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**Japanese Energy Policy after Fukushima Daiichi:
Nuclear Ambivalence**

John S. Duffield

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Abstract

This article reviews the development of Japanese energy policy since March 2011. The catastrophe at Fukushima Daiichi that month resulted in the loss or eventual shutdown of all of Japan's substantial nuclear generating capacity. It also undermined the long-term energy plan adopted just nine months earlier, in June 2010, which had called for a significant increase in the nuclear contribution to Japan's energy mix. During the next several years, successive Japanese governments took a number of steps to compensate for the loss of nuclear power by reducing electricity consumption and increasing the supply of electricity from other sources, while laying the groundwork for the eventual resumption of operations at Japan's existing nuclear power plants. The governments also labored to develop a new long-term energy plan that would take into account the new realities. These efforts did not result in a new plan until April 2014, however, and even that document left important questions about the future role of nuclear power unanswered, reflecting continuing deep divisions within Japanese society over the appropriate place of nuclear power in Japan's energy mix.

Japanese Energy Policy after Fukushima Daiichi: Nuclear Ambivalence

The tragic events of March 11, 2011 dealt a major blow to Japanese energy policy. Just the previous June, the government had adopted a new long-term energy plan that called for a substantial increase in Japan's reliance on nuclear power over the next two decades. Then the catastrophe at the Fukushima Daiichi nuclear power station resulted in the immediate destruction or shutdown of 10 reactors and cast into doubt the entire future of nuclear power in Japan.

Successive Japanese governments struggled to deal with the consequences. The first order of business was to make up for the sudden loss of so much nuclear-generated electricity, a problem that was compounded over the next 14 months as the nuclear power plants still in operation successively went off-line. But an equally important, if less urgent, task was to develop a new long-term vision for Japanese energy policy, especially concerning the role that nuclear power would play.

Perhaps not surprisingly, the process of developing a new long-term energy plan proved to be extremely difficult. It took more than four years to adopt a new plan and work out the details, and even then, Japanese society seemed no closer to reaching a workable consensus on the issue of nuclear power than it had immediately following the nuclear accident. To the contrary, it remained deeply divided, with groups on both sides of the issue marshalling arguments in support of their competing policy preferences.

This article reviews the evolution of Japanese energy policy after March 2011. It describes the steps that were taken to meet Japan's immediate energy needs as well as the attempts to develop a new long-term policy, first under the Democratic Party of Japan (DPJ), which was in power at the time of the accident, and then under the Liberal Democratic Party

(LDP), which took office in late 2012. It also seeks to shed light on the challenges faced by Japanese policy makers of both parties as they sought to fashion the new policy.¹

Japanese Energy Policy before 3.11

In June 2010, the Japanese government adopted a new triennial Strategic Energy Plan (SEP), as called for under the 2002 Basic Act on Energy Policy.² The plan established targets for energy consumption and production out to the year 2030. On the demand side, it called for cutting Japan's primary energy consumption (PEC) by some 13 percent below the 2007 level and by some 18 percent below business-as-usual (BAU) projections for 2030. The amount of electric power generated by the 10 regional utilities would decline slightly from the current level, from about 1020 to 970 terawatt hours (TWh), but would fall 25 percent below BAU projections.

At the same time, significant changes would occur in Japan's energy mix under the plan. The share of PEC provided by fossil fuels would drop from 84 percent to 64 percent, with the biggest cuts coming in oil (from 41 to 28 percent) and coal (from 22 to 17 percent). Fossil fuels would be replaced by nuclear power (from 10 to 24 percent) and renewables (from six to 13 percent).

The change in the electricity mix would be even more striking. The shares of electricity provided by renewable sources and nuclear power would rise from eight to 19 percent and from 26 to some 53 percent, respectively. Fossil fuels would account for only a quarter of electric power generation, down from two-thirds in 2007, as a principal element of the strategy for reducing Japan's CO₂ emissions.

To achieve these targets, Japan would need to realize a dramatic expansion in particular in its renewable energy generating capacity, from about 50 to 120 gigawatts (GW), a figure

equivalent to nearly 45 percent of Japan's total generating capacity in 2010. And because the potential for expanding hydroelectric power was quite limited, much of the capacity growth would have to come in the form of wind power (from 2.4 to 10 GW) and, especially, solar photovoltaic (PV) power (from 3.6 to 53 GW).³

The projected growth in nuclear generating capacity would not be so dramatic, but was still significant, from about 50 to 68 GW, or a nearly 40 percent increase. To achieve this target, Japan would have to build 14 new reactors, to supplement the 54 already in existence. In addition, the existing reactors, some of which dated to the early 1970s, would have to receive lifetime extensions beyond the original 40 years, and the plan assumed that all reactors could be operated 90 percent of the time on average, well above historic levels of capacity utilization in Japan.⁴

Even before the disaster at Fukushima Daiichi, it was clear that achieving these targets for nuclear power and renewables would not be easy. Experts questioned the ability of the existing power system to accommodate enough PV generating capacity to provide more than six to eight percent of the electricity supply. Many of the most productive sites for wind power, moreover, tended to be located far from where electricity was used, necessitating new power lines often in the face of local opposition. And the intermittent nature of both wind and solar power would require the maintenance of substantial backup fossil fuel generating capacity in the absence of large scale electric storage capacity.⁵

Equally strong doubts accompanied the plans for increasing nuclear power's contribution to meeting Japan's energy needs. The goal of 14 new reactors was feasible, but the construction of reactors had slowed greatly in the previous decade because of safety concerns and local opposition. Actual and potential opposition to new nuclear power plants, which could result in

long delays, had in turn made the utilities reluctant to invest heavily in them, given the high costs of construction. Likewise, the lifetime extensions of aging reactors, which were equally critical to the success of the plan, would probably depend on overcoming the anxieties generated by a series of recent mishaps and scandals involving nuclear power plants. Finally, a 90 percent operating capacity was not out of the question; similar or higher levels had been achieved in the United States and South Korea. But for many years, 80 percent had been the norm in Japan because of its shorter operation cycles between routine inspections and longer outage times for maintenance and repairs, and capacity utilization had fallen below 70 percent during the previous five years because of a series of unplanned outages, including a 2007 earthquake that temporarily shut down seven reactors.⁶

Impact of 3.11 on Japan's Energy Supply

The earthquake and tsunami of March 11, 2011, resulted in the loss of about 30 GW of electricity generating capacity, or about 17.3 percent of Japan's total capacity at the time. But many of the affected fossil fuel and hydroelectric power stations were quickly restored to operation.⁷ Instead, by far the biggest blow to Japan's energy supply on that tragic day was delivered to its nuclear power plants.

