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Perspectives

Curiosity, economic and environmental reasoning: Public perceptions of liberalization and renewable energy transition in Japan

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ABSTRACT

A public survey of energy users across Japan was conducted in March of 2017. It is almost one year since liberalization of the low voltage electricity market for households and small retail premises, for whom we identified an opportunity to play a positive role through their choices and participation in the energy market, which may influence the ongoing energy system restructure in Japan. The survey asked about changing to a new power provider, and about the installation of rooftop photovoltaic systems to identify the reasoning behind these choices. Additionally, future hypothetical energy scenarios were tested. The results show that a significant portion of the public make participatory decisions to gain an economic benefit, while another group appears curious about new technology, seeking information before reaching a decision in order to satisfy their curiosity. Both groups are larger than the third significant group, whose decision making is guided by environmental reasoning. The results also show that a large portion of the public are relatively conservative in their energy choices, leading to a very passive approach, while a small portion of respondents demonstrated a more active stance. These findings have ramifications for the future energy system and implications for energy policy development.

1. Introduction

Energy is a very important issue in Japan, due to a high reliance on energy imports to meet the overall energy demand [1]. National energy policy seeks to establish an energy system which: 1) addresses the energy security issues to engender a stable supply (energy security), 2) is environmentally aware (environment), 3) improves economic efficiency (economy), and 4) addresses safety in energy supply (safety); [2]. This energy policy approach is known as 3E + S and recognizes the need for further deployment of renewable generation and other low-carbon technologies, in light of the challenges surrounding the re-instatement of nuclear generators in post-Fukushima Japan. National energy policy goals recognize that dependence on foreign energy imports has negative impacts on households and industry, in the form of rising energy costs [1] and envisages an energy mix in 2030 which includes strong growth in renewable energy (RE) generation of 22–24% of total power generation [3]. In the medium term, Japan aims to reduce greenhouse gas (GHG) emissions by 26% by 2030 relative to 2013–this target is Japan's intended nationally determined contribution (INDC), pledged at the 21st Conference of Parties (COP21) in Paris, 2015 [1]. Further, Japan has agreed to an 80% reduction in GHG emissions by 2050 (G8 commitment) as a long term environmental goal. In order to meet these targets, Japan has implemented several policy approaches including the feed-in tariff to encourage the deployment of RE, energy efficiency and power conservation measures to reduce overall power consumption, the return of nuclear power at a lower than pre-Fukushima incident level (anticipated to account for 17–22% of generation by 2030), and the use of efficient fossil fuel based generation in order to constrain GHG emissions [3]. The liberalization of both the retail electricity (in 2016) and gas markets (in 2017) in Japan will potentially incorporate energy users into the policy debate, as they begin to influence the energy system through their purchasing, technology, policy approach and participation preferences. In light of the liberalization of the Japanese energy market, and evidence of a significant shift towards new energy retailers [4], this research aims to identify potential future impacts on the energy system arising from energy user's choices and energy system participation preferences as well as underlying, influential factors. The focus of this research is Japan, due to its recent, comparatively late liberalization of the energy market, when compared to other developed nations across Europe and the Americas. This research seeks to identify potential policy implications in this recently liberalized market which employs modern centralized and distributed generation technologies with differing incentives for their deployment. The future influence of households is

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investigated in detail, in terms of energy supplier choice, deployment of solar PV at the household level and other preferences relevant to the future energy system. This research also seeks to highlight any cultural aspects which affect choices or behavior, specific to Japan, in line with household's lifestyle and values [5].

2. Background and research novelty

Japanese energy policy has evolved over time with regard to an open market, and the introduction of policies which engender competition and consumer participation. In the electricity market, prior to 1995 there was no competition, and only the 'big 10′ regional electricity companies provided electricity to households [6]. Government led reforms gradually revised the nature of the electricity market, with the opening of the independent power producer market in 1995, the extra high voltage market (factories, office buildings and department store customers) in 2000, the high voltage market (small-medium sized buildings and factories) in 2005 and finally, the low voltage market, including homes and shops from 2016 [5]. Within the household energy system, following on from liberalization of the electricity market in 2016, the gas market was also opened to competition in 2017 [7]. The expected merits of these markets' liberalization include: choice of company, lifestyle-specific pricing regimes, bundled and discounted payment plans, choice of energy source (including RE), local production and consumption, reward point benefits and increased competition leading to lower prices [8].

