

## Governing the Atom: State, Society, and the Nuclear Power System in South Korea

Kyungah Song (Research Fellow, The Institute of Korean Political Studies,  
Seoul National University)\*

Hoon C. Shin (Ph.D. Candidate, School of Human Evolution and Social Change,  
Center for Behavior, Institutions and the Environment, Arizona State University)\*\*

### 논문요약

1970년 한국에 첫 원전이 건설된 이후 국가는 원자력 시스템(nuclear power system)의 발전과 확장을 위해 필요한 물적 조건을 제공하는데 있어 주도적 역할을 담당했다. 동시에 국가는 대규모 기술인프라의 안정적인 유지를 담보하기 위한 이데올로기의 창출과 관리조직의 구축에 긴밀히 관여해왔다. 이 논문은 노무현정부(2003-2008년)와 이명박정부(2008-2013년)의 원자력정책의 기본방향이 달랐다는 점에 주목하여 다음과 같은 질문을 던진다. 노무현, 이명박정부의 원자력정책은 구체적으로 어떠한 차이가 있으며 이러한 차이는 어디에서 비롯되었을까? 상이한 정책기조를 지닌 두 정부를 거쳐 한국 원자력시스템의 기본구조는 어떻게 변화하였나? 이 연구는 원자력정책은 국가(state), 사회(society), 기술체계(technological system)간의 복잡한 상호작용의 결과라는 점을 바탕으로 기술의 생산 및 발전과 관련해 한국의 국가가 갖는 독특한 역할에 주목한다. 기술의 창시자로서의 국가는 대형기술의 생산과 관리를 위한 전문적 지식과 조직을 보유하고 있다. 그러나 공적 권위체로서의 국가는 논쟁적인 기술에 수반되는 사회적 갈등을 해결해야 하는 책무를 맡고 있다. 기술의 주인이자 동시에 공적 권위체인 한국의 국가는 원자력체계 운용의 기본방향이 사회의 바람과 조응할 수 있도록 기술과 사회를 매개하는 역할을 담당해왔다. 이 논문은 원자력정책을 통해 사회와 기술을 매개하는 시각 차이가 어떠한지를 보여준다. 동시에 그 같은 정책 차이에도 불구하고 두 정부 공히 한국 원자력시스템의 생존과 지속에 기여했음을 밝힌다.

주제어: 한국, 원자력시스템, 원자력정책, 국가, 기술, 사회

\* 제1저자

\*\* 참여저자

## I. Introduction

The disaster at the Fukushima Daiichi power plant reignited worldwide concerns over nuclear power. Contrary to strengthened antinuclear consensus in Europe regarding the commercial use of nuclear power<sup>1)</sup>, South Korea, as a next-door neighbor to Japan, enjoys a thriving nuclear energy sector and keeps a long-standing policy in favor of nuclear energy. This paper examines how the nuclear power system in South Korea has evolved and survived over time through the intertwined dynamics of the state, society, and technology. Specifically, we focus on explaining how the nuclear power system has been adapted to a changing society during two recent Korean administrations (2003–2013) and their state policy changes.

Nuclear power projects in Korea started under the state's strong leadership. As Korea's military survival and domestic order in the post-war situation became defined in economic terms, the authoritarian military regime (1961–1979) in the developmental era placed the highest priority on economic development to compensate for its lack of political legitimacy.<sup>2)</sup> The oil crises in the 1970s motivated the state to search for ways to develop its own energy sources. Nuclear power was chosen as the most reliable way capable of meeting the soaring demand of energy necessary for rapid industrialization. Korea's transition to democracy in the late 1980s, however, challenged the conventional style of technocratic decision-making

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- 1) Uekoetter, Frank, "Fukushima, Europe, and the Authoritarian Nature of Nuclear Technology." *Environmental History*, Vol. 17, 2012, pp. 277~284.
- 2) Evans, Peter B, *Embedded Autonomy: States and Industrial Transformation*, Princeton, NJ: Princeton University Press, 1995; Johnson, Charlmers, *MITI and the Japanese Miracle: The Growth of Industrial Policy, 1925-1975*, Stanford: Stanford University Press, 1982; Amsden, Alice H, *Asia's Next Giant: South Korea and Late Industrialization*, Oxford: Oxford University Press, 1989.

in nuclear sector and paved ways for more civil society involvement and social consensus on the management of the nuclear power system.

The development path of the Korean nuclear power system took interesting turns in recent years. The last two administrations of Korea, the *Roh Moo-hyun government* (2003–2008) and the *Lee Myung-bak government* (2008–2013), adopted divergent approaches to the nuclear power. The Roh government devoted its tenure to solving thorny problems on site-selection of radioactive waste facilities by facilitating public involvement. In contrast, the interest of the Lee government was on the aggressive expansion of nuclear industry in a global market by packaging nuclear technology into export goods as part of its plan to foster economic growth.

We address how these two governments took different approaches to nuclear power and how the structure of Korean nuclear power system changed as a result. This paper finds that each government, in its own way, tried to reshape the Korean nuclear power system more concordant with prevalent sociopolitical milieu as a wider context of political support base. The Roh government defines nuclear as a political issue that incorporates the public into collective decisions on the democratic management of risky technology. The Lee government, on the other hand, redefines it into highly technical terms. Despite the difference in either defining the problems or and implementing policies to address them, both governments, in fact, contributed to the reinforcement of the Korean nuclear power system by selectively adjusting physical and non-physical artifacts necessary for ensuring the continuity of large-scale technological infrastructure. Building on this observation, this paper argues nuclear policies in Korea can be understood in relation to the state's strategy in a

political arena to mobilize allegiance of society toward the state-created technology. In addition, each policy demonstrates the state's capacity as a system builder to adapt and maintain technology in accordance with a changing society.

This paper progresses through four parts. First, we will briefly provide a historical background on the distinctive characteristics of the Korean nuclear power system. Second, we will present an analytical framework to explain why and how the two democratic governments chose contrasting policies on nuclear power system. The underlying idea of this framework is that the Korean nuclear policies are formed and implemented through the intertwined dynamics of the state, societal contexts, and a large-scale technological system. Third, we apply the analytical framework to the two recent Korean governments to provide detailed descriptions of why policy inconsistencies occurred and which components of nuclear power system were changed by them. Lastly, we will provide a discussion of the implications for policy debate and future studies.

