Korea's Nuclear Energy Policy in the Climate Era

— Policy Change after the Fukushima Accident —*

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Abstract

Prior to the Fukushima disaster, the world seemed to embrace "nuclear renaissance". Nuclear energy was promoted as a potential solution to global climate change as it is non-fossil fuel with relatively low carbon emission. However, the Fukushima disaster of March 11, 2011, has raised reconsideration of the future role of nuclear energy power. The magnitude 9.0 earthquake that devastated the eastern coast of Japan triggered a huge tsunami followed by power loss at nuclear reactors, leading to a major nuclear accident in history. In response to the Fukushima disaster, some nations have announced plans to slow or stop the use of nuclear energy.

This article tries to analyze the impact of Fukushima to Korea's nuclear energy. Korea has been known for following Japanese nuclear promotion

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policy in the past. What changes Korea has made after having eye-witnessed the historical disaster in neighboring country, which had a reputation of high safety maintenance capacity? This article serves to give an introductory yet comprehensive picture of Korea's past, current, and future direction of nuclear energy policy. This article starts with an overview of nuclear role in Korea's policy history. To analyze policy changes, the second and third chapters of this article focus on four dimensions before and after Fukushima: (1) Korea's energy policy directions, (2) nuclear promotion policy, (3) public perception on nuclear energy, and (4) nuclear regulation and governance. The article concludes that the overall Korean energy mix for the future has not changed after Fukushima. The government plans to double nuclear's electricity generation capacity by 2035. The government continues to seek export opportunities of nuclear reactors in other countries. There are some changes in regulation and safety governance and law after Fukushima. Further, the article poses more fundamental questions that Korea faces for future scholarly work.

Ⅰ. Introduction

Prior to the Fukushima disaster, the world seemed to embrace "nuclear renaissance". Nuclear energy was promoted as a potential solution to global climate change as it is non-fossil fuel with relatively low carbon emission. However, the Fukushima disaster of March 11, 2011, has raised reconsideration of the future role of nuclear energy power. The magnitude 9.0 earthquake that devastated the eastern coast of Japan triggered a huge tsunami followed by power loss at nuclear reactors, leading to a major nuclear accident in history. In response to the Fukushima disaster, some nations have announced plans to slow or stop the use of nuclear energy. Italy, for example, has abandoned plans to reactivate old nuclear power plants, while Germany plans to deactivate existing nuclear energy at an

earlier date than expected before Fukushima.[1] In the United States, the disaster has tempered the push for a nuclear renaissance.[2]

This article tries to analyze the impact of Fukushima to nuclear energy of the Republic of Korea (hereinafter Korea). Korea has been known for following Japanese nuclear promotion policy in the past. What changes Korea has made after having eye-witnessed the historical disaster in the neighboring country, which had a reputation of high safety maintenance capacity? This article serves to give an introductory yet comprehensive picture of Korea's past, current, and future direction of nuclear energy policy. This article starts with an overview of nuclear role in Korea's policy history. To analyze policy changes, the second and third chapters of this article focus on four dimensions before and after Fukushima: (1) Korea's energy policy directions, (2) nuclear promotion policy, (3) public perception on nuclear energy, and (4) nuclear regulation and governance. In conclusion, this article summarizes and assesses any visible policy changes after Fukushima. Further, it poses more fundamental questions that Korea faces for future scholarly work.

Ⅱ. Korea's Nuclear Energy Policy Prior to the Fukushima Accident

1. Overview of Korean Nuclear Energy Policy

Korea was estimated as the world's ninth-largest energy consumer in 2011 [3]. Its primary energy supply was 45.7 million ton of oil equivalent (TOE)

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1) Schwarz, Peter & Joseph Cochran, "Renaissance or Requiem: Is Nuclear Energy Cost Effective in a Post-Fukushima World" *Contemporary Economic Policy,* Vol.31, No.4, 2013, p. 691.

2) *Ibid.*

3) The U.S. Energy Information Administration, Country Review: South Korea, available at

in 1981 and has increased to 278.7 TOE in 2012, about 6 times in three decades.[4] Korea's electricity consumption has even more rapidly increased from 35,424 gigawatt-hours (GWh) in 1981 to 466,593 GWh in 2012, about 12 times.[5] Despite its high energy consumption, Korea's domestic energy reserves is very scarce. Korea imports 96% of its fuel from foreign countries, which makes the country one of the top energy importers in the world.[6] In 2012, Korea spent over 184 billion on imported energy, over one third of all imports.[7] In 2013, Korea was the second-largest importer of liquefied natural gas (LNG), the fourth-largest importer of coal, and the fifth-largest net importer of total petroleum and other liquids.[8]

Korea's limited domestic energy and its high consumption with its rapid economic growth naturally led its energy policy focus on sufficient energy supply at lower price. Although a majority of Korea's energy generation is fossil fuel-based, nuclear power has played a significant role. Baseload generation stems mainly from coal and nuclear power, while peak demand is generally met by its LNG imports.[9] According to a recent statistics, Korea's primary energy supply is 278 million ton of oil equivalent (TOE) as of 2012 with coal, oil, natural gas, and nuclear generation making up about 30%, 38%, 18, and 11%, respectively. Hydro power and renewable energy generation consists of much smaller shares with 0.6% and 2.4%, respectively.[10] Nuclear energy plays a significant role in electricity generation. Together, coal and natural gas account for two-thirds of electricity

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http://www.eia.gov/beta/international/analysis.cfm?iso=KOR.

4) Korea Energy Economics Institute, Yearbook of Energy Statistics 2013, p. 5. Available at http://www.keei.re.kr/keei/download/YES2013.pdf.

5) *Ibid*. pp. 156-157.

6) *Ibid*. p. 5.

7) *Ibid*. p. 8.

8) The U.S. Energy Information Administration, Country Review: South Korea, available at http://www.eia.gov/beta/international/analysis.cfm?iso=KOR.

9) *Ibid*.

10) Korea Energy Economics Institute, Yearbook of Energy Statistics 2013, pp. 4-5.

production in Korea and nuclear energy accounts for most of the remaining third (coal 40%, natural gas 22%, and nuclear power 30%). Hydropower, renewable energy and district energy account for the remaining 5% of electricity generation.[11)]

Given Korea's strong dependence on imported energy sources, it has developed and expanded its nuclear energy program since 1970s.[12)] Nuclear power has been considered to be Korea's reliable and affordable energy source and its nuclear energy is largely responsible for ensuring low electricity price. While the Korean consumer price index increased by 254 percent from 1982 to 2011, electricity prices increased by 29.9 percent in the same period.[13)] The first nuclear reactor in Korea, Kori unit 1, started generating in 1978. In 1983, Kori 2 and Wolsung 1 completed construction and started generation. During the 1980s, Korea aggressively expanded its nuclear energy generation capacity. In fact, Korea was one of only three countries of Organization of Economic Cooperation and Development (OECD) to sustain nuclear plant order beyond 1980.[14)] Korea's policy priority in the 1980s was to obtain technology to build nuclear reactors, so-called "technology self-sustain" policy. Korea's commitment to nuclear power and its need for initial imports of nuclear technology were greatly aided by the depression of the world nuclear industry in the 1980s. In

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11) *Ibid*. p. 172.

12) The history of Korea's nuclear energy has rooted in the Korea-US Nuclear Cooperation Agreement in 1955. Korea has constructed its first commercial nuclear plant in 1978. For Korea's nuclear development history, *see* generally Jin, Sanghyun, "A Study on the Path Dependency of Korea Nuclear Energy Policy", *Korea Administrative Study Journal,* Vol.18, No.4. 2009 (in Korean). (진상현, "한국 원자력 정책의 경로의존성에 관한 연구" 한국정책학회보 제18권 제4호, 2009.)

13) International Energy Agency, Energy Policies of IEA Countries: The Republic of Korea 2012 Review. p. 99.

