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A World Leader? Japan's Reactive Market Support Policies for Solar Photovoltaic (PV) Cells

1. Introduction

Japanese governmental support for solar photovoltaic (PV) cell technology began in earnest after the 1973 oil shock, under The Ministry of International Trade and Industry's (MITI) Sunshine Program. The MITI poured funds into research and development (R&D) for solar PV cells, a technology that, it was hoped, would lessen Japan's dependence on imported energy. Cooperative R&D programs, such as the Photovoltaic Power Generation Technology Research Association (PVTEC), which began in 1990, brought together corporations in diverse fields such as textiles, ceramics, chemicals, and electrical machinery to share information and experiment with different PV technologies in order to lay the foundation for a domestic solar PV industry.[1] Governmental support and public-private sector collaboration created a "virtuous cycle" in which increases in government R&D investment stimulated private sector R&D funding, leading to expanded production, lowering per-unit production costs, thereby stimulating consumer demand and attracting further R&D investment.[2] By 2004, Japan's "big four" solar PV companies (Sharp Corporation, Sanyo Electric Corporation, Kyocera Corporation, and Mitsubishi Electric Corporation) held 47.6% of the world production capacity for solar PV cells (see figure 1).[3] The rise of these companies was based largely on the Japanese market: until 2003, domestic sales accounted for more than 50% of all solar PV sales by Japanese corporations (see figure 2).[4] Indeed, Japan led the world in installed solar PV capacity until 2005.

Since 2005, however, Japan's leadership in solar PV installations has been usurped by Germany and Spain. After Madrid enacted a generous Feed-In Tariff (FIT)[5] in 2008, Spain

installed more solar PV cells in one year (2661 MW in 2008) than Japan had in its entire history (2144 MW; see figure 3).[6] Germany, having enacted a robust FIT in 2000, is now the world leader in installed solar PV, with a cumulative capacity (5340 MW in 2008) more than two times larger than that of Japan (2144 MW in 2008).[7] With the expansion of the global market for solar PV, new companies, such as China's SunTech Power Holdings and Germany's Q-Cells SE, have emerged to challenge the dominance of Japan's "big four." Due to this increased competition and the relative stagnation in the Japanese domestic solar PV market, the "big four" held only 16.6% of the world's production capacity for solar PV cells in 2008.[8] After leading the world for so many years, how did Japan's domestic solar PV market, as well as its leading companies come to be surpassed by foreign rivals?

The answer to this question lies in the reactive nature of Japanese governmental market support policies for solar PV. Japan was one of the most recent countries, both developing and developed, to enact a FIT, which it did in November 2009. Shocked by explosive growth of the German and Spanish markets, and the accompanying decline in the market share of Japan's "big four," the government of Prime Minister Yukio Hatoyama enacted a FIT that specifically targets solar PV. Before this decision, Japan had relied on other policy tools, such as installation subsidies (1994-2006) and a Renewable Portfolio Standard (RPS; since 2002), to support the deployment of solar PV and other renewable energy technologies. These policy tools use market forces to support the diffusion of renewable energy; a FIT, by contrast, distorts market forces by guaranteeing a higher-than-market price for electricity produced from renewable energy sources. These market-conforming tools jibe with the recent Japanese predilection, since the deregulation push by former Prime Minister Junichiro Koizumi in the early 2000s, for reduced bureaucratic interference in markets. Japan's electric utility companies, through The Federation of Electric

Power Companies (FEPC) of Japan, as well as Japan's peak business organization, Nippon Keidanren have lobbied against the enactment of a FIT, preferring voluntary measures and market conforming policy tools such as the RPS. Unlike the solar PV corporations, whose sales remain dependent on government support, the FEPC and Keidanren enjoy historically close and influential ties with the MITI and its successor since 2000, the Minister of Economy, Trade, and Industry (METI), in which energy policymaking power in consolidated. These private interests from the FEPC and Keidanren have established a close alliance with METI bureaucrats that they use to resist proactive policy proposals from other actors, such as the Ministry of the Environment (MOE) or upstart politicians. The fragmented nature of Japanese policymaking has led to the polarization and politicization of market support policies for solar PV.

I will argue that, due to the alignment of domestic interests, the polarization of policymaking, and the entrenched predilection for market-conforming tools, Japan's market support policies toward solar PV have been reactive in nature. I will show that the Japanese state has exhibited a pattern of reacting to exogenous pressures for change in the formulation of its market support policies for solar PV. When decisive policy shifts have been attempted in Japan's recent past, they have been defeated by vested interests in the FEPC and Keidanren. The strength and resilience of these vested interests need to be dismantled if Japan wishes to regain its position as a leader in solar PV deployment.

In the next section, I will begin by reviewing Staffan Jacobsson and Anna Bergek's theory of the evolution of technological systems in order to identify those blocking mechanisms that have engendered Japan's reactive market support policies for solar PV. In section 3, I will examine Japanese policymaking toward solar PV since 1994, with important events analyzed in sub-sections. In section 4, I will indentify the sources of Japan's reactive policymaking.

Domestic interest alignment (4.1), polarization of energy policymaking (4.2), and entrenched preferences for market conforming tools (4.3) will then be discussed in greater detail. In section 5, I will articulate some of the implications of Japan's reactive policymaking for the future of its solar PV industry. I will conclude in section 6 by considering Japan's market support policies for other renewable technologies as well as offering some suggestions for reform.

2. Defining Blocking Mechanisms

Staffan Jacobsson and Anna Bergek's framework is useful for analyzing Japan's market support policies for solar PV because it identifies blocking mechanisms that lead to reactive policymaking. Their framework emphasizes the importance of multiple actors and networks in the evolution of renewable energy technological systems. Drawing on their discussion of the evolution of wind turbines and solar PV cells in Germany, Netherlands, and Sweden, Jacobsson and Bergek show that technological evolutions are complex processes that must be viewed in broader economic and political perspectives. A technological system is defined as a "network of agents interacting in a specific technology area under a particular institutional infrastructure for the purpose of generating, diffusing and utilizing technology."[9] The most important of these agents is a "prime mover" that is technically, financially, or politically so powerful that it can strongly influence the development of a new technology.[10] In the case of Japan's solar PV industry, firms like Sharp and Kyocera acted as prime movers "investing in-house resources in R&D much more than governmental subsidies and lobbying the government for creating market-pull policies."[11] Networks such as PVTEC are important because they allow the prime mover's resources to be distributed to other actors, whom themselves expand the financial and

technological resource base of the network.[12] Institutions such as the METI serve an umpire role; they explicate the rules and regulations for interactions among the various actors of the network.

