biogenic waste (food waste, agricultural waste, etc.) originating from sludge from city wastewater treatment plants.

It is recommended that the international community should address the energy issues in Korea with more attention, as Korea is an export driven economy. The effects of poor energy performance are therefore also exported with every piece of goods shipped abroad.

A significant improvement in energy security and the simultaneous reduction of CO<sub>2</sub> emissions can be quickest to achieve by two measures, even in the very short term; i.e., the systematic management of biogenic

waste and improving the energy value of existing homes.

In a longer view, Korea has a very interesting tidal flow potential, as Korea belongs to an area in the world where tidal energy could be easily harvested, due to its shallow western coastline and high tidal range.

### **Biowaste in Korea – a wasted opportunity**

Korea has a population of ca. 50,000,000 producing ca. 250 g of food waste per day, and this waste is presently collected separately. Food waste is rich in energy and can be easily converted into biogas/methane via reliable technologies currently available in Europe. As such, a biogas plant in Korea would be an interesting investment opportunity given the high prices for the disposal of food waste (50 to 100 EUR/t).

A payback of 4 to 5 years for the installation of a plant capacity of 200 t/d could easily be achieved. Together with other organic waste from slaughterhouses, fisheries, food processing, pig and cow manure, and sludge from city waste water treatment plants, within several years Korea could produce ca. 7–10 Mio Toe of methane, which corresponds to ca. 3% to 4% of the total primary energy of Korea.

Interestingly, the biogas process is accompanied by the production of substantial quantities of organic fertilizer. As such, the conversion of food waste alone would yield more than 200,000 t/a of fertilizer.

A further benefit is that there would be no disposal of food waste (organic waste from households, restaurants etc., which is collected in Korea separately) into landfills required.

### **Existing buildings a huge potential for generation of private and individual initiatives**

Most existing buildings have a high potential for energy improvements,

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which can be achieved in each and every apartment by initiative of the owner or tenant/renter. Typical measures include the installation of new windows, new entrance doors, or indoor wall insulation.

With these simple measures, energy costs can be reduced by over 50% p.a. in old apartments, but this effect would not be sufficient to justify private investment. Private investment must be triggered by a system and/or combination of incentives (funds, low interest rates, VAT exemptions, and income tax deductions).

Korea enjoys a much higher rate in solar radiation (20%) compared to Germany, and most notably also attains significant energy gains in winter—a situation that is very favorable for the installation of thermal solar panels. Many existing roofs are horizontal/flat, which makes installation cheap and highly cost effective, and integration into existing heating systems does not pose a significant technical problem.

Whichever program for existing buildings is created, the overall impact on the quality of living, CO<sub>2</sub> reduction, and most importantly on the labor market in Korea would be huge. The refurbishment of existing apartments or buildings requires skilled trades workers and is a significant opportunity for small entrepreneurial activities.

The international community shall address these matters, as the need for CO<sub>2</sub> reduction in Korea remains in place, and economic exploitation is possible. Indeed, the labor market in Korea would profit from some adjustments that could be easily added to the present policies and direction.

## **Conclusions**

The Korean economy will continue to further grow in the near future, and as such energy demands will also increase. Based on existing energy plans and strategies, there are also suggestions that the dependency on

coal, nuclear power, and natural gas will be stronger. Within next the 10 years, is it expected that there would be no significant expansion in green energy; consequently, there are no signs that greenhouse gas emissions will decrease.

The energy policy in Korea intends mainly to secure the energy supply by two measures: 1) to increase the self-sufficiency rate in oil and natural gas, and 2) to increase capacities in electricity production.

Korea cannot create a home market for green technologies by itself. Private investment and the concurrent development of Korean green technologies for Asia or the world market is not feasible for small companies to undertake without government support. For this reason, green technology as a business field remains in the domain of international players, with chances to create business opportunities for small or midsize companies not provided on a broad level, especially in times with moderate oil prices.

The present energy policies in Korea are not suitable for mobilizing private initiatives to build green power plants, as is the case in Germany in which over 50% of all green energy installations are in private ownership or accessible to citizens with smaller income via funds and other capital means.

It remains to be seen whether it will become possible for private efforts or governmental programs to moderate the yearly increase of primary energy consumption to 0.3% at an economic growth rate of 2.8% p.a.

No significant potential can be anticipated with the present master plan for electricity production from biowaste in Korea, especially in terms of immediacy at low cost. However, the construction of biogas plants would fit into existing energy policies to ensure higher security in the grid, increasing the peak time capacity. In addition, biogas plants would create new jobs and, above all, biogas plants with an investment volume of EUR 10 to 20 million could be an opportunity for further private

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investment.

On a longer term, the support for research in tidal flow conversion technologies could tremendously profit from improvements that could be applied directly on its coastline, as the geographic conditions in Korea are quite unique in the world.

The present Korean way will not lead to a sustainable national energy supply system or CO<sub>2</sub> reduction, as could be expected from an industrialized country that has a huge trade surplus and a low national debt. Nor will this path lead to the development of a broad range of new energy-efficient and sustainable technologies that are ready for export and international competition. Other key elements that are missing from existing national policies include the possibility to democratize the energy sector, the chance for broader small size entrepreneurship to be utilized, and incentives and education for private people to reduce energy consumption.

In summary: Korea continues to attempt to secure a more self-sufficient energy future by maintaining a similar conventional energy mix as in the past while operating in a more creative industrial economy system, working to maintain low costs for consumers/industry but at a higher cost for the environment.

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Problems and Perspectives

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