



Strategic and user-driven transition scenarios: Toward a low carbon society, encompassing the issues of sustainability and societal equity in Japan.



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ABSTRACT

This study investigates the sustainability and social equity impacts of the ongoing transition toward a low carbon society in Japan to assess the merits of top-down and bottom-up approaches.

The research uses mixed methods, incorporating householder and energy expert surveys, scenario design utilizing the Japanese MARKAL/TIMES framework, and sustainability and social equity evaluation. Surveys identify householder energy system and participation preferences, alongside energy expert input on social equity and policy design. Scenario building is undertaken to compare energy system outcomes between the strategic Japanese policy approach and a user driven approach to energy transition, both cognizant of 2050 environmental goals. Both scenarios are comparatively assessed using a holistic sustainability evaluation process.

Conclusions identify the impact of liberalization and subsequent householder participation in the energy system in Japan, when compared to a strategic, policy driven approach. Both approaches have positive ramifications on social equity and policy burden distribution outcomes. However, the household participation scenario delivers a more equitable outcome, distributing energy policy burdens in a fairer manner through the realization of an energy system which is safe, stable and affordable.

The findings have practical applications in participatory policy design, and the development of energy policy which can achieve transition goals while being sensitive to householder preferences and social equity concerns.

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1. Introduction

Energy Policy to mitigate climate change in Japan is focused on economic, environmental, energy security and safety concerns (known in Japan as 3E + S). At the same time Japan is moving toward an energy transition in order to meet their 2030 goals of 22–24% of electricity from renewable energy (RE) sources (METI, 2014), and the more ambitious 2050 goal of an 80% greenhouse gas (GHG) emission reduction (UNFCCC, 2015).

With energy policy goals heavily focused on 3E + S, environmental and economic components overlap with some ideals of sustainability, however from a social point of view, apart from energy security and safety, these aspects are under-represented.

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Achieving the 3E + S goals is espoused by the Japanese government as the ideal energy policy outcome (METI, 2015), and like other OECD nations, environmental and economic concerns have priority over social aspects, which are recognized in a broader, non-specific context (Chapman et al., 2016a,b). Ideals around equal opportunity and developing an energy system which not only achieves policy goals, but does so in a sustainable, equitable manner is not discussed in detail in current Japanese strategic energy policy documents (METI, 2014; 2015).

As part of the energy transition in Japan, two major policies have, and continue to shape the residential sector contribution to energy policy goals. The two major policies are the feed-in tariff (FiT), particularly for solar photovoltaics (PV) at the household level, and the liberalization of the electricity and gas markets, introducing end-user choice as a variable in energy decision making (IEA, 2016; ANRE, 2017). Additionally, due to the FiT and liberalization, end-user awareness is growing around energy

technologies, policy tools and the impacts of a changing energy policy landscape (Chapman and Itaoka, 2018). One salient example is the “RE adjustment charge”, imparted partially as a result of FIT-induced RE deployment as an additional energy cost for end-users (TEPCO, 2017). It is anticipated that as awareness grows, and the impacts of energy policies are felt differently across households with different compositions and means, that end-users will alter their behavior and choices to derive better outcomes.

This study seeks to identify the awareness and importance of social equity issues in Japan by analyzing the linkage between energy policy outcomes, householder experiences and subsequent actions, by clarifying: 1) How the aspects of social equity are recognized by the Japanese public relative to the energy system, and how this recognition impacts upon energy system choices; 2) Whether this recognition is congruous with energy policy experts understanding; 3) Using Transition Theory as a lens, specifically the socio-technical regime of user preference, determine end-user impacts upon the future energy system and the level of social equity engendered in a liberalized energy market; 4) Through these analyses, key social, and systemic factors which influence this outcome are identified.

Following the clarification of social equity issue awareness at the household level, a comparative energy policy sustainability analysis is undertaken for the current Japanese strategic energy transition scenario and an additional user-driven scenario. Both scenarios aim to achieve ambitious 2050 goals through extensive deployment of renewable energy, storage and smart technologies based on strategic policy or end-user social preference and participatory approaches.

