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An experiment for urban energy autonomy in Seoul: The One 'Less' Nuclear Power Plant policy

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HIGHLIGHTS

- We analyze One Less Nuclear Power Plant policy, with background, governance and content framework.
- The OLNPP policy aims to achieve energy self-sufficiency at a local scale.
- An urban energy experiment is for energy transition to renewable energy and energy demand management.
- A unique contribution of Seoul's energy experiment is changing norms by adding a moral dimension.

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ABSTRACT

This study examines an experiment in energy self-sufficiency in Seoul, Republic of Korea, through a particular energy policy called the One Less Nuclear Power Plant (OLNPP) policy. We define an urban energy experiment as a purposive intervention for energy transition from an energy system based on nuclear and fossil fuels to one based on renewable energy and energy demand management. We suggest three findings. First, we find that the themes of our theoretical framework policy backgrounds, governance and policy contents have played important roles for Seoul's energy experiments aimed at urban energy autonomy. In particular, political leadership based on the mayor's previous experiences contributed significantly to the formation and implementation of this policy. Second, the OLNPP policy adds a social or moral dimension to urban energy policies. The norm change from an environmental and economic focus to a focus on the combination of social, environmental, and economic considerations is a unique contribution of the OLNPP policy to urban experiments in energy transition. Third, we find that experiments through purposive interventions serve as a means for facilitating urban energy governance where the actors involved can communicate and enhance their new ideas and practices.

1. Introduction

Climate change and fossil fuel depletion justify an energy paradigm shift from a fossil fuel-based energy supply to a renewable energy based-supply and improvements in energy efficiency. Improvements in energy efficiency and deployment of renewable energy have been successfully implemented in many parts of the world, particularly at large scales. Along with the change in energy sources, an energy paradigm shift has also occurred in terms of how the scale and scope of the energy sector are viewed. Large-scale and centralized energy systems with "significant spatial and psychological distance between energy generation and use" (Walker et al., 2007:68) have been questioned due to their inherent social, environmental, and economic problems (Byrne and Toly, 2006). Alternatively, small-scale and decentralized energy systems have been explored at local levels to tackle problems associated with large-scale and centralized energy systems (Monstadt, 2007).

Several recent experiments at local scales have been performed in the urban context (CDP, 2012; Hammer, 2008; Keirstead and Schulz, 2010; Puig, 2008). Cities powered by fossil fuels and uranium are criticized as major drivers of climate change, and are held responsible for atmospheric destruction and exposing their citizens to radiation risks (Droege, 2008). Cities are also blamed for

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almost two thirds of global primary energy consumption (Keirstead and Schulz, 2010). Furthermore, cities rely heavily on surrounding areas for their energy supply. To maintain the infrastructure and economic activities of urban spaces, suburban or rural areas carry the heavy burden of generating and transmitting energy to cities (Rickwood et al., 2008). Unequal distribution of risks, costs, and benefits of fossil fuel or nuclear power projects in non-urban areas often causes severe social tensions (Vajjhala and Fischbeck, 2007). Thus, making urban areas less dependent on non-urban areas for energy production could reduce these social tensions. Accordingly, although energy policies related to energy supply and demand management are conventionally dealt with at the national scale (Rae and Bradley, 2012; Walker et al., 2007), cities are spaces in which tangible changes can be made to ensure an environmentally sustainable energy future (Keirstead and Schulz, 2010; Monstadt, 2007). To tackle problems associated with energy, energy paradigm shifts should occur at smaller scales such as cities as well as at larger scales, such as global and national levels (Sovacool and Brown, 2009). The Republic of Korea has made efforts to move from the conventional energy paradigm to a more environmentally sustainable energy paradigm due to higher oil prices, increased environmental concerns at local, regional, and global levels, concerns about energy supply security, and the rise of environmental non-governmental organizations (NGOs) (Kim et al., 2011). However, Korea is still an energy-intensive nation. Korea is the world's eleventh largest energy consumer and the ninth largest CO_2 emitter (International Energy Agency (IEA), 2012). Additionally, 31.1% of electricity use in Korea in 2012 was from nuclear energy (Korea Energy Economics Institute (KEEI), 2013). Similar to megacities in other countries, Seoul is responsible for a large portion of the nation's energy consumption. For example, Seoul alone consumed 10.3% (46,903 GW h) of the total national energy output (455,070 GW h) while producing only 2.95% (1384 GW h) of its total energy consumption in 2011 (Seoul, 2013). To reverse this trend, Seoul has been undertaking an urban energy experiment since 2012, which, we believe, can provide insights into national and sub-national energy policy for other energy-related experiments being implemented worldwide.