At the time, approximately one-third of the 54 reactors were shut down for inspection, maintenance, or repairs, including three of the six reactors at the Fukushima Daiichi power station. As a result of the earthquake and tsunami, 10 more reactors located along the northeast coast of Japan were immediately shut down. Among these were the three operating reactors at Fukushima Daiichi, all of which subsequently experienced meltdowns. This left just two dozen or so reactors in operation.⁸

Because of safety concerns, the government did not allow temporarily idled reactors to restart, and over the next 14 months, the remaining reactors were all shut down. In May 2011, the government asked the third largest regional power company, Chubu, to shut down two operating units because of concerns about their vulnerability to future earthquakes and tsunamis. Other reactors reached the point after 13 months of operation, when they were required to stop for routine inspection and maintenance. Thus in May 2012, the last operating reactor turned off.⁹

To be sure, the government was reluctant to see Japan lose an important domestic source of power, but it would not allow any reactors to restart without the support of local leaders, and many of the latter were opposed. In an attempt to reassure the public, the government decided in July 2011 that reactors would have to undergo stress tests before they could be restarted. But even then, the influential governor of Niigata prefecture, home to the single largest nuclear power station in Japan, announced that he would still not approve restarts.¹⁰

The government's ambivalence was understandable. The loss of so much base load generating capacity threatened to cause blackouts in parts of the country, especially during peak summer demand periods. Compounding the problem was the limited number of high voltage power lines linking the regional power companies, a constraint that was exacerbated by the fact that the eastern and western halves of the country operate on different frequencies. As a result, a maximum of 1 GW of power, or the equivalent of just one nuclear reactor's output, could be transferred in either direction.¹¹

The situation was most acute in the Tokyo and Kansai regions. Indeed, the latter had depended on nuclear power for half of its electricity, much higher than the national average of 25-30 percent, which made that region particularly vulnerable to blackouts. Thus in his first

policy speech in August 2011, the new DPJ prime minister Yoshihiko Noda called for restarting reactors that passed the stress tests even as nuclear power was phased out in the long term. And the following July, after two of the reactors at the Ohi nuclear power plant in the Kansai region had successfully completed the stress tests and under strong central government pressure, the local and prefectural governments reluctantly approved restarting them.¹²

Responses to the Loss of Nuclear Power Generation

During the next several years, the government made a number of efforts to cope with the sudden loss of nuclear power. Some of these focused on reducing power demand while others concerned increasing the supply of electricity, in part by restructuring the electric power system. The government also took steps to lay the groundwork for the eventual resumption of operations at Japan's existing nuclear power plants.

Measures to Reduce Electricity Demand

The most immediate energy policy challenge faced by the government beyond dealing with the dangers at Fukushima Daiichi was how to address the potential threat of blackouts. Because of the loss of so many nuclear reactors, the available generating capacity was likely to fall well short of the amount needed to meet previous summer demand peaks. As a first step, the government established goals for cutting power consumption in 2011, including mandatory restrictions on large users, in the most vulnerable areas for the period from July to September. It set a target of reducing use by at least 15 percent below the 2010 peak in the Tokyo and Tohoku regions and by ten percent in the Kansai region, and it mounted an aggressive power saving campaign.¹³

The government had to assume that the challenge would only grow in magnitude as additional nuclear reactors went off line. Thus in August 2011, the cabinet adopted a list of “Immediate Supply-Demand Stabilization Measures,” which set out a three-year timetable for implementing almost 50 specific actions intended to address the problem. The overall goal was to minimize the risk of power shortages at peak hours while holding down the price of electricity even in the event of a complete loss of nuclear power and without imposing any further obligatory savings measures.¹⁴

In order to reduce electricity demand over the longer term, the government also decided to revise the Energy Conservation Law, which dated to the second oil shock in 1979. In March 2012, the DPJ government approved amendments developed by the Agency for Natural Resources and Energy (ANRE) within the Ministry of Economy, Trade, and Industry (METI). These changes emphasized measures to curb peak electricity demand by using storage batteries, energy management systems, or private power generation and to improve the energy efficiency of building materials. Because of the change in government later that year, the amendments were not passed by the Diet until May 2013, and some observers were skeptical of how much difference in energy consumption the new measures would actually make. In 2015, however, the government enacted a far-reaching bill intended to promote energy savings in buildings.¹⁵

Measures to Increase Other Sources of Electricity Supply

At the same time, the government and the utilities worked to increase the supply of electricity from other sources. The most immediately available options were to take advantage of underutilized or mothballed thermal generating plants that use fossil fuels and to build new ones. The government relaxed some restrictions and even offered financial incentives for self-

generation of electricity. As a result, the share of power generated from natural gas jumped dramatically, from 30 to around 45 percent, as the utilization rate of gas-fired power stations went from just half to nearly 100 percent.¹⁶

The government also took steps to accelerate the introduction of renewable sources of power. In fact, it was already developing a comprehensive feed-in tariff (FIT) scheme, which was approved by the cabinet on the morning of March 11, 2011, just hours before the earthquake. Up to that point, the measure had been intended to reduce fossil fuel-fired power generation, but it provided a ready vehicle for addressing the new exigencies, and following the disaster, the text was revised to offer more generous incentives before being approved by the Diet in August 2011.¹⁷

The original tariff levels, set in April 2012, were particularly favorable to the installation of solar PV, which would receive up to 42 yen per kilowatt hour (kWh) for as many as 20 years, depending on the size of the installation. As a result, more than 90 percent of the applications were for solar PV, and by April 2013, the end of the first year of operation, the government had approved almost 19 GW of new PV capacity. In fact, the response was so strong that the rate setting commission recommended reducing the tariff beginning that month to no more than 38 yen/kWh, a level that reflected the dramatic decline that had occurred in the cost of solar panels. Even then, another 46 GW of capacity was licensed during the following 12 months, with the majority of applications been submitted in March 2014 just before the guaranteed purchase price was again reduced, to only 32 yen/kWh for non-household producers. Actual installed capacity, however, grew much more slowly, reaching just nine GW by April 2014, and it appeared that some successful license applicants were waiting for prices to fall even more before building the approved projects.¹⁸