14) Leem, Sung-Jin, "Nuclear Power in South Korea" presented at the 16th Annual Meeting of the REORM Group, Schloss Leopoldskron, Salzburg, Agustria "Climate Policy after Fukushima", Aug. 29- Sep. 2, 2011. Available at http://www.polsoz.fu-berlin.de/polwiss/forschung/systeme/ffu/veranstaltungen/termine/downloads/11_salzburg/Leem.pdf.

mid-1980s, international oil price had fallen after the oil crisis of the 1970s. Furthermore, many western countries stopped or cancelled the construction of nuclear power plants as negative public reaction to the Three Mile Island and Chernobyl accidents grew and the anti-nuclear movement was prevailed. These factors created a buyers' market and made it possible for Korea to sign nuclear technology transfer agreements with foreign suppliers under favorable conditions.[15)]

As of 2013, Korea has 23 reactors with a power generation capacity of 20.7 GW. Detailed information on each nuclear reactors is listed in Table 1. Nuclear plants are at only four sites in Korea (Figure 1), which makes the operation sites very dense. This makes Korea the fifth-largest nuclear country in the world. The plants are operated by Korea Hydro and Nuclear Power (KHNP), a company which is part of the state-owned electricity transmission and distribution monopoly, Korea Electric Power Corporation (KEPCO).[16)]

<Figure 1> Nuclear Power Plants in Korea
Source: KHNP Website

15) IEA. Country Review: South Korea, *supra* note 13. p. 99.
16) *Ibid*. pp. 101-102.

<Table 1> Nuclear Power Plants in Operation

Name	Unit	Location	Capacity (MW)	Commercial Operation	Reactor type	Cumulative Generation until 2014 (MWh)
Kori	#1	Gijang, Busan	587	Apr.29,1978	PWR*	144,423,895
	#2	Gijang, Busan	650	Jul.25,1983		158,602,480
	#3	Gijang, Busan	950	Sep.30,1985		220,806,003
	#4	Gijang, Busan	950	Apr.29,1986		219,934,660
Shin-Kori	#1	Gijang, Busan	1,000	Feb.28,2011	OPR1000**	27,090,558
	#2	Gijang, Busan	1,000	Jul.20.2012		18,165,621
Wolsong	#1	Yangnam, Gyeongju	679	Apr.22,1983	PHWR***	139,681,517
	#2	Yangnam, Gyeongju	700	Jul.01,1997		101,904,309
	#3	Yangnam, Gyeongju	700	Jul.01,1998		97,508,453
	#4	Yangnam, Gyeongju	700	Oct.01,1999		92,017,475
Shin-Wolsong	#1	Yangnam, Gyeongju	1,000	Jul.31,2012	PWR	17,814,483
Hanbit	#1	Yonggwang, Jeollanamdo	950	Aug.25,1986	PWR	216,295,914
	#2	Yonggwang, Jeollanamdo	950	Jun.10,1987		204,380,640
	#3	Yonggwang, Jeollanamdo	1,000	Mar.31,1995		158,273,941
	#4	Yonggwang, Jeollanamdo	1,000	Jan.01,1996		156,345,659
	#5	Yonggwang, Jeollanamdo	1,000	May.21,2002		102,607,426
	#6	Yonggwang, Jeollanamdo	1,000	Dec.24,2002		99,625,505
Hanul	#1	Ulchin, Gyeongsangbukdo	950	Sep.10,1988	PWR	196,551,365
	#2	Ulchin, Gyeongsangbukdo	950	Sep.30,1989		191,535,329
	#3	Ulchin, Gyeongsangbukdo	1,000	Aug.11,1998	OPR1000	133,526,091
	#4	Ulchin, Gyeongsangbukdo	1,000	Dec.31,1999		118,243,231
	#5	Ulchin, Gyeongsangbukdo	1,000	Jul.29,2004		89,069,627
	#6	Ulchin, Gyeongsangbukdo	1,000	Apr.22,2005		83,813,154
Total	23		20,716			2,988,217,336

* PWR: pressurized water reactor

**OPR1000: a Korean designed two-loop 1000 MWe PWR Generation II reactor

***PHWR: pressurized heavy water reactor

Source: based on KHNP Website

2. Green Growth and Nuclear Renaissance

Since 1990s, human influence on the climate through increased use of fossil fuels has become widely acknowledged as one of the most pressing issues for the global community. In 1992, countries around the world agreed that we need the international legal framework to curb carbon emissions, which has led to the signing of the United Nations Framework Convention on Climate Change (UNFCCC)[17], followed by the Kyoto Protocol[18] in 1997. The Kyoto Protocol was the first legally binding international law that imposes carbon emission targets for industrialized countries.[19] These international concerns have increasingly become manifest in a new strand of political debate around energy policy, which frames nuclear power as part of the solution to the need for low-carbon energy options.[20] Nuclear energy, as a relatively low emitter of greenhouse gases compared with fossil fuel-based electricity sources, has been proposed as a potential solution to global climate change in many countries. Prior to the Fukushima disaster, the United States was considered as being in the midst of "nuclear renaissance". Thirty new nuclear plants have been proposed in the U.S in the last five years and in the last 10 years, the operating licenses of more than half of the U.S.'s 104 nuclear plants have been extended from 40 to 60 years. Further, in the years preceding the Fukushima disaster, the percentage of the U.S. population who favors the use of nuclear energy had reached new highs.[21] In 2009, Sweden announced its intention to construct

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17) The United Nations Framework Convention on Climate Change (UNFCCC). 31 ILM 849 (1992).

18) The Kyoto Protocol to the United Nations Framework Convention on Climate Change. 37 ILM 22 (1998).

19) Annex I of the UNFCCC contains the list of countries that needs to set up binding reduction targets. UNFCCC, *supra* note 17, Annex I.

20) Bickerstaff, K. *et al.* "Reframing Nuclear Power in the UK energy Debate: Nuclear Power, Climate Change Mitigation and Radioactive Waste" *Public Understanding Science* 17, 2008, p.145.

new nuclear power plants, reversing its 30-year nuclear phase-out policy. In 2010, Germany announced the extension of its nuclear plants. In several European countries nuclear power has been making a comeback under the climate change stride.[22] Prof. Jin explains that climate change and high oil price were two main reasons that led to the global nuclear renaissance.[23] Two decades since the Chernobyl accident, negative public reaction to nuclear energy has faded out and the low-carbon feature of nuclear power has been promoted.[24] Korea entirely embraced the global trend of nuclear renaissance.

The former President Lee, Myung-bak promoted the green growth initiative. According to the government, Korea's green growth focuses on regarding the active response to climate change and energy crisis themselves as the core driving forces for new growth and creation of jobs. Against this background, the former President Lee proclaimed "Low Carbon, Green Growth" as a new national vision on August 15, 2008, the 60th anniversary of the founding of the nation.[25] The concept of green growth is similar to sustainable development as it promotes the harmonization between economic growth and the environment.[26] Yet, the focus of green growth is securing new growth engines through the conservation and effective use of energy and resources, mitigation of climate change, and R&D of clean energy and green technology. The three main policy goals of green growth are (1) to

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21) According to Truelove & Greenberg,. Truelove, Heather & Michael Greenberg, "Who has become more open to nuclear power because of climate change?" *Climate Change* 116, 2013, pp. 390-391.

22) Courmont, Barthélémy, "Europe's Response to Fukushima", *International Studies Review* Vol. 13, No. 1, 2012, p. 68.

23) Jin, Sang-hyun "The Prospect and Change of Korean Nuclear Policy After the Fukushima Accident" *Critical Review of History* 96, 2011 p. 141 (in Korean).

24) *Ibid*.

25) Committee on Green Growth, "Green Growth, Now and the Future" p.6. Available at http://www.greengrowth.go.kr/wp-content/uploads/2014/12/green-eng-bro.pdf

26) For detailed policy introduction on green growth, *also see* Global Green Growth Institute (GGGI), *Green Growth in Motion: Sharing Korea's Experience,* Nanam: Seoul, 2011.

curb carbon emissions to address climate change, (2) to improve energy independence, and (3) to create new engines of economic growth.[27] Although nuclear power—already firmly entrenched in Korea's energy mix—seems well suited for achieving all three of these overarching goals.

