Energy Policy at a Crossroads in the Republic of Korea

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Foreword

Tackling climate change will not be possible without a significant contribution from Asia. According to economic forecasts, Asia's share of global greenhouse gas emissions will grow dramatically in the coming decades due to increasing population rates and relatively robust economic growth. At the same time, millions of people in the region will be affected by climate change. Serious environmental pollution has resulted from the burning of fossil fuels. Health risks due to air pollution already affect millions of Asians.

There is growing interest in renewable energy in many parts of Asia as a result of energy security and environmental concerns and the need to deliver electricity to energy-poor regions. With dropping renewable energy prices, there is growing investment in the sector in Asia. This makes it increasingly possible to talk about the beginning of energy transitions in the region. Greater use of renewable energy may lead to more socially and environmentally just energy structures. We still know little, however, about the actual social and political contributions, costs and implications of renewable energy expansion.

Friedrich-Ebert-Stiftung has examined these questions with a series of country studies in Asia. The studies looked at the political and social factors that drive—but also hamper—socially just energy transitions. The authors of each case study in China, India, Indonesia, Japan, the Philippines, the Republic of Korea, Thailand and Vietnam worked with Miranda Schreurs, Professor of Environmental and Climate Policy in the Bavarian School of Public Policy, Technical University of Munich, to provide in-depth analysis of the situation in their respective countries. Julia Balanowski, a climate change consultant based in South-East Asia, supported the preparation of each country study and their review.

Two important questions that motivated this comparative study were whether renewable energy development was contributing to a more socially just energy structure and which factors foster and impede political acceptance of renewable energy development. Each country case study provides insights on the status of climate and energy policies, their socioeconomic implications and the actors involved in developing and implementing the policies.

Energy policy in South Korea stands at a crossroads. The Moon government, which came to power in early May 2017, pledged to shut down aged nuclear power plants and coal power plants, to abolish plans for new reactors and to expand the share of renewable energy. If carried out, this energy transformation will create windows of opportunities for different stakeholders. We hope that the study provides a starting point for further debate and analysis and provides incentives for policy makers, academics and civil society to work together towards low-carbon development in South Korea and beyond.

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Abbreviations

KHNP	Korea Hydro and Nuclear Power Corporation
MPEDS	Master Plans for Electricity Demand and Supply
OECD	Organisation for Economic Co-operation and Development
TOE	tonnes of oil equivalent
TPES	total primary energy supply

1. Introduction

Energy policy in the Republic of Korea is at a crossroads. It dominated the issues in the 2017 presidential election campaign, with four of the five candidates pledging to achieve a nuclear power phase out, a coal-fired power phase out and the expansion of renewable energy use.

After Moon Jae-in won the election in May, he announced the essence of his "safe and clean energy policy", which he strongly pushed during his campaigning. He seeks to shut down aged nuclear power and coal-fired power plants, abolish plans for new reactors and expand the share of renewable energy up to 20 per cent by 2030.[1] Following that declaration, the Moon government established a Public Engagement Commission on July 26, 2017, to determine whether ongoing construction of two nuclear reactors, Shin-Kori 5 and 6, should continue.

In a July board meeting right before the establishment of the Public Engagement Commission, the Korea Hydro & Nuclear Power Corporation (KHNP) voted 11 to 1 to suspend the construction. The decision received a strong backlash from nuclear power proponents, including professors in nuclear engineering, electronic and energy-relevant fields, the KHNP labour union, conservative media, reactor construction companies and residents living around reactor construction sites who argue that the post-nuclear policy, including suspension of Shin-Kori 5 and 6 reactors, will lead to local employment decline, local economic damage and compensation problems for residents.

The Moon government also announced it would shut down 10 aged coal-fired power plants within its tenure. Because the country is struggling with air pollution, in particular problems related to a high concentration of particulate matter (fine dust) in the air, Moon further promised to temporarily shut down some coal-fired power plants during the spring season, when the adverse particulate matters are especially dense.

The Public Engagement Commission was given a three-month mandate, during which time it was to set up a group of representative citizen participants and draft rules for it to follow to reach public consensus on the fate of the two nuclear reactors. On October 20, 2017, the Public Engagement Commission submitted its recommendations to the government, based on deliberative survey of the group of representative citizen participants composed of 500 citizens who participated in orientation, e-learning process and three day workshop (finally 471 citizens). Its recommendations are composed of two: One is resuming the construction of Shin-Kori 5 and 6 reactors and another is gradual reduction of the share of nuclear power, nuclear phase out.

If carried out, these changes would be breakthroughs in the country's energy policy history. Previously, the centralized energy policy was based mainly on large-scale nuclear and fossil fuel power supply. The Moon government intends a paradigm shift from the conventional energy system toward an energy system in favour of renewable energy and natural gas. As well, the Moon government wants to shift from a central administration making all energy

[1] National Planning and Advisory Committee, *Five-Year Plan of State Administration* (Seoul: Government of the Republic of Korea, 2017).

policy decisions (at the exclusion of lay persons and even local governments) to a decentralized energy system based largely on renewable energy, new actors, new technologies and new regulations. In short, the Republic of Korea is taking the first steps in an unprecedented experimental stage.

This country case study explores the past and present energy policy paths and the related current policy development in the Republic of Korea. It further examines challenges to and opportunities for the country's ambitious energy transition.

2. Past and present energy and climate mitigation policy

1. The energy mix

In 2015, 287,479 million tonnes of oil equivalent (TOE) in primary energy were consumed in the Republic of Korea. Within that mix, petroleum accounted for 38.1 per cent, followed by coal (at 29.7 per cent), liquefied natural gas (at 15.2 per cent), nuclear power (at 12.1 per cent), new and renewable energy (at 4.5 per cent) and hydroelectric power (at 0.4 per cent), as shown in table 1. Energy consumption per capita was 5.64 TOE, and the country imported 94.8 per cent of its total energy that year.[2]

Table 1: Energy supply and demand in the Republic of Korea

Category	2015	% share
Primary energy (million TOE)	287,479	100
Coal	85,473	29.7
Petroleum	109,566	38.1
Liquefied natural gas	43,613	15.2
Hydro	1,223	0.4
Nuclear	34,765	12.1
Renewable energy	12,839	4.5
Final energy (millions TOE)	218,608	76 of TPES

Note: TOE: tonnes of oil equivalent; TPES: total primary energy supply.
Source: Ministry of Trade, Industry and Energy and Korea Energy Economics Institute, *Yearbook of Energy Statistics* (Seoul: Government of the Republic of Korea, 2016).

The country's population was 50.4 million in 2014 and slightly more than 51 million in 2015, ranking 26th in the world (table 2).[3] Its total primary energy supply (TPES) was 268.41 million TOE in 2014. The Republic of Korea is a power-intensive society: Total electricity consumption was 532.66 terawatt hours (TWh), which ranks it among the 10 largest energy-consuming nations worldwide.[4] Its per capita electricity consumption was 10.564 kilowatt hours (kWh) in 2014.

Table 2: Energy characteristics of the Republic of Korea, 2014

[2] Ministry of Trade, Industry and Energy and Korea Energy Economics Institute, *Yearbook of Energy Statistics* (Seoul, 2016).
[3] Korea Energy Economics Institute, *2016 Korea Energy Info* (Seoul, 2017a).
[4] International Energy Agency, *Key World Energy Statistics* (Paris, 2016).

Category	Number
Population (million)	50.42
GDP (million 2010 US dollars)	1,233
GDP (PPP) (million 2010 US dollars)	1,697
Energy production (million TOE	49.11
Net imports (million TOE)	232.84
Total primary energy supply (million TOE)	268.41
Electricity consumption (TWh)	532
CO_2 emission (million TOE of CO_2)	567.81

Note: PPP=purchase price parity.
Source: International Energy Agency, *Key World Energy Statistics* (Paris, 2016), accessed April 5, 2017.

