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INTRODUCTION

EEPS special issue on "Enhancing renewable energy and energy efficiency: Japanese and US policies with implications for Asia"

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1 Introduction

Over the past several years, we have observed increased attention paid to energy policy issues in the United States and Japan. In the United States, the Environmental Protection Agency (EPA) has proposed the Clean Power Plan, the most comprehensive climate regulation on the electricity sector in the US to date. This policy will likely promote the use of renewable energy and natural gas at the expense of reducing coal combustion.[1]

In Japan, in the meantime, energy policy has gained increased visibility among the general public as its priority to national and local governments has seemed to increase. The Fukushima accident following the 2011 Great East Japan Earthquake led to the shutdown of all nuclear reactors in Japan. The restart of nuclear power plants has become quite a contentious political issue as evident in the Otsu district court decision on the safety of the Takahama nuclear reactor owned by the Kansai

[1] Given the recent transition in the U.S. administration, how this regulation will be implemented and continued remains highly uncertain.

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Electric Power Company.[2] This special issue on "Enhancing renewable energy and energy efficiency: Japanese and US policies with implications for Asia" introduces research papers that address the energy policy challenges relevant to these trends in the US and Japan. Most of the articles are outputs of a series of workshops hosted at Waseda University and the University of Hawaii from 2013 to 2015.

2 Promotion of energy efficiency in the United States and Japan

Energy efficiency has become an essential part of energy policy globally as policy makers recognize "energy saved" as the largest source of energy.[3] Japan is no exception given its limited fossil fuel sources historically and its limited nuclear power more recently. Energy efficiency is also high on the US energy policy agenda. Power companies conducted various demand side management efforts in residential, commercial, and industrial sectors (Allcott 2011; Arimura et al. 2012; Gillingham et al. 2009). More recently, energy efficiency was one of the four building blocks of the Clean Power Plan, and it still plays a crucial role in rate-based regulation under the final rule of the Clean Power Plan.

Since the 1970s, Japan has achieved remarkable energy efficiency improvements through the government's implementation of various policies. For example, the Japanese government enacted the Act on the Rational Use of Energy (also known as the Energy Conservation Act) in 1979 and implemented various policies and rulings in the following decade (Arimura and Iwata 2015). Recently, in the aftermath of the Great Recession in 2007, the government implemented the "Eco-point" program, officially named as "the Program to Promote the Spread of Green Home Appliances by Utilizing Eco-Points". Under this system, which was effective from May 2009 to March 2011, consumers received subsidies, in essence, by purchasing energy efficient appliances (Morita and Arimura 2016).

Akao (2016) examined the cost-effectiveness of the Home Appliance Eco-point program in Japan. Unlike a simple subsidy on energy-efficient appliances (where there is no restriction on how a consumer could use the savings due to the subsidy), the eco-points were exchangeable only for environmentally friendly goods. Akao finds that this limitation, which would reduce the demand for energy-saving appliances, limits the cost-effectiveness of the eco-point system relative to a simple subsidy. The second feature of the system—where the duration of the system was uncertain—also influenced the policy's environmental impacts by affecting the consumers' timing of investment in energy-saving appliances.

Based on Japan's Family Income and Expenditure Survey, Nakano and Washizu's (2016) study also reveals another unintended consequence of the eco-points system through its influence on energy efficiency investment at the extensive

[2] "Takahama injunction delivers body blow to Japan's nuclear power industry" http://www.japantimes.co.jp/news/2016/03/10/national/takahama-injunction-delivers-body-blow-to-japans-nuclear-power-industry (accessed on March 22, 2017).

[3] Between 1974 and 2010, the "energy savings from efficiency measures taken over the longer term exceed the output from any other single fuel source in a subset of 11 IEA member countries" (International Energy Agency 2014).

margin: the eco-points might induce durable purchases in households that had not owned the durables (particularly in those outside large cities). The uptake of the eco-points across households indicates that targeting efficiency-enhancing policies to certain groups of households may improve the program's effectiveness. Taken together, these two articles indicate the directions to improve the cost effectiveness of the eco-point system.

