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Power fluctuations: How Japan's nuclear infrastructure priorities influence electric utilities' clout

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ABSTRACT

Analyzing Japan's situation, this study examines how shifts in national government prioritization of infrastructure for large baseload electricity sources influence the political power of entities responsible for maintaining and expanding this infrastructure. Applying two theoretical frameworks – the theory on co-evolution of technological systems and institutions, and the advocacy coalition framework – the study shows how infrastructure prioritization leads to economic vested interests and political power that combine to shape energy system trajectories in complex ways that can enable both stasis and change after external shocks. Findings generate insights on how shifts in electricity infrastructure priorities and utility empowerment affect economic considerations for energy systems. Findings also provide lessons for policymakers on how linkages between infrastructure prioritization and political power can promote energy system lock-in. The study suggests that energy system adaptability requires framing of energy system goals in ways that enable necessary infrastructure investment while creating flexibility that allows future infrastructure changes.

1. Introduction

Developed nations face twin challenges of maintaining aging electricity infrastructure and incorporating new infrastructure to accommodate introduction of additional energy sources. In this context, many governments are promoting policies that prioritize this infrastructure development. As they embark on these policies, governments can benefit from past lessons on their political effects and implications for energy system transitions.

Japan offers a useful case study. From the 1970s oil crises until the 2011 Fukushima disaster, the Japanese government focused on nuclear power infrastructure expansion. Since the disaster, prioritization of preservation and expansion of this infrastructure remains ambiguous. The electric utilities' role in Japanese energy policymaking also has evolved during the same four-decade period. Analyzing these concurrent shifts in Japan from the time of the oil crises through four years after the Fukushima disaster, this study examines how shifts in national government prioritization of infrastructure for large baseload electricity sources influence the political power of entities responsible for investing in, maintaining and expanding this infrastructure. Findings also offer informative insights on implications for electricity system stasis and change.

Several recent studies have described Japan's central government's movement away from prioritizing nuclear power development since the Fukushima disaster, including work by Hermwille [1] and Ohira [2]. These studies suggest that central government policymakers responded to public opposition by reversing the prior policy focus on nuclear infrastructure expansion. Other recent studies, including those by Hymans, Kingston, and Vivoda [3–5], propose that national-level focus on nuclear infrastructure and accompanying utility influence have remained largely unchanged since the disaster. This study provides context that reveals how these seemingly contradictory sets of work – one positing a system shift, and the other, stasis – can simultaneously reflect accurate depictions of Japan's electricity infrastructure and political power trajectory. Applying two theoretical frameworks – Hughes' theory on co-evolution of technological systems and institutions [6], and the advocacy coalition framework (ACF) developed by Sabatier and Jenkins-Smith [7,8] – the study shows how economic vested interests and political power combine to influence energy system trajectories in complex and non-linear ways.

The study offers three broader contributions to existing work on electricity infrastructure and political power. First, applying two complementary theories explains how changes in electricity infrastructure prioritization influence empowerment of actors involved in implementing it. Second, the Japanese case study generates novel insights on how shifts in electricity infrastructure prioritization and utility empowerment affect economic considerations for energy system design. Finally, the study provides important lessons for policymakers on how linkages between infrastructure prioritization and political power can promote energy system lock-in as empowered actors resist policy

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change that would limit recovery of prior infrastructure investments.

2. Theoretical frameworks and hypothesis

Two theoretical frameworks inform this study's analysis of factors contributing to energy system stasis and change after external shocks: the theory on co-evolution of institutions and large technological systems, and the advocacy coalition framework (ACF). The co-evolution theory, which posits gradual alignment of institutions with technological system development, offers insights on how infrastructure priorities can, over time, create economic vested interests that resist technological system change, even after external shocks. The ACF provides a complementary framework that sheds light on how external shocks can alter this power and coordination abruptly, influencing short-term shifts in energy systems. Applying these two frameworks enables understanding of how shifts in energy infrastructure priorities can influence long-term economic vested interests and short-term stakeholder power balance to shape energy system trajectories.

2.1. Energy system stasis and politics of infrastructure priorities

The co-evolution theory offers an economic explanation for energy system entrenchment that emerges from infrastructure investments. In this theory, Hughes describes co-development of large technological systems and the institutions that support them. He connects this co-evolution with lock-in of these systems based on increasing returns [6]. The theory suggests that relationships based on vested interests lead to institutional preservation of an existing technological system. Scholarly work on large technological systems by Hughes and others such as Unruh, Berkhout, Foxon, and Van der Vooren and Alkemade [9–12] suggests that the energy sector is particularly susceptible to such co-evolution of technological and institutional systems, due to its dependence on infrastructure and institutional support. Hughes, Foxon and others, including Kemp; Lovio, et al.; and Moe [13–15], observe that large investments in energy system infrastructure, including power plant construction and connections to electricity transmission and distribution grids, create vested interests in perpetuating an existing system. These vested interests prioritize returns on investment over increasing efficiency. The co-evolution theory thus helps to explain how vested economic interests based on infrastructure prioritization lead to long-term preservation of an energy system and its infrastructure even after a catastrophic event. While the theory suggests that connections between energy system development and institutional coordination can contribute to political power over time, it does not explain how sudden changes in this political power can alter institutional support for and direction of an energy system.