In 2015, the Republic of Korea had a power generation capacity of 97,648,761 kilowatt hours (kWh) and 528,091 gigawatt hours (GWh) of power generation. Thermal power (at 60.3 per cent) and nuclear power (at 31.2 per cent) produced the most electricity. Renewable energy combined with hydro electricity and alternative energy accounted for 4.4 per cent, whereas the share of coal was 39.3 per cent in 2015.[5]

Table 3: Electricity capacity and generation in the Republic of Korea, 2015

Category	Electricity capacity		Electricity generation	
	(kW)	(% share)	(GWh)	(% share)
Total	97,648,761	100.0	528,091	100.0
Hydro	6,470,709	6.6	5,796	1.1
Nuclear	21,712,683	22.2	164,762	31.2
District energy	5,360,020	5.5	22,019	4.2
Alternative energy	5,649,367	5.8	17,318	3.3
Thermal	58,452,981	59.9	318,196	60.3

Source: Ministry of Trade, Industry and Energy and Korea Energy Economics Institute, *Yearbook of Energy Statistics* (Seoul: Government of the Republic of Korea, 2016).

The term "new and renewable energy" is used in the Republic of Korea instead of "renewable energy". "New energy" includes hydrogen energy, fuel cells, energy from liquefied or gasified coal and energy from gasified heavy residual oil. Renewable energy includes solar energy, wind power, water power (also hydropower exceeding 10 MW), marine energy, geothermal energy, bio energy and energy waste material. Based on its definition of new and renewable energy, total primary energy in 2014 was 4.5 per cent; but when applying the renewable energy categories as defined by the Organisation for Economic Co-operation and Development (OECD), it shrinks to nearly 1.1 per cent.[6] The gap is attributed to waste, which accounts for more than 60 per cent of new and renewable energy generation. Currently, waste includes waste heat from industries, which originates from fossil fuel.

2. Energy policy of the former government

[5] Ministry of Trade, Industry and Energy and Korea Energy Economics Institute, *Yearbook of Energy Statistics* (Seoul: Government of the Republic of Korea, 2016).

[6] Organisation for Economic Co-operation and Development, *OECD Factbook 2015–2016* (Paris: OECD Publishing, 2016).

The Basic Energy Plan and the Master Plan for Electricity Demand and Supply form the central strategy for energy and electricity planning in the Republic of Korea (table 4). The Basic Energy Plan provides the primary guidance on all areas relevant to energy and defines the direction of the mid- to long-term energy policy. With its macro perspective, it adjusts and guides the direction of sector-specific and local energy plans. The Basic Energy Plan is changed every five years, when the Ministry of Trade, Industry and Energy prepares a new draft, with consultation from the heads of topic-related central administrative bodies, followed by a public hearing. Confirmation is made through the consecutive deliberation processes of the Energy Commission (within the Ministry), the Committee on Green Growth and the Cabinet Council.

The Basic Energy Plan must include:

1. matters concerning trends and prospects of the domestic and overseas demand and supply of energy;
2. matters concerning measures for stable securing, import, supply and management of energy;
3. matters concerning the targets of demand for energy, the composition of energy sources, the saving of energy and the improvement of efficiency in the use of energy;
4. matters concerning the supply and use of environment-friendly energy, such as new and renewable energy;
5. matters concerning measures for the safety control of energy;
6. matters concerning the development and diffusion of technology related to energy, the training of professional human resources, international cooperation, the development and use of natural resources of energy and welfare in energy.

The first Basic Energy Plan was established in 1997 (1997–2006) as a requirement of the Energy Use Rationalization Act (article 4) and with a 10-year parameter. The second Basic Energy Plan, for 2002–2011, established in the Roh Moo-hyun government was cut short after the Lee Myung-bak government changed the legislation in 2006 to the framework Act on Energy, which included a 20-year parameter for the Basic Energy Plan. Due to the changes, the plan that was introduced for 2008–2030 was regarded as the “first” Basic Energy Plan. Thus, the most recent iteration is the “second” Basic Energy Plan, for 2013–2035, which was drafted by the Park Geun-hye government in January 2014 but under the revised law, now known as the Framework Act on Low Carbon, Green Growth.

Article 39 of the Framework Act defines the energy policy principles. The most recent Basic Energy Plan specifies six priority policy objectives: (i) changing energy policy towards demand-side management, (ii) establishing a decentralized generation system, (iii) harmonizing the environment and safety, (iv) strengthening energy security, (v) ensuring a stable supply for each energy source and the system as a whole and (vi) promoting energy policy across the population.

The Basic Energy Plan suggests that it seeks an energy policy transition. In reality, however, the Framework Act on Low Carbon, Green Growth pursues energy security as the overall target and prioritizes cheap energy prices for industry rather than pushing for the reduction of fossil fuels and increasing the share of new and renewable energy.

The Master Plan for Electricity is 15 years in scope and revised every two years by the Ministry of Trade, Industry and Energy. It covers the basic direction of power supply and demand, a long-term outlook of power supply and demand, a plan for power installations, the management of power supply and demand and other related matters. The Master Plan for Electricity aims to ensure the "stable supply of electricity", as article 25.1 of the Electric Utility Act requires. The first Master Plan for Electricity was established in 2002. The most recent, and seventh, iteration was introduced in July 2015 under the Park Geun-hye government.

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

	Basic Energy Plan	**Master Plan on Electricity Demand and Supply**
Applicable legislation	Framework Act on Low Carbon, Green Growth (article 41)	Electric Utility Act (article 25)
Governing entity	Government	Ministry of Trade, Industry and Energy
Duration	Revised every five years, with a 20-year scope	Revised every two years, with a 15-year scope
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	▪ Trends and outlook on energy demand and supply in the Republic of Korea and abroad ▪ Matters on stable introduction, supply and management of energy ▪ Goals on energy demand, energy mix, energy saving and energy efficiency improvement ▪ Measures on supply and use of eco-friendly energy, including new and renewable energy ▪ Measures on energy safety management ▪ Energy-related technology development and deployment, development of professional human resources, international cooperation, natural energy resource development and use, energy welfare, etc.	▪ Basic direction of electricity demand and supply ▪ Long-term outlook on electricity demand and supply ▪ Plan on power facilities and equipment ▪ Power demand management ▪ Other matters required for power demand and supply
Park Geun-hye government	▪ Officially announced the second Basic Energy Plan, 2013–2035, in January 2014	▪ Officially announced the seventh Master Plan, 2015–2029, in July 2015

Source: Yun Sun-Jin, "Korea's Nuclear Policy: Past, Present, Future," in *Environmental Policy in South Korea: Problems and Perspectives,* ed. Konrad Adenauer Stiftung (Seoul: Konrad-Adenauer-Stiftung Korea Office, 2015).

The Basic Energy Plan estimates energy demand by the target year and outlines the way to meet that demand. In the current plan, total energy demand is projected to increase by 1.3 per cent annually until 2035, which means an increase of 37.1 per cent over the base year of 2012. Electricity demand is projected to increase by nearly 2.5 per cent every year, to a total of 179.5 per cent by 2035. To meet the projected increase in energy and electricity demand, the previous government had planned to expand the share of nuclear energy to 29 per cent and new and renewable energies to 11 per cent of the primary energy mix in 2035. Hence, the goal of new and renewable energy share became even lower than in the first Basic Energy Plan of 2008, which targeted an 11 per cent share by 2030.

There is little progress in the current Basic Energy Plan, compared with previous versions. It reflects shifted emphasis on demand-side management and expansion of the decentralized generation system. However, nuclear energy was selected as an alternative power option to respond to climate change, justifying this choice with reduced greenhouse gas emissions and a reliant electricity supply. To reach the targeted share of 29 per cent of nuclear power of the TPES in 2035, five to seven additional nuclear reactors would need to be constructed, reaching more than double of the current installed capacity.

