Japan’s post-Fukushima Challenge - Implications from the German Experience on Renewable Energy Policy

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Abstract

The Japanese electricity sector is facing serious challenges in the aftermath of the Fukushima nuclear disaster. The government has responded to the crisis with a new feed-in-tariff to promote increased utilization of renewable energy, and proposed to reduce the dependence on nuclear power. In this viewpoint, we liken the transition implied by recently updated goals for the diffusion of renewables in Japan to the transition in Germany in the last decade. We argue that some of the lessons learned in Germany might prove valuable for the steps Japan considers taking. In particular, we focus on the new Japanese feed-in tariff for solar photovoltaics. In view of the recent developments in Germany, we emphasize the importance of the scheme’s political legitimacy, which needs to be maintained through adequate design of both policy instrument and political process. We conclude with policy implications and a targeted research agenda.

Key Words: renewable energy policy, nuclear energy, solar photovoltaics, feed-in-tariff, Japan, Germany
1 The Japanese Energy Crisis after Fukushima

On March 11, 2011, a 9.0 magnitude earthquake struck off the coast of Japan’s Tōhoku region, followed by a tsunami and a nuclear meltdown at the Fukushima Dai-ichi power plant. The accident and the continued struggle to contain radiation at the 4.7 GW nuclear facilities have plunged the country’s electricity sector into a massive crisis. Having revealed the vulnerability of the country’s power system, the disaster appears set to shift the fundamental paradigms of Japan’s energy policy.

Before Fukushima, the country’s long-term energy strategy had revolved around an ever-increasing share of nuclear power. Japan’s energy strategy is formulated in the ‘Basic Energy Plan’, outlining the long-term strategy for the country’s future energy mix. The latest version in 2010 targeted the nuclear share of power production to surge from roughly 30% to 50% by 2030 (see Duffield and Woodall, 2011). This strategy has been shaken to its very foundations. A substantial part of Japan’s nuclear capacity has been forced to shut down in the aftermath of the earthquake1. The decision over whether idle reactors should be allowed to restart has been delegated to the local governments of jurisdiction (IEEJ, 2011a). This currently represents a significant challenge, amid a public growing increasingly distrustful of nuclear power (DeWit, 2011a).

Consequently, Japan declared in an energy white paper in October 2011 that it would aim to reduce the dependency on nuclear power and revise the Basic Energy Plan, starting “from a blank state” (METI, 2011a, p. 2). The Fukushima meltdown thus represents a major turning point and a huge opportunity for Japan’s energy future. The government’s response will set the course regarding nuclear safety, energy security, costs, and carbon emissions. Whether and how these objectives can be reconciled will depend on the political steps taken in the in the coming years (Ashina et al., 2011). It has been proposed that Japan should follow the example of countries that successfully promoted the use of renewable energy, such as Germany (e.g., DeWit and Kaneko, 2011; Iida, 2011). In this viewpoint, we liken the transition implied by recently proposed goals for renewables to the transition Germany underwent in the last decade. In particular, we describe some important lessons learned from the support of solar photovoltaics (PV) in Germany and discuss their implications in the context of Japanese policy.

2 Renewable Energy Policy in Japan Before Fukushima

Lacking significant domestic fossil fuel resources, Japanese energy policy has always been centered around concerns of energy security (Bobrow and Kudrle, 1987; Toichi, 2003). More recently, pledges to cut carbon emissions by 25% by 2020 from 1990 levels, and by roughly 80% by 2050 (Tollefson, 2011), have added reduced carbon intensity to the country’s long-term goals. In this context, the Japanese energy strategy before Fukushima increasingly focused on nuclear power as a (nominally) cheap, quasi-indigenous, and low carbon power source.

In contrast, renewables played a rather minor role before Fukushima. Despite policy support in the form of investment subsidies (since the mid-1990s) and a Renewable Portfolio Standard (since 2003), PV and wind power accounted for only 0.21% and 0.24% of electricity production in 2008 (IEA, 2011). Some geothermal projects were installed in the 1970s and 1990s (533 MW in total), but growth has slowed to nil since 1999

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1 In addition to the units immediately affected, the government ordered all reactors that have since been shut down for regular inspections to remain offline for ‘stress tests’. In total, 51 out of 54 nuclear reactors were out of service in early 2012 (JAIF, 2012).
When it became apparent that the renewable energy goals for 2010 would not be met (the goal was 1.35% of electricity production), a feed-in tariff (FIT) was eventually introduced in Japan in 2009. However, the scheme had been restricted to residential PV systems, and rewarded only net electricity production of the households (IEA, 2010).