In this study, we aim to analyze Seoul's example, using the newly developed concept of an urban energy experiment. We also provide policy suggestions that other cities within and beyond the borders of Korea can implement to promote sustainable energy policies. We examine Seoul's One 'Less' Nuclear Power Plant (hereafter OLNPP) policy. In the second section of this paper, we provide a theoretical framework to understand a transition to energy autonomy at the city level. In the third section, we analyze Seoul's energy policies, using the theoretical framework suggested in the previous section. We conclude with a discussion of our findings and propose lessons and policy implications based on our analysis of Seoul's urban energy experiment.

2. Methods: Experiments for transitioning to urban energy self-sufficiency

2.1. Urban experiments for energy transition

Notwithstanding numerous stalls in international and national rules on climate change and energy policies, some sub-national governments including provinces (or states), cities, and communities have taken serious actions to mitigate and address global climate change problems (Bomberg and McEwen, 2012; Koski and Lee, 2014). Local governments and non-governmental actors have conducted a variety of experiments to tackle climate change and energy nexus issues at the sub-national level. In particular, Bulkeley and Broto (2012): 361 defined "climate change experiments" as "purposive interventions in urban socio-technical systems designed to respond to the imperatives of mitigating and adapting to climate change in a city." As Hoffmann (2011) noted, urban climate governance experiments share three characteristics: they (1) engage in explicitly making rules for local climate responses; (2) are independent from international negotiations such as the Kyoto Protocol or national policies; and (3) take place across jurisdictional boundaries.

However, the aims and measures of urban climate change experiments and urban energy experiments may not be equivalent. We also acknowledge that there are commonalities between urban climate experiments and urban energy experiments since most climate change mitigation experiments take place in the energy system. In our understanding, urban climate experiments are bigger concepts than urban energy experiments, since the former include almost all energy related climate mitigation measures plus flood protection measures, forestry projects and carbon markets (see Bulkeley and Broto, 2012: 363–364), while the latter do not necessarily include those measures.

Experimentation here refers to trial and error with innovative ideas with the goal of accomplishing better outcomes. Thus, we define an "urban energy experiment" as proposing and implementing new ideas, technologies, and practices to alter existing ways of supplying, transmitting, and consuming energy to provide reliable, environment-friendly, self-sufficient, and affordable energy in and beyond urban areas. Cities and sub-national entities are ideal places for energy experimentation, because new ideas and practices to revise or upscale the extant energy supply and consumption policies have been tested in these areas (Evans, 2011). Examples of urban energy experiments are abundant. The C40, a translocal network of global cities to collectively tackle climate change, and Arup, an international urban consulting company, reported 4734 climate actions taking place in 58 member cities (C40 Cities, 2011). What are the purposes of these urban experiments? If uncertainty prevails, experiments can test new ideas and technologies. More generally, new ideas are likely to be successful, efficient, and effective at achieving their own stated aims (Broto and Bulkeley, 2013). The purpose of experiments can range from learning to changing the behavior of institutions to scaling-up or down the output of experiments (Lee and Van de Meene, 2012). To diffuse or scale-up/down urban energy experiments to other urban areas, communities, or nations, it is imperative to evaluate how experimentation influences targeted entities' behavioral or institutional changes. Thus, experimentation is a driver for political, technological, and socio-economic *transitions* by testing out new forms of aims, policies tools, and governance structures (Evans, 2011; Hodson and Marvin, 2007).

2.2. Transition from energy dependency to energy autonomy

The term transition inherently contains the concept of direction: from some place to some other place. Transitions usually change extant socio-economic settings. Low carbon transitions aim to transform existing interests, power, and norms based on fossil fuel or nuclear energy-based systems into renewable energy-based systems by using energy demand management and efficiency enhancements (Bulkeley et al., 2011). Therefore, transitions require not only the existence of technological alternatives, but also institutional and socio-economic drivers (Droege, 2008). For any alternative to challenge the entrenched system, there must be a mobilization of resources and leadership that is supported by heterogeneous actors including political leadership, experts, NGOs and citizens (Späth and Rohracher, 2012).

Accordingly, energy autonomy is an experiment in energy transition from a state of energy dependency. Seeking urban energy autonomy involves reducing, at a scale, the energy supplied from centralized power generators based on fossil or nuclear fuels