The evolution of technological systems occurs in two phases: the formative period and the market expansion period. The formative period of a new technology is supported by four elements: market formation, entry of firms, institutional change and technology specific coalitions. Governments use subsidies and other policies to create a nursing market where "learning processes can take place, the price/performance of the technology be improved, and new customer preferences be formed."[13] The creation of this space guides firms and other actors into the nursing market; these actors bring knowledge and capital into the industry. The METI's collaborative R&D projects for solar PV under the Sunshine Program in the late 1970s and early 1980s, which attracted major firms like Kyocera and Sanyo, could be thought of as performing this guiding function. To protect and grow this market, institutions must change to provide actors with access to resources that advance technological evolution.[14] The creation of the New Energy and Industrial Technology Development Organization (NEDO) in 1980 was an institutional change that symbolized Japan's commitment to solar PV and expanded governmental resources for technological development. Actors should form a technology specific coalition, a group of actors that believe in the power of a particular technology to address larger policy concerns. Coalitions, such as the Japan Photovoltaic Energy Association (JPEA), founded in 1987, can then legitimize that technology and engage in wider political debates in order to gain influence over institutions that can aid or block market expansion.[15] The transition to market expansion can be achieved if the technology enters positive feedback loops, one that was achieved for Japan's solar PV industry under PVTEC (see pg. 1)

Blocking mechanisms, such as weak connectivity among actors, government policy, and the opposing behavior of established energy suppliers, can easily derail the evolution of a technological system.[16] In the case of Japan's solar PV industry, these blocking mechanisms have been particularly entrenched and powerful. Due to their historically unbalanced relationship with the METI, Japanese solar PV companies, as will be described in section 4.1, suffer from weak connectivity and are unable to strongly influence central government policymaking. As will be demonstrated in section 4.2, the FEPC and Keidanren have been and remain strongly critical of solar PV's ability to contribute significantly to Japan's energy portfolio. These actors, who support nuclear energy, have formed a powerful coalition to block aggressive market support policies for solar PV and other renewable energy technologies. Entrenched bureaucratic preference for market-conforming policy tools, as explicated in section 4.3, has created a blocking mechanism within the Japanese government against more aggressive, market-distorting tools such as FITs.

These blocking mechanisms, which I refer to as the asymmetrical alignment of domestic interests (section 4.1), the polarization of policymaking (4.2), and the entrenched predilection for market-conforming tools (4.3), have proven intractable and produced a pattern of reactive policymaking in support of solar PV in Japan's domestic market. I define reactive policymaking as, "the enactment of market support policies due to forces exogenous to the technological system itself." These exogenous forces include international pressure, developments in international markets, and political ideology. I define proactive policymaking, by contrast, as, "the enactment of market support policies that are motivated by forces endogenous to the technological system itself." Persistently high costs of electricity generation from solar PV

relative to other energy sources would be an example of such endogenous forces that necessitate proactive government policymaking.

The proceeding analysis is inspired in part by a body of scholarly literature on Japan's foreign policy and its relation to international institutional change. Kent Calder (1988) identified bureaucratic fragmentation as one source of Japan's reactive foreign economic policy in which the state "fails to undertake major independent foreign economic policy initiatives when it has the power and national incentives to do so."[17] This fragmentation has an important role to play in discussions of energy policymaking in Japan; while regulatory power is concentrated in the METI, the MOE has a voice in climate change negotiations and renewable energy policy decisions. Kenneth B. Pyle (2007) has characterized Japan's adaptive foreign policies since The Meiji Restoration as a blend of historically determined strategic vision and pragmatic flexibility.[18] In Pyle's framework, Japan has taken its foreign policy cues from major changes in the international system, reacting to those changes with decisive, strategic policy shifts. As will be demonstrated below, however, I am skeptical of the strategic element in Japan's reactive policymaking in support of solar PV market deployment. Some of Japan's reactive policies inspired from abroad have achieved a high degree of success. Others have proven retardant to solar PV's growth. Recently, though, Japan has shown some degree of willingness to learn from the mistakes and successes of market support policies in countries like Germany and Spain.

3. Japan's Reactive Policies

Since the inception of the Residential PV System Dissemination Program (RPVDP) in 1994, Japan has exhibited a pattern of reactive behavior in its market support policies for solar PV.

While the exogenous pressures for Japan's policy shifts over the past two decades exhibit a degree of variation, the domestic sources of Tokyo's reactive behavior have been remarkably consistent. To illustrate this pattern, I will examine six case studies relating to solar PV in recent Japanese history: the inception of the RPVDP in 1994, the failed Hashimoto FIT Initiative of 1999, the RPS Law of 2002, the termination of the RPVDP in 2005, the resumption of the RPVDP in 2009, and the enactment of the Solar FIT in 2009.

3.1 The Residential PV System Dissemination Program (RPVDP) – 1994

The creation of the Residential PV System Dissemination Program (RPVDP), after protracted and contentious negotiations, was a reactive gesture to the Earth Summit in Rio de Janeiro in 1992 and the German 1000 Roof Project. The 1992 Rio Summit brought together representatives of 172 governments, including Japan, to discuss issues relating to patterns of clean production, alternative sources of energy, and other issues. The United Nations Climate Change Convention, which led to the Kyoto Protocol, emerged from the Rio Summit. More than highlighting the importance of renewable energy, the discussions in Rio de Janeiro emphasized demand side management (DSM) approaches to reducing the environmental burden from energy consumption. DSM "refers to administrative, regulatory and technical approaches which can help dampen energy demand at the source without penalising the final user."[19] In other words, the discussions in Rio de Janeiro demonstrated that market forces could be used to reduce energy demand and the resulting environmental impact without distorting the supply and demand balance in electricity markets. For Japan, and indeed many other countries, the Rio Summit both

inaugurated the nascent drive to commercialize renewable energy technologies and established the use of market-conforming policy tools to support such technologies.[20]

Just prior to the Rio Summit, in 1991, Germany started its 1000 Roof Program, the first comprehensive dissemination program for solar PV, which provided government subsidies of up to 70% for the installation costs of solar PV systems installed on residences. The subsidy amount was decreased to 33% in 1994. After the program concluded in 1995, Germany's installed solar PV capacity had tripled.[21] Germany had succeeded in creating a virtuous cycle in which "PV systems reached a certain standard of technical reliability…system costs dropped, and…the acceptance of this technology increased considerably."[22] Japan, looking to build on 20 years of R&D for solar PV technology development under the Sunshine Program, took notice of the German model. Observing the success of the German program, some Japanese Diet members argued that Tokyo should adopt a similar support program.[23] The negotiations around the genesis of the RPVDP were, however, very contentious. The Ministry of Finance (MOF) challenged the then-unprecedented idea of giving subsidies to individual consumers. There were also serious doubts about the commercial viability of solar PV, into which the MITI had already plunged JPY 600 billion for R&D. In the end, the MOF compromised by creating a Special Account for Alternative Energy Development to be administered by the MITI that was used to finance the RPVDP outside of the general budget.[24] In 1994, Japan enacted the RPVDP, which, like the 1000 Roof Program, provided subsidies for 50% of installation costs for residential applications. Like the German example, the subsidy amount was reduced to 30% after 1999 and was later changed to a variable subsidy based on the size of the installed system. The RPVDP was actually quite successful in creating a niche market for solar PV among high-income Japanese families (by the end of the program in 2005, the subsidy only covered 5 to 7% of

installation costs, which remained high). Between 1994 and 2004, Japan's cumulative residential installed capacity of solar PV grew from basically zero to 825 MW.

For the present discussion, however, the success of the RPVDP is less important than the factors that led to its genesis. The negotiations among Diet members, the MITI, and the MOF demonstrate that, due to the fragmentation of bureaucratic control, policy debates in Japan can become contentious and polarized very quickly.[25] The compromise between the MOF and the MITI over the budgetary allocation for the RPVDP provided the mechanism through which the subsidy program could function. The impetus for such a compromise, I believe, was rooted in exogenous factors. The 1992 Rio Summit served as a starting gun for the worldwide race to commercialize renewable energy technologies. Before 1987, only one country had a market support mechanism in place specifically for solar PV; between 1991 and 1996, eight such support mechanisms were introduced around the world.[26] The German 1000 Roof Program served as an even stronger exogenous influence on Japanese policymaking. According to Osamu Kimura and Tatsujiro Suzuki, the German experience demonstrated to Japanese officials that subsidies could be used to create a virtuous cycle that would lower the production costs of solar PV.[27] Germany's success provided the MITI and the MOF with a tangible foundation on which to reach a compromise over the funding allocation for the RPVDP. In this case, as will be shown below in similar instances, exogenous factors provided the necessary pressure for Japanese policymakers to reach common ground and enact market support policy for solar PV.