Korea made an active move to reduce carbon emissions. In 2009, the Korean government announced a voluntary target to reduce greenhouse gas emissions by 30 percent below the expected level by 2020.[28] At an international arena, the target was officially declared by the then-President Lee at the UN Climate Summit in December 2009. This target was enshrined in the Korea's domestic law, "Enforcement Decree of Framework Act on Low Carbon Green Growth" promulgated in April, 2010. According to a recent report by the International Energy Agency (IEA), Korea's per capita CO2 emission increased 115.4 percent between 1990 and 2010.[29] The same report noted that electricity demand from all sectors "has grown significantly since 2000."[30] The challenge of achieving this commitment while meeting increasing electricity demand provides a very justification for the Korean government's plans to expand nuclear power.[31]

Under the green growth initiatives of the Lee administration, the role of nuclear energy in the country's energy mix was planned to increase significantly. The government announced the First National Basic Energy Plan in 2008. Under the 2008 Basic Energy Law[32], the Basic Energy Plan lays out the country's energy planning and forecast every five years over a period of 20 years.[33] The plan purported to reduce Korea's dependence

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27) Committee on Green Growth, *supra* note 25 p. 10.

28) Na, Jeong-ju, "Korea to Cut Greenhouse Emissions 30% by 2020", *the Korea Times,* November 17, 2009.

29) IEA. Country Review: South Korea, *supra* note 13, p. 9.

30) *Ibid*. p. 77.

31) O'Donnell, Jill "Nuclear Power in South Korea's Green Growth Strategy" Council on Foreign Relations, June 2013, p. 2. Available at http://www.cfr.org/south-korea/nuclear-power-south-koreas-green-growth-strategy/p31030

32) The Basic Energy Law was later re-named as Energy Law. Amendment 2009.

on fossil fuel from 82 in 2006 percent to 61 percent in 2030 supplying energy, while increasing nuclear energy and renewable energy. The plan detailed that the installed capacity of nuclear energy would increase from 24 percent in 2009 to 41 percent in 2030.[34)]

Another linkage between nuclear energy and green growth is that the Korean government aggressively worked for new export opportunities for its nuclear expertise to boost its economic growth. This is a strong case for nuclear energy to function as a new engine of growth. In December 2009, a Korean consortium won a bid to build four nuclear reactors in the United Arab Emirates (UAE), valued at about 20.4 billion, prevailing over competitors from Japan and France.[35)] After winning the UAE contract, the Korean government stressed its aim to expand nuclear export business. In January 2010, the Ministry for Knowledge Economy announced that it aims to export 80 nuclear reactors worth 400 billion by 2030, which would make Korea the world 3rd largest supplier of nuclear reactors with 20 percent of the world market. According to the government report, the ministry emphasized, "Nuclear power-related business will be the most profitable market after automobiles, semiconductors and shipbuilding in Korea."[36)] Korea's first nuclear reactor export has boosted the government confidence in commitment to nuclear expansion policy. In 2010, then-President Lee wrote in the journal Global Asia, "Nuclear is one of the most efficient power

33) Under the Basic Energy Law 2008, the plan shall be decided after consultation among the head of a relevant central administrative agency and the national energy committee's review. The purpose of the plan is to direct future-oriented energy policies and determine mid- and long-term strategies. The Basic Energy Law 2008, Article 6.

34) The First National Basic Energy Plan, August 27, 2008 (in Korean) p. 62.

35) Coker, Margaret, "Korean Team to Build UAE Nuclear Plants" *Wall Street Journal* (Dec 28, 2009) Available at http://www.wsj.com/articles/SB10001424052748704905704574621653002992302

36) Ministry for Knowledge Economy, Press Release "Aiming the World 3rd Largest Supplier of Nuclear Reactor by 2030" (Jan 13, 2010) ; World Nuclear News "South Korea Seeks to Boost Reactor Exports" (Jan 13, 2010). Available at http://www.world-nuclear-news.org/NP-South_Korea_seeks_to_boost_reactor_exports- 1301104.html

generation methods that will lead us to a low-carbon society, and I intend to make sure that Korea keeps up with its role as one of the major suppliers of these zero-carbon power plants."[37]

3. Nuclear Regulations and Governance

Since 1950s, the Ministry of Education, Science and Technology (MEST) had an overall responsibility for comprehensive nuclear policies, including nuclear safety, nuclear safeguard, nuclear R&D, nuclear non-proliferation and international cooperation.[38] With the first nuclear reactor built in 1978, the Ministry for Knowledge Economy (MKE) has been responsible for energy policy, the construction and operation of nuclear power plants, nuclear fuel supply, and radioactive waste management. Thus, prior to the Fukushima accident, MEST and MKE were two ministries that governed the nuclear policy related work.[39]

Atomic Energy Commission (AEC), established under the Atomic Energy Act of 1958, was the highest decision-making body for nuclear energy policy and was chaired by the Prime Minister. Atomic Energy Commission had four government commissioners and seven civic commissioners that were recommended by the chair and appointed by the President. Ministers from Ministry of Finance, MEST, and MKE and a chair (Prime Minister) served as government commissioners. Civic commissioners served for a three-year term, eligible for a second term.[40] The Expert Group on Atomic Energy Use and Development served to advise the Atomic Energy Commission in

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37) Lee, Myung-bak, "Shifting Paradigms: The Road to Global Green Growth," *Global Asia,* vol. 4, no. 4, January 2010, pp. 11-12, reciting from O'Donnell, 2013, *supra* note 32 p. 3.

38) Kim, Min-hoon, "A Study on Efficiency of the Legal System According to the Launch of Nuclear New Administration Systme" *Law Review,* Vol. 53, No. 2, 2012, p. 15 (in Korean).

39) *Ibid*.

40) Atomic Energy Act, Article 4.2.

the areas of technical review and consideration. The chair of Expert Group was appointed among the commissioners of the AEC by the chair of the AEC.[41]

The high-level Nuclear Safety Commission (NSC) chaired by the Minister of Education, Science & Technology (MEST) was responsible for nuclear safety regulation. Previously, nuclear safety regulation was under the work scope of the AEC. The NSC was set up under the MEST by amendment of the Atomic Energy Act in 1996 and was independent the AEC. The regulatory framework is largely modelled on the United States Nuclear Regulatory Commission.[42] As of December 2010, the NSC had eight commissioners including the chair. Commissioners served for three years with a possibility of re-appointment. Any person who were engaged in operation of commercial nuclear plants could not serve as a commissioner. The Expert Group on Nuclear Safety was established to advise the NSC in the areas of technical review and consideration. The chair of Expert Group was appointed among the commissioners of the NSC by the chair of the NSC.[43]

Under the Ministry of Education, Science & Technology (MEST), several agencies were involved in nuclear energy related tasks. The Korea Atomic Energy Research Institute (KAERI), established in 1959, was responsible for R&D. Nuclear Safety Center under KAERI became an independent organization of the Korea Institute of Nuclear Safety (KINS) in 1990. Activities on nuclear engineering, nuclear fuel designing, and radioactive waste management were transferred from KAERI to industry in 1996. Technology Center for Nuclear Control under KAERI became an

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41) The Expert Group was set up by amendment of Atomic Energy Act in 1989. Hwang, Hae-bong, "Review of Korean Nuclear Energy Laws" *Monthly Government Legislation, July 2011,* p. 106 (in Korean).