3 Renewable energy integration in the United States and Japan

Along with standards for energy efficiency improvement, many governments have adopted quantitative targets for integrating renewable sources into their energy systems. In the US, while several policies have been implemented at the federal level (e.g., income tax credit for investments in renewables), many states have implemented their own policies to encourage the use of renewables (Palmer et al. 2011). A typical example is the renewable portfolio standard (RPS), a quantitative target on the electricity sales based on renewables. The expansion of renewables, many of which are intermittent, create challenges to maintaining stable electrical grids. Texas had a black out when the generation from wind power exceeded the load. Hawaii, which is known for aggressive integration of renewables, also faces a similar problem. In some circuits with high penetration of solar panels in Hawaii, back-feeding of electricity occurs during the daytime, making grid management more challenging than ever for the local electric utility.

Tarui (2017) reviews the recent development of policies to enhance the integration of renewables in the energy system and distributed electricity generation in the United States. The current performance of these policies indicates both challenges and opportunities in improving the policies to further integrate distributed generation. As an example, under traditional natural-monopoly regulation, energy efficiency improvement and distributed generation tend to reduce the profits of electric utilities. How to align the interests of utilities and the regulators aiming for further integration of renewables will remain an issue of practical and academic interest.

The State of Hawaii in the United States has one of the most ambitious RPS targets (100% renewables by 2045). Policy makers debate on whether the state, which currently relies heavily on imported petroleum as the major source of energy, should adopt imported liquefied natural gas (LNG) as a bridging fuel as the state transitions its energy system. Coffman et al. (2016) apply a computable general equilibrium model to find that the use of LNG would indeed lower the cost of electricity generation. The greenhouse gas (GHG) emissions in Hawaii would be lower as LNG combustion is less GHG intensive than petroleum thermal. However, the authors caution that the use of LNG might increase the overall GHG emissions through the upstream processes such as processing, transmission, and liquefaction of natural gas. Such concerns are larger with nonconventional sources such as shale gas. Thus, the authors point to a potential tension between the gains in the electricity markets (through lower prices) and GHG emissions reduction.

Japan also implemented policies to promote renewable energy for power generation. In 2003, the government adopted its Renewable Portfolio Standard

(RPS) to increase power generation from renewable energy. Its impact was limited in the early period: the share of renewables in generation changed from 0.6% in 2003 to 1% in 2008. Given the limitation of the RPS, the Japanese government decided to adopt a feed-in tariff (FIT) to address climate and energy issues by promoting renewable energies in Japan (Arimura 2015). Introduced in November 2009, Japan's FIT set a fixed price at which the electric utilities must purchase electricity generated from solar energy. Later, the scope of the FIT system was expanded to cover wind, geothermal, biomass, and micro-hydro resources.

Promotion of renewable energy can have impacts on the energy systems as well as the economic structure. One solution to the transmission problem due to intermittent generation is new technology. Nakano et al. (2016) applies a new input–output table to study the economy-wide impacts of a "next-generation energy mix," i.e., an energy mix with higher penetration of renewables. Their analysis indicates positive impacts on not only the renewable electricity generation sector but also the production of electric vehicles (EVs) and plug-in hybrid vehicles (PHVs). They also find a positive impact on the service sector: renewable-energy-induced service activities, such as research and business services, will become more pervasive. These impacts tend to counterbalance the potential cost impacts of higher renewables penetration.

Nuclear power generation has been facing difficulties in Japan. The Fukushima accident, followed by the Great East Japan Earthquake in March 2011, coincided with regular maintenance for many other nuclear reactors in Japan. Thus, all the nuclear power generators were shut down from 2013 to 2015. The government enacted a new safety regulation with more stringency. Power companies had to make investments and adjustments to comply with the new safety standard. Even after the investment for the more stringent regulation, however, many Japanese people were not satisfied with the investment and were nervous about the restart of nuclear reactors. In fact, 2 years passed before a power company could restart the first nuclear power plant. The controversy on the restart did not stop there. Residents living near nuclear power plants started a lawsuit against the restart due to their concerns on the safety of power plants. The lawsuits were expanded to neighboring prefectures since they could also have faced radiation risks from an accident. Finally, the Otsu court in Shiga prefecture provided a verdict that the power plants in Takahama did not meet the safety target (or the new safety standard set by Nuclear Regulatory Commission is not strict enough to address a possible future tsunami or earthquake). Consequently, the Kansai nuclear power company had to stop the Takahama nuclear power plant, which was the second nuclear generator restarted after the long hiatus due to the Fukushima accident. Thus, the acceptance of the nuclear power restart has been of interest to academics.