The ACF developed by Sabatier and Jenkins-Smith [7,8] can help to explain the role of such short-term political power shifts on energy system stasis and change. The ACF defines advocacy coalitions as groups of policy participants who "share similar policy core beliefs" and "engage in nontrivial degree of coordination [16]." The framework asserts that in a context of relatively stable parameters, policy participants coordinate their behavior with allies in advocacy coalitions to influence policy. The ACF's description of policy beliefs suggests that they overlap heavily with coalition members' policy priorities. The ACF explains both energy system stasis and change as emerging from this coordinated behavior based on the beliefs of the actors in power. As long as individual actors within an empowered coalition maintain similar beliefs, a system remains stable. This ACF concept aligns with co-evolution theory's explanation of stable systems that co-evolve with institutions. However, it also suggests a vulnerability to political and system change that the co-evolution theory does not include.

2.2. Energy system change and politics of infrastructure priorities

The co-evolution theory explains how economic interests can perpetuate energy system lock-in even after shocks, suggesting that sudden system change is unlikely. Incremental change may result if technological innovation alters an entrenched technological system's investment returns, or if an external event triggers a shift in large-scale institutional priorities [17]. This second scenario suggests a role for political factors, but the theory does not focus on these. While the co-evolution theory proposes slow institutional change that accompanies technological system development, it does not address rapid political power shifts that can enable sudden system change.

The ACF addresses the role of this political influence, positing that external shocks can suddenly alter coalitions' beliefs or relative influence on policymaking [18]. The ACF predicts that two possible shifts can yield this effect. First, external shocks can draw public attention that alters the mechanisms through which coalitions can influence policy, shifting the power balance to a different coalition with different policy beliefs. Second, external events can change the dominant coalition's policy beliefs, enabling system change [19]. These two shifts suggest the potential for rapid system change, which the co-evolution theory suggests is unlikely.

Original ACF applications focused on energy and environmental policymaking, and many recent energy policymaking studies utilize or reference it, including those by Hsu, Birkland, Jacobsson and Lauber, Nohrstedt, Stefes and Laird, and Akin and Urpelainen [18–24]. Japanese energy policy analyses by Valentine and Sovacool [25], Duffield and Woodall [26], Moe [13], and Sklarew [27] also indicate the role of government priorities as drivers that affect policy coordination and the direction of policy change in response to shocks. Application of the ACF to Japan's energy policymaking history complements seminal work by Johnson [28] and Samuels [29,30] on government-utility relationships. The ACF thus offers a framework for examining how the Fukushima disaster's alteration of national government priorities influences the power of the electric utilities in Japan's energy policymaking coalitions.

Some scholars observe linkages between the bodies of work that apply the co-evolution theory and the ACF, including Jacobsson and Lauber, Valentine and Sovacool, Sklarew, and Jacobsson and Lauber [20,25,27]. Valentine and Sovacool and Sklarew note the overlap in the two frameworks' views on system entrenchment as rooted in stakeholder interests and influence [25,27]. Jacobsson and Lauber cite institutional changes and advocacy coalitions as conditions for energy system change [20].

This study builds on all of this existing work to deepen understanding of how shifts in infrastructure priorities can influence the political power of electric utilities as key stakeholders in development of this infrastructure. In utilizing both the ACF and co-evolution theory, the study also offers a holistic view of how the economic and political effects of infrastructure prioritization can combine to reinforce or challenge an existing energy system and prevent or promote change.

2.3. Hypothesis

Analyzing the co-evolution theory's economic and institutional factors alongside the ACF's framing of the influence of political power, this study sheds light on the broader puzzle of Japan's post-Fukushima energy system trajectory: how seemingly simultaneous energy system change and stasis can emerge after an external shock. To address this puzzle, the study posits that economic vested interests in infrastructure and accompanying gradual institutional alignment contribute to long-term preservation of an incumbent electricity system after a shock, while sudden shifts in electric utility political power enable short-term potential for a transition away from the incumbent system.

3. Methods and limitations

Findings emerge from analysis of data collected in Japan through 65 interviews of 58 interviewees from 2013 to 2015: 21 current or former government officials involved in energy policymaking; 23 executives