3.2 The Failed Hashimoto FIT Initiative – 1999

The failure of former Prime Minister Ryutaro Hashimoto and his cross-party coalition to enact a FIT in 1999 demonstrated the inability of the Japanese state to create proactive policies in support of solar PV. Hashimoto was one of the more environmentally conscious of Japan's recent prime ministers. He was instrumental in the Kyoto Protocol ratification negotiations, giving backing to the MOE in support of the 6% reduction target that the MITI strongly opposed.[28] Hashimoto also spearheaded an effort to devote more of Japan's Official Development Assistance (ODA) to environment-related projects.[29] Hashimoto continued his environmentalist streak after resigning as Prime Minister in 1998 and resuming his post as the leader of his powerful faction in the Liberal Democratic Party (LDP).

In November 1999, Hashimoto led a 200-person cross-party coalition of Diet members to lobby for a comprehensive FIT that, it was hoped, would do more to promote the diffusion of renewable energy technology than the voluntary measures that had been in place since 1992.[30] While the coalition was unprecedented, the outcome, as will be developed further, was typical of the alignment of domestic interests in Japan's policymaking apparatus. The LDP's nuclear energy *zoku* (tribe) banded together with Japan's 10 electric utility companies and MITI bureaucrats to block the legislation. This counter-coalition argued that there was little hope that renewable energy technologies such as solar PV and wind could become commercially viable. Rather, they argued, Japan should focus on the nuclear energy sector, whose generation costs (JPY 9/ kWh) were significantly lower than solar PV (JPY 70-100/ kWh) at the time.[31] Many European countries, including Germany (1990) and Spain (1994), had instituted comprehensive FITs by this time and had demonstrated both the dangers of poorly planned FITs and the

successes of carefully organized FITs.[32] Indeed, November 1999 would have been an opportune time for Japan to learn from international examples and institute its own FIT to support the deployment of the advanced technological products of its "big four" solar PV companies. The FIT would, over the long term, have reduced Japan's dependence on imported oil and uranium. This, in turn, would have improved Japan's natural environment. From both economic and environmental perspectives, then, the enactment of the Hashimoto FIT Initiative would have been in Japan's national interests.

Outside pressure, however, was not sufficient to produce a compromise between the Hashimoto coalition and the vested interests in favor of nuclear energy; this episode indicates the polarization of energy policymaking in Japan. When one considers the fact that, on an annual basis between 1996 and 2003, Japan spent 20 times as much on R&D for nuclear energy (roughly USD 2.6 billion) as it did for *all* renewable energy technologies (roughly USD 120 million), it is easy to understand how much influence such vested interests carry.[33] Through their industry organization, the FEPC, Japan's 10 electric utilities frequently argue that nuclear energy is Japan's best bet to lessen energy dependence. From their perspective, these corporations were already doing their part to support the fringe industry of renewable energy technology. The FEPC Chairman Hiroji Ohta, in a January 2000 speech, stated that Japan's electric utilities, having "independently supported the development of new energy sources" for over 15 years under the Voluntary Purchase Agreement (VPA), were doing enough to support solar PV.[34] Citing Japan's land constraints, the fluctuation of electricity supply from renewable sources, and the high investment costs required, Ohta's attacks on solar PV would become familiar refrains from the FEPC chairmen.[35] Such comments weaken the legitimacy of solar PV in both popular and political circles. In many ways, the failure of the Hashimoto FIT Initiative

established the rhetorical parameters for future battles between advocates of proactive market support policies for solar PV and vested interests supporting nuclear energy.

3.3 The Renewable Portfolio Standard (RPS) Law – 2002

The enactment of the RPS Law in 2002, largely a reaction to the failure of the Hashimoto FIT Initiative, reflected the continued polarization of energy policymaking as well as the entrenched predilection for market-conforming policy tools. Following on the heels of the defeated Hashimoto FIT Initiative, the bureaucrats in the METI knew that Japan needed a new policy tool in support of renewable energy technologies in order to address the growing calls from politicians and the public for an aggressive FIT. Many citizens groups, drawn from environmental non-governmental organizations (NGOs), were indeed supporters of the Hashimoto FIT Initiative.[36] In 2000, the METI formed a special subcommittee to study potential policy mechanisms to support the deployment of renewable energy technologies. On December 19, 2001 the subcommittee announced that it would enact the RPS Law; this policy tool requires Japan's electric utility companies to purchase a certain percentage of electricity from renewable sources each year. The eventual target for 2014 is 1.63% of Japan's gross electricity supply. When compared with the RPS targets of other countries (California's RPS aims for 33% by 2020), Japan's is almost embarrassingly low.[37]

Keidanren, the FEPC, and the METI, however, are strong supporters of the RPS because it relies on market mechanisms to support the diffusion of renewable energy technologies. The doctrine of using market forces in energy regulation was established in the METI's June 2002 Basic Act on Energy Policy: "measures shall be promoted in a manner such that business

operators can fully demonstrate their initiative and such that creativity and the interests of energy consumers are sufficiently secured."[38] The Basic Act's market fundamentalism was part of the larger political discourse of the early 2000s in which then Prime Minister Koizumi removed state intervention in many sectors through privatization and deregulation. The RPS was part of this movement to "leave it to the market." By establishing a gross percentage for electricity from renewable sources, electric utilities are free to choose the cheapest renewable options. As a result, cheaper technologies, such as wind and biomass, receive an unfair advantage under the RPS.[39] Indeed, in 2004, electricity from solar PV accounted for only 7.1% of the gross electricity purchased under the RPS.[40] Because the RPS favors the cheapest technologies, it provides no incentive to invest in new, more efficient plants that require large investments. The RPS targets are so low (less than the actual capacity of existing renewable energy sources in Japan) that electric utility companies are able to purchase an over-target amount of electricity from biomass sources and use the RPS' "banking" rule to carry over the surplus for the following year's target.[41] "Banking" effectively suppresses demand for electricity from renewable energy sources by allowing the previous year's excess supply to carry over to the following year. All these aspects of the RPS present significant disincentives to investment in solar PV and other expensive renewable energy technologies. Despite this, Keidanren and the FEPC are strong supports of the RPS because it levies minimal constraints on their business operations.

Japan's 10 electric utilities' mission is to provide low-cost, stable electricity to its customers. Aggressive requirements to purchase expensive (solar PV) and unstable (wind) technologies, under the Hashimoto FIT Initiative for example, only increase costs for these companies and, thus, encounter fierce resistance. The RPS, by contrast, continues to receive strong support from Keidanren and the FEPC because it is a relatively weak policy tool

ostensibly operating under market forces. The RPS penalty mechanism, a fine of JPY 1 million for not fulfilling the annual quota, is so low as to be meaningless. Coupled with the "banking" provision and the inclusion of cheap renewable options like biomass, the RPS is, according to Keiji Kimura, so flexible that it defeats its own purpose and "hampers new renewable energy developments."[42]

The RPS both discourages investment in these technologies and favors sources like biomass, which actually damage Japan's natural environment. Indeed, the RPS cannot be classified as a proactive market support policy because it discourages investment in solar PV. The enactment of the RPS is thus consistent with my argument about the reactive nature of Japanese policymaking. The failed Hashimoto FIT Initiative, and the public and political support for renewable energy that it carried, exerted pressure on the METI to enact new policies. Support from Keidanren and the FEPC catalyzed the METI's desire to enact such market support policy mechanisms for renewable energy technologies that jibed with the market fundamentalism embodied in the Basic Act on Energy Policy. This predilection for market-conforming tools and decreased bureaucratic intervention in energy markets would continue to affect policymaking toward solar PV for many years to come.