Less favorable tariffs were not the only reason that the growth in other renewable sources of power lagged solar PV. A 2011 Ministry of the Environment study had found that, of all the possible renewable sources, wind power had by far the greatest potential in Japan. But wind farms had to pass more complex environmental impact assessments, and some two-thirds of the most promising onshore areas were located in the very north of the country, where they threatened to overwhelm the local grids in the absence of better interregional connections.¹⁹

And as early as mid-2013, even the incorporation of new PV capacity was beginning to face challenges, as some power grids were reportedly already reaching their capacity to absorb renewable sources. The most acute situation arose on Hokkaido, where the availability of large amounts of inexpensive, undeveloped land made solar power particularly attractive. Limited demand and interconnections with other regions, however, prompted the regional power monopoly to limit purchases from large solar power installations to 400 MW, or just one-quarter of the amount of capacity applied for. And the problem was not confined to the north; power grids in southern Japan were also close to their limits, after accounting for existing and approved renewable capacity. More fundamentally, Japan lacked clear regulations defining grid access for renewables, including purchase volumes and costs, leaving decisions on such critical matters largely to the discretion of the utilities.²⁰

The issue came to a head in the fall of 2014, when five of the 10 regional utilities suspended the review of applications for connecting new renewable capacity to the grid in the face of concerns about oversupply and network instability. The situation was particularly acute in southwestern Kyushu, where the amount of solar power capacity certified under the FIT – nearly a quarter of the national total – already exceeded peak demand. METI responded by establishing a working group to determine a formula for calculating the amount of renewable

power that the grid could accommodate. In early 2015, ANRE promulgated a revision of the FIT scheme that would set deadlines for constructing approved renewable projects, allow utilities to limit the output of renewable-generated electricity on an hourly basis in order to maintain the balance between supply and demand, and expand the scope of such curtailment to include facilities smaller than 500 kilowatts. Although the changes were justified as necessary to allow the connection of additional solar capacity, some critics alleged that the real purpose of the reforms was to limit the amount of renewable energy on the grid in order to ensure its ability to accommodate electricity from nuclear power plants once they returned to service. And in March, the government announced further reductions in the solar PV tariff, which would drop in July to 27 yen/kWh for projects of more than 10 kilowatts.²¹

Reform of the Electric Power System

The challenges facing the take-up of renewable power sources also helped to maintain pressure for a sweeping reform of the entire electric power system. The crisis at Fukushima Daiichi had already revealed several serious limitations, including the capacity to transmit power between the regional networks, the ability to handle changes in the energy mix, especially an increase in intermittent sources, and the choice of tariffs for many customers. These limitations in turn prompted calls for fundamental changes in the electric power system, including the creation of a nation-wide transmission system, the unbundling of transmission and distribution from generation and retailing, and full competition in generation and retail sales.²²

The DPJ government decided to pursue systematic reform of the electric power system in December 2011 and established a task force and then an expert committee to study the problem. By May 2012, the government was able to issue an outline of its overall plan, although many

details remained to be worked out. On the demand side, it called for the full opening of the retail market through the abolition of regional monopolies along with the supply obligations and rate regulations previously imposed on the utilities. On the supply side, it called for the full liberalization of power generation and the revitalization of wholesale power exchange markets. And it called for the creation of a national grid operator to coordinate transmission and distribution across supply areas and the assurance of grid neutrality through either functional or legal unbundling.²³

In February 2013, the expert committee presented a final report, which called for full liberalization of the retail electricity market and legal unbundling of transmission and distribution. The report was subsequently adopted in April of that year by the new LDP-dominated cabinet, which established three goals: ensuring a stable power supply, keeping electricity rates as low as possible, and expanding user choice and business opportunities. The final plan called for carrying out the reforms in three phases. In the first phase, to be completed in 2015, the government would establish a new entity to operate a nation-wide grid system. In the second, to be completed by 2016, it would liberalize the choice of electricity suppliers for all customers, and establish a new framework for securing adequate supply capacity. And in the third, to be completed during the 2018-2020 timeframe, the government would carry out the divestiture of the transmission and distribution assets of the regional utilities and abolish any remaining price restrictions.²⁴

Rather than try to implement all the reforms at once, however, the LDP-led government decided to divide the proposal into three separate legislative packages, corresponding to the three phases. The packages would be introduced over three years, with the first being sent to the Diet in 2013. This piecemeal approach raised concerns among some observers that it would provide

opportunities for the regional monopolies to water down the final legislation.²⁵

Nevertheless, through 2015, the reform process appeared to be on track. The Diet had enacted the first promised piece of legislation in November 2013, the second in June 2014, and the third in June 2015. The new national grid management agency, the Organization for Cross-regional Coordination of Transmission Operators (OCCTO), was established in 2015, and preparations were underway for the introduction of full retail competition the following year. Indeed, hundreds of companies had already applied for approval to sell electricity. Even the most contentious element of the package -- the legal unbundling of the regional transmission and distribution systems from the power generation and retail functions -- had been approved, although it would not go into effect until the latest possible date, and some observers questioned whether the government would be willing and able to prevent the expected efforts of the utilities to dilute this reform effort.²⁶

Efforts to Improve Nuclear Safety

A final major thrust of Japanese energy policy after March 2011 was to overhaul the institutions and regulations for ensuring the safety of Japan's nuclear power industry. There was widespread belief, subsequently confirmed by several detailed investigations, that lax oversight had contributed to the circumstances leading to the explosions and meltdowns at Fukushima Daiichi, which might even have been avoided. At a minimum, the safety regime would have to be fundamentally reformed if the government and the utilities were ever to regain the trust of the populace and restart the shuttered reactors.