Another policy which has heavily impacted upon consumer choice and participation in the energy market, is the RE feed-in tariff which subsidizes large-scale RE sources including wind, geothermal, hydro and biomass, as well as large (>10 kW) and small-scale (<10 kW) solar photovoltaics (PV), which can be deployed at the household level [9]. The household PV market has grown significantly since the introduction of the feed-in tariff to 4,460GW as of November 2016, making it the second largest RE capacity in Japan, exceeding biomass, wind, small and mid-scale hydro and geothermal RE capacity (household PV's capacity is exceeded only by large-scale PV; [10]). The increase in RE deployment in Japan at the household level has positive ramifications for energy security and environmental improvement at the national level, and recent research identifies electricity cost savings as well as some behavioral changes for households who install PV [11].

This research complements existing academic evaluation of choices, perception and preferences toward renewable and alternative energy technologies, which have previously assessed willingness to pay in order to estimate greenhouse reductions [12], as well as attitudes towards nuclear power and energy saving in Japan, post-Fukushima [13,14]. The novelty of this research when contrasted with these Japanese studies, also based on a survey approach is its focus on market liberalization, which occurred after the cited studies, and the potential to change energy provider for a variety of reasons as an enabler for household level participation in the energy market. Further this research explores the underlying factors which influence participation, including economic and environmental merit, along with curiosity and the influence of messaging information quality.

As residential energy use accounts for approximately 15% of final energy consumption in Japan [15,16], the impact of this significant market sector cannot be overlooked in the transition of the Japanese energy system to meet its future energy policy goals.

3. Methodology

The methodology employed in this study includes the development and testing of a public survey, including focus groups and respondent screening. Following the collection of results, statistical analysis is applied to identify important issues and the reasoning behind these issues to identify potential future impacts on the energy system.

3.1. Survey design

The Energy Use, Choice and Knowledge Survey was conducted through an internet survey company with respondents throughout all 47 prefectures of Japan, above the age of 20. Stratified sampling was conducted to achieve a representative sample of the population, by age group, region, and level of educational achievement (approximately 50% of respondents holding a bachelor degree or higher; [17]).

The survey was conducted during March 2017 and a total of 4148 responses were received from adults across Japan. Appendix A outlines the respondent demographics and a comparison to national averages to demonstrate the representativeness of the sample.

The survey is divided into five sections, 1) Social and environmental issues: investigating global and national scale issues and environmental awareness, 2) Energy knowledge: investigating technology, policy and energy market awareness, 3) Energy use: investigating types and purpose of energy use in the home and for transport as well as opinions about energy cost, 4) Energy choice: investigating the choice of energy supplier, deployment of household renewables and reasoning for choices, and 5) The future energy system: investigating participation in energy system reform activities, preferences about the future energy mix, the future of liberalization, and policies and technologies to address climate change. In total, 30 questions were asked (in addition to demographic screening questions). Questions types ranged from closed questions (yes/no), the identification of preferences (ranking from 1 to n), and questions which required a weighted response (ranging scales measuring knowledge, consideration, cost, usage, income and participation). Section 3.2 highlights the key issues to be analyzed in this study, and the results section details the scales and ranks used for each question analyzed.

3.2. Survey analysis

The survey analysis in this study is focused on the two key issues affecting energy system structural change: energy choice, and the future energy system. These two issues are investigated specifically with regard to the factors which influence decisions, and, in order to determine the future level of active or passive participation in the transition of the liberalizing energy system toward a low-carbon future. Questions asked and response formats are described below for each of the key issues assessed.

3.2.1. Energy choice

The energy choice section builds on the earlier energy knowledge and energy use sections of the survey which assessed general awareness and energy usage properties of households; investigating respondent's choices with regard to changing electricity provider, deploying household solar PV, and the reasoning behind these choices.

Questions asked on a yes/no basis were whether respondents had changed electricity providers or whether they had installed PV at their home. Following up on these questions, the level of consideration given to changing electricity provider (no consideration, some consideration and serious consideration) was investigated. Finally, the reasons for changing, or not changing provider, and for installation or non-installation of PV were probed.

3.2.2. The future energy system

Firstly, in this section, respondents were asked to indicate which sources of generation, currently available in the Japanese grid that they would like to see increase or decrease. The range of options given was; decrease, if anything decrease, neither, if anything increase, and, increase. In addition, respondents were asked to identify the reason for their choice for each generation technology considered.

Secondly, to attempt to determine participation levels in the future, liberalized energy market, three participation scenarios were tested in our survey: The first scenario assessed participation in voluntary