The core of the seventh Master Plan on Electricity developed under the Park Geun-hye government is construction of two additional nuclear reactors, also exclusively directed towards energy security. Under the guise of environmental concerns, nuclear energy was proposed as a "clean" energy alternative. This was asserted, despite strong resistance against nuclear energy during the period of the sixth Master Plan on Electricity—after the Fukushima Daiichi Nuclear Power Plant in Japan. To reflect the energy targets of the new government, the second Basic Energy Plan and the seventh Master Plan on Electricity both require fundamental revision.

Due to a reorganization of government agencies in March 2013, the ambits of commerce, trade and industry within the Ministry of Knowledge and Economy were shifted, along with foreign investment, resources and energy, into the Ministry of Trade, Industry and Energy. The Office of Energy Resources within the Ministry has responsibility for managing a stable and efficient supply and demand system and fostering the transition to an energy-efficient and environment-friendly economic structure.

The director general for the Nuclear Power Industry Policy (Nuclear Power Industry Policy Division, Nuclear Power Industry Management Division, Nuclear Power Export Promotion Division, Nuclear Power Plant Environment Division) sits within the Office of Energy and Resources, along with the New and Renewable Energy Division, which promotes the renewable energy policy (table 5). Compared with the director general for the Nuclear Power Industry Policy, the director general for Energy and Resources Policy has a weak foundation of governance. Now, the Ministry of Trade, Industry and Energy is in charge of the reducing the share of nuclear power and publishes a white paper on nuclear power with the Korea Hydro and Nuclear Power Co., Ltd every year.

The Office for Government Policy Coordination became the main authority of environmental and climate change policy in May 2016 during the Park Geun-hye government. When the Ministry of Environment was in charge of climate change administration, the climate change

response system was rather weak in coordinating ministries. For this reason, the Office for Government Policy Coordination of the Prime Minister acted as a control tower, which oversaw the reduction of greenhouse gases by ministries. The Ministry of Strategy and Finance, instead of the Ministry of Environment which originally was responsible for management of ETS, has established and coordinated policies related to the allocation of emission rights since May 2016 during the Park Geun-hye government. The Ministry of Trade, Industry and Energy, the Ministry of Agriculture, Food and Rural Affairs, the Ministry of Environment, and the Ministry of Land, Infrastructure and Transport manage greenhouse gas reduction within their own policy areas. In case of climate adaptation, each ministry is in charge of its own field but the Ministry of Environment plays a headquarter role. Currently, the Moon government has tried to rearrange climate policy authority to give more power to the Ministry of Environment.

Table 5: Administrative organizations of the Office of Energy and Resources in the Ministry of Trade, Industry and Energy

Office of Energy and Resources	Sub-organizations
Director General for Energy and Resources Policy	Energy and Resources Policy Division
	Energy Safety Division
	Resources Development Strategy Division
	New and Renewable Energy Division
Director General for Energy Industry Policy	Petroleum Division
	Gas Division
	Electric Power Division
	Electricity Market Division
	Coal Division
Director General for Nuclear Power Industry Policy	Nuclear Power Industry Policy Division
	Nuclear Power Industry Management Division
	Nuclear Power Export Promotion Division
	Nuclear Power Plant Environment Division
Director General for Energy Industry Policy	Energy Industry Policy Division
	Energy Industry Promotion Division
	Energy Demand Side Management Division

Source: Ministry of Trade, Industry and Energy, http://english.motie.go.kr/www/main.do, accessed April 5, 2017.

The government also established a number of public and semi-governmental agencies. Private energy companies are also subject to the government's regulatory and support frameworks, which have limited principles of free competition market. Government dominance in the energy sector is found everywhere. The government has created a number of systems based on planning, directing and controlling and has exercised strong control over the energy industry and the market by providing extensive regulation, administrative guidance and support.

3. The goal of climate change policy and current status

According to the Germanwatch Global Climate Risk Index, which indicates the level of exposure and vulnerability to extreme weather events, the Republic of Korea ranked 75th of 180 countries between 1996 and 2015. However, the industrial sector is energy-intensive and thus, the influence of changes in the energy sector on the economy will be substantial.

Especially, because the country has an export-intensive industrial structure, actions taken by the international market to combat climate change can impose pressure on Korean businesses.[7] Carbon dioxide (CO_2) emissions in 2014 totalled 690.6 million tonnes, of which energy-related CO_2 emissions amounted to 599.3 million tonnes, or 86.7 per cent. The energy sector together with industrial processes accounted for 94.7 per cent of total CO_2 emissions.[8] CO_2 emissions from fuel combustion ranked seventh in the world in 2014,[9] and the growth rate of emissions from fuel combustion put the country in second rank among OECD members from 1990 to 2014.

The Park Geun-hye government projected CO_2 emissions to reach 851 million tonnes by 2030. Greenhouse gas emissions in the energy sector are expected to increase by 1.32 per cent per year from 2013 to 2030, when it will reach 739 million tonnes, or 87 per cent of total emissions then. In the Intended Nationally Determined Contribution submitted in June 2015 for the Paris conference, the Park government targeted a greenhouse gas emissions reduction for 2030 at 37 per cent of its business-as-usual level.

Previous governments, especially the Lee and the Park administrations, regarded the expansion of nuclear power generation as a major strategy for climate change mitigation and developed plans to expand nuclear power. There are 24 nuclear reactors in operation in the country, with five more under construction and four being prepared for construction. This means a total of 33 nuclear reactors could be operable by 2027 if there is no permanent shutdown of all aged reactors (one, the Kori-1, has already stopped). The density of nuclear power reactors, calculated by comparing the capacity of nuclear reactor facilities to the area of national territory, is the highest in the world. The effects of an accident would be grave. The population living within a 30-km radius of the nuclear power plants in Kori is more than 3.8 million people, and in Wolsung it is 1.3 million people. Despite these risks, the Lee and Park governments promoted nuclear power as a major method of climate change mitigation with stable electricity supply and planned for further expansion with the argument that nuclear power has minimal CO_2 emissions.

The two former governments had included the construction of an additional 20 coal-fired power plants before 2025 in the sixth and seventh (current) Master Plan on Electricity. The 53 coal-fired power plants in operation have a generation capacity of 26,273.6 MW of electricity. The 11 coal-fired power plants under construction are expected to contribute 9,680 MW, and 9 plants that are planned will add 8,420 MW, increasing electricity generation capacity by 68.9 per cent. It is becoming increasingly difficult to maintain coal-fired power plants, which are the main sources of CO_2 emissions. Since the late 1990s, social interest in fine dust has increased; the Park government introduced special measures for dealing with fine dust in 2016, following regulations on PM2.5 in 2015. The country suffers from PM problems (PM10 and PM2.5), which derives from mainly from coal-fired power plants and diesel-powered automobiles. The expansion of coal-fired power plants stirred social

[7] Yun Sun-Jin, Ku Dowan and Han Jin-Yi, "Climate Policy Networks in South Korea: Alliances and Conflicts," *Climate Policy* 14, No. 2, 2014.

[8] Government of the Republic of Korea*, The First Basic Plan for Responding Climate Change* (Seoul, 2016).

[9] International Energy Agency, *Key World Energy Statistics* (Paris, 2016).

controversy due to the worsening air quality, especially in the spring season, when yellow dust and fine dust blow in from China.

To cope with the impacts of climate change, the Lee government proposed the reduction of coal-fired power when it announced a 2020 target in 2009. The Park government further proposed expansion of gas power generation along with new and renewable energy in 2015 in the Intended Nationally Determined Contribution. However, the reality was different. The fine dust along with the CO_2 emissions was caused by the expansion of coal power generation.