As a first step, the DPJ government called for a clear separation of the functions of nuclear regulation and promotion. For some years prior to the accident, the principal regulatory

body, the Nuclear and Industrial Safety Agency (NISA), had been housed within METI, which was responsible for promoting the nuclear industry, creating a conflict of interest. Then, in January 2012, the government announced that it would create a new nuclear safety agency under the Ministry of the Environment (MOE). It also proposed a number of amendments to the Atomic Energy Basic Act and the Nuclear Reactor Regulation Law, subsequently adopted, that would, among other things, impose a 40-year cap on the operational lives of nuclear power plants, subject to a single extension of not more than 20 years, require utilities to retrofit existing plants with the latest safety features, and make accident management preparations obligatory.²⁷

In September 2012, the new Nuclear Regulation Authority (NRA) came into existence. Although nominally part of the MOE, it was established as a legally independent agency without control or supervision by any superior body. Nevertheless, concerns were quickly raised about whether the new body would be free of the “culture of complacency” and “willful ignorance” that had allegedly permeated the regulatory environment. After all, a high percentage of the staff came from the former, now discredited, regulatory bodies, and even the first chairman had served as president of the Atomic Energy Society, which advocates the use of nuclear energy. But some additional measures were taken to prevent conflicts of interest and avoid regulatory capture in the future, such as locating the authority outside the government district and forbidding the transfer of senior officials to any government organization under the NRA’s jurisdiction.²⁸

The new NRA quickly went to work. In October 2012, it began a series of investigations of nuclear power plants located in areas suspected of being seismically active, and it established guidelines for nuclear emergency preparedness that local authorities were to implement by March 2013.²⁹ But its most important order of business was to draw up a new

comprehensive set of strong safety regulations that all power plants would have to meet.

A first draft of the regulations was issued in February 2013 and contained both measures to prevent future accidents and countermeasures for mitigating the impact of an accident if one nevertheless occurred. Among other things, they called for stronger tsunami defenses, alternative power supplies, multiple sources of cooling water, filtered vents, backup control rooms and emergency command centers, and methods of injecting water into a molten core that had already left the reactor vessel. In addition, the proposed regulations limited nuclear reactors to a service life of 40 years [takahashi, 71] Following a period for public comment and a set of hearings, the regulations were finalized and went into effect in July 2013.³⁰

Four power companies quickly submitted applications to restart a total 12 reactors at six different sites (another dozen were submitted over the following two years). It was clear that all plants would have to make significant safety improvements, ranging in cost from \$700 million to \$1 billion per unit, and in some cases, the necessary modifications would be too expensive to be worthwhile. In other cases, however, it appeared that the required investments would not be an obstacle to reopening the plants, and given the high cost of fossil fuel, restarting as many as possible was the top priority of the power companies.³¹

Nevertheless, it remained uncertain how quickly the NRA would be able to reach decisions on the applications. The chairman initially stated that the review period would normally take about six months and that, given the urgency of the situation, the process would be expedited as much as possible. But the process turned out to be much slower, for several reasons. First, the NRA was inclined to proceed cautiously, especially as it sought to gain credibility in the public eye. Moreover, the NRA had only enough experts to evaluate several sites at a time.³²

Thus, it was not until September 2014 that the NRA determined that two reactors at the Sendai nuclear power station in far southwest Japan met the new safety requirements and then five months later two units at the more centrally located Takahama power plant. The restart of the Sendai reactors was soon approved by the governments of Kagoshima prefecture and the local community in which they are located. And after a final round of inspections, they resumed operation in August and October 2015, respectively.³³

The situation at Takahama, located in Fukui prefecture, was more problematic. Although the host municipality and prefectural government were favorably disposed to a restart, parts of other populous prefectures and municipalities were located within the expanded 30 kilometer evacuation zone around the power plant, and their governments insisted on having a say in the matter, citing the potential risk to their citizens, and in April 2015 obtained a provisional injunction from the prefectural court against restarting the reactors that was not lifted until the very end of the year. Japanese law and policy remained unclear as to which bodies should be involved in restart decisions. Although it was generally agreed that local consent was a requirement, uncertainty remained over which localities should be included.

Even as the NRA was issuing the first safety approvals – a fifth was issued in July 2015 for a reactor at the Ikata nuclear power plant, moreover, the NRA concluded that a reactor at the Tsuruga nuclear power plant stood on top of an active fault. And in March 2015, four power companies announced the decommissioning of five older reactors, leaving just 43 potentially operational units. Thus at the end of 2015, nearly five years after the Fukushima Daiichi nuclear accident, only two of Japan's reactors were back in operation, and as few as another five to seven were expected to restart over the next several years.³⁴

Broader Implications of 3.11

Despite these efforts to improve nuclear safety, the major premise on which Japanese energy policy had been based – that nuclear power was fundamentally safe – had been profoundly undermined by the Fukushima disaster. As a result, the degree to which Japan would rely on nuclear power in the future came under fundamental review. In May 2011, less than a year after the adoption of the most recent Strategic Energy Plan, the government announced that “There is no alternative but to start from scratch on a new national energy plan.”³⁵ There seemed to be general agreement that Japan should reduce its planned dependence on nuclear power, but a number of consequential questions would still have to be answered: how much should Japan cut its nuclear reliance? How quickly should the reductions be implemented? What alternatives should Japan rely on to meet its electricity needs? And how much was the country willing to pay in terms of economic, social, and environmental costs?

Efforts to answer to these questions went through in two phases. During the period ending in September 2012, the DPJ government came close to, but stopped short of, adopting a new energy plan that called for phasing out nuclear power by the end of the 2030s but continuing to rely on it in the meantime and that set concrete targets for total electricity consumption and the contribution from different power sources. The new LDP-led government, which took office in December 2012, adopted a different approach, seeking to avoid establishing specific long-term targets for Japan’s energy mix. This intentional ambiguity culminated in April 2014 with the government’s adoption of a new Strategic Energy Plan that left these questions largely unanswered, and even the preparation of a long-term energy supply and demand outlook the following year was silent on critical issues.