42) World Nuclear Association, "Nuclear Power in South Korea". Available at http://www.world-nuclear.org/info/Country-Profiles/Countries-O-S/South-Korea/

43) Hwang (2011), *supra* note 41, pp. 107-108.

independent organization of the Korea Institute of Nuclear Nonproliferation and Control in 2004. Korea Institute of Radiological & Medical Sciences (KIRAMS) was separated from KAERI and became an independent entity in 2007.[44]

Under the Ministry for Knowledge Economy, Korea Electric Power Corporation (KEPCO), Korea Hydro & Nuclear Power (KHNP), Nuclear Engineering & Technology Institute (NETEC) under KHNP, and Korea Nuclear Fuel Company (KNFC) were involved in construction and operation of nuclear power plants, nuclear fuel supply and radioactive waste management. The KEPCO was incorporated as a state-owned company in 1982 and the limited portion of its shares were open to the market by amendment of the Act on Korea Electric Power Corporation 1989. KHNP and KNFC are affiliated companies of KEPCO.[45]

Before the Fukushima disaster, administration of nuclear related laws in Korea also divided by two ministries – Mistry of Education, Science and Technology (MEST) and Ministry for Knowledge Economy (MKE). Most of laws that were related to nuclear energy use and safety were administrated by the MEST. Nuclear related laws can be divided into five themes: (1) laws on promotion, (2) laws on safety and safeguard, (3) laws on institutions, (4) laws on wastes, and (5) laws on energy utility. Amongst, the Atomic Energy Act was the primary source of law that governed comprehensive areas of nuclear policy both nuclear promotion and nuclear safety. Legislated in 1958, the original Atomic Energy Act (the Act) laid out legal framework on the peaceful use of nuclear energy. With time, the Act became to compass various issues of nuclear energy development and safety as Korea's nuclear industry has evolved.[46] The Act had four major components: (1) develop

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44) Korea Atomic Energy Research Institute, *Brief History,* available at http://www.kaeri.re.kr:8080/english/sub/sub01_03.jsp

45) Legal nature of the Korea Electric Power Corporation is available at http://home.kepco.co.kr/kepco/EN/main.do, The history and legal nature of Korea Hydro & Nuclear Power is available at https://cms.khnp.co.kr/eng/.

and implement "Comprehensive Nuclear Energy Promotion Plan" for every five years[47][48], (2) establish "Nuclear Energy Research and Development Fund" to secure the financial resources required for nuclear energy R&D projects[49], (3) construction and operation of nuclear reactor and related facilities including permits and inspection[50], (4) nuclear safety.[51] Other nuclear promotion related laws include "Promotion of Radiation and Radioactive Isotope Utilization Act", first enacted in 2002, and "Act on the Promotion and Management of Non-Destructive Testing Technology", first enacted in 2006.

Laws on nuclear safety and safeguards include Atomic Energy Act, Act on Measures for the Protection of Nuclear Facilities and Prevention of Radiation Disasters, Nuclear Damage Compensation Act, and Act on Governmental Contracts for Nuclear Damage Compensation. The MEST was the administrative body for these laws on safety and safeguards. Laws relating to nuclear wastes include Radioactive Waste Control Act enacted in 2009 and Special Act on Assistance to the Locations of Facilities for Disposal Radioactive enacted in 2007. The Ministry for Knowledge Economy was the administrative body of these laws. The laws regarding energy policy, electric utility, and assistance to power plants neighboring areas were also the regulations under the MKE's authority.

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46) Hwang (2011), s*upra* note 41, p. 109.

47) Atomic Energy Act, Article 8-2.

48) English translation of this Act and the following Korean laws in the text are available at http://www.law.go.kr/engLsSc.do?menuId=0&subMenu=5

49) Atomic Energy Act, Article 10-3. The Fund has three financial resources (1) operating charges from a nuclear reactor operator, 1.2 won per kilowatt-hour (2) revenues accrued from the operation of the Fund; and (3) borrowing or other revenues. From 1997 to 2010, the Fund has invested more than KRW 2,000 billion (about USD 2 billion). *See* Hwang (2011), s*upra* note 41, p. 111.

50) Atomic Energy Act, Articles 11-36.

51) Nuclear safety agendas include regulation on nuclear fuel cycling business (Articles 43-56), regulation on use of nuclear materials (Articles 57-64), regulation on radioactive isotopes and radiation generating devices (Articles 65-75), and regulation on nuclear disposal and transport (Articles 76-95).

Ⅲ. Changes in Laws and Policies after the Fukushima Accident

1. Fukushima Accident and Public Distrust

The Fukushima disaster of March 11, 2011, has raised reconsideration of the future role of nuclear energy power. The magnitude 9.0 earthquake that devastated the eastern coast of Honshu triggered a huge tsunami. The human consequences of these events were devastating. According to the UN Office for the Coordination of Humanitarian Affairs, around 16,600 persons went missing, while many more were displaced from their home.[52] Several nuclear power plants in the vicinity were affected by natural disaster: Tokai, Higashi, Dori, Onagawa, Daiichi, and Dai-ni.[53] The worst affected was TEPCO's (Tokyo Electric Power Co.) Daiichi nuclear power plant, which managed to resist the consequences of the earthquake by successfully shutting down all operating units. However, the ensuing tsunami led to the loss of power supply which subsequently obstructed the cooling of the three reactors at the Fukushima Daiichi nuclear plant. The absence of the cooling system quickly led to an explosion on site, leading to a major nuclear accident rated 7 on the International Nuclear Event Scale (INES).[54] In the following weeks, parts of Japan were affected by nuclear fallout (measured in terms of caesium-137) equivalent to about one-third of that released after the 1986 Chernobyl accident.[55] Concern about wider nuclear safety led to the shutdown of other nuclear plants, resulting in severe shortage of power

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52) UN Office for the Coordination of Humanitarian Affairs, *Japan: Earthquake & Tsunami, Situation Report No. 7* (March 18, 2011).

53) Cavosky, Aleksandra, "Revisiting the Convention on Nuclear Safety", *Asian Journal of International Law,* 3, 2013, p. 367.

54) *Ibid*.

55) Skea, Jim et al., "Climate Policies after Fukushima: Three Views" *Climate Policy,* Vol. 13, No. S01, 2013, p. 37.

supply capacity of Japan.[56] After a few years after the disaster, a criticism that the disaster was more man-made than natural has raised within the Japanese society.[57] Emergency manual did not work. Lack of prompt response from the government and thereafter lack of public communication damaged the Japanese trust in its government's nuclear safety capacity.[58]

In response to the Fukushima disaster, some nations have announced plans to slow or stop the use of nuclear energy. Italy, for example, has abandoned plans to reactivate old nuclear power plants, while Germany plans to deactivate existing nuclear energy at an earlier date than expected before Fukushima.[59] In the United States, the disaster has tempered the push for a nuclear renaissance.[60]

In Korea, public confidence in nuclear safety has been plummeted after the Fukushima disaster. According to a survey result published by the Korean Nuclear Energy Promotion Agency (KONEPA), in October 2010, 53.3 percent of respondents viewed nuclear power as safe. After the Fukushima disaster, a recent poll showed, public confidence on nuclear safety dropped to 26.2 percent by November 2014.[61] In addition to the unprecedented nuclear disaster in neighboring Japan, Korea had a series of domestic scandals and safety problems.

In February 2012, a power loss at the Korea's oldest nuclear plant, Kori unit 1 went unreported until authorities discovered it.[62] Its power

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56) *Ibid*.

57) Yokoyama, Jorato, "Fukushima Disaster and Reform" *Environmental Policy and Law,* Vol.43, No.4-5, 2013, p. 226.

58) Jeon, Jin-ho, "Nuclear Power of Japan and Korea after Fukushima", *Korean Journal of Japanese Studies,* Vol. 7, 2012, pp. 169-170 (in Korean).

59) Schwarz, Peter & Joseph Cochran, "Renaissance or Requiem: Is Nuclear Energy Cost Effective in a Post-Fukushima World" *Contemporary Economic Policy,* Vol.31, No.4, 2013, p. 691.

60) *Ibid*.

61) Yun, Sun-jin, "Challenges and Directives of Nuclear Governance in South Korea" *Environmental Law and Policy,* Vol. 14, 2015, p. 2 (in Korean).

62) O'Donnell (2013), *supra* note 31, p. 5; Han, Sangim & Yuriy Humber, "Nuclear Halt

failure caused the temperature of its core to rise for twelve minutes, a dysfunction that was very similar to the accident of the Daiichi unit of Fukushima. Kori unit 1 had reportedly 128 accidents and troubles in 2011 alone. In November of 2012, it was revealed that falsified quality-control documents has been used to certify more than seven-thousand reactor parts led to the temporary closure of two reactors, Yeonggwang units 5 and 6.[63] One month later, hundreds of falsely certified parts were discovered in two other reactors, Kori units 3 and 4, as well as in their water-cooling system.[64] The government shut down four reactors temporarily, and another six were offline for maintenance, removing up to 40% of the nuclear capacity from service until the government inspected all reactors.[65] These nuclear safety scandals dropped public trust on nuclear safety and the government's management capacity.