## II. State-led Development of Nuclear Power System

The birth of Korean nuclear power system should be understood in a broader historical context of a turbulent period of modern Korea. Nuclear effects reached into the Korean Peninsula as a powerful symbol much earlier than the actual construction of nuclear plant. Atomic bombings of *Hiroshima* and *Nagasaki* led Japan to surrender to Allies, which liberated Korea from Japanese colonial rule (1910-1945). Phrases such as “atom for peace”<sup>3)</sup> and “atom for national development”<sup>4)</sup> illustrate that nuclear technologies had already been loaded with powerful social meanings that

stand for the power of science and technology when it was first introduced into Korea. It also was interpreted as a symbol of freedom as well as a proof of national power. The first Korean President *Rhee Syng-man* asserted that atomic energy meant “freedom” and “would facilitate reunification” with North Korea by making the South a strong democratic nation.<sup>5)</sup>

Based on this interpretation of nuclear technology, the military regime led by General *Park Chung-hee* (1961–1979) started to scrutinize technical and economic feasibility of nuclear power. The authoritarian state in the developmental era in the 1970s took a “midwifery role” to assist in the emergence of new industry and nurture it.<sup>6)</sup> Securing energy supplies and keeping energy prices low provided the bases for a nascent domestic industry to grow. In addition, as an energy-poor country with no significant oil or natural gas resources, reducing external vulnerability to energy was a necessary task for the Korean state in order to maintain its political survival and internal order.

Historical legacies of Japanese colonialism, confrontation with North Korea, and state-led rapid industrialization trajectories, all combined have brought about distinctive features of the Korean nuclear energy system. First, the system has dramatically expanded and developed in terms of material scale and technological level at remarkable speed. The construction

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3) Kim, Dong-Won, “Imaginary Savior: The Image of the Nuclear Bomb in Korea, 1945–1960.” *HistoriaScientiarum: International Journal of the History of Science Society of Japan*, Vol. 19, No. 2, 2008, p. 105.

4) Jasanoff, Sheila, and Sang-Hyun Kim, “Containing the Atom: Sociotechnical Imaginaries and Nuclear Power in the United States and South Korea.” *Minerva*, Vol. 47, No. 2, 2009, p. 131.

5) Jasanoff, Sheila, and Sang-Hyun Kim, *Ibid.*, p. 133.

6) Evans, Peter B, *Embedded Autonomy: States and Industrial Transformation*. Princeton: Princeton University Press, 1995, pp. 13~16.

of Korea's first nuclear power plant at *Kori* began in 1970 and it started generating electricity in 1978. The nuclear reactor at *Kori* was manufactured by the US firm Westinghouse Electric Corporation and General Electric Company in the UK supplied the steam generator and turbine generators.<sup>7)</sup> Despite the humble beginning of Korean nuclear industry, Korea now became one of leading countries that export nuclear reactors designed by its own technology. As of 2014, the total number of reactors in operation is 23 and 5 reactors are under construction.<sup>8)</sup> The Summary statistics confirm the nuclear share in total electricity generation in 2014 was about 30.4%, which shows that Korea is more reliant on nuclear power than the United States whose nuclear share is 19.5%<sup>9)</sup> According to the 2<sup>nd</sup> National Energy Basic Plan adopted by the Korean National Energy Committee, additional nuclear power plants need to be built to generate 43GW electricity by 2035.<sup>10)</sup>

Secondly, it is the state that took the risk of building a large-scale technological infrastructure and has been singularly responsible for creating a national nuclear energy project. The dramatic expansion of technological infrastructure, carried out in parallel with the nation's big push for industrialization, came with bureaucracy-dependence not only in producing energy but in managing detailed aspects of system maintenance. It is mostly government agencies or public enterprises who are in charge of

7) Holt, Mark, "U.S. and South Korean Cooperation in the World Nuclear Energy Market: Major Policy Considerations." CRS Report for Congress R41032, Congressional Research Service. 2010. <https://fas.org/sgp/crs/row/R41032.pdf>2010(Accessed June 28, 2015.).

8) IAEA (International Atomic Energy Agency), *Nuclear Power Reactors in the World*. 2015. <http://www-pub.iaea.org/MTCD/Publications/PDF/rds2-35web-85937611.pdf>(Accessed July 2, 2015.), p. 10.

9) IAEA, *Ibid.*, p. 19.

10) Ministry of Trade, Industry, and Energy, *The 2nd National Energy Basic Plan* (in Korean). 2014, p. 44.

technological research, construction of nuclear facilities, distribution of electricity, regulation of safety, and management for the radioactive wastes. At present, Korea Hydro & Nuclear Power Corporation (KHNP), a so-called market-oriented public corporation and the only consumer of nuclear fuel in Korea, has the responsibility to construct, operate, and manage nuclear power plants. KHNP is under the control of Korea Electric Power Corporation (KEPCO), and again KEPCO as a transmission and distribution monopoly is under the direct management of the central government. Another important quasi-government agency is the Korea Radioactive Waste Management Corporation (KRWMC) funded by the KHNP.<sup>11)</sup> These institutional arrangements demonstrate a considerable degree of state monopoly in the Korean nuclear power system.

### III. Technological System, Society, and the Role of the State

A technology can become deeply entrenched in a society only if it is consistent with underlying social contexts.<sup>12)</sup> The concept of “technological system,” which views technology as an amalgamation of the technical and the social, contrasts with the perspective of technical autonomy.<sup>13)</sup> Thomas P. Hughes argues that a same technology evolves to different forms depending on underlying social contexts.<sup>14)</sup> A large technological system

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11) *Atomic Energy Act; Radioactive Waste Management Act*: Agencies in charge of research and safety management such as *Korea Atomic Energy Research Institute (KAERI)*, *Nuclear Safety Center (NSC)*, and *Nuclear Safety Commission (NSC)* are also public and government-related bodies.

12) Sovacool, Benjamin K. and Janet L. Sawin, “Creating Technological Momentum: Lessons from American and Danish Wind Energy Research.” *The Whitehead Journal of Diplomacy and International Relations*, Summer/Fall, 2010.

13) Hughes, Thomas P, “Technological Momentum.” In Leo Marx and Merritt Roe Smith eds., *Does Technology Drive History? The Dilemma of Technological Determinism*, Cambridge: The MIT Press, 1994, p. 10.

cannot be developed without legal, organizational, and political commitments since establishing the system is a risky business that requires mobilizing substantial financial resources.<sup>15)</sup> In this sense, a technological system is not an assembly of technical equipment; nor does it evolve in a politically neutral space where its development is determined solely by internal logics of techniques.<sup>16)</sup> The evolution of large technological system is inevitably coupled with social and political processes through which relevant actors instill material and ideological considerations into the system.<sup>17)</sup>

## 1. Identifying components of technological system

By borrowing Hughes's account of system components, we understand that nuclear power system is made up of both physical and non-physical artifacts<sup>18)</sup> as seen in Figure 1. Nuclear power plants and radioactive waste storages are two representative physical artifacts of nuclear power system. They are technically indispensable for a stable supply of electricity but socially controversial hazardous facilities that are likely to cause sharp

14) Hughes, Thomas P, *Networks of Power: Electrification in Western Society, 1880-1930*. Baltimore: Johns Hopkins University Press. 1983.

15) Walker, William, "Entrapment in Large Technology Systems: Institutional Commitment and Power Relations." *Research Policy*, Vol. 29, 2000, pp. 833~846.

16) Williams, Robin, and David Edge, "The Social Shaping of Technology." *Research Policy*, Vol. 25, No. 6, 1996, pp. 866~867.