Development of a New Strategic Energy Plan: The DPJ

Shortly after the disaster at Fukushima Daiichi, then DPJ prime minister Naoto Kan initially signaled a willingness to maintain a significant degree of reliance on nuclear power once the safety of the existing facilities was assured. In July 2011, however, following the revelation that a public forum on nuclear safety measures had been rigged by METI and the regional power company, he reversed course and declared that Japan should gradually reduce its nuclear dependence, eventually to the point where it could do without nuclear power altogether. His successor in September 2011, Yoshihiko Noda, was more ambivalent, limiting his position to reducing Japan's nuclear dependence as much as possible in the medium- to long-term, although he opposed building new reactors and extending the operating licenses of existing ones, and it was this more ambiguous position that was initially adopted by the DPJ government.³⁶

The Process of Developing a New Plan

As a first step in developing a new national energy plan, the cabinet established in June 2011 a new interministerial Energy and Environment Council (EEC), which was tasked with formulating an "Innovative Energy and Environment Strategy." The EEC was chaired by the Minister of National Policy and included seven other cabinet members, including the METI and MOE ministers as co-chairs. The EEC quickly adopted three guiding philosophies: reducing dependence on nuclear energy while avoiding energy shortages and price hikes, shifting to distributed energy systems, and holding national discussions. And based on these guidelines, it requested that the Japan Atomic Energy Commission, METI's Advisory Committee on Natural Resources and Energy (ACNRE), and MOE's Central Environmental Council prepare options for the nation's nuclear policies, energy mix, and measures to prevent global warming,

respectively. It also created an independent committee within the National Policy Office Unit to develop independent estimates of the costs of alternative means of power generation.³⁷

Most of the subsequent discussions regarding Japan's future energy mix took place within the Fundamental Issues Subcommittee (FIS) of the ACNRE. The subcommittee initially had 17 members, only two of whom were viewed as opponents of nuclear power. This composition was roundly criticized by outside groups, and the membership was expanded to 25, including eight nuclear critics and an equal number of nuclear proponents.³⁸

Starting in October 2011, the subcommittee met approximately weekly. Despite the internal tensions, the members were able to agree the following December on four "basic directions" for future discussions: 1) fundamental reinforcement of energy and electricity conservation, 2) accelerated development and use of renewable energies to the maximum degree possible, 3) effective utilization of fossil fuels, beginning with a shift to natural gas, and 4) reduced dependency on nuclear power wherever possible.³⁹

Meanwhile, the cost investigation committee also issued its report that December. Taking into account the full costs of nuclear power, it arrived at an estimate that was 50 percent higher than the most recent official estimate, or 8.9 yen/kWh versus 5.9 yen/kWh. Thus, the cost difference between nuclear and alternative sources of power would be smaller, especially in the medium to long term, than previously thought.⁴⁰

In late June 2012, the EEC summarized the discussions of the various committees and presented three scenarios for the year 2030, reflecting the wide range of views held by committee members. All three scenarios involved a significant reduction in Japan's planned reliance on nuclear power, but the projected share of electricity generated in nuclear plants ranged from zero to 15 to 25 percent, well below the roughly 50 percent contained in the 2010 Strategic Energy

Plan. Nuclear power would be replaced by some combination of renewable power sources and fossil fuels, with the former ranging from 25 to 35 percent, depending on the scenario, versus the 20 percent contained in the 2010 plan. To help make these targets possible, conservation efforts would reduce electricity demand by nearly 20 percent below the previous projection. In all three scenarios, however, the reduction in greenhouse gas emissions below the base year of 1990 would be significantly less than the 30 percent previously anticipated, and all would result in higher electricity bills and some reduction in projected GDP, although the estimates varied widely.⁴¹

The Innovative Strategy for Energy and Environment

Following the presentation of the three scenarios, the EEC initiated a national discussion of the options, which lasted through mid-August of 2012. It held public hearings in 11 different cities that drew about 1000 people. It invited public comments, of which it received about 90,000. And it conducted deliberate polling and small group discussions in which some 300 people participated. A substantial majority of the responses favored the zero or 15 percent options for nuclear energy, reflecting widespread public doubts about the safety of nuclear reactors at a time when demonstrations in Tokyo were drawing hundreds of thousands.⁴²

Some elements of Japanese society were highly critical of the report. For example, the Japanese Business Association (Keidanren), the leading voice of big business in Japan, issued a sharp critique of all three scenarios. It argued that the assumptions about economic growth on which they were based were inconsistent with the government's own policy and that those about energy conservation and renewable sources of power were unrealistic. It feared that electricity prices would increase significantly, with negative consequences for the economy.⁴³ Other

groups, especially environmental NGOs that favored a complete nuclear phase out, felt that the scenarios were not truly sustainable and did not go far enough to reduce greenhouse gas emissions.⁴⁴

Following this period of discussion and feedback, the EEC prepared and issued a final set of recommendations, called the Innovative Strategy for Energy and the Environment (ISEE), on September 14, 2012.⁴⁵ The overall goal of the strategy was to reduce dependence on nuclear energy as well as on fossil fuels by maximizing energy efficiency and renewable energy. The strategy contained three main pillars: realization of a society not dependent on nuclear power, realization of a green energy revolution, and ensuring a stable supply of energy.

Under the first pillar, the government would “mobilize all possible policy resources to such a level as to even enable zero operation of nuclear power in the 2030’s” [sic]. In particular, rules limiting reactor operating lifetimes to 40 years would be strictly applied, and no new nuclear power plants would be planned. At the same time, however, existing power plants would be restarted “as an important power source” once the NRA had assured their safety.

Under the second pillar, Japan would reduce its annual electricity consumption by up to 10 percent, to as little as 1000 TWh, and total final energy consumption by as much as 19 percent by 2030, depending on the rate of economic growth, and the strategy outlined a number of measures for achieving these reductions. In addition, the amount of renewable electricity would nearly triple, from 110 TWh in 2010 to 300 TWh in 2030, with most of the gains coming from solar and wind power. Achieving this goal would require increasing the amount of installed renewable capacity other than hydropower from nine GW to 108 GW.

Under the third pillar, Japan would increase the contribution of co-generation from 30 TWh to 150 TWh, or 15 percent of electricity production in 2030. It would also take advantage

of advanced technology to generate power from fossil fuels as efficiently and with as little environmental impact as possible.

Finally, the strategy noted that the achievement of these pillars would be facilitated by a fundamental reform of the electric power system, which the DPJ government had already decided to pursue, and it indicated the government's intention to present a detailed restructuring plan by the end of the year. It also discussed the strategy's impact on greenhouse gas emissions and what other steps the government would take to prevent global warming, since energy-related emission cuts under the ISEE would fall short, and possibly well short, of the targets previously set for 2020 and 2030.