Taken together, we see that no stringent regulatory framework encouraging significant investment in renewables had been implemented before Fukushima (Maruyama et al., 2007; DeWit and Iida, 2011; Moe, 2012). Maruyama et al. (2007, p. 2763) even come to the rather sobering conclusion that “Japan’s renewable energy policy [was] impeding renewable energy use rather than contributing to the spread of it”. The main reason is to be found in the regulatory structure. Most responsibilities related to the energy sector are concentrated in the Ministry of Economy, Trade, and Industry (METI), including the Agency for Natural Resources and Energy responsible for renewables. The METI is by tradition ‘in league’ with powerful industry organizations, such as Denjiren (the Federation of Electric Power Companies of Japan), and Keidanren (the Japanese Business Federation). Through this ‘cozy relationship’ between monopolistic utilities, industry, and a pro-nuclear bureaucracy (Aldrich, 2011, p. 62; also DeWit and Kaneko, 2011), vested interests have been able to hollow out all attempts towards stringent policies for renewables (DeWit and Iida, 2011, Moe, 2012).

### 3 A New Policy Approach Emerging in Response to the Crisis

In the immediate aftermath of the disaster, the Japanese energy sector administration faced an imminent supply shortage. For historical reasons, the grid is running on different frequencies. Therefore, being practically unable to import electricity from Western to Eastern Japan, where the disaster hit, utilities concentrated their efforts on curbing peak demand, managing rolling blackouts, and reactivating ‘mothballed’ (retired but not decommissioned) thermal power plants (IEEJ, 2011a, 2011b).

In the medium term, in view of the immediate supply shortage, experts foresee an increasing share of power production from fossil fuels, especially natural gas (ACCJ, 2011; Tollefson, 2011). In the long term however, the Fukushima disaster has highlighted the merits of a decentralized and resilient energy supply system. Then premier Naoto Kan had outlined in June 2011 a plan to increase the contribution of renewables to power supply to 20% by 2020, a share that even the most ambitious plans did not envisage before 2030. To that end, he proposed to revise the existing FIT and to extend it to other forms of renewable electricity, and offered his resignation conditional on, inter alia, the Diet passing it (Muramatsu et al., 2011). Amid the rising concerns about nuclear energy, a coalition of public figures, companies, politicians, and NPOs formed in support of the new bill (DeWit, 2011a). Eventually, on August 26, 2011 the extended FIT was passed by the Diet (the “Act on Purchase of Renewable Energy Sourced Electricity by Electric Utilities”, METI, 2011b). The new FIT starts in July, 2012, encompassing PV, wind power, small hydro, geothermal and biomass (Ayoub and Yuji, 2012).

This creates a regulatory situation similar to that under the German Renewable Energy Act (Langniß et al., 2009). Indeed, the 20%-target formulated by former Premier Naoto Kan implies an electricity sector transformation similar to the one that took place in Germany in the last decade (see Figure 1). Germany produced 7% of its electricity from renewables including hydropower and 29 % from nuclear in 2000; the

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2 A feed-in tariff guarantees the power producer a fixed electricity purchase tariff for a specified period (often 10-20 years), typically in combination with preferential grid access for the electricity produced.

3 Among the influential opponents of renewable energy were the fishing industry, opposing offshore renewables, and the Onsen (bathing) industry, opposing the exploitation of geothermal energy.
numbers for Japan were 8% and 30% in 2009. In the decade after 2000, Germany installed some 43 GW of renewables and increased their share to 17% of electricity production. Japan aims to raise the renewable share of power generation from 8% to 20% in the next 9 years (requiring roughly 70 GW of capacity, see Duffield and Woodall, 2011). Having long been a ‘pet project’ (DeWit, 2009) of the METI, PV seems perfectly positioned to play a major role in the proposed transition. Not only because PV plants are quick to install, but also because they are suitable to fill the current gap between electric capacity and peak demand around noon. In June 2011, the government announced a goal of putting PV systems on 10 million roofs by 2030. Also, the revised FIT envisages PV to account for more than 80% of newly installed capacity in the coming decade (METI, 2011c). Japanese industrial expertise in solar energy is significant, and also among the political proponents of renewable energy, solar energy enjoys a special position (see, e.g., calls for a ‘solar belt’ in East Japan, Son and DeWit, 2011). Therefore, it appears appropriate to outline some of the lessons learned from the policies for PV in Germany.