Since 2007, the conflict between the Korea Electric Power Corporation (KEPCO) and local residents of Miryang, South Gyeongsang Province (south eastern part of Korea) have been prolonged over the construction of ultra-high-voltage (765 kilo voltage) overhead electricity power line and power towers.[66] It started as a local opposition to the state-led construction project. After Fukushima, anti-nuclear activists and protesters got also involved as the main purpose of the project was to connect power line from new nuclear power units, Shin-Kori No. 3 and 4, to major cities in the nort h.[67] The anti-nuclear protest movement in connection with the Miryang

in South Korea Seen Boosting Coal: Energy Market" *Bloomberg Business,* April 14, 2012.

63) "Looming Blackout Threat" *Korea Herald,* December 6, 2012.

64) Park, Si-soo, "More fake certificates for nuclear reactor parts found," *Korea Times,* December 6, 2012.

65) IEA. Country Review: South Korea, *supra* note 13; Nam, In-soo, "South Korea Indicts 100 over Faked Nuclear Documents" *The Wall Street Journal,* October 10, 2013.

66) For detailed description of the conflict, *see* Choe, Sang-hyun, "As Power Line Grows, So Does Fight Between Ancient and Modern Korea" *The New York Times,* October 29, 2013.

67) Choi, Sang-won, "Battle against construction in Miryang still far from over" *The Hankyoreh* English Edition, September 24, 2014. Experts also stated the Miryang conflict could be

conflict became nation-wide. Alternatives were proposed by protesters (underground transmission cables and re-routing), but rejected by KEPCO. After several strong protests and physical conflict between the government and protesters, the transmission lines and power towers were finally completed in September 2014.

Lastly, the situation in the east-coast town of Samcheok, where there are plans to build a nuclear power plant, may illustrate the drastic change of Korean citizens' perception on nuclear energy after Fukushima. Since 2009, Samcheok was under consideration of for a new nuclear site. According to a March 2011 survey of residents taken before the Fukushima accident, 75 percent of respondent favored locating the new plant in their town. Seven month later, following the accident, support dropped 50 percent.[68] In October 2014, the residents of Samcheok overwhelmingly voted in a referendum against a national government plan to build a nuclear power plant in their town. The government announced that the vote, organized by the local city and its council, has no legal effect as a nuclear policy is a national project, which is outside of jurisdiction of referendum under the Korea's relevant laws.[69] However, the central government has now difficult position to forge the new construction in the city as 85 percent of voters voted against the construction. The new independent mayor won the election with a campaign pledge to scrap nuclear project in the city. The Fukushima accident and a series of scandal over nuclear reactor safety in previous years seemed to influence the citizens' sentiment on nuclear energy.

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understood as a part of the problem of "environmental inequality." *See* Kim, Kyo-sil & Mi-hyang Kim, "Roundtable Discussion: South Korea's energy crisis", *The Hankyoreh* English Edition, October 21, 2013.

68) Survey data cited in article by Yoon, Ja-young, "Yeongdeok, Samcheok tapped as candidates for nuclear power plants", *The Korea Times,* December 23, 2011.

69) Nam, In-soo, "South Korean City Fights against Nuclear Plant", *The Wall Street Journal,* October 10, 2014.

2. Changes in Energy Policy

To analyze any changes in Korea's energy policy after Fukushima, it is important to compare the first and second National Energy Plans, as two plans were announced before and after Fukushima, respectively. Under the Basic Energy Act in 2006, the government is mandated to establish and implement a long-term national basic plan for energy every five years over a period of 20 years.[70] The purpose of each plan is to suggest the direction of future-oriented energy policies, determine mid- and long-term strategies to systematically secure energy resources, expand stable infrastructure for supplying domestic energy, and rationalize the use of energy needed for the sound development of the national economy.[71] The first National Energy Plan was announced in 2008. As discussed in Chapter II-2, during 2008, Korea strongly promoted the green growth initiatives, also aggressively promoted nuclear energy. The first Plan purported to reduce Korea's dependence on fossil fuel from 82 in 2006 percent to 61 percent in 2030 supplying energy, while increasing nuclear energy and renewable energy. The first Plan detailed that the installed capacity of nuclear energy would increase from 24 percent in 2009 to 41 percent in 2030.[72]

When the government developed its second National Energy Plan in 2013, one of key issues was how much of nuclear energy should account for the nation's total electricity production. The new administration took a different approach in decision-making process. For the first National Energy Plan, the then-relevant Basic Energy Law required the Plan to be decided after consultation with the heads of relevant ministries and a review by the

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70) The Basic Energy Act was amended and renamed as Energy Act in 2009. With the legislation of the Framework Act on Low Carbon Green Growth in 2009, the Framework Act became the highest law regarding energy and green growth. The second national energy plan was announced under the Framework Act. *Supra* note 32.

71) The Basic Energy Act of 2006, Art. 6.

72) The First National Basic Energy Plan, *supra* note 34, p. 62.

National Energy Committee.[73] For the second National Energy Plan, the newly enacted Framework Act on Low Carbon Green Growth required the Plan to be decided after a review by the Energy Committee, the Green Growth Committee and then by the Cabinet Council.[74] Both are rather government-driven drafting processes followed by public announcement. For the second National Energy Plan, however, the government launched a joint working group composed of sixty members from government, industry, academic, and civil organizations. The joint working group drafted a recommendation to the government to finalize the Plan.[75] According to the government report, it is a more open process embracing public opinion.[76] After more than fifty meetings since May 2013, in October 2013, the joint working group recommended that installed capacity of nuclear energy shall account for no more than 22 to 29 percent for Korea's energy mix by 2035.[77] The fact that the government took a more open process in deciding Korea's future energy mix policy showed that the government was under pressure of public concern over nuclear energy after having witnessed neighboring Japan's Fukushima disaster.

In January 2014, the Ministry of Trade, Industry and Energy (MOTIE)[78] revised down the share of nuclear capacity to 29% of total generating capacity by 2035 from the prior 41% by 2030, specified in the previous plan.[79] The

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73) The Basic Energy Act of 2006, Art. 6.

74) The Framework Act on Low Carbon Green Growth, Art. 41. As the Framework Act takes precedence over other laws in application of low carbon, green growth (which include national energy planning), the development of National Basic Energy Plan became under the authority of the Framework Act from previous Basic Energy Act. *See* Framework Act on Low Carbon Green Growth, Article 8 (Relationship with other Acts).

75) Ministry of Trade, Industry and Energy (MOTIE), the Second National Energy Plan, January 14, 2013, p. 12 (in Korean).

76) Ministry of Science, ICT and Future Planning (MSIP), Nuclear White Paper 2014, p. 19 (in Korean).

77) Ministry of Trade, Industry and Energy (2014), *supra* note 75.

78) Ministry for Knowledge Economy was renamed as MOTIE under the new administration.

79) MOTIE (2014), *supra* note 75.

<Table 2> Comparison of Energy Plans before and after Fukushima

	1st National Basic Energy Plan	2nd National Basic Energy Plan
Period	2008-2030	2014-2035
Drafting Process	Government driven drafting process and announcement	Joint drafting with private sectors to include public opinion
Nuclear Capacity	41% by 2030	29% by 2035
Renewable Target	11% by 2030	11% by 2035
Decision Process	Review by Energy Committee	Review by Energy Committee, Green Growth Committee, then Cabinet Council

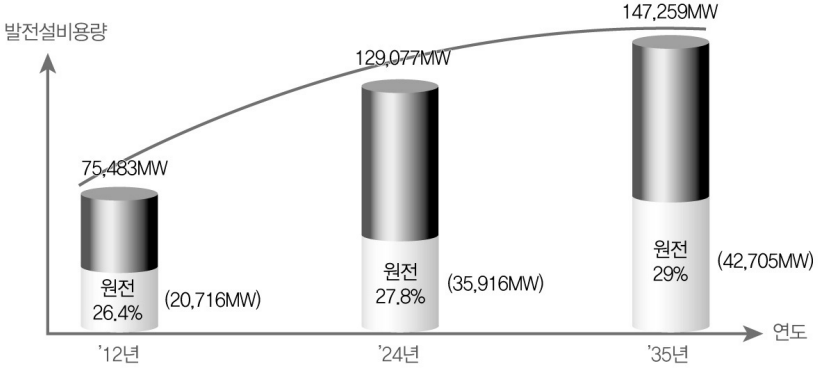
Source: based on MSIP, Nuclear White Paper 2014, p. 20

Ministry explained that the reduction of nuclear target is the result of consideration of electricity demand, public acceptance of nuclear power, and transmission capacity. The target for renewable energy generation by 2035 was announced at 11 percent, the same level since the first National Basic Energy Plan. The comparison between the first and second plan is summarized at table 2.