Overall, the strategy appeared to combine elements of the 0 percent and 15 percent scenarios that the EEC had presented in June. The targets for electricity savings and renewable power were consistent with both scenarios. Although nuclear power would presumably continue to make an unspecified contribution to meeting Japan's electricity needs in 2030, it would be phased out by the end of the following decade.

The Demise of the Innovative Strategy

Prime minister Noda welcomed the ISEE and even seemed to endorse it.⁴⁶ But the cabinet immediately came under pressure not to adopt the strategy as government policy. Business and industry in particular expressed concerns about and lobbied against the plan to phase out nuclear power. They argued that implementing the strategy would cause an unacceptable increase in electricity prices, make Japanese industry uncompetitive, result in a hollowing out of the Japanese economy, boost unemployment, threaten the financial viability of the electric utilities, and make it impossible for Japan to maintain its prowess in nuclear technology. Instead, they

demanded an alternative and, in their view, more realistic plan that would contain a continuing significant role for nuclear power in Japan's energy mix.⁴⁷

Additional pressure came from abroad. In particular, the U.S. government reportedly demanded that the cabinet take no definitive decision to phase out nuclear power. Washington was eager to see Japan restart its reactors so it could use up reprocessed spent fuel. Japan's failure to do so would undermine the U.S. position on nuclear non-proliferation, since it would allow Japan to acquire substantial amounts of plutonium without any obvious commercial use.⁴⁸

In the face of this tsunami of criticism, DPJ leaders quickly began to hedge their positions. They suggested that some reactors might be allowed to operate for more than 40 years after all. They indicated that they would not necessarily block work on reactors that were already under construction. Thus nuclear power might in fact continue to be part of the energy mix well beyond the 2030s.⁴⁹

The government's backtracking culminated on September 19, when the cabinet met to consider the ISEE. Rather than adopting the strategy, it issued the following statement:

The Government of Japan will implement future policies on energy and the environment, taking into account of "the Innovative Strategy on Energy and the Environment," while having discussions in a responsible manner with related local governments, the international community and others, and obtaining understanding of the Japanese public, by constantly reviewing and reexamining policies with flexibility.⁵⁰

Thus the ISEE was left in limbo and work on the development of a new energy plan was suspended, pending the outcome of the national elections now scheduled for December.⁵¹

Development of a New Strategic Energy Plan: The LDP

The fate of ISEE was sealed with the victory of the opposition LDP in the lower house elections of December 2012. Although the LDP leader, Shinzo Abe, had voiced his support for nuclear power, the party had said very little during the campaign about how it would address Japan's energy challenges, preferring to emphasize other issues. Discussion in the LDP's election manifesto was largely limited to stating that the party would seek to establish the best energy mix within 10 years.⁵²

Then, in early 2013, Abe, the new prime minister, announced that the government would conduct a review of the ISEE from the ground up. The goal would be to formulate a responsible energy policy aimed at ensuring a stable supply of energy and lower energy costs.⁵³

In many respects, the initial positions expressed the LDP were very similar to those of the DPJ. The government would seek to restart existing plants, but only where their safety had been confirmed by the NRA. It would promote the introduction of energy conservation and renewable energies to the greatest possible extent in order to reduce Japan's dependence on nuclear power as much as possible. And it would begin a fundamental reform of the electric power system.⁵⁴

In other respects, however, it appeared that the new government preferred a greater role for nuclear power. It hoped to extend reactor lifetimes to 50 years, although this too would require approval by the NRA. It hoped to build new reactors, which would, in the words of Abe, "be totally different from the ones built 40 years ago..." And it would make greater efforts to persuade local governments to restart nuclear power plants, once the NRA gave the green light.⁵⁵

The Process of Developing a New Plan

This time, responsibility for developing a new energy plan was turned over to a subcommittee of METI's Advisory Committee for Natural Resources and Energy. The membership of the new General Subcommittee, moreover, was reduced to just 15 people, and only two of the members were regarded as holding critical views of nuclear power. The interministerial EEC, which had previously coordinated the effort, was disbanded.⁵⁶

The General Subcommittee held its first meeting in March 2013. The initial goal was to develop a new plan by the end of the year. In contrast to the previous Strategic Energy Plan and the ISEE, however, there was no intention of establishing concrete targets for the contribution of each type of energy to Japan's energy mix, reflecting the uncertainty of predicting how many of the nuclear reactors would restart.⁵⁷

The discussions proceeded slowly at first, as the subcommittee met just once a month. In July, it was renamed the Basic Policy Subcommittee, and the pace quickened, with multiple meetings in September and October. As the months passed, moreover, the proceedings became more heated, especially when the subject turned to the future of nuclear policy. Likewise, testimony by business and consumer groups evidenced deep splits over the issues of restarting nuclear reactors and the value of the FIT.⁵⁸

At the same time, deep fissures emerged within the LDP itself. Most notably, the popular former prime minister Junichiro Koizumi spoke out forcefully in favor of phasing out nuclear power immediately, reflecting his concern about the lack of a long-term solution for the disposal of high-level nuclear waste. "Some people say it is irresponsible to call for zero nuclear plants," he noted, "but I think it is even more irresponsible not to have a disposal site for the waste or even any prospect of constructing such a facility." Restarting reactors would only result in the production of more dangerous radioactive waste.⁵⁹

The Strategic Energy Plan of April 2014

The Basic Policy Subcommittee submitted its final report in December 2013. Because of divisions within the government, however, it was not until four months later, in April 2014, that the cabinet was able to adopt a new Strategic Energy Plan, more than three years after the disaster at Fukushima had undermined the previous one.⁶⁰

Largely as expected, moreover, the document was long on general principles and short on specifics. In the much anticipated discussion of each potential energy source, it described nuclear energy as “an important base-load power source” and affirmed that the government would “proceed with the restart of the nuclear power plants” as soon as the NRA confirmed that they conformed to the new safety regulations. Nevertheless, the plan hastened to add that “Dependency on nuclear power will be lowered to the extent possible through energy saving and introducing renewable energy as well as improving the efficiency of thermal power plants.”⁶¹

In that connection, the government would do as much as possible to promote renewable energy, and it established a cabinet-level group to that end. The goal was to introduce a slightly higher level of renewable energy in the electricity supply than had been contained in the previous SEP, approximately 20 percent or more than 200 TWh. Beyond that, however, the plan was silent on the details of the future energy mix, as had been expected.⁶²

In that regard, the new SEP was strikingly different from the 2010 plan and the ISEE. It also differed from the ISEE in terms of its open-ended support of nuclear power. In a number of other respects, however, the SEP did not go beyond the ISEE. It did not question the previous plan to limit reactor operating lives to 40 years and to ban new construction. Nor did it call explicitly for any changes in reactor operating tempos and capacity utilization. And even the

ISEE had provided for restarting reactors whose safety had been assured by the NRA and continuing the policy of reprocessing spent nuclear fuel.