17) Russell, Stewart, "The Social Construction of Artifacts: A Response to Pinch and Bijker." *Social Studies of Science*, Vol. 16, No. 2, 1986, pp. 340~342.

18) Hughes, Thomas P., "The Evolution of Large Technological Systems." In Wiebe E. Bijker and Trevor J. Pinch eds., *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*. Cambridge: MIT Press, 1987; Hughes, Thomas P, "Technological Momentum." In Leo Marx and Merritt Roe Smith eds., *Does Technology Drive History? The Dilemma of Technological Determinism*. Cambridge: The MIT Press, 1994.

conflicts over site selection. Public attitudes toward nuclear waste are more negative than those toward nuclear power in general.<sup>19)</sup> This implies that radioactive waste storage is more likely to get trapped in a technological and political stalemate than nuclear power plants. Radioactive wastes produced from nuclear fuel cycle are classified into two categories according to the national standard in Korea: low- and intermediate-level waste (LILW) that loses its radioactivity within a number of years and high-level waste (HLW) including spent nuclear fuel (SNF) that emits its radiation for hundreds of thousands of years (*Nuclear Safety Act and its enforcement ordinance*). Because of this long-lasting hazard, a waste facility is stigmatized as an unwanted artifact and the residents around it are also stigmatized.<sup>20)</sup> This stigma effect leads radioactive waste storage facilities to become involved in “site fights.”<sup>21)</sup>

A nuclear power system should be equipped with at least two non-physical artifacts to secure its functional stability by calming social tensions generated from risk perception and decision-making processes.<sup>22)</sup> One is social meanings that make ideological contributions to alleviate concerns over nuclear hazards and promote a favorable image on nuclear power. Nuclear technology evokes two ambivalent feelings: fears of irreversible catastrophe<sup>23)</sup> and its necessity for economic vitality. The

19) Litmanen, Tapio, “Environmental Conflict as a Social Construction: Nuclear Waste Conflicts in Finland.” *Society & Natural Resources*, Vol. 9, 1996, pp. 523~524.

20) Edelstein, Michael R., “Sustainable Innovation and the Siting Dilemma: Thoughts on the Stigmatization of Projects and Proponents, Good and Bad.” *Journal of Risk Research*, Vol. 7, No. 2, 2004, pp. 233~250.

21) Aldrich, Daniel P., *Site Fights: Divisive Facilities and Civil Society in Japan and the West*. Ithaca: Cornell University Press, 2010.

22) Davis, Charles, “Public Involvement in Hazardous Waste Siting Decisions.” *Polity*, Vol. 19, No. 2, 1986, p. 296.

23) Pollock, Philip H., M. Elliot Vittes, and Stuart A. Lilie, “Who Says It’s Risky Business? Public

conflicting perceptions on nuclear technology need to be resolved through the union of two social beliefs: a political belief that risk management should be transparent and can be successful through democratic controls; an economic belief that nuclear technology is not only indispensable for domestic energy supply but also highly profitable in international markets. The other non-physical artifact refers to a set of institutionalized organizations that intervene in the actual operation of a system. Maintaining a large technological system requires decision-making on a wide range of issues such as technical and economic feasibility, safety standards, and site selection. The legitimization of nuclear technology depends on how these decisions are made. In this sense, identifying types of organizations that play active roles in decision-making processes helps us better understand how technological systems gain legitimacy in civil society.

## 2. Bidirectional influence between technological system and societal context

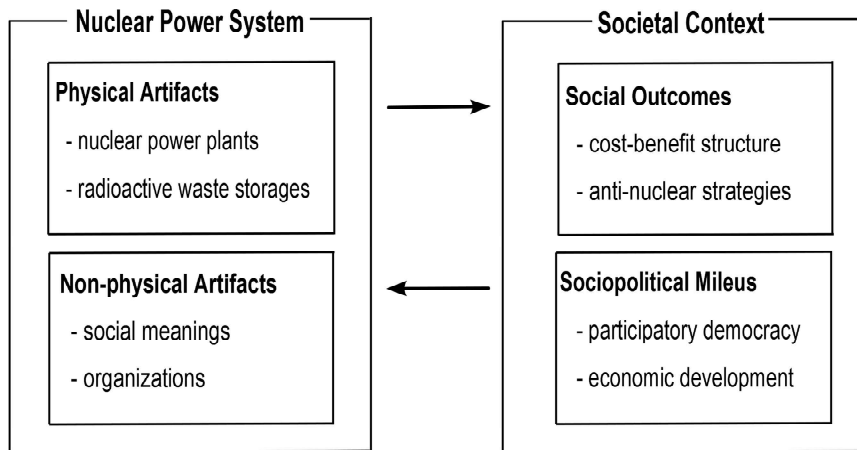
In order to examine how technological systems affect society and conversely how society affects technological systems, we divide societal contexts into two elements. One is the social outcomes resulting from the variations of physical and non-physical components of technological system. When changes in physical artifacts are made, it may change the traditional way of allocating costs and benefits of using a specific technology. This may cause people to side with or oppose the new physical artifact. For instance, radioactive wastes storage sites are likely to impose social costs on a specific group of people while the resulting

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Attitudes toward Hazardous Waste Facility Siting." *Polity*, Vol. 24, No. 3, 1992, p. 501.

benefits are shared by many. This structure of concentrated costs and diffused benefits divides people into two groups: a majority who acquiesce and a minority who oppose. Locating waste facilities, in this respect, inevitably causes a seemingly technical problem to turn into a contested political issue that requires entrepreneurial role of political leaders in making a breakthrough.

Figure 1. Nuclear Power System and Societal Context



Likewise, changes of non-physical artifacts can shape a set of anti-nuclear strategies (see Figure 1). Taking the Korean case for example, anti-nuclear groups, most of which are Seoul-based NGOs, have long adopted a monolithic hit and run strategy through which local people at a prospective site are mobilized into massive and militant protests to thwart the government's decisions. Anti-nuclear movements in Korea, unlike such cases in France, Sweden, the United States and West Germany,<sup>24)</sup> failed to be scaled up into national controversies due to the lack of popular base

and diversified strategies. Ironically, vocal opposition groups that lacked a compelling strategy lost momentum when the central government preemptively institutionalized a consultative process to discuss waste facilities. The *Gyeongju* case in the next part shows this irony.

Other than direct effects of technological systems on society, a sociopolitical milieu as a wider context of society also affects the ways that the system is socially shaped.<sup>25)</sup> Relevant actors' definitions of technology vary with changes in sociopolitical milieu surrounding the technology.<sup>26)</sup> Bearing it in mind that "the sociocultural and political situation of a social group shapes its norms and values, which in turn influence the meaning given to the artifact,"<sup>27)</sup> we need to clarify what kind of milieu enjoys a dominant position in Korea. Two major types of sociopolitical milieus prevailed over time. One has been to emphasize economic value. Contrary to the United States whose priority is to build an effective containment system,<sup>28)</sup> nuclear power in Korea has been socially defined as a crucial element to achieving modernization and economic growth. The other sociopolitical milieu has been the development

24) Kitschelt, Herbert P., "Political Opportunity Structures and Political Protest: Anti-Nuclear Movements in Four Democracies." *British Journal of Political Science*, Vol. 16, No. 1, 1986, p. 60.