3.4 The Termination of the RPVDP – 2005

The termination of the RPVDP in March 2005 demonstrated the entrenchment of market fundamentalism and the politicization of energy policymaking. Although reactive in nature (see section 3.1), Japan's RPVDP is considered to be one of the most successful and cost-effective market support policies for solar PV.[43] At a cost of JPY 130 billion for the RPVDP, over 800

MW had been installed and the average price of a solar PV system for residential use had declined by 65.6% to JPY 670,000/ kW in 2005. As mentioned above, the RPVDP succeeded in creating a niche market for solar PV among high-income Japanese families. But, solar PV remained expensive on a per kWh scale and depended on government market support policies; in 2004, electricity generated from solar PV (JPY 40/ kWh) was almost twice as expensive as average residential electricity rates (JPY 22/ kWh).[44] It was quite surprising when, in March 2005, the RPVDP was abruptly terminated by the METI. This decision, it will be shown, was a reaction to the political climate of the mid 2000s.

In the Koizumi-era push to downsize the reach of the Japanese government and reign in spiraling government debt, the RPVDP was an easy target for a number of reasons. As Ando Haruhiko, former Director of the METI's New and Renewable Energy Division, commented, the sheer cost of the RPVDP "caught the eye of the financial reform authorities. The political climate of 2005 had shifted toward reform."[45] In the wake of burst bubble and scandals involving dubious ties between bureaucrats and businessmen, there was a strong movement to remove the state from markets as much as possible. "It is important to break free from a bureaucracy-led society, and in its place mold a society in which individuals and companies can give birth to new businesses and employment by taking on a diversity of challenges," echoed Keidanren's then Chairman Hiroshi Okuda in a 2003 speech in support of neoliberal reforms.[46] The RPVDP was a particularly easy target because, due to the step-down diminution of the subsidy rate, in 2005, subsidies covered only 5 to 7% of solar PV system costs. With the subsidies exerting such a low monetary impact, it was believed that the termination of RPVDP would not have a large impact on the domestic solar PV market.

Over the objections from solar PV companies and renewable energy advocates, however, the 2005 termination of the RPVDP took the bottom out of Japan's residential solar PV market. Between 2005 and 2007, residential solar PV installations decreased by 32%. While the Japanese domestic solar PV continued to grow due to commercial and industrial installations covered by other support programs, the termination of the RPVDP had a chilling effect on new residential installations. "In financial terms, the amount of the [RPVDP's 2005] subsidy was not great, but it appears to have a played a key role in signaling opportunities to the markets," commented Andrew DeWit and Tatsuhiko Tani on the symbolic impact of the decision to end the RPVDP.[47] The termination of the RPVDP essentially removed a cog from Japan's virtuous cycle for solar PV development: by removing state support for residential solar PV, the METI signaled to manufacturers that their products would have to compete on an uneven playing field with conventional energy sources and other, lower-cost renewable sources. Corporations were effectively discouraged from investing in new, more efficient production facilities for solar PV. Coupled with the increased demand from the growing German market, the termination of the RPVDP transformed Japanese solar PV into essentially an export industry: exports as a percentage of solar PV sales by Japanese companies increased from 58.3% in 2004 to 78.9% in 2008 (see figure 2). More importantly, however, the termination of the RPVDP contributed to Japan (1421 MW) losing its position as the world's leader of installed solar PV capacity when Germany (1926 MW) took over the top spot in 2005 (see figure 3).

The termination of the RPVDP was not the product of exogenous forces in the sense that international developments had little impact on the METI's decision making. But, exogenous pressure in the form of political ideology unrelated to the technological system of solar PV itself—the Koizumi-inspired neoliberal market reform movement—played a catalyzing role in

the decision to terminate the RPVDP. While considerations about the cost of the RPVDP did factor into the decision to terminate the program, the persistent costliness of electricity generated from solar PV (see pg. 15) should have been sufficient evidence that solar PV still required government support. In this instance, however, political considerations overwhelmed economic necessities to produce a reactive policy shift that sapped the strength of Japan's residential solar PV market.

3.5 The Resumption of RPVDP – 2009

The decision to restart the RPVDP in January 2009, a reaction to the June 2008 Toyako Summit and the "Fukuda Vision," demonstrated the entrenched bureaucratic predilection for market-conforming policy tools. On June 9, 2008, then-Prime Minister Yasuo Fukuda announced his vision for Japan to achieve a 60 to 80% reduction in greenhouse gas emissions by 2050 through programs such as emissions trading and the diffusion of renewable energy technologies. The "Fukuda Vision" was assailed by environmental NGOs for the concessions it made to the METI and Keidanren by not including a mid-term target for emissions reductions.[48] The "Fukuda Vision," however nebulous its goals, was motivated by the former Prime Minister's "determined bid to fulfill his responsibility as chairman of the summit of the Group of Eight industrialized nations in Toyako, Hokkaido [the following month]."[49] Knowing that the global spotlight would focus on Japan and its efforts to address climate change, Fukuda used his influence as sitting Prime Minister and international pressure to alter Japan's energy policies. His cabinet responded by approving the "Action Plan for Achieving a Low-carbon Society" in July 2008, which set national targets for cumulative solar PV capacity. In January 2009, the METI, in response,

restarted the RPVDP with a budget of JPY 20 billion for 2009. The subsidies cover JPY 70,000/ kW, or about 10% of the average cost of a solar PV system.

While Fukuda did show some degree of policy independence in his rhetorical flare supporting his "low-carbon revolution," the METI's choice of market support mechanisms for solar PV was hardly innovative.[50] Subsidies, like the RPS, are market-conforming tools that merely increases customers' "willingness to pay (WTP)" for solar PV. Subsidies raise WTP, which includes calculations such as investment costs and technical performance, because they place cash in the hands of consumers.[51] Subsidies do not affect the forces of supply and demand because they are so-called "end of pipe" funds disbursed after the transaction has been completed. The decision to restart the RPVDP in January 2009, then, was consistent with the market fundamentalism established in the 2002 Basic Act on Energy Policy and did not represent proactive policymaking. The METI's reactive policy shift in the resumption of the RPVDP was, as Tetsunari Iida, Executive Director of the Institute for Sustainable Energy Policies (ISEP), argued, "an attempt to get Japan on the renewable energy bandwagon that emerged after the Toyako Summit."[52] The international attention focused on Japan, as host of the summit, as well as the visibility of the "Fukuda Vision" coalesced to exert pressure on the METI to restart support policies for solar PV. Just as the 1992 Rio Earth Summit had motivated the MITI to create the RPVDP, the 2008 Toyako G8 Summit provided momentum for the METI to resurrect the RPVDP.