Over the following year, one question left unanswered by the new plan, concerning the future energy mix, was resolved. In January 2015, the government established an advisory committee to examine the issue. The committee's report, issued in April, was adopted largely unmodified in July. Most notably, the report set targets for the nuclear share of electricity production at 20-22 percent and for renewables at 22-24 percent in 2030.⁶³

The target for nuclear power was significantly lower than that contained in the 2010 plan and not much greater than that possible under the ISEE. Even then, however, its feasibility was quickly called into question. Independent experts pointed out that such a figure could not be achieved without restarting virtually all of the remaining 43 reactors, extending the lifetimes of many that would otherwise be decommissioned beyond 40 years, and completing the two reactors that were under construction in 2011. Instead, they argued that a more realistic target would be nine to 10 percent.⁶⁴

Explaining Japan's Nuclear Ambivalence

The difficulty of developing a new long-term energy plan – and the remaining questions regarding the nuclear program after more than four years of analysis and debate -- reflected the deep ambivalence within Japanese society over the issue of nuclear power. Although the two major parties seemed to agree at least on the value of restarting existing nuclear plants once their safety had been assured by the NRA, they differed on the key question of nuclear energy's long-term role in meeting Japan's electricity requirements. And a significant number of rank-and-file Japanese would not concede the need for any nuclear contribution even in the short term. At the

risk of oversimplification, the principal actors in the debate could be roughly divided into two camps.

Pro-Nuclear Arguments

On one side were those who argued for maintaining a substantial role for nuclear power in Japan's energy mix for the foreseeable future. They offered three broad sets of arguments in support of their position.⁶⁵

First, nuclear power was critical for Japan's energy security. At home, it enhanced the stability of Japan's electricity supply, both by increasing Japan's overall generating capacity and by providing a reliable source of base load electricity. Abroad, it reduced Japan's dependence on potentially unreliable sources of fossil fuel imports, such as the Middle East and Russia.

The second set of arguments concerned the economic costs and benefits. Without nuclear power, electricity prices would necessarily be higher, with potentially dire consequences. Japanese manufacturers would become less competitive, forcing them to move operations overseas where energy costs were lower and boosting unemployment at home. Fossil fuel imports would go up, resulting in higher financial outflows and contributing to trade deficits. Indeed, during the first years after the nuclear accident, fuel costs for the power industry rose by some 3.6 trillion yen, while electricity prices increased by 25 (for households) to 38 (for industry) percent.⁶⁶ And Japan would lose an important source of exports as its nuclear industry, once among the best in the world, withered. Japan needed to restart its existing reactors and build new ones if its companies were to compete successfully abroad for nuclear power contracts.

Third, nuclear power had distinct environmental advantages, especially in the fight

against climate change. During the first year after the accident at Fukushima, Japan's overall greenhouse gas emissions were seven percent higher than before March 2011 largely because of the increased use of fossil fuels to generate electricity, and CO2 emissions per kilowatt hour in the power sector increased by nearly 40 percent. And in late 2013, the government announced that 2020 greenhouse gas emissions would actually be three percent higher than the 1990s level, assuming that no nuclear reactors were operating, in contrast to the six percent cut promised under the Kyoto protocol.⁶⁷

Expressing these pro-nuclear views was a powerful coalition of interest groups. Perhaps first among these were the influential regional electric power utilities, led by the Tokyo Electric Power Company (TEPCO), and their investors and lenders, who had the most to lose from a nuclear phase out. The utilities were already spending on the order of \$30 billion per year on additional imports of fossil fuels, which resulted in a combined operating loss of \$16 billion in the 2012-13 fiscal year alone. And they had invested substantially over the years in nuclear power plants. Thus if all the reactors were permanently closed, the utilities would incur additional losses of on the order of \$56 billion, which would make at least four of them insolvent.⁶⁸

Also certain to be hurt would be the companies that built and serviced nuclear power plants both in Japan and abroad. These include such industry heavyweights as Toshiba, Mitsubishi, and Hitachi, which have been major players in the global nuclear business. Although these companies had other lines of work, their bottom lines would surely suffer from a nuclear phase out.

Not to be overlooked were the many manufacturers that used substantial amounts of energy and were thus sensitive to energy costs. For these companies, higher prices mean

reduced competitiveness at home and in world markets. These businesses, along with the utilities and power plant builders, have often voiced their concerns through the Keidanren, which was particularly outspoken in the debates over energy policy.⁶⁹

One other interest group meriting mention consisted of the local communities that have hosted nuclear facilities and have benefited from substantial financial subsidies over the years. Between 1990 and 2010, TEPCO alone donated some 40 billion yen to the communities near its three nuclear power plants on top of the tens of millions of dollars they had already received from the central government. As a result of such largesse, town budgets and employment became highly dependent on the continuing presence and operation of nuclear power plants.⁷⁰

Anti-Nuclear Arguments

Arrayed on the other side of the nuclear issue were those who opposed the restart of any reactors or argued that Japan should phase out nuclear energy within a reasonable amount of time. These elements of Japanese society also marshaled powerful arguments in support of their positions.