25) Klein, Hans K. and Daniel Lee Kleinman, "The Social Construction of Technology: Structural Considerations." *Science, Technology & Human Values*, Vol. 27, No. 1, 2002, p. 30; Pinch, Trevor J. and Wiebe E. Bijker, "The Social Construction of Facts and Artefacts: or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other." In Wiebe E. Bijker, Thomas P. Hughes and Trevor J. Pinch eds., *The Social Construction of Technological Systems, New Direction in the Sociology and History of Technology*. Cambridge: The MIT Press, 1987.

26) Litmanen, Tapio, "Environmental Conflict as a Social Construction: Nuclear Waste Conflicts in Finland." *Society & Natural Resources*, Vol. 9, 1996, pp. 523~535. Petts, Judith, "Effective Waste Management: Understanding and Dealing with Public Concerns." *Waste Management & Research*, Vol. 12, No. 3, 1994, pp. 207~222.

27) Pinch, Trevor J. and Wiebe E. Bijker, "The Social Construction of Facts and Artefacts: or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other," p. 46.

28) Jasanoff, Sheila and Sang-Hyun Kim, "Containing the Atom: Sociotechnical Imaginaries and Nuclear Power in the United States and South Korea." *Minerva*, Vol. 47, No. 2, 2009, pp. 119~146.

of democracy. The burst of civic activity in a more open political climate in the late 1980s gave rise to the environmental issues such as distributive justice and public involvement in hazardous facilities sitings. In response to this, the state began to take nuclear sector as an opportunity to declare its willingness to listen to public opinion.

### 3. The role of the state: a medium between technological systems and society

It is the dual position of the Korean state that enables it to play an active role as a medium between society and nuclear power system. The state as a “system builder”<sup>29)</sup> can display its mastery of complex technical issues during the development of technological systems; at the same time as a public authority, it can identify and solve intractable social problems resulting from the system.

The Korean state situated in this dual position has maximized its legitimacy by adapting physical and non-physical components to a dominant sociopolitical milieu. However, unlike pluralist assumptions in the *Social Construction of Technology (SCOT)* approach that understands relevant actors’ capacities or powers as equally distributed,<sup>30)</sup> there exists a clear asymmetry of power between the state and other social groups in Korea. The state, according to Skocpol and Finegold, enjoys the advantage

29) Hughes, Thomas P, “The Evolution of Large Technological Systems.” In Wiebe E. Bijker and Trevor J. Pinch eds., *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, p. 52.

30) Klein, Hans K., and Daniel Lee Kleinman, “The Social Construction of Technology: Structural Considerations.” *Science, Technology & Human Values*, Vol. 27, No. 1, 2002, pp. 30~31; Yun, Sun-Jin and Eun-Jeong Oh, “A Study on the Social Construction of the Nuclear Power Generation Policy in Korea: Focused on the Introduction Processes of Nuclear Technology.” *Journal of Environmental Policy and Administration*, Vol. 14, No. 1. 2006.

of having administrative capacities.<sup>31)</sup> In addition, as Evans argued, in a developmental state like Korea, “highly selective meritocratic recruitment and long-term career rewards create commitment and a sense of corporate coherence”<sup>32)</sup> within state bureaucracies. This gives the state a significant level of coherence and autonomy to pursue its own goals over external pressures. McAvoy sees state capacities as coercive tools to systematically and authoritatively implement state’s own policy preferences, independent of public opposition.<sup>33)</sup> When local people resist a plan for a waste repository, for example, the state can make use of its coercive capacity to completely exclude them from the decision-making process. This kind of exclusionary strategy could erode the authority and legitimacy of decision-making processes. It is at this point that the state needs to mobilize its non-coercive power based on financial, intellectual, and technical resources in order to induce stakeholders to cooperate in a national project.<sup>34)</sup>

In this sense, nuclear power policy is a representation of state’s capacity for selective operations of both coercive and non-coercive measures to undertake a political reconstruction of nuclear power system. It has been suggested that there are three major types of policies through which governments have dealt with nuclear power facilities. First, a plan rationality policy focuses on scientific and technical evaluation by a small

31) Skocpol, Theda, and Kenneth Finegold, “State Capacity and Economic Intervention in the Early New Deal.” *Political Science Quarterly*, Vol. 97, No. 2, 1982, pp. 255~278.

32) Evans, Peter B, *Embedded Autonomy: States and Industrial Transformation*. Princeton: Princeton University Press, 1995, p. 58.

33) McAvoy, Gregory E, “State Autonomy and Democratic Accountability: The Politics of Hazardous Waste Policy.” *Polity*, Vol. 26, No. 4, 1994, p. 704.

34) Nordinger, Eric A, *On the Autonomy of the Democratic State*. Cambridge: Harvard University Press, 1981; McAvoy, Gregory E, “State Autonomy and Democratic Accountability: The Politics of Hazardous Waste Policy.” *Polity*, Vol. 26, No. 4, 1994, pp. 699~728

group of experts and bureaucrats and pursues a unilateral announcement of a final site for waste storage. Secondly, a contract policy depends on a bilateral tradeoff between the local people willing to take the controversial facility on one hand and the central government offering considerable amounts of economic incentives on the other. Lastly, a multilateral consultation policy emphasizes the importance of public arena where relevant actors are invited to reach a deliberative decision on how the radioactive wastes should be managed.

The following chapters show how one of three policies is selected and how it changes nuclear power system. The Roh government (2003–2008) implemented a contract policy on the LILW and at the same time prepared a path for a consultation policy on the SNF in Korea. In contrast, the Lee government (2008–2013) called an abrupt halt to a consultation policy and preferred going back to a plan rationality policy to fully utilize the economic opportunity coming from the nuclear industry.

#### IV. Dynamics in the Development of Nuclear Power System: The Roh Moo-hyun government (2003–2008)

##### 1. Societal context: social conflicts and participatory democracy

Korea's attempts to secure a central interim spent-fuel storage and repository for LILW began in 1986. However, the central government surrendered to local protests nine times from 1989 to 2004.<sup>35)</sup> The failure in securing sites, particularly for SNF, emerged as a growing concern that

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35) Yun, Si-Tae, "Site Selection for Low and Intermediate Level Radioactive Waste Disposal Facility in Korea." *Progress in Nuclear Energy*, Vol. 50, 2008, p. 680.

threatens the persistence of an entire system. As of December 2014, 75% of total storage capacity of at-reactor (AR) facilities was already used up to store an estimated 750 tons of SNF from 23 reactors annually.<sup>36)</sup> Further, the ROK-US Atomic Energy Agreement, which prohibits Korea's independent reprocessing of SNF, worsens the storage issues for Korea. Without any action, the *Kori* plant would face its limit of SNF storage by 2016, the *Wolsong* Plant by 2017, the *Uljin* Plant by 2018, and the *Younggwang* Plant by 2021.<sup>37)</sup>

After realizing that unilateral decisions only intensify local resistance, the state turned to non-coercive measures including financial and institutional resources. The critical change was made during the presidency of Roh Moo-hyun (2003-2008). Roh's tenure is often labeled "participation government" backed by younger and more progressive electorates. Lessons from past failures, combined with a prevailing democratic sociopolitical milieu made the Roh government take a new approach to handling siting dilemmas. Roh regarded the waste storage issue as a political opportunity for showing its commitment to democratic values.