**Transformation of the electricity sector in Germany in the past decade**

<table>
<thead>
<tr>
<th>Year</th>
<th>Electricity Production by Source</th>
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<tbody>
<tr>
<td>2000</td>
<td>Coal: 51%; Nuclear: 29%; Non-hydro Renewables: 9%; Hydro: 14%; Others: 7%</td>
</tr>
<tr>
<td>2010</td>
<td>Coal: 42%; Nuclear: 22%; Non-hydro Renewables: 13%; Hydro: 4%; Others: 13%</td>
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**Projected transformation in Japan**

<table>
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<tr>
<th>Year</th>
<th>Electricity Production by Source</th>
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<tr>
<td>2009</td>
<td>Coal: 25%; Nuclear: 30%; Non-hydro Renewables: 1%; Oil: 7%; Gas: 30%</td>
</tr>
<tr>
<td>2020</td>
<td>Coal: 3%; Nuclear: 20%; Non-hydro Renewables (new goal): 12%; Oil: 5%; Gas: 22%</td>
</tr>
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**Figure 1** Comparison of German energy sector transformation 2000-2010 with challenges faced by Japan in period 2009-2019; 1data from BMWi (2011); 2data from FEPJ (2011); 3data from projection for 2019 by FEPJ (2011); 4data for nuclear power from projection by lida (2011); non-hydro renewable contribution in 2020 assumed to fulfill 20% goal announced in 2011.4 As Figure 1 shows, even with 20% renewables a supply gap of about 20% remains, if no new nuclear power plants are to be build and old plants retire after 40 years of operation, as the government recently announced (Kageyama, 2012). This illustrates the urgency of the Japanese energy crisis.
June, 2011. To avoid double counting, we excluded pumped hydropower, assuming the split of conventional/pumped hydropower to remain constant at the level of 2005 given in IEA (2008).

4 Lessons from the PV FIT in Germany applied to the Japanese Context

Although a widely appraised success story, the politics behind the German renewable energy policy are all but smooth. The German FIT, or ‘Renewable Energy Act’, came into effect in 2000, guaranteeing (differentiated) purchase tariffs for wind, PV, small hydropower, geothermal, biomass, as well as landfill, sewage, and mine gas (BMU, 2011a). Initially designed to be updated every four years, the German FIT has been amended and revised repeatedly. The design of the law itself is subject to a continuous learning and adaptation process. In the following, we will outline what we believe are the three main political challenges in this process: mounting costs, low R&D intensity (R&D per sales), and rising net imports. All three illustrate the dynamics of conflicting policy objectives.

The political responsibility for the PV FIT is held jointly by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and the Federal Ministry of Economics and Technology (BMWi). The BMU leads the drafting process, while the BMWi contributes to the law’s bi-annual evaluation. According to the official objectives, the FIT aims to integrate environmental policy (ensure a sustainable energy supply and conserve fossil resources), economic policy (contain the overall costs, including external effects, of energy supply in the long term), and technology policy (foster technical change in renewable energy technologies). Industrial policy objectives are not explicitly mentioned, but the competitiveness of the domestic renewable energy industry (in terms of jobs, exports, etc.) features prominently among both proponents and critics of the FIT. For instance, the current Minister of the Environment declared that he objects to fundamental changes to the FIT because he wants “the [German] solar industry to survive” (Photon, 2012).

With regard to its main purpose, attracting private investment, the German FIT was successful. As for PV, the installed capacity surged from 32 MW in 1999 to 17,320 MW in 2010, making Germany by far the world’s largest market for solar cells. Critics argue that the FIT has even been too effective. Before a limit to annual installations was removed in 2004, household investments in rooftop systems, which contributed significantly to the diffusion of PV and the scheme’s legitimacy in the general public, did not take off. But without the ‘cap’, the volatile domestic market and the overall cost burden proved extremely difficult to contain. Over the last couple of years, the mounting payment commitments of the scheme have fuelled a public and scientific debate about the scheme’s future (Frondel et al., 2009). PV accounted for only about 14% of electricity production from non-hydro renewables in 2010 (BMU, 2011a, 2011b). At the same time, cumulative committed payments (discounted, over 20 years) reached approximately €100bn in 2011 (Frondel, 2012), with annual payments accounting for more than 40% of the total payments under the EEG (BMU, 2011b).
Main challenges for legitimacy of FIT for PV in Germany: installations and net imports are growing exponentially while the research intensity in the industry is declining. Data from the German industry association BSW-Solar (2010, 2011, 2012), which since 2011 refrains from publishing R&D data; net imports for 2009 and 2010 calculated from Photon (2011).