Omata et al. (2015) examined the determinants for the public to support the restart of nuclear power generation in Japan using internet survey data from 6500 individuals. The authors apply the Bayesian ordinal quantile regression approach to consider different attitudes toward nuclear power by individuals with differences in unobserved preferences for the nuclear restart. They indeed find different levels of willingness to support the result and differences in unobservable preferences as well as across genders.

Shutting down nuclear power generation can have significant impacts on the energy mix. While advocates for renewable energy are skeptical about nuclear power, the shutdown of nuclear power generation often leads to an expansion of coal power generation, which can increase carbon emissions. The nuclear shutdown may also lead to increases in natural gas use, which is more expensive with larger economic burdens for the Japanese economy.

Yamazaki and Takeda (2016) assess the economic and environmental impacts of Japan's FIT for supporting renewable energy under alternative nuclear power scenarios by applying a multi-regional, recursive-dynamic, computable general equilibrium model based on the Global Trade Analysis Project (GTAP) database. Compared to a reference case (consistent with the IEA projection), under two alternate scenarios with less nuclear power (phasing down nuclear power in 40 years or no restart of nuclear power), CO_2 emissions would indeed increase due to the substitution of nuclear by fossil fuel sources of energy. This result illustrates the tradeoff between the nuclear shutdown and CO_2 emissions control under policies to support renewable energy.

4 Implications of the US and Japanese experiences for developing countries in Asia

Reducing GHG emissions in developing countries is critical to achieve a meaningful difference in the atmospheric concentration of GHG. For this purpose, the Kyoto Protocol under the UN Framework Convention on Climate Change designed a market mechanism known as the Clean Development Mechanism (CDM). The CDM allows Annex I countries, which have GHG emissions reduction targets under the Protocol, to earn credits for emissions reduction by financing and implementing projects to reduce GHG emissions in developing countries. As of 2014, 99 countries hosted more than seven thousand CDM projects (IGES CDM database).

One objective of the CDM is the transfer of low carbon technology such as renewable energy or energy efficiency. Simon et al. (2016) examine the impact of technology transfer under CDM in India. Although India is the second largest host of CDM, the share of the CDM projects that involve technology transfer is the lowest among the top four CDM host countries. The authors investigate the relationship between technology transfer and the costs of CDM projects. On one hand, CDM may induce Annex I countries to pursue lowest-cost emissions abatement projects in non-Annex I countries, indicating increased marginal GHG abatement costs as more CDM projects are implemented (the "low-hanging fruit" problem). On the other hand, learning effects may induce decreasing marginal abatement costs over time. The authors find no evidence of the low-hanging fruit problem. In addition, once the learning effects are controlled for, the abatement costs of projects that include technology transfer are not higher than those that do not. This result indicates that factors other than the abatement costs may explain whether a CDP project involves technology transfer. This suggests an interesting venue for further research to the extent that technology transfer enhances further overall GHG emissions reduction.

Although CDM has contributed to GHG emissions reduction, it has faced various criticisms (e.g., costs of proving additionality and limits on the types of projects covered under CDM). To address these issues associated with CDM, the Japanese government has promoted a new mechanism to promote emissions reduction in developing economies. Under the proposed Joint Crediting Mechanism (JCM), developed economies can reduce GHG emissions in developing economies by exporting energy-efficient products/technologies.

Sugino et al. (2016) examined the economic impact of JCM on Japan. Their analysis, based on Japan's and the Asian international input–output tables with disaggregated sectors to capture hybrid vehicles, solar panels, wind and geothermal turbine industries separately, reveals differential impacts across sectors. An increase in the demand for GHG emissions abatement due to JCM implies different multiplier impacts (higher for hybrid vehicles, wind turbines and air conditions; lower for boilers and solar panels) as well as different employment effects (higher for coke dry quenching plants and lighting equipment). These results indicate the distributional impacts of increased demand for GHG emissions reduction, even among those sectors and products that would all benefit from such demand increases.

Taken together, the articles in this Special Issue provide some lessons on how policies to enhance energy efficiency, renewables integration, and GHG emissions reduction could be improved upon. While some papers indicate tradeoffs in pursuing these goals (e.g., the eco-point systems and subsidies for energy efficiency investment are not cost-effective in reducing GHG emissions), others also point to the ways in which policies can be designed to pursue a goal without compromising the others. This Special Issue combines studies based on a variety of methodologies ranging from applied theory, input–output analysis, CGE modeling, to state-of-the-art econometric models. We hope these methods as well as the future research opportunities that these articles indicate are of interest to the readers.

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