In December 2004, the Atomic Energy Commission (AEC), the highest-ranking decision-making body on the utilization of nuclear energy, decided to separate LILW and SNF and then started to focus on the LILW repository as a politically easier way.<sup>38)</sup> This decision was based on

36) Park, Won-Jae, et. al., *Current progress and future preparedness on public engagement of national spent fuel management* (in Korean), Report for the Korea Institute of Nuclear Safety. Report no. KINS/RR- 1255, February, Daejeon, Korea: Korea Institute of Nuclear Safety, 2015, p. 15.

37) Park, Won-Jae, et. al., *Ibid.*, p. 16.

38) IPFM (International Panel on Fissile Materials), "Managing Spent Fuel from Nuclear Power Reactors: Experience and Lessons from Around the World," 2011, p. 67.  
<http://www.creativecommons.org/licenses/by-nc/3.0/>(Accessed April 29, 2014.); IAEA (International Atomic Energy Agency), "Country Nuclear Power Profiles 2013, Republic of Korea," 2013, p. 10.  
<https://cnp.iaea.org/countryprofiles/KoreaRepublicof/KoreaRepublicof.htm>(Accessed July 26, 2014.).

the estimation that the saturation of LILW would occur earlier than that of SNF: it was estimated that the *Ulsan* Plant would face the saturation problem in 2008, the *Wolsong* Plant in 2009, the *Younggwang* Plant in 2012, and the *Kori* Plant in 2014.<sup>39)</sup> In March 2005, National Assembly passed the government-initiated legislation with the full title of the *Special Act on Assistance to the Locations of Facilities for Disposal of Radioactive Waste* (hereafter the 2005 Special Act).<sup>40)</sup> This legislation implies that the Roh government took a more inclusive approach to storage problems, which was a clean departure from the plan rationality policy of the past.

## 2. Contract policy on LILW: political consent and economic compensation

The 2005 Special Act is intended to exchange political consent and economic compensation. First, it states that a high degree of local acceptance is required in site-selection procedures. The site-selection committee composed of various groups from the legal profession and academics to media and civic groups is given authority to monitor the entire process so as to secure procedural legitimacy.<sup>41)</sup> The most significant innovation is to call for a local referendum. If there are two or more prospective sites competing to host the LILW disposal facility, the one with the highest percentage vote in favor should be chosen as a final site.<sup>42)</sup>

39) Yun, Si-Tae, "Site Selection for Low and Intermediate Level Radioactive Waste Disposal Facility in Korea." *Progress in Nuclear Energy*, Vol. 50, 2008, p. 681.

40) Policy Forum, "Policy Recommendations for the Management of Spent Nuclear Fuel and Public Discussions (in Korean)." Final Report, Research Project of Ministry of Knowledge Economy. 2012, p. 117.

41) *Enforcement Ordinance of the Special Act on Assistance to the Locations of Facilities for Disposal of Radioactive Waste*.

42) Ahn, TK, and Jung-Hoon Han, "A Case Study of Public Acceptance in Finland Nuclear Industry (in

Secondly, it provides a guideline that the central government must offer a considerable compensation. This would amount to 270 million dollars as a special upfront payment plus an additional 600 dollars per waste drum to be paid to the local government. Additionally, the KHNP headquarters would be relocated to the city that hosted the facility.<sup>43)</sup>

After this legislation, four cities applied to compete for hosting storage facilities, each of which was having fiscal problems. The low fiscal self-reliance ratio of candidate cities inevitably made government's promises look attractive.<sup>44)</sup> In November 2005, *Gyeongju* was selected as a final site for LILW disposal facility.<sup>45)</sup> The main reason why *Gyeongju* welcomed nuclear storage facilities was the local economic situation. *Gyeongju*, the capital of the ancient kingdom, is famous for numerous archaeological sites and national treasures. A number of special regulations that actually restrict property rights have become a source of grievances for local residents.<sup>46)</sup> In this situation, people began to consider having waste facilities may be one of the alternatives to boost a lagging local economy.

Another reason that explains *Gyeongju* case is the change in decision-making procedure. It is important to remember that *Gyeongju* before 2005 was not much different from other cities that resisted government's waste storage plan. However, new procedures with voluntary

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Korean)." Final Report, Research Project of Korea Nuclear Energy Promotion Agency. Seoul, Korea. 2012, p. 97.

43) IPFM (International Panel on Fissile Materials), "Managing Spent Fuel from Nuclear Power Reactors: Experience and Lessons from Around the World," p. 67.

44) "Nuclear, A Drug to Local Economy" *Pressian*, December 2, 2011; Ahn, TK, and Jung-Hoon Han, "A Case Study of Public Acceptance in Finland Nuclear Industry (in Korean)." Final Report, Research Project of Korea Nuclear Energy Promotion Agency. Seoul, Korea. 2012, p. 101.

45) "Gyeongju wins vote for nuclear dump" *Korea Herald*, November 3, 2005.

46) Choi, Chul-Won, "A Study on Causes of Policy Acceptance in Local Governments (in Korean)." *Journal of Administration and Policy Studies*, Vol. 7, No. 1, 2009, p. 143.

application and residents' direct vote helped change people's perceptions. The Roh government, by departing from an authoritarian way of unilateral decisions, successfully redefined nuclear waste not as a source of protest, but as an opportunity worthy to be considered in terms of economic and democratic criteria. Among the 70.8% of the voters who participated in the local referendum in *Gyeongju*, 89.5 % approved the LILW disposal facility.<sup>47)</sup>

### 3. Consultation policy on SNF: public participation and inclusion

The Roh government also prepared a conference with a wide range of actors for attaining an SNF storage site. *Civil Society–Government Forum for Energy Policy* established in 2004 became a cornerstone in bringing headstrong anti-nuclear groups to the discussion table. However, it was not easy to find reasonable solutions to SNF management. Major environmental groups such as *the Green Korea United* and *the Korean Federation for Environmental Movement* criticized the government for pretending to be consensus building, but that never seriously considered a complete facelift of national energy structure.<sup>48)</sup> In June 2004, environmental groups left the deliberation table. It was the ruling political party that mediated the gridlock between the government and civic groups. The ruling party suggested the establishment of a time-limited organization for building public consensus on nuclear energy.<sup>49)</sup> In December 2004, the

47) Yun, Si-Tae, "Site Selection for Low and Intermediate Level Radioactive Waste Disposal Facility in Korea." *Progress in Nuclear Energy*, Vol. 50, 2008, p. 682.