3.6 The New Purchase System for Solar Power-Generated Electricity (Solar FIT) – 2009

The decision to enact the New Purchase System for Solar Power-Generated Electricity (Solar FIT) in November 2009 was a reaction to the explosion of global demand for solar PV and increased market competition that accompanied the enactment of the 2008 Spanish FIT and the sustained growth of the German solar PV market. After Madrid ratified its generous FIT for solar PV in early 2008, Spain installed 2661 MW of solar PV capacity over the course of the year and leapfrogged Japan to become the second largest market for solar PV behind Germany (see figure 3). Germany, for its part, installed 1075.5 MW and 1504.5 MW of solar PV capacity in 2007 and 2008 respectively. More than disrupting the global balance of supply and demand for silicon feedstock, a key material in solar PV cells, the Spanish FIT invited new players into the solar PV market.[53] In early 2008, China's SunTech, which had not *existed* in 2001, made huge capital investments in manufacturing plants to become the world's second largest producer of solar PV cells.[54] Other Chinese and Taiwanese companies followed suit. In 2003 there was only company, Sharp, with a production capacity of over 100 MW. By 2008, 13 companies had production capacities over 100 MW.

This was a level of competition that the Japanese "big four" had not experienced. By 2008, the combined production capacity of the four largest Japanese solar PV makers was 16.6% of the world's total; in 2004, it was 47.6%. "The [Japanese] government's termination of financial aid [under the RPVDP] and the emergence of Chinese and Taiwanese makers are the two main reasons" for the drop in Japanese companies' global market share during 2008, commented Sanyo's General Manager of Global Communications, Hiroyuki Okamoto.[55] Lacking government support (the RPVDP wasn't restarted until January 2009), Japan's domestic

solar PV market remained sluggish in 2008, adding a mere 225.3 MW of capacity. This stagnation continued into 2009, even after the RPVDP was restarted; only 61.9% of an expected 35,000 applications for residential solar PV subsidies were filed in the first quarter of 2009.[56] The prolonged weakness of domestic demand coalesced with the declining global position of the Japanese "big four" to induce the Japanese government to enact new market support policies for solar PV.

On November 1, 2009 the METI initiated a FIT that specifically targeted solar PV by guaranteeing a fixed purchase price of JPY 48/ kWh for residential systems, more than double the average market price for electricity (JPY 19.9/ kWh in 2007). Unlike its Spanish and German counterparts (comprehensive; 20-year guarantee), Japan's FIT applies only to electricity generated from solar PV and guarantees preferential purchase prices for 10 years. According to DeWit, this "hardly innovative" policy shift might not provide the necessary incentives to revive Japan's domestic solar PV market.[57] Although exact estimates vary, the average homeowner will need at least 15 years to recoup their investment in a residential solar PV system.[58] Japan's FIT may therefore not provide the guaranteed payment horizon necessary to attract investment in residential solar PV systems. However, the METI hopes that the Solar FIT and the revived RPVDP will provide sufficient incentives for consumers to purchase solar PV systems and support the renewed growth of Japan's "big four."

Japan's Solar FIT could be classified as a proactive policy because, the underlying cause of its enactment, the declining leadership of Japan's "big four" is endogenous to the solar PV technological system. The FIT, moreover, represents a significant shift away from the market-conforming tools (RPVDP and RPS) that the METI had used in the past. The timing of the enactment of Japan's FIT, however, indicts it as reactive. The market share of the "big four" had

been declining since 2004, when companies like Q-Cells and SunTech began to aggressively expand production (see figure 1). In that same year, the growth of the domestic Japanese solar PV market began to slow relative to its German counterpart (see figure 3). Indeed, the METI could have enacted a FIT or other proactive policies at any time between 2004 and 2009. That the METI chose to wait until the 2008 Spain boom had invited violent competition in the international solar PV market marks the 2009 Solar FIT as a reactive policy.

4. Sources of Japan's Reactive Behavior

The reactive nature of Japan's market support policies for solar PV lies in the alignment of domestic interests, the polarization of energy policymaking, and the entrenched bureaucratic predilection for market-conforming tools. Due to historically paternalistic business relationships, Japan's solar PV makers hold little influence over the METI's policymaking. Japan's electric utilities, through the FEPC and Keidanren, by contrast, enjoy close and powerful ties with the METI; these vested interests can influence and sometimes block market support policies for renewable energy. Recent legislative battles over environmental and energy policies have polarized the Japanese government into positions for and against aggressive market support policies for solar PV and other renewable energy technologies. Attempts to enact aggressive support policies are often blocked or watered down by other ministries, making proactive policymaking quite difficult. When support policies do achieve enactment, they are often market-conforming tools, which reflect the post-bubble predilection for low state intervention in markets. Despite the observed deficiencies of such market-conforming tools, such as the RPS

and VPA, they have proven difficult to dislodge in Japan, thereby preventing more proactive, interventionist policies in support of solar PV.

4.1 Domestic Interest Alignment

Vested interests in the energy and other business sectors, which support low-cost nuclear energy, form strong blocking mechanisms and contribute to Japan's reactive policymaking. Through campaign donations to politicians, personal relationships with bureaucrats, and media attention through the FEPC and Keidanren, Japan's electric utilities can water down or block aggressive market support policies for solar PV and other renewable energy technologies. Japan's solar PV manufacturers, by contrast, have little influence over the METI's policymaking due to a historically unbalanced relationship with the ministry.

Japan's energy markets have been characterized by a close historical relationship between the public and private sectors. In his foundational 1987 examination of Japanese energy markets, Richard J. Samuels cast this relationship as one of "reciprocal consent," in which both "business and government have jurisdiction [over energy policy]; both lack exclusive control."[59] Based on detailed examinations of the 200-year histories of Japan's coal, oil, and electricity industries, Samuels argues that private interests, such as electric utilities, enjoy "systemic inclusion in the policy process, access to public goods, and rights of self-regulation."[60] The Japanese state, in return, has the power to define the structure of energy markets as well as the distribution of public funds.[61] Japan's energy markets, according to Samuels, have exhibited recurrent patterns of conflict, negotiation, and comprise between the public and private sectors, structured under the parameters of reciprocal consent. The plurality of interests within the private and public

sectors has created a particularly strong interdependent relationship in Japan's electricity industry. Although the Japanese state has a "pervasive presence, it consistently exchanges jurisdiction for private control. State initiatives succeed only when bolstered by considerable support [from Japan's electric utilities]."[62] This interdependent relationship persists to this day, with Japan's electric utilities exerting significant influence over state policymaking.

Japan's electric utility companies enjoy regional monopolies; in their individual markets, these 10 corporations control the generation, transmission, and distribution of electricity. These companies are the largest employers in many regions and thus have traditionally been "the most influential political actors [in] both national and local government [elections]," according to ISEP's Iida.[63] Japan's electric utilities came under heavy criticism for making political campaign contributions after the first oil shock in 1973 when electricity rate increases, to compensate for increasing oil prices, were under negotiation in the Diet.[64] Since that time, influence from the electricity sector has emerged from the backrooms of political power brokering, with utility companies and the MITI participating in joint regulatory committees.[65] Collectively controlling 97.6% of the nation's electricity grid, Japan's 10 companies aim to keep their operating costs down as much as possible. Toward that end, Japan's electric utilities use their close relationship with the METI to support nuclear energy, currently the cheapest form of electricity generation in Japan. These companies employ the FEPC and Keidanren as outlets to influence public opinion.