Perhaps foremost among these was concern about the safety of the existing nuclear facilities. The tragedy at Fukushima Daiichi had powerfully demonstrated how dangerous they could be. Yet even the new, more stringent safety guidelines issued by the NRA were criticized for placing too much emphasis on hardware fixes, at the expense of worker training and crisis management skills, and no amount of safety regulation could fully ensure against a recurrence of regulatory capture or a return of the culture of complacency that had previously reigned in the so-called “nuclear village,” which brought together pro-nuclear politicians, bureaucrats, and industry representatives as well as some elements of the media and academics. As a result,

oversight was lax, enforcement was perfunctory, and regulators often turned a blind eye to lapses.⁷¹ Nor could new rules and procedures compensate for the fact that the geology of Japan was inherently unstable.

Close behind, and somewhat related, was the concern that Japan still lacked a long-term solution for the disposal of nuclear waste. Nor did a solution seem likely, for the same geological reasons that the nuclear reactors were inherently unsafe. To restart the reactors would only compound the problem by generating yet more nuclear waste.

The arguments on this side were not limited, however, to the dangers and disadvantages of nuclear power. Some argued that the economic and environmental costs of the nuclear shutdown had been exaggerated. The rise in fuel costs, for example, had more to do with world prices. In fact, total natural gas consumption had increased by only 20 percent, while that of oil and coal remained nearly flat. As for carbon emissions, by 2014 they had nearly returned to their pre-Fukushima levels.⁷² Others pointed to the fact that Japan had already weathered periods of peak demand while obtaining little electricity from nuclear power plants to make the case that nuclear power was in fact unnecessary to meet Japan's energy needs. Thanks to various energy saving measures, overall national electricity consumption was down approximately five percent, and the most affected areas achieved reductions on the order of 15 percent during peak demand periods. And yet others emphasized the feasibility of quickly ramping up alternative sources of electricity and the broader economic and environmental benefits to be had by investing in renewable energy. As noted above, by April 2014, the government had certified some 65 GW of new solar capacity under the FIT, although the actual deployment of solar PV was proceeding much more slowly.

These arguments were generally reflected in public opinion polls, which consistently

showed majorities or pluralities in favor of phasing out nuclear power. Surveys conducted during the national discussion of the EEC's three scenarios found 30-40 percent wanting Japan to be nuclear-free and another 30-40 percent supporting the 15 percent scenario. A February 2013 poll following the LDP electoral victory indicated that 59 percent wanted Japan to abandon nuclear power by 2040. A May 2013 sounding yielded a similar percentage opposing reactor restarts. Polls in early 2014 found about two-thirds of respondent against restarts and nearly 80 percent favoring an eventual exit from nuclear power. And a November 2014 survey conducted after the NRA's clearance of the Sendai reactors likewise showed twice as many participants opposing as supporting restarts.⁷³ Particularly strongly opposed were the residents of regions that were likely suffer the consequences of a future nuclear accident because of their proximity to power plants but that did not receive the generous subsidies reserved for the actual host communities.⁷⁴

At the same time, more and more companies were benefiting from the expansion of renewables. Perhaps not surprisingly, leaders of new industries, such as Masayoshi Son, the CEO of the telecommunications giant Softbank, and Hiroshi Mikitani, the president of Japan's leading online retailer, became the most outspoken proponents of a shift from nuclear to renewable sources of power. But even some of the major nuclear vendors were positioning themselves to take advantage of the business opportunities afforded by the new market.

In closing, it is worth reiterating that these fault lines ran through even the relatively pro-nuclear post-2012 government. Already noted was former prime minister Koizumi's prominent plea against restarting reactors, but he was not the only LDP member to hold that view. And the LDP was further constrained by its coalition partner, the New Komeito party, whose 2012 election manifesto had called for "optimizing the phase-out of nuclear power and transition to

renewable energy sources.”⁷⁵

Conclusion

Following the catastrophic accident at Fukushima Daiichi, the Japanese government took a number of steps to compensate for the sudden loss of so much nuclear generating capacity. It promoted conservation measures to reduce electricity demand, especially during peak summer periods. It encouraged the deployment of alternative generating capacity, introducing a new feed-in tariff to promote renewable sources of power. It developed and began to implement a comprehensive program for reforming the electric power system. And it revamped the nuclear regulatory system in an attempt to ensure that nothing like the events of March 2011 would ever recur.

More than four years later, however, the future role of nuclear power in Japan’s energy mix remained uncertain. Even with the adoption of a new Strategic Energy Plan in April 2014, important questions had yet to be answered. The LDP-led coalition was able to affirm the importance of nuclear power as a base-load source of electricity and its support for restarting idled power plants once their safety had been assured by the NRA, but little more. The establishment of a long-term target for nuclear generated electricity more than a year later did little to clarify the situation. How many of the reactors would in fact be restarted? Of those that were, how many would have their operational lives extended beyond 40 years? And would new reactors be completed or built from scratch?

Strong forces stood on each side of the issue, resulting in policy paralysis. Given the intensity of the opposition, the strategy of the pro-nuclear interests seemed to be to put off long-term decisions, in the hopes that anti-nuclear sentiment would wane over time in the face of the

harsh realities of high electricity costs, possible power shortages, and elevated CO2 emissions from burning more fossil fuels to generate electricity.⁷⁶

But there was no guarantee that this strategy would succeed. The serious problems plaguing the cleanup of the Fukushima Daiichi power plant provided a continuing reminder of the potential pitfalls of reliance on nuclear energy, with seemingly no end in sight. And each year that went by without blackouts and the steadily rising contribution of renewable sources of power would serve to strengthen the anti-nuclear arguments.

Even the restart of existing reactors, if only to serve as a bridge to a new, greener energy future, was plagued by uncertainty. As noted above, the process of approving reactor restarts was subject to multiple veto points, ranging from the NRA to local communities, and even some of those reactors that could overcome these hurdles would not be cost-effective to operate, given the new safety requirements. Thus, although the first shuttered reactors finally began to come on line -- two in late 2015 with more expected in 2016 -- estimates for the total number that would eventually be in service varied widely, but generally fell below the government's expectation. A 2015 Reuters analysis, for example, concluded that nine reactors were unlikely to ever restart and that the fate of another 26 was uncertain. A Bloomberg study offered a range of 12 to 37 restarts, with a medium estimate of 26. And even in the most optimistic restart scenarios, the number of reactors in operation would soon begin to decline as more and more reached the end of their 40-year lifespans.⁷⁷ Whatever role nuclear power might play in the future, it would certainly be much more circumscribed than it had been in the past.

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Notes

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