Section 2 details the policy background under which the Japanese energy system transition is likely to occur. Section 3 outlines pertinent academic scholarship with regard to energy policy and technological evaluation in terms of sustainability, identifying a gap in the literature with regard to quantitative social considerations. Section 4 describes the methodologies employed to measure end user and strategic policy influence on energy system scenario building and sustainability evaluation. Section 5 details the survey, scenario and sustainability results, while Section 5 discusses the results and the key influencers of scenario outcomes in terms of social equity and sustainability. Section 6 outlines the key findings and conclusions of this research.

2. Background: policy, sustainability, social equity and liberalization

Considering the significant reduction of GHG emissions required in Japan by 2050, a transition to a new energy system is envisaged, likely to be underpinned by RE and other innovative technologies. In Japan solar power is projected to experience the largest growth, and by 2030 to account for approximately 30% of the total RE contribution, second only to existing hydropower based generation (METI, 2015 p8). Transition theory provides a lens through which to analyze this change in energy system. Previous analysis of the Japanese transition in a liberalizing market identified the need for strong strategic direction, prudent technology choice and the consideration of successful international precedents in order to engender a successful transition (Chapman and Itaoka, 2016). Building on this analysis, with a strong focus on the socio-technical regimes of transition; policy, user preference, culture and technology (Geels and Schot, 2007), the importance and impact of social equity on the energy transition in Japan is investigated.

To enable a holistic evaluation of sustainability, social equity is quantitatively measured, considering economic and environmental energy system inputs. In this study, social equity is defined according to the results of two surveys undertaken in Japan, one

directed toward energy policy experts to assess equity factors and their importance, and another directed toward the public, measuring specific equity issues such as household burden and participation, alongside the overall importance of social equity when compared to environmental and economic concerns. In the quantitative assessment of sustainability, social equity is considered to improve when the burdens and benefits of energy policies and energy system outcomes are shared fairly, such that the gap between lower and higher income households is reduced (often described as vertical equity; Mooney and Jan 1997). This definition of social equity is derived from the energy justice concept (Jenkins et al., 2016), specifically on the core tenets of distributive justice (distribution of burdens and benefits), and procedural justice (meaningful participation in decision making; Sovacool and Dworkin, 2015). ‘Meaningful participation’ is assessed by observing the change in the future energy system based on end-user’s participation and energy technology preferences derived from the household survey.

The recent liberalization of the Japanese energy market (both electricity and gas by April 2017) provides the exogenous impact on the energy system, which may facilitate or expedite the energy transition to a low carbon society with an increased share of domestically sourced energy, predominantly RE (METI, 2014). With the liberalization of the energy market, end-users can choose to change their energy provider, based on broad criteria (including price, convenience and other factors).

3. Literature review: evaluation of energy policy and technologies in Japan

Energy policy and a range of technologies have been evaluated in Japan, and a significant portion of this recent analysis was brought about by the Fukushima incident and its impact on both the energy system and society, demonstrated by the pertinent academic contributions reviewed below.

Using a survey approach about participatory energy and environmental governance in urban and nuclear hosting prefectures in Japan, it was discovered that environmental consciousness was positively linked to willingness to participate in energy and environmental deliberation. At the same time, to a lesser degree, political obedience and an aversion to socializing or addressing sensitive issues reduced willingness (Nakamura, 2017). Regarding cultural and social impacts on sustainable energy and development, for geothermal energy, it was found that Japanese culture tends to be conservative and risk averse. This has led to a comparatively slow deployment of geothermal generation (with opposition from hot-spring owners), even post-Fukushima. While other economic, environmental and technical factors are considered influential in this analysis, the inclusion of the public as stakeholders in energy decision making is determined to be beneficial for furthering sustainable energy deployment (Shortall and Kharrazi, 2017). Additionally, the provision of sustainability information (predominantly economic and environmental) was found to be influential upon individual and group decision making processes with regard to specific RE technology choices (Hayashi et al., 2016). All of these findings for post-Fukushima Japanese energy policy decision making show a level of uncertainty, and limited consensus on the best option for the future deployment of RE. However, in terms of nuclear policy in Japan, there is broad recognition that further investment is unlikely at least in the short to medium term, and therefore, a significant investment in alternative technologies such as PV and wind power is likely. As to the feasibility of this approach, under a 50% CO₂ mitigation scenario incorporating the decommissioning of nuclear generation, by 2050, such a system is half the cost of a nuclear, non-CO₂ constrained

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