Besides the overall costs, issues in terms of technology policy and industrial policy objectives have further undermined the scheme’s legitimacy. On the one hand, recent research suggests that the generous FIT incentivized firms to reallocate resources to new production capacity and, in relative terms, away from R&D (Hoppmann et al., 2011). This led to a declining R&D quota (see Figure 2) that even the industry itself considers unsustainable (Prognos and Roland Berger, 2010). On the other hand, since 2010 the imports of PV modules far outweigh exports (displayed in Figure 2), and German manufacturers increasingly move their production to low-wage countries. Both developments attracted much criticism in the media, although not always justified. Total R&D expenditures in the industry grew 17-fold from 2001 to 2008, but when net imports surged and firms moved production to Asia, the declining R&D intensity of firms that were ‘busy growing’ was an easy target for the media. The FIT was termed a ‘failed’ industry and technology policy (Schroer, 2010; Wetzel, 2011), and critics raised concerns about the long-term perspectives of PV technology and its costs. This criticism is unlikely to harm the overall prospects of renewables in Germany, given the decision to phase-out nuclear power in Germany by 2022 (as a consequence of the Fukushima accident). However, the legitimacy of support for PV is eroding, resulting in, e.g., recent high-level calls to end the FIT and replace it with other, less generous policies (Sigmund et al., 2012).

These recent experiences in Germany are particularly relevant for the Japanese context, considering the idiosyncrasies of Japanese politics and the current developments in the PV industry. In Germany, the balance of powers between BMU and BMWi has created a policy environment that provided for intermediation between different objectives during the initial implementation of the FIT. While the BMU is a strong proponent of renewables, mainly for environmental reasons, the BMWi aims at conformity with economic and industry political targets. This makes it difficult for vested interests from either side of the debate to erode the policy. In Japan, by contrast, the concentration of regulatory authority in the METI assigns a prominent role to economic policy objectives. This makes stringent incentives to invest in renewables very difficult to implement. The new FIT is a major step ahead of the intransparent RPS. But even in this legislation, interests of the big energy monopolies are apparent: Electric utilities can refuse to purchase the power from renewables if it is “likely to be
a hindrance to securing the smooth supply of electricity” (METI, 2011d). Preventing unwilling utilities from exploiting this loophole will be extremely difficult. Surely, the clout of the nuclear industry in the energy policy process has been reduced by the Fukushima disaster (DeWit, 2011a; Kingston, 2011). But even if such opposition is to wane in face of new political realities, it is very likely that paying attention to economic objectives will significantly ease the political process in the revisions (planned to occur at least every three years).

In the past, whenever plans for the Japanese energy sector and the diffusion of renewables have been drafted, they prominently featured industrial policy objectives. The new FIT, too, lists “promotion of the domestic industry, and thereby strengthening the international competitiveness of [Japan]” as one of its main targets. At the same time, changes in the global industry landscape might make it difficult for Japan to achieve such objectives. Early market support and research funding in Japan in the 1980s and 90s had spurred competitiveness (Watanabe et al., 2000), allowing Japanese firms to take leading positions in the global PV industry. Yet their position has eroded since then: The Japanese shares of global PV patents, solar cell production, and capacity additions fell from 51%, 22%, and 36% in 1995 to 22%, 13%, and 7%, respectively, in 2009 (Peters et al., in press). The growth of the global market allowed huge production capacities to be built up, increasingly located in low-wage countries. These cost advantage of Chinese/Taiwanese firms will surely pose a significant challenge for their Japanese counterparts.

Japan is still a net exporter of PV cells, and domestic firms may regain momentum from the new FIT. Furthermore, the incremental costs of installed capacity under the FIT will be lower than in Germany, due to rapid reduction in price of solar cells in the last 2 years and Japan’s relatively high electricity prices. But the future of the Japanese energy sector is contested (DeWit, 2011b), and the PV industry has become much more competitive than it was a decade ago.