> While there is no questioning the importance of incorporating renewable energy--such as solar power--into such [national energy] policy, there is little hope that these technologies will be able to become Japan's primary source of energy for the foreseeable future. Accordingly, Japan should strengthen its infrastructure and capacity for nuclear power generation.[66]

As these November 2008 comments from Keidanren's former Vice Chairman of the Board of Councillors, Yasuchika Hasegawa demonstrate, the organization is quite skeptical of renewable

energy's growth potential in Japan. Keidanren's preference for nuclear energy is reflected in the METI's funding policy between 1996 and 2003, nuclear energy consistently received 20 times more funding for R&D than did *all* renewable energy technologies. Indeed, the FEPC and Keidanren have come out in opposition against government initiatives that would impose hard targets for renewable energy diffusion (Hashimoto FIT Initiative); such policies would necessarily diminish the predominance of nuclear energy in Japan and increase costs for Japan's electric utilities.

As former Chairman Hiroshi Okuda said in November 2004, Keidanren favors voluntary measures to support renewable energy technologies, arguing that actions such as VPA and "not a force of laws and regulations will provide the foundation for the drive to build a vibrant, sustainable society."[67] Indeed, the established policy line of the FEPC and Keidanren is that Japan's electric utilities are the best judges of how to support solar PV and other renewable energy technologies. In instances where hard targets have been set by the METI, as in the RPS, such policies receive support from the FEPC and Keidanren because they set a very low target for renewable sources (1.63% by 2014) and provide a high degree of flexibility (banking provision). Japan's electric utilities thus exert pressure on the METI to enact voluntary or weak market support policies while blocking more aggressive measures; Japan's solar PV companies do not enjoy the same level of influence over state policy.

In response to the first oil shock, the MITI essentially created Japan's solar PV industry with the 1974 initiation of the Sunshine Program that aimed to encourage "the broad involvement of cross-sectoral industry" in solar PV R&D and induce "vigorous investment in PV R&D leading to an increase in industry's PV technology knowledge stock."[68] The MITI attracted electrical machinery companies into the solar PV field through generous R&D funding

and access to government research laboratories. Although some companies had been conducting R&D into solar PV technology since the 1960s, the Sunshine Program was "the biggest stimulus for these firms to expand their activities of PV development."[69] Funding for solar PV R&D more than doubled in 1980 after the second oil shock and the establishment of NEDO in 1980.[70] This state support, in turn, attracted investment from solar PV companies, decreasing costs, increasing cell efficiency, and creating a virtuous cycle of technology development. Under the guidance of government-organized R&D consortia such as PVTEC, Japanese companies shared knowledge and solved technological problems. Aided by the domestic market's growth under RPVDP, Japan's "big four" held 36% of the world's production capacity for solar PV cells by 2000. Over time, however, the Japanese government's support for solar PV created an asymmetrical power relationship.

As members of one of the MITI's pet industries, Japan's solar PV companies have a "historically subservient relationship" to the ministry according to ISEP's Iida.[71] Although the MITI did create a virtuous cycle of R&D investment and cost reduction, solar PV makers were nevertheless dependent on government market support policies. This dependency was institutionalized under the RPVDP, which provided the stimulus for domestic market growth. "Without the subsidies, the [solar PV] companies could not sell their products. For that reason, the solar PV companies do not have the power to influence the METI," commented the METI's former director Ando.[72] The METI, by contrast, has preponderant power to influence the operations of Japan's solar PV companies. In Spring 2000, the METI forced Sanyo CEO Sadao Kondo to resign after it learned that 20% of solar PV systems sold by the firm between 1996 and 1998 had defects. The METI further punished Sanyo by freezing subsidies for the company's products under the RPVDP for a period of three years.[73] In that same year, Kyocera was

penalized in a similar manner (subsidy ineligibility for three years) when the MITI discovered that the company's mangers were using government R&D funds earmarked for solar powered cars for other purposes.[74] This episodic evidence suggests the extent to which the METI can influence business operations in the solar PV industry. The "big four," conversely, have little power to influence government market support policies for solar PV.

Unlike their counterparts in the electricity industry, Japan's solar PV companies do not enjoy strong ties within the energy policymaking establishment. The FEPC was established in 1952 and provides all 10 electric utilities with consolidated research and media apparatuses to influence public opinion and government policy. The JPEA, solar PV companies' lobbying organization, was founded in 1987. As relatively new players on the political scene, JPEA and its membership do not possess the same level of influence on the METI as do the FEPC. The strong influence electric utilities push through the FEPC is complemented by Keidanren, in which energy-intensive industry players from steel, automobiles, and heavy machinery dominate.

Due to this asymmetrical alignment of domestic interests, the voluntary (VPA) and weak (RPS) market support policies pushed by the FEPC and Keidanren often win out over the more aggressive legislation (Hashimoto FIT Initiative) backed by solar PV manufacturers. This asymmetry hinders proactive policymaking in support of solar PV because new policies must necessarily "pacify" all 10 of Japan's electric utilities and meet the approval of their supporting bureaucrats and politicians.[75] Solar PV companies, by contrast, occupy a historically subservient position to the METI and, due to high generation costs from solar PV, continue to be dependent on government support for the sales of their products. This asymmetrical alignment, between solar PV companies and Japan's 10 electric utilities, generates blocking mechanisms to proactive legislation and contributes to reactive policymaking in support of solar PV in Japan.

4.2 Polarization of Energy Policymaking

Although regulatory jurisdiction over energy is concentrated in the METI, the influence of Keidanren and the FEPC, as well as the more aggressive policy proposals from the MOE, the cabinet, and upstart politicians, make for a highly polarized environment that blocks decisive policymaking for solar PV and other renewable energy technologies. Ever since the 2001-2002 negotiations over the ratification of the Kyoto Protocol, Japanese political actors have become fiercely divided over the imposition and strictness of emissions reduction and renewable energy installation targets.[76] The aggressive policy proposals from upstart politicians (Hashimoto FIT Initiative), prime ministers ("Fukuda Vision"), and the MOE (environmental tax) have been met with fierce resistance from the FEPC and Keidanren, who favor voluntary measures to support the diffusion of renewable energy technology.

This polarization of energy policymaking has led to what ISEP's Iida refers to as "divided pluralism," in which different Japanese political actors compete against each other to draw up legislation in the same policy area.[77] For example, Keidanren's Voluntary Action Program on the Environment was released in June 1997 in anticipation of the emissions reduction targets proposed by the then Environment Agency in advance of the Kyoto Protocol negotiations in December of that year. As one of the weaker Japanese ministries, the MOE does not have the power to fight the coalition of the METI and Keidanren. "An environmental tax has been long discussed at the MOE...Keidanren strongly opposed the idea and effectively blocked its introduction, stressing the good performance of the Keidanren Voluntary Action Program," wrote Kentaro Tamura of the Institute for Global Environmental Strategies (IGES) on the sharp divisions that persist in Japanese energy policymaking.[78]

This polarization extends to energy technologies, with the METI and Keidanren supporting nuclear energy while the MOE and some politicians push renewable technologies. The METI's 2008 Cool Energy Innovative Energy Technology Program demonstrates the extent to which that ministry is betting on nuclear energy as the key to Japan's sustainable future. According to that report, nuclear power is "currently the only clean base load energy source in Japan…that can address both…emissions reductions and economic development since it is capable of stably supplying electrical power…at a relatively low cost."[79] The METI's position is supported by the FEPC, whose chairman Shosuke Mori, in a February 2009 speech, described his vision of Japan's low-carbon society "in which nuclear power takes the lead...."[80] Because low-cost nuclear energy has so many powerful backers (the METI, the FEPC, Keidanren), it is very difficult for policies that aggressively support renewable energy technologies to gain support sufficient for enactment. Proactive market support policies for solar PV, such as the failed Hashimoto FIT Initiative, encounter fierce opposition from these nuclear supporters, whose costs would necessarily increase if forced to purchase more expensive electricity from renewable sources.