The nuclear target of 29 percent, although the highest number among the Joint Working Group's recommendation, seems like a significant fallback from the previous 41 percent target. However, the close look shows that the 29 percent target is still a high increase in nuclear generation compared to the current level, because the government expects a much higher energy supply in total. The second National Basic Energy Plan forecasts an electricity consumption growth rate of 2.8 percent per year for the forecast period.[80] The total installed capacity of energy is 75,483 mega-watt (MW) in 2012. The government estimates that the total energy capacity will be doubled in 2035, up to 147,259 MW. To meet this energy demand, nuclear energy will account for 29 percent of the total energy generation. Considering the current nuclear portion is 26.4 percent, to meet the 29 percent target

80) The first National Basic Energy Plan forecasts an electricity consumption growth rate of 2.4 percent per year for 2008-2030. Ministry for Knowledge Economy (MKE), the First National Energy Plan, August 27, 2008, p. 65 (in Korean).

by 2024, the nuclear generation capacity also needs to be doubled. Figure 4 shows the projection of total energy and nuclear capacity, respectively. The horizontal axis shows years and the vertical axis shows the installed electricity generation capacity.



<Figure 4> Projection of Nuclear Capacity
Source: MOTIE 2nd Energy Plan, p. 44

This would require about 42,705 MW of installed capacity by 2035. Roughly speaking, in addition to existing 23 nuclear reactors with a generation capacity of 20,716 MW in total, about 22 more 1,000 MW reactors will be needed to meet an additional energy demand of 22,000 MW. In fact, Korea has planned to construct 11 more reactors by 2024 according to the fifth Basic Plan for Long-term Electricity Supply and Demand.[81] Five

[81] The Electricity Business Act requires that the MKE (now MOTIE) prepare and publish a Basic Plan for Long-term Electricity Supply and Demand (BPE) every two years. The BPE is a lower level plan under the National Basic Energy Plan. The BPE sets out a clear policy direction for the electricity sector, including supply and demand forecasts, a capacity plan and infrastructure needs. The fifth BPE, which contains projections for the period 2010-24, was published in December 2010, before Fukushima, and forecasts an electricity consumption growth rate of 1.9% per year for the forecast period. According to the plan, much of this increase in demand will be met by incremental growth in nuclear (48.5% in 2024), new and renewable energy capacity (8.9% in 2024) while the shares of coal (31%), natural gas (9.7%) and oil (0.5%) are expected to fall by 2024. Ministry

reactors are currently under construction and six reactors are to be constructed.[82] Therefore, Korea will have increasing number of nuclear reactors by 2024 and by 2035, according to current government plans. After Fukushima, Korea's dependence on nuclear power has not changed. Meanwhile, the government approved a life extension of ten years after its 30-year operation of the nation's second oldest nuclear reactor, Wolsong unit 1, in February 2015.[83] There were rising public protests against the extension due to growing concern over nuclear safety after Fukushima.[84]

3. Creative Economy and Nuclear Energy

The Park Geun-hye administration, incumbent since January 2013, put forward the "creative economy" as a new growth strategy for the sustainable growth of Korea. The creative economy agenda is aimed at switch Korea's conventional growth paradigm to a new growth strategy founded on innovation, technology, creative ideas. To achieve this goal, small and medium business, start-ups and ICT (information, commutation and technology) industry are regarded as key players in fostering the creative economy ecosystem.[85] The government's primary goal under the slogan of creative economy is to create new jobs and markets through creativity, innovation, and fusion and new technology.[86]

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for Knowledge Economy, the Fifth Basic Plan for Long-term Electricity Supply and Demand, December 29, 2010.

82) MSIP, Nuclear White Paper 2014, *supra* note 79, pp.19-20, footnote 3.

83) Seo, Ji-yeon, "Life extension of Wolsong unit 1 reactor approved", *The Korea Herald,* February 27, 2015.

84) Lee, Heesu, "Fukushima Meltdowns Pervade South Korea Debate on Reactor Life", *Bloomberg Business,* January 15, 2015.

85) Ministry of Strategy and Finance, "Press Release: The Park Guen-hye Administration Creative Economy Blueprint, 'Creative Economy Action Plan and Measures to Establish a Creative Economic Ecosystem'", June 5, 2013, available at http://english.mosf.go.kr/pre/view.do?bcd=N0001&seq=3289.

86) *Ibid.*

According to the government's 'Creative Economy Action Plan and Measure' announced in June 2013, advanced nuclear technology was specified as an example of new engine for economic growth for new industry and new market.[87] In December 2014, Ministry of Science, ICT and Future Planning (MSIP), the new ministry under the Park administration responsible for science and nuclear policies[88] announced the 'Action Plan for Creative Economy in Nuclear Technology'.[89] The Action Plan specified that (1) R&D promotion and spill-over effect through government-affiliated research institutes to small and medium nuclear businesses, (2) promotion of nuclear export business, in particular the small-sized reactor, (3) support advanced nuclear technology and industry through regulatory system and investment to human resources.[90]

The Park administration also reaffirmed to continue the government effort to promote nuclear export. As discussed in the Chapter II-2, the previous Lee administration had succeeded the sale of four modern nuclear power reactors designed by Korea, the SMART (System-integrated Modular Advanced Reactor), to the United Arab Emirates (UAE) in December 2009. Later the year of the Fukushima accident, the Korean government had announced its goal to be the third largest reactor exporter by 2030, supplying 20 percent of the world market, under the plan known as Nu-Tech 2030.[91] The new Park government obviously wanted to follow her predecessor in supporting the nuclear industry as one of the major export business of Korea under the name of "Creative Economy."

In January 2015, the SMART Power Company (SPC) was launched with

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87) *Ibid,* p.5.

88) In 2013, the Ministry of Education was split from Ministry of Education, Science and Technology (MEST), and the remnant became the Ministry for Science, ICT and Future Planning (MSIP).

89) MSIP, Nuclear White Paper 2014, *supra* note 76, p.66.

90) *Ibid,* pp. 66-68.

91) Ministry for Knowledge Economy, Press Release "Nu-Tech 2030: Leap forward the World Third Nuclear Technology by 2030", November 23, 2011 (in Korean).

support from six supply chain companies in order to export the technology, particularly to the Middle East for desalination. The Ministry for Science, ICT and Future Planning (MSIP) plans to form a government-supported consultative body with the Office for Government Policy Coordination, the Ministry of Trade, Industry & Energy (MOTIE) and the Ministry of Foreign Affairs (MOFA) to support SMART export cooperation activities and private businesses.[92]

In March 2015, the Korea Atomic Energy Research Institute (KAERI) signed an agreement with Saudi Arabia's King Abdullah City for Nuclear and Renewable Energy (KA-CARE) to assess the potential for building at least two Korean SMART reactors in Saudi Arabia, and possibly more. The government assessed this agreement as opening opportunities for major involvement in Saudi nuclear power projects, and expected to win 2 billion worth of nuclear reactor deals in Saudi Arabia and additional orders in the further.[93] If realized, it would be the first case of commercialization and promotion of the SMART, small and medium sized reactors to third countries. After Fukushima, Korea's export promotion policy of nuclear reactor seems to be continued. Under the initiative of "Creative Economy", the government attention has focused on small and medium sized reactors.