Ten of the 53 coal-fired power plants (2,845 MW) in operation are aged, having operated for more than 30 years, and will be phased out according to the Moon government. But 43 plants will be efficiently upgraded, and an additional 20 plants (about 18,100 MW) will be built as planned. According to the plan of the Park government, the proportion of coal-fired power plant capacity in the energy mix will be reduced, from 27 per cent in 2014 to 26.4 per cent in 2019. However, the installed capacity of coal-fired power plants will increase, from 26.3 GW in 2014 to 41.5 GW in 2029, and the proportion of coal-fired power generation will increase, from 36.6 per cent to 38.3 per cent during the same period. Thus, the Moon government has set a new goal to reduce coal-fired power plants, from 39.6 per cent in 2016 to 23.7 per cent in 2030.

The Moon government plans to accelerate the nuclear phase out. Gas power and renewable energy generation emit a relatively a small volume of pollution, but the cost of gas power generation is relatively high when compared with other energy sources. The Moon government also plans to increase gas power generation, from 22.4 per cent of the energy mix in 2016 to 38.4 per cent in 2030, and the share of new and renewable energy, from 4.8 per cent in 2016 to 20 per cent of electricity generation in 2030.

Global trends show a stagnant power demand, reduced coal power generation and the expansion of renewable energy and gas power generation.[10] As ambitious as the Moon plans seem, they are still an insufficient response to the climate change-related risks. The continued construction and operation of coal-fired power plants and the current small share and relatively less ambitious target for renewable energy go against the global trend. A low-carbon power generation structure based on liquefied natural gas and renewable sources has not been pursued due to the high cost of power generation. Yet, the process of conventional fossil-fuel energy generation does not reasonably reflect the social and environmental costs.

Energy consumption, especially power consumption, is steadily increasing.[11] Therefore, CO_2 emissions are also increasing as the supply increases to meet demand. Although, the growth rates of power demand have been slowing since 2011. Since the financial crisis that began in 1997, the electricity consumption growth rate peaked in 2000, at 11.8 per cent, and slowed to 2.4 per cent in 2009. It surged in 2010, to 10.1 per cent then fell to 0.6 per cent in 2014 and 1.2 per cent in 2015. Growth perked up in 2016, but only to 2.7 per cent.[12] At this point, it is

[10] British Petroleum, *BP Energy Outlook 2017 edition* (Paris, 2017).

[11] Korea Energy Economics Institute*, 2016 Korea Energy Info (*Seoul, 2017a).

[12] Ministry of Trade, Industry and Energy and Korea Energy Economics Institute, *Yearbook of Energy Statistics* (Seoul: Government of the Republic of Korea, 2016).

not easy to determine if this recent trend is a temporary phenomenon resulting from the stagnant economy or due to lower economic growth rates.

4. Present discussion on the energy transition in the Republic of Korea

It is remarkable that the energy policy became a national agenda because of the current government's unconventional approach. Even after the Fukushima nuclear disaster in 2011, there was not much change in energy policy for the Republic of Korea, despite its geographic proximity to Japan. Even though the incident contributed to greater awareness among Koreans regarding the risks associated with nuclear power and more active post-nuclear protests resumed, no significant change occurred in policy planning and implementation under the Lee and Park governments, which did not take the public's concerns seriously.[13] But even the public at large showed little real concern. During the 18th presidential election in 2012—in the wake of the Fukushima accident, energy policy was barely an issue. Comments from candidates at that time on the safety of nuclear power plants found no resonance with the voters. Which makes the campaign scene of 2017 particularly stunning for the dramatic shift, when, as previously noted, four of five candidates pledged the phase-out of nuclear power and the aged coal-fired power plants and expansion of renewable energy sources. Even though the Fukushima incident had little bearing on the previous election outcome, perhaps dangerous threats need critical mass or proximity. Described as the most powerful seismic activity in Korean history, with more than 500 aftershocks, the 5.8 magnitude earthquake that jolted the Gyeongju area in September 2016 shook the broader public. The earthquake's epicentre was only 28 km from the Wolsung nuclear power plants.

Midnight of June 19, 2017 was a historical moment in the country's nuclear power history. The first reactor built, Kori 1, was shut down permanently after 30 years of operation and 10 more years of life-time extension. Wolsung 1 is another reactor that reached its 30-year mark but is still operating, after a 10-year extension upgrade in 2015 prolonged its service until 2022, as declared by the Nuclear Safety Commission. That extension was granted amid great controversy. Residents around the reactor subsequently filed a lawsuit against the Nuclear Safety Commission. The Seoul Administrative Court cancelled the life-time extension after finding measures to secure safety were not sufficient. The Nuclear Safety Commission, supported by the KHNP, immediately appealed the decision. In July 2017, the Seoul High Court overruled the lower court and upheld the 10-year extension. Debate on that extension continues as does debate on the true costs of nuclear power.

Currently, five reactors are under construction. Construction of Shin-Kori 4 is almost completed. It will start commercial operation next year 2018. Construction of Shin-Hanul 1 and 2 is also almost done with completion rates of over 96%. Two other reactors, Shin-Kori 5 and 6, are about a quarter of the way into their construction, which has been suspended since President Moon took office due to the controversy and resumed on October 2017 based on recommendation of the Public Engagement Commission. If Shin-Kori 4 begins commercial operation, there will be seven reactors. If Shin-Kori 5 and 6 are completed, there will be eight reactors of 10,150 MW at one plant site. The Kori nuclear power plants would be the largest

[13] Sun-Jin Yun and Riley Dunlap, *Environmental Movements in Korea: A Sourcebook* (Seongnam, Republic of Korea: The Academy of Korean Studies Press, 2017).

in terms of number of reactors and installation density (and it is this installation around which some 3.8 million people live within a 30-km radius). Safe operation and management of reactors in the Kori-site require utmost policy concern.

The possible halting of Shin-Kori 5 and 6 and the nuclear phase-out policy ignited heated debate. Nuclear phase-out has more social support but the suspension of Shin-Kori 5 and 6 construction was controversial. Pro-nuclear professors and experts relevant to the nuclear power industry, to the KHNP labour union, reactor construction companies, workers of fuel manufacturing and residents around Shin-Kori 5 and 6 were resisting the Moon government's decision, while other experts and People's Action for Post-Nuclear, composed of environmental organizations, religious groups and consumer cooperatives, opposing the use of nuclear power were supporting the decision on nuclear phase-out. On October 20th 2017, the Public Engagement Commission announced the results of a three-month public discussion. 59.5% of the representative citizen participants agreed to resuming construction of Shin-Kori 5 and 6, and 40.5% of the participants had the opinion for stopping construction. However, 53.2% of participants recommended that the proportion of nuclear power plants should be reduced.

3. Challenges to the energy transition

1. Structure of the energy market and energy infrastructure

The energy market in the Republic of Korea is generally dominated by public corporations. In a period of reform, the power generation was divided into the Korea Hydro & Nuclear Power Co. Ltd and five affiliated power-generating companies. Power transmission and distribution are controlled and operated by the Korea Electric Power Corporation (KEPCO). Today, private companies can generate power but only after receiving approval from the Ministry of Trade, Industry and Energy. KHNP has a monopoly on the hydraulic power and nuclear power sectors.

The coal and natural gas markets are led by public companies (Korea Coal Corporation and Korea Gas Corporation). However, private companies can directly import natural gas for power generation. The supply of gas within urban areas is operated by a regional monopoly.

2. Low electricity prices and electrification of industry

The electricity pricing system is divided into six categories, by usage: residential, commercial, industrial, educational, agricultural and street lighting. The pricing is graded, with different tariffs based on the usage type. In 2017, electricity prices for recharging electric cars were set at cheaper rates to encourage greater use of electric cars.