48) Policy Forum, "Policy Recommendations for the Management of Spent Nuclear Fuel and Public Discussions (in Korean)." Final Report, Research Project of Ministry of Knowledge Economy. 2012, pp. 113~114.

Atomic Energy Commission (AEC) reconfirmed basic principles that public consensus-building must be preceded before the implementation of any action plan.<sup>50)</sup>

With regard to SNF management, a special subcommittee of the National Energy Commission, the “Task Force for Spent Nuclear Fuel” was established with the President as a chair in order to design a more detailed process to achieve public consensus.<sup>51)</sup> The task force was composed of members with different views on nuclear power: 4 academic scholars, 2 professional researchers, 4 civic groups, and 2 nuclear industry leaders. The task force team, comprised of both pro-nuclear groups and anti-nuclear scholars and civic organizations, made a thorough comparative analysis on SNF management in other countries.<sup>52)</sup>

After 13 months of research, the task force team released a key recommendation in 2008. The 2008 report was boiled down into what is called the *PRESIDeNT* principle: Participation, Responsibility, Ethics, Sincerity, Independency, Deliberation, Non-linearity, and Transparency.<sup>53)</sup> This report became a stepping stone toward a consultation policy with higher levels of public inclusion. The 2008 report advised the creation of an independent legal body called Public Engagement Commission on Spent Nuclear Fuel Management (PECOS).<sup>54)</sup> PECOS is the essence of the Roh government’s policy to seek a democratic solution to waste storage

49) Policy Forum, *Ibid.*, pp. 114~115.

50) Lee, Young-Hee, “Politics of Expertise and Social Movements (in Korean).” *Economy and Society*, Vol. 93, 2012, pp. 28~29.

51) IPFM (International Panel on Fissile Materials), “Managing Spent Fuel from Nuclear Power Reactors: Experience and Lessons from Around the World,” p. 68.

52) Policy Forum, “Policy Recommendations for the Management of Spent Nuclear Fuel and Public Discussions (in Korean),” p. 23.

53) Policy Forum, *Ibid.*, p. 24.

54) Lee, Young-Hee, “Politics of Expertise and Social Movements (in Korean),” p. 29.

dilemmas.

#### 4. Socially reshaping the nuclear power system

As mentioned earlier, the nuclear power chosen as a grand modernization project has rapidly developed under the centralized guidance of the state. However, having no waste facilities became a major obstacle. It also shows that the system not only lacks institutionalized organization to deal with technical gridlock but struggles with gaining political consensus. The Roh government's two policies can be understood as a way to readdress the technological system in a changed environment where the state can no longer claim unilateral decision-making authority. Contract policy for LILW was designed to induce local communities to make a collective decision on their own. Redistribution mechanisms, including compensation, are used as a way to resolve disputes over the siting of controversial facilities that has been observed in most industrialized countries.<sup>55)</sup> In particular, contract policy is to offer an "equal opportunity"<sup>56)</sup> to all interested parties in that every local government is entitled to apply for the LILW repository and every resident in the region has a voice for or against it. Consultation policy aims to build a deliberative arena where a wider variety of groups can collectively search for more acceptable solutions. PECOS is a representative achievement to deal with SNF storage problems that involves greater health and environmental

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55) Lesbirel, S. Hayden, "The Political Economy of Project Delay." *Policy Sciences*, Vol. 20, No. 2, 1987, p. 154.

56) Short, James F., and Eugene A. Rosa, "Some principles for Siting Controversy Decisions: Lessons from the US Experience with High Level Nuclear Waste." *Journal of Risk Research*, Vol. 7, No. 2, 2004, p. 144.

risks than LILW and thus requires greater political consensus.

Figure 2. Dynamics during the Roh Government

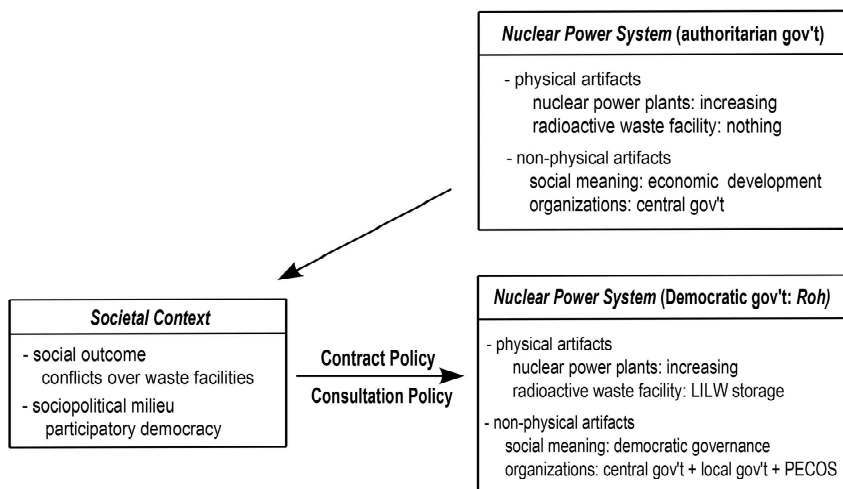


Figure 2 briefly summarizes the path of how the state and society facilitated the transformation of their interests into two policy solutions. It shows how the state tried to maintain the system by adding physical and non-physical artifacts. Roh strengthened the system by adding institutional catalysts for local government and PECOS. He also tried to re-center nuclear technology into democratic governance through which many stakeholders are invited for collective decision-making. For these efforts, the Korean nuclear power system gained momentum to tide over an impending problem of LILW repositories.

## V. Dynamics in the Development of Nuclear Power System: The Lee Myung-bak government (2008–2013)

### 1. Societal context: stagnant anti-nuclear movements and economic revitalization

By enhancing the role of local government and strengthening a consultative body for a greater public engagement, the Korean nuclear power system managed to overcome the problem of having LILW repositories. This newly reshaped system weakened the anti-nuclear movement in a paradoxical way. In his evaluation on *Gyeongju* case, Choi says anti-nuclear groups lost public attention in a sudden change of the government's strategy.<sup>57)</sup> One member of *Energy Justice Action* said, "For anti-nuclear groups, *Gyeongju* was a fatal defeat out of 10 important matches with the central government seeking radioactive wastes storage, which made anti-nuclear movements stagnant."<sup>58)</sup> Anti-nuclear groups in Korea which had mainly resorted to mere "confrontational strategies" are not yet well-acquainted with deploying "assimilative strategies" such as lobbying, petitioning, referendum campaigns, and partisan involvement in electoral processes.<sup>59)</sup> For this reason, antinuclear groups were weakened when the central government turned to a more inclusive approach.

The LILW repository in *Gyeongjuand* weakened anti-nuclear groups made the Lee government take a more aggressive stance. In order to isolate the nuclear power system from a vocal arena of public involvement,

57) Choi, Chul-Won, "A Study on Causes of Policy Acceptance in Local Governments (in Korean)." *Journal of Administration and Policy Studies*, Vol. 7, No. 1, 2009, pp. 141~142.