The persistence of these sharp divisions within the Japanese government produce long, contentious negotiations, such as that over the 2002 RPS Law, and support a pattern of reactive policymaking. Indeed, ISEP's Iida has referred to the late 1999 Diet debates over the Hashimoto FIT Initiative as a political "trauma," from which the energy policymaking establishment has not recovered.[81] The same rifts were exposed in the 2006-2007 negotiations over the post-2012 framework for Kyoto Protocol compliance, with the MOE proposing aggressive reduction targets and Keidanren responding with its own proposal that favored voluntary measures and increased use of nuclear energy.[82] Thus, the persistent cleavages that encourage reactive behavior in

market support policies for solar PV and renewable energy are rooted in larger debates over energy policy.

4.3 Entrenched Preference for Market Conforming Tools

The entrenched preference for market-conforming policy mechanisms, which emerged among vested interests after the burst bubble, prevents proactive market support policies for solar PV and encourages reactive behavior. Scandals from the early 1990s in which MOF officials instructed Japanese bankers to hide non-performing loans tainted governmental intervention in markets and interference with market forces.[83] Since that time, there has been a strong preference for market-conforming policy tools within the METI, the FEPC, and Keidanren. This predilection, which has been entrenched over time, contributes to reactive policymaking in support of solar PV because the currently accepted policy tools are not market conforming.

The FIT is not a market-conforming policy mechanism; by guaranteeing a higher-than-market price for electricity generated from renewable sources, the FIT generates excessive demand. By contrast, Japan's RPS, it is argued, uses market forces and allows electric utilities to chose the cheapest electricity produced from a variety of renewable options. This, it is believed, should induce companies to develop better renewable energy technology to lower the cost of electricity production, thereby making their products more competitive. As argued in section 3.3, Japan's RPS does not function in this way and actually discourages investment in new renewable energy sources. The FIT, by contrast, has gained wide traction in the international community as one of the best drivers to diffuse renewable energy technologies. The International Energy Agency (IEA) has recently come out in favor of FITs, writing in a 2008

report, "less mature high cost technologies further from economic competitiveness, such as solar PV, need…very stable low cost-gap incentives such as…FITs."[84] RPS systems surveyed in 35 countries, by contrast, "turned out to be much less effective and more costly than expected…."[85] In Japan, however, such pronouncements have not shifted the landscape of debate over market support policies for solar PV.

The 2002 Basic Act on Energy Policy established the use of market-conforming policy tools for energy markets (see pg. 12). Such mechanisms combined with voluntary measures from the electricity industry, Keidanren argued, would allow businesses "who are in the best position to grasp the true situation in each industry, to formulate and implement action plans" for emissions reductions.[86] Compulsory tools, such as FITs and emissions trading have "the strong character of a controlled economy and…[have] no place in a market economy."[87] The METI engenders such fierce allegiance to market-conforming tools through its own brand of market fundamentalism. ISEP's Iida recounts how, in a 2007 negotiation session of Diet members, METI officials distributed copies of an IEA report that was critical of Germany's FIT for its high costs and distortion of market forces.[88] "We voluntarily agreed to purchase surplus power from photovoltaic generation 17 years ago, and we have since been facilitating the spread of photovoltaic generation. However, we have been and are still against the German [FIT] model…" commented the FEPC Chairman Mori in a March 2009 speech, echoing the policy line of Keidanren and the METI.[89] This fierce opposition remained entrenched and engendered reactive policymaking until late 2009.

The calls for a Japanese FIT finally found traction in 2009, when the Solar FIT was enacted in November of that year. The prolonged stagnation of Japan's domestic solar PV market in 2009 and the decreasing global market share of Japan's "big four" provided sufficient

pressure on the METI to enact the Solar FIT. The Solar FIT did, however, include several concessions to Japan's electric utility companies. Japan's FIT only covers electricity produced from solar PV and thus leaves market forces for other renewable energy technologies, such as wind and geothermal, untouched. As mentioned in section 3.6, Japan's FIT provides only a 10-year guarantee for the preferential purchase price at JPY 48/ kWh and might, therefore, not provide the incentives necessary to attract investment from homeowners. To pacify the electric utilities, the Solar FIT had been "watered down" so much that one of FIT's most fervent and long-standing supporters, ISEP's Iida, called for its freezing until a more robust, comprehensive FIT could be developed.[90]

Thus, the preference for market-conforming tools among Japan's energy policymaking establishment remains strong. Just as vested interests from the FEPC and Keidanren united to block the Hashimoto FIT Initiative in 1999, they used their influence to weaken the impact of the 2009 Solar FIT. These vested interests continue to support market-conforming policy mechanisms (RPS) that have been proven ineffective. Indeed, these political actors might continue to inhibit policymaking for proven market-distorting tools (a comprehensive FIT) and prolong Japan's reactive behavior in the field of renewable energy support.

5. Implications of Japan's Reactive Behavior

The inertia that characterizes Tokyo's support policies for solar PV could cause Japan to lose its technological edge to countries with competitive companies and more aggressive support programs like Germany and China. The success of the German and Spanish FITs in increasing demand for solar PV inaugurated a new era in the commercialization of solar PV, inducing new

companies to enter the market and hinting at the potential for explosive growth in the industry. Japan, however, was late to notice the changing tides. Vested interests blocked the Hashimoto FIT Initiative in late 1999 and a FIT emerged only in November 2009 after it had been watered down by those same vested interests. By that time, Japan had slipped to third in terms of installed solar PV capacity, behind Germany and Spain. Japan's "big four" solar PV makers suffered greatly due to the prolonged stagnation of the domestic market as well as the increased competition invited by the 2008 Spain boom. If Japan's market support policies continue along a reactive path, these trends are likely to worsen.

In the corporate sphere, Chinese solar PV companies are making rapid gains on their Japanese competitors. Aided by lower labor costs, newcomers like SunTech are quickly lowering production costs through economies of scale. Chinese firms also benefit from the their government's aggressive R&D programs into renewable energy technologies.[91] SunTech's 2006 acquisition of the Japanese PV maker MSK Corporation provides the Chinese company with a sales and distribution network in the Japanese market. More generally, however, the global solar PV market is becoming more competitive because turnkey production facilities are now available for purchase though companies such as Applied Materials. "The global PV industrial arena has been shifting [since 2008] from where Japan took the lead…in the areas of technological development and formation of industry, to a stage where global development has been observed. Accordingly, the position of Japan's PV industry has been relatively slipping," commented NEDO in its 2009 roadmap for solar PV development.[92] Indeed, the road ahead for the Japanese "big four" will be increasingly difficult in the fiercely competitive global market. Because Japanese solar PV makers are predominantly exporters (78.8% of sales in 2008 were exports),

their fortunes depend on the extent to which they can trump low-cost Chinese exports with superior quality and reliability.