Within the pricing system, residential electricity is the highest. As of 1974, the price abides by a six-stage progressive pricing structure based on amount used, at intervals of 100 kWh: stage 1 is for consumption of less than 100 kWh, and stage 6 is for consumption of more than 500 kWh. The price of 1 kWh at stage 6 is 11.7 times more than that of stage 1. Due to increasing complaints from households, the previous government lowered the progressive price system from six stages to three stages in December 2016: 0–200 kWh, 201–400 kWh and more than 400 kWh. The cost per kWh at the third stage is about threefold of the first stage.

In a 2014 study, the Research Institute of Energy and Economy found that consumers were generally willing to pay an additional 3,456 Korean won (3.10 US dollars) per month to use electricity generated from new and renewable energy sources. This was double the amount portrayed by a previous study, that found willingness to pay 1,500 Korean won (1.40 US dollars) per month. Further, consumers were willing to pay an additional 4,554 Korean won (4.10 US dollars) per month for the substitution of nuclear power generation with new and renewable energy sources and 4,005 Korean won (3.60 US dollars) per month for substituting coal-fired power generation with new and renewable energy source. This increase of interest in the safety and environment-friendly use of energy was attributed to the Fukushima nuclear power plant accident and the increasingly occurring ultrafine particle matter dust phenomenon.[14]

It is not easy to increase electricity prices because of the energy-intensive nature of the country's industrial sector. In 2015, the industrial sector consumed 62.5 per cent of final energy and 54.9 per cent of electricity generated. And despite consumers willing to pay higher prices for renewable energy, some people regard electricity as a public good that the government should provide at a cheap price. In 2015, electricity price for residential use corresponded to approximately 64 per cent of the OECD average price (89 per cent for the price of industrial electricity). The electricity price compared with other energy sources is rather low. As a result, electricity consumption is expected to soar, leading to increased electricity demand. Due to the rather low electricity prices, there is no incentive to improve energy efficiency.

Table 5: Comparison of electricity price in OECD countries

Country	Household		Industry	
	US$/MWh	OECD=100 (%)	US$/MWh	OECD=100 (%)
Republic of Korea	102.70	63.8	95.00	89.2
Germany	327.10	203.3	145.10	136.2
Italy	257.90	160.3	263.30	247.2
Japan	225.10	139.9	162.00	152.1
Norway	94.50	58.7	35.30	33.1
England	236.90	147.2	143.00	134.3
USA	126.70	78.7	69.00	64.8
OECD average	160.90	100.0	106.50	100.0

Source: Organisation for Economic Co-operation and Development and International Energy Agency, *Energy Prices and Taxes* (Paris: OECD Publishing, 2016).

The industrial sector uses the largest proportion of electricity among all types of consumption. In 2015, industry accounted for 55 per cent of total electricity used, while households accounted for 14 per cent. Although KEPCO supports conglomerates with cheap industrial electricity rates, in 2015, its annual sales revenue was 54 trillion Korean won. In 2016, KEPCO sales grew to 60,190 billion Korean won—the most revenue ever. KEPCO posted an operating profit of 12 trillion Korean won for 2015 and 2016.

[14] Currency conversion based on an exchange rate of 1 US dollar to 1,115.30 Korean won as of July 25, 2017.

Table 6: Electricity price for use purpose, 2015

Use purpose	Number (thousands)	Sales volume (million kWh)	Proportion (%)	Sales revenue (hundred million Korean won)	Proportion (%)	Sales prices (Korean won/kWh)
Household	14,419	65,619	13.6	81,162	15.0	123.69
Commerce	3,017	103,679	21.4	135,264	25.1	130.46
Education	20	7,691	1.6	8,707	1.6	113.22
Industry	397	273,548	56.6	293,826	54.4	107.41
Agriculture	1,638	15,702	3.2	7,429	1.4	47.31
Street light	1,673	3,341	0.7	3,788	0.7	113.37
Total	22,030	483,655	100	539,637	100	111.57

Source: Korea Electric Power Corporation, http://home.kepco.co.kr/kepco/main.do, accessed April 5, 2017.

Currently, 11 taxes are levied on energy. But those taxes on energy resources for power generation do not reflect external costs, such as environmental pollution and CO_2 emissions, and the standards and principles of tax levying on fuel are not clear. The taxation system is complicated, with insufficient taxation standards and principles. Electricity charges are subject to a value-added tax and a contribution to the electric power industry fund. A tax of 15.94 Korean won (1.43 US dollars) is added to the combined value of 11.64 Korean won (1.04 US dollars) per kWh and 4.3 Korean won (0.39 US cents) of total electricity bill for the electric power industry fund contribution. Thus, the tax portion of the electricity billing is slightly less than 12 per cent.

The low electricity prices are causing excess demand. The Republic of Korea is the only member of the OECD with electricity prices lower than the primary energy price. But there is no electricity tax item, and no taxes are imposed on uranium.

The tax on liquified natural gas is four times the tax on coal. This energy tax structure, which also does not reflect the environmental and social costs, is an obstacle to the energy transition. Uranium needs to be taxed to reflect the risks of nuclear accidents, nuclear dismantlement, environmental restoration and the disposal of spent fuel. To increase the use and share of liquified natural gas and renewable energy, it is necessary to include the social and environmental costs in the electricity bill. The government needs to change the electricity prices and the energy tax system.

Table 7: Energy tax on electricity, August 2016

Energy category	Total tax (Korean won)	Price (Korean won)	Tax share in price (%)
Gasoline (Korean won/litre)	873.35	1,275.93	68.84
Diesel (Korean won/litre)	642.91	1,074.54	59.83
Liquified natural gas (Korean won/cubic m)	110.38	709.05	15.57
Bituminous (Korean won/kg)	24.00	-	-

Electricity (Korean won/kWh)	15.94	128	12.45
Heat (Korean won/Mcal)	6.61	72.66	10

Source: Korea Energy Economics Institute, *2016 Korea Energy Info* (Seoul, 2017a).

Transportation-energy-environment taxes are imposed on fuels. However, not only do the transportation-energy-environment taxes have limitations in terms of tax payment, but the distribution of the tax to the transportation, energy and environment sectors is 80 per cent, 3 per cent and 15 per cent, respectively, prompting the majority of taxes to be spent on transportation infrastructure construction and maintenance rather than on environmental damage caused by energy use or climate change mitigation and adaptation. It is important to adjust the proportion of the annual expenditure of the tax so that more is allocated to the environmental and energy sectors, where the money can be used for environmental improvement, climate change response and energy transition.

In addition, the ratio of gasoline to diesel is 100 to 85. Cheaper prices for diesel promote more use of diesel cars leading to air pollution including ultra fine particles. The average ratio of OECD countries is 100:91. There are still controversies around adjustment of relative prices of gasoline and diesel in South Korea.

3. Changes in employment structure and systemic resistance from the pro-nuclear camp

The nuclear supply expansion policy as a response to climate change impacts is the biggest disabling factor for an energy transition. Actors in the nuclear power plant sector are even called a “nuclear mafia” in reference to their widespread presence in the government, industry, academia, research and even the media, through which they lead with public opinion in favour of nuclear power expansion to influence government policies. Nuclear is the only energy source that has an agency for promotion of its use, called Korea Nuclear Energy Agency (KNEA) whose Korean name is Korea Nuclear Culture Foundation. The KNEA has spent more than 5 billion Korean won (about 5.6 trillion US dollars) per year for nuclear advertisement, funded by Electric Power Industry Basis Fund paid by electricity consumers with 3.7 per cent of the electricity fee.