58) "Nuclear, A Drug to Local Economy." *Pressian*, December 2, 2011.

59) Kitschelt, Herbert P, "Political Opportunity Structures and Political Protest: Anti-Nuclear Movements in Four Democracies." *British Journal of Political Science*, Vol. 16, No. 1, 1986, p. 67.

Lee tried to redefine it into highly technical terms. The change in sociopolitical milieu also explains Lee's policy choice. With a broader backdrop of global recession emanating from the United States, the Lee government (2008–2013) took the stage with campaign promises of economic revitalization and national competitiveness. Lee viewed nuclear power as a lucrative business that could help secure his conservative support base. With a provocative slogan of “Green Growth,” the Lee government chose nuclear power technology as the representative energy sector.

## 2. Revival of plan rationality policy on SNF storage: expertise and exclusion

In Lee's presidency, the previous government's keynote policy was completely reversed. Civic groups criticized the revival of technocratic approach, labeling his tenure the “politics of expertise.”<sup>60)</sup> Politics of expertise in dealing with SNF can be captured by observing the following anecdote. On August 6, 2009, the official opening day of PECOS, the government suddenly announced that a legal framework and solicitation of expert opinion were required first. PECOS, as explained earlier, was started in 2007 as a task force to reach consensus among various societal actors for dealing with SNF storage.<sup>61)</sup> According to the press release by the Ministry of Knowledge Economy, SNF is highly technical and scientific issue that demands a serious technological investigation and scrutiny.<sup>62)</sup>

60) Policy Forum, “Policy Recommendations for the Management of Spent Nuclear Fuel and Public Discussions (in Korean).” Final Report, Research Project of Ministry of Knowledge Economy, 2012.

61) Damveld, Herman, and Dirk Bannink, “Management of Spent Fuel and Radioactive Waste.” *Nuclear Monitor*, 2012, p. 18. [http://www.nirs.org/mononline/nm746\\_48.pdf](http://www.nirs.org/mononline/nm746_48.pdf) (Accessed April 28, 2014.).

62) Ministry of Knowledge Economy, *Managing Spent Nuclear Fuel: A Legal Framework and Export Solicitation Needed* (in Korean). A Press Released. 2009. <http://www.mke.go.kr/motie/ne/rt/press/>

After paralyzing PECOS, Lee instead initiated a government project composed of expert groups from the nuclear establishment such as *Korea Radioactive Waste Management Corporation*, *Korean Nuclear Society*, and *Green Korea 21*. These are all considered pro-government organizations representing energy industry and academia.<sup>63)</sup> Members of the project took up the position that SNF storage is a severely specialized domain and it should not be interfered with by nonprofessional views. Underlying the idea of the expert panel was that technology is purely scientific issue.

Meanwhile, Korea and United Arab Emirates sealed a contract in 2009 that Korea would build 4 nuclear reactors in *Barakah*, UAE by 2020. The story of an over 20 billion dollar contract to build nuclear power plants and develop oil field was splashed across the front pages of newspapers with flashy headlines: “Korea, New Tiger in Nuclear Technology,”<sup>64)</sup> “Lee’s Green Diplomacy,”<sup>65)</sup> “Fierce Nuclear Fights Korea vs. Japan,”<sup>66)</sup> which all helped to silence civic opposition. By reviving a powerful rhetoric that binds nuclear with the national wealth, Lee began to gain the upper hand in a confrontation with his opponents. The dramatic expansion of the total volume in nuclear sectors, as shown in Figure 3 and 4, clearly indicates how the Lee government took an uncompromising stance to boost nuclear industry whereas opposition groups were marginalized due to the widespread anxiety of possible economic crisis and diminished organizational power. Though civic groups and progressive academia asserted that nuclear technologies should not be confined to the technocrats, their efforts to expand the scope of conflict

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bbs/bbsView.do?bbs\_seq\_n=53147&bbs\_cd\_n=16 (Accessed May 5, 2014).

63) Lee, Young-Hee, “Politics of Expertise and Social Movements (in Korean),” p. 33.

64) “Korea, New Tiger in Nuclear Technology.” *Segye Daily*, January 15, 2010.

65) “Lee’s Green Diplomacy.” *Munwha Daily*, December 26, 2010.

66) “Fierce Nuclear Fights Korea vs. Japan.” *Kookmin Daily*, March 9, 2010.

were neither as strong nor as effective as the government's.

Figure 3. Investment in Nuclear Industry (2003-2011)<sup>67)</sup>

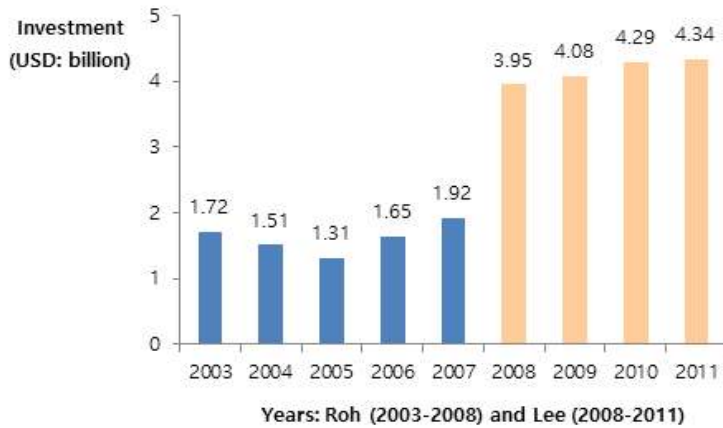
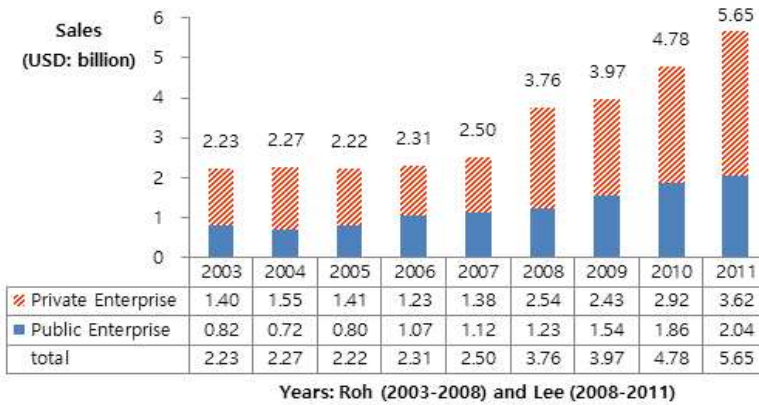


Figure 4. Sales in Nuclear Sector (2003-2011)<sup>68)</sup>



67) Ministry of Education, Science and Technology. 2013, 74. The unit of currency was converted by the authors from the Korean Won (KRW) to the US dollars (USD) with the exchange rate, KRW 1,000 = USD 1.