5 Implications for Japanese Energy Policy and a Research Agenda

In this viewpoint, we have argued that the allocation of political responsibilities to the METI renders economic and industrial policy aspects of the FIT particularly important. In the meantime, at least for PV, changes in the global industry might make these objectives especially difficult to fulfill. Therefore, the government will have to work towards reducing the impact of industry interests on the regulatory process if any policy for renewables is to be effective (Kanie, 2011a, 2011b). A process of ‘policy learning’ and refinement, as achieved in Germany over the last 10 years, is only possible under a political framework with balanced powers and objectives.

In the short run, closing the new FIT’s grid stability loophole must be the first priority – it was not before unlimited grid access was granted to renewables in Germany that significant investment was attracted. Further, institutionalizing an FIT revision process which involves several ministries, such as for the German FIT, could enhance transparency of the political process. In the long run, the government should strive for an integrative policy framework, balancing priorities of energy security, environmental policy, climate policy, as well as economic and industrial policy. To that end, responsibilities for energy policy could be shared between the METI and the Ministry of the Environment, or allocated to a new ministry for the environment and energy.

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5 Since the relationship between Japan and China is still a sensitive issue, a FIT that obliges electricity customers to pay a premium for the import of Chinese solar cells could be expected to spur even more opposition in Japan than it did in Germany.
The ongoing initiative made by the National Policy Unit of the Cabinet Secretariat to discuss energy policy in connection with environmental issues at the Energy and Environment Council, which was established on 22 June 2011, can serve as a point of departure. This council is not sufficient, however, because it is not yet institutionalized and could be terminated easily.

In the meantime, Japan will have to find ways to reconcile the different objectives under the current framework. In particular, it should aim at fostering both rapid cost reductions and industrial competitiveness. Here, Japan’s challenge is representative of that of many developed and developing countries in search of integrative energy policies that bring both economic and environmental benefits (Bazilian et al., 2010). To inform such policy decisions, we need to better understand the impact that policies stimulating investment in new technology, such as a FIT or investment subsidies, have on technical change and industrial performance. Theory and evidence suggest that demand-pull policies not only speed up diffusion, but also ‘induce’ innovation (Jaffe et al., 2002). Industrial performance is suggested to improve by the Porter Hypothesis (Porter and van der Linde, 1995) and the literature on ‘lead markets’ (Beise-Zee, 2004), as firms may receive a competitive advantage when there is strict regulation in the home market. However, cases such wind in Californian in the 1980s (see Nemet, 2009) and the PV FIT in Germany show that there are important context and technology-specific factors that may lead to adverse outcomes. An improved understanding of these context effects is indispensible to reliably foresee policy implications.

From an industrial policy perspective, the focus on market subsidies rather than research funding in Germany appears to have created incentives to favor deadweight effects over long-term research. One way to avoid such situation could be for Japan to tap into its own environmental policy experience. Indeed, for a product very similar to PV modules, liquid crystalline displays, Japan has, with the ‘Top-Runner’ programme, implemented one of the world’s most successful environmental policies. Enacted in 1998 by the METI, the scheme is designed to stimulate energy efficiency for household and office appliances. It does so by iteratively setting mandatory efficiency standards based on the most efficient products on the market, and consultations with advisory committees (Kimura, 2010).

Integrating aspects from the successful Top-Runner approach and the FIT could be a way to incentivize both diffusion and investment in long-term R&D and continuous product innovation. A modified FIT could, for instance, require solar modules to fulfill a condition similar to one that had been implemented in an investment subsidy that was granted to residential systems in 2009: in order to receive the subsidy, conversion efficiency had to exceed the average on the market (IEA, 2010). Since Japan has a well functioning innovation system in the semiconductor and solar PV industries, and is a high-wage country, we expect that such a policy is much better suited to the capabilities of the industry than a scheme merely rewarding production at the lowest costs. How to implement such a policy, how to reconcile it with WTO rules, and how to design a committee-based standard-setting process, requires further research. In practice, a bigger challenge may exist in bridging bureaucratic boundaries and creating a well coordinated policy mix. Yet a successful integration of economic and environmental benefits might turn problem-fraught Japan into a role model for renewable energy policy.
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