In the home market, Japan's solar PV companies face an equally uncertain picture. It is unclear if the combination of the revived RPVDP and the 2009 Solar FIT will provide households with sufficient incentive to install solar PV systems on their roofs. Forward-thinking local governments, however, might take up the slack left by the METI. In April 2009, the Tokyo Metropolitan Government (TMG) began its own subsidy program for rooftop solar PV systems. "The Tokyo [metropolitan] government sees itself as Japan's California. It wants to be proactive on renewable energy. It sees that the central government has not exhibited leadership for solar PV," commented ISEP's Iida on the TMG's headstrong thinking.[93] More than 400 other local governments throughout Japan have similar schemes in place. Many of these towns and cities view solar PV and other renewable energy technologies as potential drivers of local economies in the coming years. These proactive local governments might provide the support necessary to compensate for the central government's reactive policymaking and to reinvigorate the domestic market for solar PV.

6. Conclusion

Japan is often characterized as a world leader in renewable energy; it began research into solar PV technologies in 1974 under the Sunshine Program, before many other countries. Japan's universities, as well as its "big four" solar PV makers have achieved some of the world's highest levels of cell efficiency recorded in laboratory testing. The country's solar PV industry, however, has not received proactive, consistent market support policies that the Japanese

government's investment in R&D and the country's deficiency of natural resources would seem to justify. Due to the alignment of domestic interests, the polarization of policymaking, and the entrenched predilection for market-conforming tools, Japan's policy toward solar PV has been reactive in nature. Responding to both international environmental pressures (the 1992 Rio Earth Summit and the 2008 G8 Toyako Summit) and domestic political ideology (the 2005 termination of the RPVDP), Japan's market support policies for solar PV have been motivated more by exogenous forces than the realities and economic necessities of technological development and product deployment.

Is this pattern of negligent market support policies confined to solar PV? Or is it part of a larger trend in Japanese policymaking toward renewable energy? Like Japan's "big four" solar PV companies, heavy machinery firms like Mitsubishi Heavy Industries, Fuji Electric Systems, and Toshiba Power Systems are world leaders in building turbines for geothermal power plants. Geothermal energy production, which uses steam heat generated by the earth's core to spin turbines that generate electricity, is perfectly suited for Japan, with its seismically active location on the Pacific Ring of Fire. While Japan did undertake an aggressive geothermal exploration campaign in the early 1990s, it has added a meager 2 MW of geothermal capacity since 1996, bringing its cumulative installed capacity to 535.2 MW at present. RPS covers only a certain type of small-scale geothermal technology (binary cycle) that exists at only one power plant in Japan, the 3,300 kW Hachijo-jima Geothermal Power Plant. In 2004, Japan's electric utilities purchased only .00006% of their quota under RPS from geothermal sources.[94] Land scarcity and the length of time required for exploration, testing, and construction (roughly 20 years) are cited as significant obstacles to further geothermal development in Japan. "Geothermal is too expensive to develop. Further exploration is dead," commented one official from NEDO's

Energy and Environment Policy Department.[95] According to The Geothermal Research Society of Japan, however, the country could easily triple its geothermal capacity by 2020 with the aid of aggressive support policies.[96] Geothermal energy was not, however, included in the 2009 Solar, signaling that the METI is not seriously committed to further development. Thus, Japan's reactive or negligent policy support for solar PV market deployment might be part of a broader pattern.

How can Japan reverse this trend and regain its position as a world leader in solar PV deployment? By more closely monitoring the market support policies of other countries, Japan can transform its policymaking from reactive to adaptive. Japan should build on the experiences of Germany, whose FIT was too generous and has become unsustainably expensive.[97] Tokyo should also learn from Madrid's mistakes—Spain's overly generous FIT led to a building boom of poorly constructed, large scale solar PV plants that have little chance of ever becoming profitable.[98] By becoming a more discriminative, *adaptive* actor, the METI can select the best policies from throughout the world and tailor them to Japan's geographical and technological conditions. Such policies will, however, continue to be hamstrung by vested interests unless reform is undertaken. More competition needs to be introduced into Japan's electricity markets. Independent power providers should be encouraged to enter the power generation market. Off-grid applications of solar PV and other renewable energy technologies should be encouraged (more than 90% of Japan's solar PV capacity is connected to the main electrical grid). Such installations would spur the development of innovative, site-specific technologies and erode the dominance of Japan's electric utilities. The MOE, NGOs, and the media should do more to publicize the environmental benefits of solar PV and other renewable energy technologies. Politicians should use their office to emphasize the dangers from and dependency on imported

uranium that increased nuclear power generation will engender. Public opinion and political pressure for renewable energy could neutralize Keidanren's fierce support for nuclear power and contribute to proactive policymaking. Until such reforms and activist movements are created, however, Japanese market support policies for solar PV will continue to be reactive in nature.

Notes

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[2] Watanabe, Wakabayashi, and Miyazawa 299.
[3] Tomo Marukawa, "Taiyou denchi sangyou ni okeru nicchu gyakuten [The sudden reversal of Japan and China in the solar cell industry]," Chugoku keizai gakkai [Academic Meeting on the Chinese Economy], Tokyo daigaku shakai kagaku kenkyujo [University of Tokyo Social Science Research Center], Tokyo, 20 June 2009, slide 11.
[4] "Nihon ni okeru taiyou denchi shukkaryou no suii [Trends in exports of solar PV cells from Japan]," Taiyou kouden kyoukai [Japan Photovoltaic Energy Association], accessed 8 Mar. 2010 <http://www.jpea.gr.jp/pdf/qlg2008.pdf>.
[5] A Feed-In Tariff (FIT) is a policy tool that pays electricity producers a long-term, fixed-price for electricity generated from renewable sources (solar PV, wind, etc.). Electric utility companies are required to purchase such electricity at a higher-than-market price that is fixed by the government. The funding for FIT is usually generated by a small electricity tax levied on all customers. For more information, see Miguel Mendoca, David Jacobs, and Benjamin Sovacool, Powering the Green Economy: The feed-in tariff handbook (London and Sterling, VA: Earthscan, 2010).
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[13] Jacobsson and Bergek 819-20.
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[15] Jacobsson and Bergek 821.
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[24] Kimura and Suzuki 15.
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[27] Kimura and Suzuki 14.
[28] Yves Tiberghien and Miranda A. Schreurs, "High Noon in Japan: Embedded Symbolism and Post-2001 Kyoto Protocol Politics," Global Environment Politics 7.4 (Nov. 2007): 80.
[29] The Ministry of the Environment (MOE), "Statement by Prime Minister of Japan, Ryutaro Hashimoto at UNGASS, 23 Jun. 1997," accessed 8 Mar. 2010 <http://www.env.go.jp/en/earth/iec/ungass.html>.
[30] Japan's electric utility companies introduced a Voluntary Purchase Agreement (VPA) in 1992, in which they agreed to buy electricity from solar PV at market prices. This policy was largely ineffectual because the cost of producing electricity is significantly higher than the VPA's purchase price.
[31] "'Fushin' ni yureru genshiryoku kaihatsu seisaku rinkai jiko de mokuhyou anun [Critical temperature accident casts a dark cloud of 'mistrust' over nuclear power development policy]," Asahi shimbun [The Asahi Newspaper] 2 Dec. 1999: 12.
[32] Under the German FIT, for example, there was no distinction made between solar PV and less expensive renewable options, such as wind. The same FIT, however, increased the share of Germany's electricity from renewable sources from 3.4% to 5.5% in 10 years. For more information, see Mendonca, Jacobs, and Sovacool (2010).
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