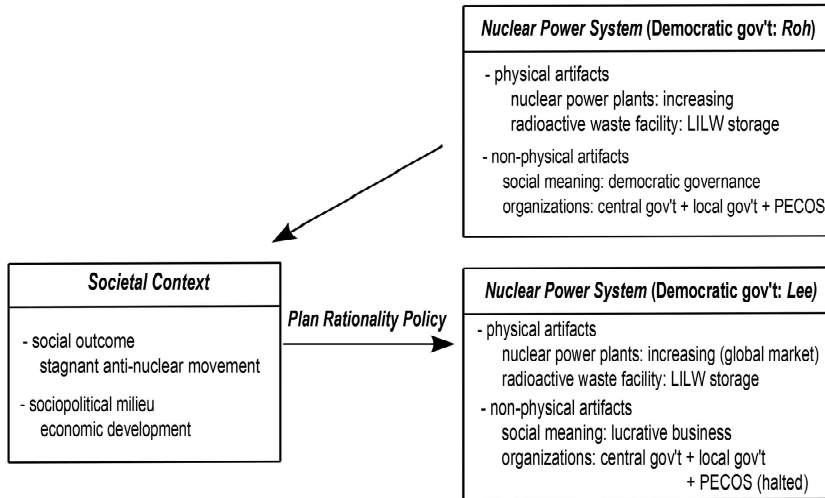
68) Ministry of Education, Science and Technology. 2013, 46. The unit of currency was converted by the authors from KRW to USD with exchange rate, KRW 1,000 = USD 1.

### 3. Socially reshaping the nuclear power system

Lee's attention was overwhelmingly focused on extracting as much economic value as possible from a well-prepared nuclear industry, whereas Roh placed major emphasis on democratic governance on nuclear wastes. The Lee government considered extracting profits by selling nuclear technology overseas to be a more critical task than the completion of SNF facility. A catchphrase of "Green Growth" signifies how the Lee government strived to give economic significance to nuclear technology. The president himself stood in the vanguard of so-called "resource diplomacy." Through this mercantilist drive, Lee sought to redefine the value of nuclear technology as a realm of technical rationality and professionalism. It is important to note that Lee's plan rationality policy strategically dealt with nuclear issues through different strategies in domestic and international dimension, respectively. In domestic dimension, the government kept a passive strategy by holding SNF issue in suspension in order to avoid social antagonism. In the international dimension, the government pursued a fiercely aggressive involvement in an overseas sales effort.

As *Figure 5* shows, the social outcomes that are produced by previous stage and a broader sociopolitical milieu influences policy choice. The LILW disposal facility prepared by the previous government gave Lee some room to avoid domestic debate on waste management. The Lee government enhanced the economic value of the nuclear industry while terminating consultative organizations. In the meantime, the Lee government expanded the physical scale of the system by transforming nuclear industry into export goods. The expanded volume of nuclear industry consequently contributed to the reinforcement and continuity of the Korean nuclear power system.

Figure 5. Dynamics during the Lee Government



The revival of a plan rationality policy with a strong economic emphasis suggests that the Korean nuclear power system resembles a battlefield where the meaning of technology is being contested. The state defines the problem and tries to imbue a particular social meaning to technology in order to secure social allegiance toward it. Yet, as important as the interests of the state are the social conditions under which the state selects a particular choice.

## VI. Conclusion

This paper firstly addressed the distinctive characteristics of the Korean nuclear power system in historical context. Based on the interpretation of atomic technology as freedom and power, the state in the developmental era began to craft a domestic nuclear power system for meeting a soaring

demand of energy for industrialization. While nuclear technology became a symbol of national development, a state-driven nuclear power system boiled down to state monopoly and technocratic realm. Since the transition to democracy in the late 1980s, Korean civil society began to challenge the government's decisions on the site selection for nuclear waste.

Through the lens of the dynamics of the state, society, and technology, this paper traced how the Korean nuclear power system has developed over time. Physical and non-physical artifacts in nuclear power system produce social outcomes such as conflicts over site selection and variation of anti-nuclear activities. Conversely, sociopolitical milieus as a wider political context affect how components are reconfigured. The state as a system builder within nuclear power system intervenes in mediating the bidirectional influence between society and nuclear power system through policy choices in a way that serves the ultimate goal of system reinforcement. For this purpose, the state as a public authority in society strives to reshape the nuclear power system more concordant with prevalent sociopolitical milieu in order to weaken the social resistance.

This paper finds that the Roh government took inclusive strategies in site selection of radioactive waste storage to show its commitment to democratic governance. Contract and consultation policies were chosen as a way of gaining political support and technological stability of nuclear power system. The Lee government, on the other hand, defined nuclear power system in terms of economic opportunity and technocratic decision-making. The Lee government kept its distance from the vocal arena of public engagement and instead invested heavily into exporting nuclear technology. Lee's plan rationality policy corresponds to the prevailing social concerns of economic revitalization following the 2008

global recession. Nuclear policy, in this regard, can be understood in relation to the state's strategy in a political arena to better mobilize allegiance of society toward the nuclear power system. In addition, each policy approach demonstrates state's capacity to adapt and maintain a large-scale technological infrastructure in accordance with a changing society. Despite the differences, both governments did not try a structural transformation of national energy system in Korea. In effect, Roh strengthened the system by adding institutional catalysts necessary for alleviating social concerns over risky technology. Lee, by expanding the volume of nuclear industry, consequently contributed to the reinforcement and continuity of the Korean nuclear power system.

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- Radioactive Waste Management Act.*
- Nuclear Safety Act and its enforcement ordinance.*
- Special Act on the Locations of Facilities for Disposal Radioactive Waste.*
- Enforcement Ordinance of the Special Act on Assistance to the Locations of Facilities for Disposal Radioactive Waste.*

Abstract.

Governing the Atom: State, Society, and the Nuclear Power System  
in South Korea

Kyungah Song (Research Fellow, The Institute of Korean Political Studies,  
Seoul National University)

Hoon C. Shin (Ph.D. Candidate, School of Human Evolution and Social Change,  
Center for Behavior, Institutions and the Environment, Arizona State University)

Since the construction of the first nuclear power reactor in 1970, the Korean state has played an entrepreneurial role not only in expanding the material scale of nuclear power system but in also crafting ideology and organizations to maintain a large-scale technological infrastructure. Building on the observation that the last two democratic governments (2003–2008; 2008–2013) adopted divergent approaches to the management of nuclear power system, this article tackles the following questions: how and why they chose different policies; how did the structure of Korean nuclear power system change as a result? To answer these questions, this article presents an analytical framework whose underlying idea is that a nuclear policy is formed through the intertwined dynamics of the state, societal contexts, and a technological system. In the Korean context where state-led development of technology coexists with a changing democratic environment, the state is situated both within a technology and in society. This dual position of the Korean state leads us to a better understanding of a nuclear policy in relation to the interaction between technology and society mediated by the state. This article finds that the two governments eventually contributed to entrenching the Korean nuclear power system despite their policy discrepancies.

Keywords: South Korea, Nuclear Power System, Nuclear Policy, State,  
Technological System, Society

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