Coal-fired thermal power plants that are expanding are also disabling elements for the energy transition. Those that are being constructed or scheduled for construction are generally 1,000 MW in capacity, and total installation capacity of the newest 20 coal-fired power plants is 18,100 MW in capacity. If the environmental costs, especially the climate costs due to CO_2 emissions, are not properly accounted for, the construction of coal-fired thermal power plants will make the energy transition difficult due to the large number of employees and the long lifetime of the facilities.

The previous Park government, through its first climate change response plan, in December 2016, announced the intention to create 100 trillion Korean won of new markets and create 500,000 jobs by 2030 by focusing on new energy businesses. No detailed plan was ever followed. In November 2016, labour unions within the energy industry established an Energy Policy Network (EPN) to discuss major topics related to “energy democracy”, energy fundamental rights, energy welfare and the “just” transition of the conventional energy system toward a sustainable one. They insist that the issues of creating green jobs through an

energy transition and the socially and economically just transition of the energy system are not sufficiently discussed in terms of social needs. EPN has 50,000 members working for 34 labour unions of public energy corporations. Job transition programmes, including re-education and training, are required for a socially and economically just and smooth job transition. However, one EPN member, the KHNP labour union, opposes suspension of Shin-Kori 5 and 6 construction only because of the impact it would have on the employers of the construction companies contracted to build Shin-Kori 5 and 6. Finally, the KHNP labour union and the labour union of the Korea Electric Power Corporation (KEPCO) left the EPN in the process of public engagement process on Shin-Kori 5 and 6 reactors.

4. Potential of energy efficiency and renewable energy

Decreasing energy consumption through energy conservation and efficiency improvement and increasing the use of renewable energy are important methods of climate-sensitive energy use. After a peak in 2010 at a rate of 10.1 per cent, the trend suggests that annual growth rates of electricity consumption have slowed down: 4.8 per cent in 2011, 2.5 per cent in 2012, 1.8 per cent in 2013, 0.6 per cent in 2014 and 1.3 per cent in 2015. The projection by the former government, on an average growth rate of 2.2 per cent of electricity consumption by 2029, has not borne out since 2013. The new government released renewed projection of electricity demand by 2030 in order to prepare the 8th Master Plan on Electricity Demand and Supply, in which electricity demand in 2030 was reduced 11.3GW from 113.2GW to 101.9GW.

The "energy consumption value (TOE per 1 million US dollars)", as the national index of energy efficiency, had a slightly improving trend from 2008 to 2014. The energy consumption value is the same as energy intensity, which is the amount of primary energy consumption used to create one unit of GDP. It has since improved, moving from 0.204 in 2008 to 0.198 in 2014. The second Basic Energy Plan established by the Park government in 2013 proposed the goal of reducing final energy consumption by 2035 by 13 per cent and electricity consumption to 15 per cent, in relation to the business-as-usual level.

When looking at the proportions of power generated by new and renewable energy in 2014, waste led the pack, at 60.6 per cent, followed by biomass, at 15 per cent, solar energy, at 10.7 per cent, hydraulic power, at 5.8 per cent, wind power, at 3.6 per cent, fuel cell, at 2.9 per cent and ocean energy, at 1.3 per cent.

The Park government, in the second Energy Basic Plan, announced that it will decrease the proportion of waste to 47.3 per cent among primary energy sources by 2020 to 29.2 per cent by 2035, although it will still contribute the largest proportion of energy. The Park government planned to expand new and renewable energy sources by 2035 with the following targets: waste at 29.2 per cent, wind power at 18.2 per cent, biomass at 17.2 per cent, solar energy at 14.1 per cent, geothermal heat at 8.5 per cent, solar power at 7.9 per cent, hydraulic power at 2.9 per cent and ocean energy at 1.3 per cent. The four new and renewable energy sources with the highest potential for expansion at that time are waste, wind power, biomass and solar power.

The proportion of new and renewable energy supply in relation to primary energy sources was 4.3 per cent in 2015. When the government at that time created the second Basic Energy

Plan and the fourth New and Renewable Basic Energy Plan in 2014, the share of the new and renewable energy supply among the primary energy sources was targeted at 11 per cent by 2035. This goal and this approach, however, are inadequate due to the provision for "new and renewable" rather than renewable energy only because it goes beyond the boundaries of renewable energy used by the international community.

The Moon government upgraded the target to a 20 per cent share of renewable energy among electricity generation by 2030. A specific plan will be prepared in 2018 when the government will start to develop the next 3rd Basic Energy Plan.

A renewable energy portfolio standard was introduced in 2012. Power producers that have generating facilities of an installed capacity that is more than 500 MW are required to produce a minimum proportion of their output using new and renewable energy sources. The renewable energy portfolio standard is ensured by the circulation of renewable energy certificates. Power generators can purchase renewable energy certificates to meet their obligatory new and renewable energy supply target. Renewable energy certificates are issued based on the weighted new and renewable energy supply.

In January 2017, the Park government began to give more weight to renewable energy certificates of new and renewable energy projects in which local residents participate to construct solar photovoltaics of more than 1 MW and wind power plants of more than 3 MW. "Local residents" are defined as households who have lived within 1 km of the facilities for more than one year. More than five local residents must participate in, and investment of one participating resident should not exceed 30 per cent of the total investment of the group. If these conditions are fulfilled, the renewable energy certificates of the project have more weight. If local residents more than a 10 per cent stake and share more than 2 per cent of total project costs, a 0.1 renewable energy certificate weight is given. If local residents hold more than a 20 per cent stake and share more than 4 per cent of the total project costs, a 0.2 renewable energy certificate weight is given. The higher that the renewable energy certificate weight is, the greater will the monetary return be.

The required supply amounts of the energy portfolio standard started at 2 per cent in 2012, and the goal is to reach 10 per cent after 2023. But it is difficult for the energy portfolio standard to ensure the safe investments of power suppliers, and there are disadvantages for the small-scale new and renewable energy power suppliers with weak competitiveness. There is talk of restoring a feed-in tariff—at least for the small-scale solar energy generating facilities with less than 100 kW.

In November 2016, the Park government introduced a 20-year long-term fixed pricing system for the solar energy market to take effect in 2017. Prices as well as the renewable energy certificates are to be fixed through contract between the energy portfolio standard's obligatory companies and renewable electricity generators. This new approach is favourable to renewable electricity investors because they see it as stabilizing profit gains. However, the government adopted a maximum price that will preclude renewable electricity generators to realize their targeted profit. Also, the government increased support for residential solar panel subsidies from 20 per cent to 50 per cent and increased support for mini solar panels by adding 25 per cent government support to the 50 per cent local matching fund. Rooftop

rental fees are expected to decrease by one tenth. These new policies are perceived as helping expand the use of renewable energy and should be more aggressively pushed forward. More policies are expected to follow, in line with the Moon government's intention to promote the development of renewable energy.

5. Isolated grid system and the possibility of stable power supply

Energy is supplied to almost 100 per cent of the population. The expansion of power supply facilities with grid infrastructure occurred in the Republic of Korea the fastest out of all the OECD countries. With the lowest electricity prices, electricity service can be easily accessed in comparison with other countries. The prices of electricity for industry are also much cheaper than in other OECD countries, which helps keep its consumption continuously growing.

The Republic of Korea is a peninsula country but seems more an isolated island due to divisions with its northern neighbour, which causes difficulties in connecting electricity grids, oil pipelines and gas pipelines with other countries. This makes energy security an important issue. For example, because natural gas needs to become imported by ship, its price in the Republic of Korea is relatively more expensive than in countries that import through a pipeline.