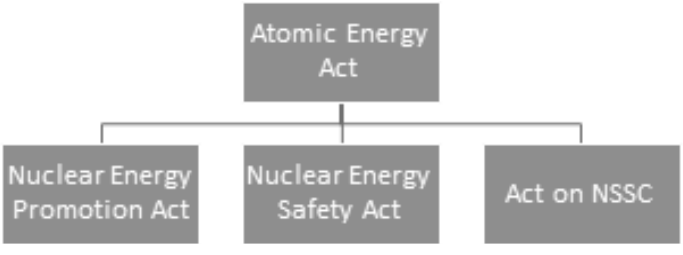
4. Changes in Energy Law and Governance

Before Fukushima, the Ministry of Education, Science and Technology (MEST) was in charge of nuclear safety and nuclear safeguards, as well as nuclear promotion and R&D. The Nuclear Safety Commission, which was in charge of nuclear safety and safeguards, licenses and permit, was under the control of the MEST which took the imitative in promoting

92) World Nuclear Association, *supra* note 42.

93) Cho, Chung-un, "Korea, Saudi Arabia to push for nuclear reactor cooperation", *the Korean Herald,* March, 3, 2015.

nuclear power. Even before Fukushima, such dependence was criticize d.[94] The dependence went against, for example, the standards promulgated by the International Atomic Energy Agency (IAEA), which mandated that "[t]he political system shall ensure clear and effective separation of responsibilities and duties between the regulatory body and organizations promoting or furthering the development of nuclear technologies."[95] Given the heightened importance of safety and effective nuclear regulation after Fukushima, the Korean government modified laws and institutional arrangements to separate nuclear promotion and nuclear safety. First, the Atomic Energy Act was separated into two laws, the Nuclear Energy Promotion Act and the Nuclear Energy Safety Act in October 2011. Second, the government set up an independent presidential commission, the Nuclear Safety and Security Commission (NSSC). The NSSC took over the work of previous Atomic Energy Safety Commission This independent agency was set up under the new Act on Establishment and Operation of the Nuclear Safety and Security Commission in the same year.



<Figure 5> Changes in Energy Law after Fukushima

94) Kim, Min-hoon (2012), *supra* note 38, pp.68-69.

95) IAEA, *Organization and Staffing of the Regulatory Body for Nuclear Facilities,* Article 2.6, 2002.

Given the heightened importance of safety and effective nuclear regulation, ensuring a high profile and clear identity for the regulator was a key issue. The NSSC came under as an independent agency under the Presidential Office.[96] Its chairman has ministerial rank. The chair is appointed by the President. With a full-time serving chair and vice-chair, there are seven independent individual experts commissioners. The commissioners shall not have conflict of interest with nuclear reactor operation within the past three years.[97] When it was established in October 2013, the NSSR commissioners consisted of two members recommended by the ruling party, two members by the opposition party, and three members by the government recommendation.[98] Thus, the composition of the NSSR members shows the government's effort to ensure diverse perspectives on nuclear energy.

The NSSC's scope covers licensing, inspection, enforcement, incident response and emergency response, non-proliferation and safeguards, export/import control and physical protection.[99] The NSSR is advised by the Nuclear Safety Commission and by the Korean Institute of Nuclear Safety (KINS), formerly the expert safety regulator under MEST, which both also carry out inspections, R&D, and safety reviews. The Ministry for Science and Future Planning (MSIP), formerly MEST, simply promoted nuclear power. The Ministry of Trade, Industry and Energy (MOTIE), formerly MKE, continues to be responsible for energy policy, for the construction and operation of nuclear power plants, nuclear fuel supply and radioactive waste management.

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96) The NSSC was reorganized to be under the Prime Minister's Office in 2013. Amendment to Act on Establishment and Operation of the Nuclear Safety and Security Commission, 2013.

97) Act on Establishment and Operation of the Nuclear Safety and Security Commission, Article 10.

98) Yoon, Sun-Jin (2015), *supra* note 61, p. 29.

99) Act on Establishment and Operation of the Nuclear Safety and Security Commission, *supra* note 97, Article 11, 12.

After Fukushima, to ensure radioactive safety, a new law, the Act on Safety Control of Radioactive Rays Around Living Environment, was enacted in 2012. Another change in nuclear energy governance after Fukushima is that the government set up a "Public Engagement Commission on Spent Nuclear Fuel Management".[100] It is widely accepted that spent nuclear fuel and high-level reprocessing and plutonium wastes require well-designed storage for periods ranging from tens of thousands to a million years, to minimize releases of the contained radioactivity into the environment.[101] The promise of nuclear power is impeded by the lack of a permanent solution to the difficult problem of where to dispose of its radioactive byproducts, and moreover by the ongoing uncertainty over whether there will ever be a solution.[102] Currently, no country has successfully constructed and operated deep geological repository for spent fuel.[103]

Established in October 2013 with 13 nuclear experts, professors, city council members and an official from a private environmental watchdog, the Public Engagement Commission is to take account of public opinion on high-level radioactive waste issues and feed into policy decisions. It is an advisory commission, reporting to MOTIE. High level radioactive used fuel is stored on the reactor site pending construction of a centralized interim storage facility. Currently, three reactor sites, Wolsong, Hanul, and Kori, have temporary storages, which are expected to reach capacity in 2016.[104]

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100) Website of the PECOS, https://www.pecos.go.kr

101) Feiveson, Harold, *et al*., "Managing nuclear spent fuel: Policy lessons from a 10-country study", *Bulletin of the Atomic Scientists,* June 27, 2011.

102) For the history of US nuclear waste policy and difficulties over the construction of permanent repository for spent fuel, *see* White, Adam, "Yucca Mountain: A Post-Mortem", *the New Atlantis,* Fall 2012.

103) The permanent deep geological repository is being constructed in Onkalo, Finland. World Nuclear News, "Finland starts building plug for repository tunnel", April 1, 2015.

104) Cho, Meeyoung, "South Korea running out of spent nuclear fuel storage space − advisory body", *Reuters,* August 18, 2014.

The new Public Engagement Commission was due to produce a report about the end of 2014. As of May 2015, the Public Engagement Commission is yet to announce the report.

In sum, Korea's legal system and institutional arrangements underwent some changes after Fukushima. There has been the separation of nuclear safety regulation from nuclear promotion policy. The government tries to embrace more transparent and open governance in nuclear safety and nuclear waste management.

Ⅳ. Conclusion and Challenges Ahead

This article has tries to answer the question of whether there were any changes in Korea's nuclear policy after Fukushima. The policy comparison between the first and second National Basic Energy Plan shows that the overall energy policy direction of Korea seems to remain the same after the Fukushima. The second Basic Energy Plan scaled back the role of nuclear power from the previous plan (29 percent, instead of 41 percent of the electricity would come from nuclear by 2035 according to the second plan). However, the absolute amount of nuclear capacity will be doubled for the planned period because the government forecasts the energy consumption growth at a higher rate than the previous plan. In addition to 23 nuclear reactors at present, 16 to 18 more nuclear reactors (100 MW generation capacity) will be needed in the next 20 years. Considering the old reactors soon to be expired, even more nuclear reactors might be required to meet the plan.

Furthermore, the nuclear export promotion policy seems to remain the same after Fukushima. Eight months after the Fukushima disaster, the Korean government reaffirmed its commitment to grow as the world third largest export country of nuclear reactors by 2030, supplying 20 percent

of the world market, under the plan known as Nu-Tech 2030. The current administration also strongly supports nuclear export business and closely works with private and public entities through R&D and financial support to keep the Korean nuclear technology competitive in the world market. Under the policy initiative called "Creative Economy," the Korean government continues to promote nuclear export business, with a particular focus on small and medium sized nuclear reactor. The previous government promoted nuclear export business under the policy initiative called "Green Growth". Although, the policy slogan has changed, the key concept of seeing nuclear reactor export as a new export opportunity seems to be same. The second oldest power reactor, Wolsong unit 1 was extended to operate another 10 years despite public opposition.