There are gas exchange markets, such as Singapore SGX, Shanghai SHPGX and Japan JOE. In China, Pipeline Natural Gas is linked and has a large market size. Because the Republic of Korea has a rigid trading system, Pipeline Natural Gas is not linked and a gas exchange has not yet opened. With the global gas market transformed into a buyers' market, rigid gas contract conditions are improving. Korea-China-Japan cooperation is in progress to eliminate the obstacles to free gas trading, such as destination clauses to resolve the three countries' Liquified Natural Gas issues in North-East Asia. Since a summit of the Republic of Korea, China and Japan in 2015, the government has been strengthening cooperation on gas issues. In 2017, a memorandum of understanding for the abolition of the destination clause between the representative companies of the three countries will be pursued. With the Republic of Korea importing only liquified natural gas, it is a valuable option to introduce Russian gas into another transport system called Pipeline Natural Gas.

Therefore, the Park government planned to resume the discussion of a gas pipeline connecting the Republic of Korea, the Democratic People's Republic (DPR) of Korea and Russia. Under the premise that the inter-Korean relations will be improved in the near future, it will be used as a bargaining card in China in the short term to induce DPR of Korea to cooperate with the South-North Korean gas pipeline and to use it to enhance negotiating power in Russia.

Jungeui Son, President of Soft Bank Group in Japan, proposed an "Asia Super Grid" that produces electricity from wind and solar energy in the Mongolian deserts and transmits electricity to Japan and Korea. If the super grid project is pushed forward, it may cause a change in energy source from fossil fuel or nuclear power to renewable energy. However, it may also cause problems in terms of whether dependency on energy imports can be avoided and the stability of energy supply can be secured.
If the Republic of Korea can get out of its energy island without grid connection with other countries, an alternative to nuclear power can be found. If the rich water resources in the Russian Far East and the wind power generation in the Inner Mongolia region are supplied to

the country, the nuclear power plants to be built can be minimized. This approach, however, does not offer energy supply security. More progressive option is energy efficiency improvement and expansion of renewable energy. Application of information and communication technology to renewable-based decentralized system together with weather forecast will reduce electricity loss while responding to fluctuation of electricity demand.

4. Opportunities for an energy transition

1. Social acceptance of electricity charge rise

Nuclear power generation, thermal power and diesel cars are increasingly losing support among consumers, most probably due to a raising awareness of the consequences of nuclear accidents, a global trend towards sustainable energy and domestic phenomena, such as worsening air pollution and the occurrence of earthquakes.

According to the nuclear power consumer awareness survey conducted in August 2016 by the Nuclear Power Energy Agency, 75.4 per cent of the respondents agreed on the necessity of nuclear power, but only 38 per cent agreed on its safety. The general perception is that nuclear power is a necessary evil that is not safe but nothing can be done about it. Only 28.4 per cent of respondents agreed on the extension of nuclear power plants, 38.2 per cent agreed with maintaining the status quo, and 29.5 per cent wanted the share of nuclear energy reduced. These findings are contradicted with another survey before the Fukushima nuclear accident, in which the majority of respondents agreed on expanding nuclear power generation. In general, 60.8 per cent of respondents agreed on the use of nuclear energy, with 11.7 per cent of respondents wanting the country to rely on nuclear power. Some 76 per cent of respondents disagreed, stating that new and renewable energy sources should be dominantly used.

In an effort to accelerate the energy transition, public perceptions were surveyed in June 2017. Just as the 2014 study found,[15] consumers are willing to pay for renewable energy (table 8): 83.6 per cent of consumers said they favour the Moon government's energy transition policy, and 65.6 per cent of consumers are in favour of higher costs on the electricity bill if the money is used towards the energy transition.

Table 8: Willingness to pay for renewable energy

Category	Agreement (%)	Opposition (%)
Energy transition	83.6	12.3
Old nuclear power plant shut down	74.7	20.6
New nuclear power plant construction to stop	49.8	41.1
Coal power plant early shut down	79.8	15.9
New coal power plant construction to stop	70.2	22.9
Additional payment of electricity bill	65.6	15.4

Source: Korea Gallop, *Public Opinion on Energy Policy* (Seoul, 2017).

[15] Korea Gallop Poll, *Public opinion on energy policy* (Seoul, 2017).

2. Integrated energy and climate change national plans

The energy sector is managed by the government through the Basic Energy Plan, with sector-specific plans deriving from it. For the types of energy sources, the following plans exist: Master Plan on Electricity Demand and Supply, Long-Term Natural Gas Supply Plan, Coal Long-Term Plan, New and Renewable Energy Technology Development and Dissemination Plan and the Oil Reserve Plan and Resource Development Abroad. There is also the Mineral Resources Development Basic Plan and the Energy Usage Rationalization Basic Plan.

There is a Five-Year Plan for Green Growth. The most recent one published in 2014 to systematically implement the National Strategy for Green Growth, which the Lee government had introduced in 2009. The first Five-Year Plan for Green Growth aimed for the country to be among the top seven countries by 2020 and among the top five countries in the world in terms of green growth. The plan presented strategies for climate change response and energy self-sufficiency, creation of a new growth engine, quality of life improvements and national status improvement. The 2014 Five-Year Plan for Green Growth under the Park government talked about people's happiness and the harmonized development of the economy and the environment. It presented three policy targets: establishment of low-carbon economic and social structure, realization of a creative economy through green technologies and building the basis of safe and comfortable life from climate change. However, these plans were initiated by the government without public discourse or consumers' participation. In particular, the Park government proposed a creative economy instead of green growth; there was little concern for green growth after the Lee government.

The government follows a basic plan for responding to climate change, that is 20 years in scope and revised every five years. In 2016, the first Framework Plan for Response to Climate Change (2017–2036) was established. The basic plan's response to climate change threats is a focus on greenhouse gas reduction. It is also in conflict with the Five-Year Green Growth Plan, the Basic Energy Plan, climate change adaptation measures, the 2030 Greenhouse Gas Reduction Implementation Roadmap and the Emissions Trading Scheme Basic Plan. The lack of coherence is attributed to the lack of coordination among energy- and climate change-related government plans. To cope with the future of climate change threats sufficiently, a change in governance is required to achieve an integrated energy and climate change policy and to convert to a carbon-neutral energy economy.

The Kim Dae-jung government established the Presidential Commission on Sustainable Development in 2000, reporting to the president. Through that commission, the Framework Act on Sustainable Development was drafted and enacted by the government in 2007 during the Roh Moo-hyun government. But the 2010 enactment of the Framework Act on Low Carbon Green Growth rendered the Framework Act on Sustainable Development and Framework Act on Energy ineffective. It resulted in not only a disruption of the legal system, but also in few legal and institutional infrastructure for sustainable development. Thus, the legal basis of the energy and climate change policy is the Framework Act on Low Carbon Green Growth, and the Committee on Green Growth is the centre of the administrative organization.

There is little worldwide case of such a range of content, including greenhouse gas, energy, land, environment and economic growth, in one law. Under this legal system and

administrative organization, the country's energy and climate change policies are integrated but are trapped in the paradigm of low-carbon green growth still adherent to growth by using the environment as instruments for material well-being and have not achieved the ecological transition of the economy and energy. The National Energy Commission was changed to the ministerial level of Energy Committee under the Ministry of Knowledge and Economy by the Lee government in 2010.

The Moon government plans to restore the previous legal position of the current sustainable development law and energy law into the Framework Act on Sustainable Development and the Framework Act on Energy, respectively. This approach gives more concern to sustainability issues and, consequently, attempts to integrate the topics of energy transition and climate change.

3. Growth of local government and civil society participation in the policy-making process

The actors participating in the energy policy process have increased over the years in both numerical terms and in terms of their interactions. The energy policy process, which originally was in the hands of economic development bureaucrats, is led by the central government. Increasingly, social and ecological issues are raised that link to energy use, such as environmental degradation, energy security, affordability, and the adverse impacts of climate change. Energy companies and civil society now have joined the energy policy process. Local energy transition movements led by citizens and local governments are on the increase.