However, there are some changes in laws and governance structure in nuclear energy regulation after Fukushima. First, the Atomic Energy Act was separated into two laws, the Nuclear Energy Promotion Act and the Nuclear Energy Safety Act. This was to correct the problem of having one ministry being in charge of both promotion and safety regulation at the same time. Second, the new safety regulatory body was established, independent from the nuclear promoting agency. The newly established Nuclear Safety and Safeguard Commission (NSSC) is the highest decision making body, in charge of regulating nuclear facilities including licenses and permit. Third, against the growing concern over nuclear safety and nuclear waste problem, the government tries to embrace more transparent and open governance. The second National Basic Energy Plan was drafted based on a recommendation by the joint working group with government, industry and civil society together. Two members of the NSSC were appointed by the recommendation of the opposition party. Both members are long-time anti-nuclear activists. The government also launched a new Public Engagement Commission on Spent Nuclear Fuel to discuss and embrace public opinion over the high level radioactive wastes. This is too

early to fully assess the policy impact of the change of laws and governance. However, it would be interesting to see whether a more open and transparent governance of nuclear regulation would make any substantial change in finding a solution of various social conflicts involving nuclear energy, such as nuclear safety scandals, a growing opposition over construction of new nuclear power plants, transmission lines and/or repository facilities.

Although this paper does not address, there are more fundamental challenges of nuclear power in the climate change era. Previous Lee administration and current Park administration seem to reiterate the importance of nuclear energy in curbing carbon emissions. Do we really reduce greenhouse gas emissions through relying on nuclear? The Korean government continues to forecasts its future energy demand generously and thus justifies the need for more and more nuclear plants in the future. With this trend unchanged, how do we manage the growing energy consumption? In the past, the Korea's nuclear power policy focused on a sufficient supply of energy at lower price. Thanks to this supply-oriented policy, Koreans have enjoyed relatively cheap electricity. For the past 30 years, while the Korean consumer price index increased by 254 percent from 1982 to 2011, electricity prices increased by 29.9 percent.[105] With this low price policy, the electricity consumption has skyrocketed, and this pushes the need for more nuclear reactors in turn. This is a very example of a failure of demand control.

More fundamental challenges of nuclear power which this article does not address are whether it is safe, economic and green energy that our future can rely on. Safety concern over nuclear plants in Korea has not settled after Fukushima. More likely than not, the fact that Korea needs more nuclear reactors in the future would mean more reactors in the current site because there are growing protests from residents against a new construction site. Samcheok's unofficial referendum was a good example. Unless nuclear

105) IEA. Country Review: South Korea, *supra* note 13, p. 99.

waste issue gets resolved, i.e., how to store spent nuclear reactor in a safe and economic way, it would be doubtful to say that nuclear is economic and green energy. These challenges ahead of Korea's nuclear power would be topic of future work. I hope that this article can stimulates more vibrant discussion over challenges of Korean nuclear power by other scholars.

Ⅴ. Epilogue

After completion of the article, two important events have happened related to nuclear policy. First, the Korean government finalized and announced the 7th Basic Plan for Long-term Electricity Supply and Demand in July 22, 2015, much overdue its original deadline, the end of 2014. According to the Basic Plan setting the energy mix for the next 15 years (2015-2029), the Korean government decided to expand nuclear power and build two new nuclear reactors (3,000 MW). Samcheok and Youngdeok are considered as a new site. Under the projection of the country's demand to increase 2.2 percent per year on average over the next 15 years, the government increases the nuclear power ratio by 0.8 per cent and deceases the coal power ratio by 2.4 per cent in the energy mix compared to its 6th Basic Plan. Renewable energy ratio is increased by 0.1 percent compared to its previous plan.[106] The government explained that giving up the proposed coal-powered plants under the 6th Basic Plan and raising the ratio of "environmentally-friendly" energy source (nuclear) in the energy was an unavoidable choice of Korea to be in line with its Post 2020 climate change mitigation commitments.[107]

Second, on August 22, 2015, Japan restarted one of its nuclear

106) MOTIE, the 7th Basic Plan for Long-term Electricity Supply and Demand, July 22, 2015.
107) Seo Ji-yeon, "Korea to build two new nuclear reactors by 2029", *The Korea Herald,* June 8, 2015, available at http://www.koreaherald.com/view.php?ud=20150608000946.

reactors for the first time since new safety requirements were introduced after the 2011 Fukushima nuclear disaster, ending a nearly two-year period of the country's zero nuclear reactor in operation. Kyushu Electric Power Company restarted the No. 1 reactor at the Sendai nuclear power plant. The plant's second reactor is scheduled to be brought back online later this year.[108)]

These events show two countries' strong tendency to rely on nuclear power in its energy mix. According to a new plan, the Korean government does not seem to have strong will to increase renewable energy. The government explains the increase of nuclear power is unavoidable due to meet the increasing energy demand and to reduce greenhouse gas reduction at the same time. However, it seems also unavoidable that the government will face strong opposition against the construction of additional nuclear reactors either in Samcheok or Youngdeok, given the past record of nation-wide anti-nuclear movement. Unless the government makes ground-breaking effort to increase renewable energy capacity or to curb energy demand, it will be situated in a very difficult stance between the international pressures to mitigate carbon emissions and domestic opposition against nuclear.

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108) Martin, Alexander, "Japan Restarts Nuclear Power After Two-Year Shutdown", *The Wall Street Journal*, August 22, 2015, available at http://www.wsj.com/articles/japan-restarts-first - reactor-since-fukushima-disaster-1439259270

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[국문초록]

기후변화 시대 한국의 원자력 정책
— 후쿠시마 사고 이후 정책변화를 중심으로 —

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후쿠시마 원전사고 이전 세계는 원자력 르네상스를 맞이하고 있는 듯 하였다. 원자력은 기후변화 시대 온실가스배출을 줄이고 화석연료의 의존도를 줄일 수 있는 대안으로 각광받았다. 그러나 2011년 3월 11일 동일본 해안에서 발생한 9.0 강도의 지진과 쓰나미로 인해 원자력발전소의 전력이 차단되었고 그 결과 원자력 역사에서 가장 큰 규모의 원전사고가 발생하였다. 후쿠시마 사고 이후 몇몇 국가들은 원자력 이용을 재고하거나 의존도를 줄이기 위한 정책을 발표하였다.

동 논문은 후쿠시마 사고가 한국의 에너지 정책에 미친 영향을 살펴보고자 한다. 사고 전, 한국은 일본의 원자력 정책을 비슷한 경로로 뒤쫓고 있었다. 사고를 바로 옆에서 지켜 본 한국에서 후쿠시마 사고 이후 원자력 정책에 어떤 변화가 있었는가를 분석하는 것이 논문의 목적이다. 동 논문은 첫 장에서 한국 원자력 정책의 배경과 경로를 개괄한다. 둘째, 셋째 장은 정책 변화를 감지하기 위한 네 가지 분석요소((1) 한국 에너지 정책의 방향, (2) 원자력 진흥 정책, (3) 원자력에 대한 국민 인식, (4) 원자력 규제와 거버넌스)에 집중적으로 살핀다. 논문의 결론은 한국 원자력 정책의 변화를 요약한다. 후쿠시마 사고 이후 한국의 전반적인 에너지 정책 방향은 변화가 없으며, 정부는 향후 원자력 발전소의 규모를 두 배 정도 확대할 계획을 가지고 있다. 후쿠시마 사고 이후에도 한국 정부의 원자력 수출진흥 정책은 변화없이 유지되고 있다. 국민들의 원자력 안전에 대한 우려가 커짐에 따라 정부는 원자력 규제 관련한 법제도와 거버넌스에 변화를 꾀하였다. 마지막으로, 동 논문에서 논하지 않은 한국이 당면한 원자력 정책의 보다 근본적인 질문을 제시하고 향후 연구를 도모한다.

주 제 어: 한국 원자력 에너지, 후쿠시마 사고, 한국 에너지 정책, 원자력, 기후변화
Key Words: Korea Nuclear Energy, Fukushima, Korea Energy Policy, Nuclear Export, Climate Change