Local governments have introduced energy efficiency improvements and renewable energy expansion policies closely related to the climate action plan. And 56 local governments (12 municipalities and 44 lower-level governments) have joined the International Council for Local Environmental Initiatives, in which Seoul Mayor Park Won-soon chairs currently. Supported by the international climate change negotiations, local governments are becoming more active in their response to the impacts of climate change. In February 2012, 45 municipalities (the 46th joined later) declared themselves a “Nuclear-Phase Out Energy City”, with ambitions to reduce energy consumption through conservation activities and efficiency improvements and to expand the use of renewable energy towards a nuclear-free society. In April 2012, the city of Seoul initiated the “One Less Nuclear Power Plant” campaign; the first phase (April 2012 to December 2014) targeted the reduction of conventional energy consumption by 2 million TOE, which is equivalent to the power generated by one nuclear power plant, mainly through household engagement in energy savings and renewable energy generation. The target was accomplished in June 2014, six months ahead of schedule, mainly through household engagement in energy savings. Highlighting the three core values of energy self-sufficiency, energy sharing and energy participation, the government of Seoul launched the second phase (August 2014 to December 2020) with targets of energy consumption reduction and increase of renewable use of 4 million TOE, electricity self-supply rate of 20 per cent and greenhouse gas emissions reduction of 10 million tCO_2.[16] In June 2015, the provincial government of Gyeonggi-do (province) launched its Energy Vision 2030, and in November 2015, the city government of Seoul and the provincial governments of Gyeonggi-

[16] Yujin Lee, *One Less Nuclear Power Plant: From energy consumption city to energy production city* (Seoul: The Seoul Institute, 2016).

do, Chungcheongnam-do and Jeju-do announced a Joint Declaration for Local Energy Transition, which are estimated successful than any other energy transition movements in other regions.

The majority of activities for energy transition are based on power saving through energy conservation, efficiency improvements and on the establishment of small-scale solar power plants. Civil society, lower-level governments and households are the main change agents of an energy transition. Among the non-government organizations, the Energy Alternatives Center declared the necessity of a post-nuclear energy transition at an early stage. The Energy Alternatives Center, established in 2001, was affiliated to the Federation for Environmental Movement, which is the country's largest environmental movement group, but it became an independent organization in 2003 and changed its name to Energy Transition in 2005. This organization established the first citizen solar photovoltaic power plant in the Republic of Korea and made continuous efforts to construct more power plants with citizens and members. Individuals who recognized the necessity of an energy transition donated funds to build small-scale photovoltaics. Environment-related organizations of the four major religious groups (Catholic, protestant, Buddhist and Won Buddhist) have constructed solar photovoltaic power plants and created power-saving movements. Even though specific doctrines of all religions are different, all of them share ecological values and recognize the necessity of energy transition..

5. Conclusion

This is the energy crossroads where the Republic of Korea now stands. The Moon Jae-in government, which was elected in May on a pledge to phase out coal-fired and nuclear power generation and bring renewable energies to a large scale, has taken the first steps to implement its promises. For the energy transition to be carried out, several changes are crucial: First, with the energy sector responsible for a large part of the country's greenhouse gas emissions and due to its energy-intensive industry sector, policies that further emphasize demand-side management and strengthen the expansion of renewable energy are essential. Second, more policy engagement to support citizens' involvement to push an energy transition are required. This should be integrated into a major awareness-raising approach—many consumers believe that nuclear power is inevitable to meet the high power demand, although they are aware that it is not a safe solution. However, the recent public engagement on the construction of Shin-Kori 5 and 6 reactors revealed public consensus on the reduction of nuclear power in South Korea. The Moon government's energy transition policy can be aggressively promoted based on the deliberative decision-making process.

Further, there should be proper taxation on energy use, especially electricity. Koreans tend to call the electricity bill an "electricity tax." Koreans think electricity is a kind of public goods what should be provided by the state, not a commodity, because the public utility KEPCO had monopolized the electricity generation market for long time. To expand renewable energy generation and use, it is necessary to add environmental and social costs that occur from fossil- and nuclear-based energy generation into the electricity prices that consumers pay. One option the government can take is to impose fuel taxes on electricity. Currently, the amount of the tax placed on bituminous coal is not high enough, and there is still no tax on uranium. This situation is unfavourable for renewable energy and natural gas-fired power

plants because their costs are higher than bituminous coal-fired and nuclear power facilities in spite of their relative less negative impacts on the environment and communities.

For an energy transition to be possible, it is imperative not to expand nuclear power plants anymore. In terms of nuclear power density (nuclear power installation capacity divided by national land area), the country ranks first in the world. In addition, the nuclear risk in reactor-located areas is more intensive than in other countries. There are 11 locations (6 per cent) with more than 6 reactors among the 187 locations where nuclear reactors operate in the world. In the Republic of Korea, however, all its nuclear power plants have more than 6 reactors, which means the nuclear power-relevant risks are more intense. The Kori nuclear power plant currently under suspended construction will be the most nuclear-dense area if the construction of Shin-Kori 5 and 6 reactors completed, with 10 reactors and a capacity of 11,500 MW.

The country's nuclear reactors are aging. Only one has been shut down, with 11 more reactors whose life span will run out before 2030. Thus, decommissioning will be a critical field, especially because the technology has not been properly developed in the country. There are arguments to use the decommissioning work as an opportunity to lead the international decommissioning market. The KHNP stated its will to develop decommissioning technology, but there has been little investment in developing the technology and no experience in decommissioning. An agreement on the methods for disposing spent fuel has not been reached, and the publicity on spent fuel disposal is inadequate. The on-site storage facility for spent fuel is expected to be saturated from 2019 onwards, and thus more aggressive countermeasures must be arranged. However, resistance from the pro-nuclear camp, including the KHNP labour union, has been strengthening. More jobs are needed in the field of energy efficiency improvement and renewable energy and a smooth job transition must be ensured to counter some of that resistance.

The Moon government now needs to develop energy transition scenarios and a road map to achieve the pursued phase out of nuclear and coal and to start the huge transformation. It will be important to realize good energy governance in which various actors participate in decision-making processes. In particular, actors from civil society and local governments must be included in energy decision-making. Previous central governments monopolized the energy decision-making power while excluding these actors. As the energy system develops more towards decentralization, the participation of local actors, including local governments, local residents and local NGOs, must increase. The Moon government recognizes this necessity. And last, the country's ongoing energy experiment needs global attention by presenting the ambitions and achievements of the Moon governance on the international stage, especially in the context of the Paris Agreement, but also by enhancing the exchange with other pioneering energy transition countries.

6. Recommendation for Friedrich-Ebert-Stiftung

Germany's success story might serve as a role model to be introduced to the Republic of Korea. Knowledge on how financial resources for energy transition were prepared and what methods were used to vitalize the participation of both citizens and businesses would contribute in a significant way to the country's energy transition.

Friedrich-Ebert-Stiftung should consider supporting local governments, including Seoul metropolitan government, the Gyeonggi-do provincial government, the Chungcheongnam-do provincial government and the Jeju-do government, by building up their capacity for new tasks and roles in relation to a decentralized energy system. Energy or environmental NGOs and NGO-based research institutes, such as the Energy and Climate Policy Institute, the Institute for Climate Change Action, the Citizens' Institute for Environmental Studies and the Green Energy Strategy Research Institute, are suitable cooperation partners for fostering the Korean clean energy transition.

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Energy & Climate Policy Institute: http://enerpol.net/english/
Green Energy Strategy Research Institute: https://re100.modoo.at/
Greenhouse Gas Inventory and Research Center: https://www.gir.go.kr/eng/
Institute for Climate Change Action: http://www.climateaction.re.kr/

Korea Electric Power Corporation: http://home.kepco.co.kr/kepco/main.do
Korea Energy and Economics Institute: https://www.keei.re.kr/main.nsf/index_en.html
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