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Japan's New Basic Energy Plan

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Abstract

In June 2010, the Japanese cabinet adopted a new Basic Energy Plan (BEP). This was the third such plan that the government has approved since the passage of the Basic Act on Energy Policy in 2002, and it represents the most significant statement of Japanese energy policy in more than four years, since the publication of the New National Energy Strategy (NNES) in 2006. Perhaps more than its predecessors, moreover, the new plan establishes a number of ambitious targets as well as more detailed measures for achieving those targets. Among the targets are a doubling of Japan's "energy independence ratio," a doubling of the percentage of electricity generated by renewable sources and nuclear power, and a 30 percent reduction in energy-related CO2 emissions, all by 2030. This paper explains the origins of the 2010 BEP and why it was adopted. It then describes the content of the plan and how it differs from the NNES. A third section analyzes the appropriateness of the new goals and targets contained in the BEP and their feasibility, finding that achievement of many of the targets was likely to be quite challenging even before the March 2011 earthquake, tsunami, and nuclear crisis.

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Keywords: Japan, energy policy

1. **Introduction**

In June 2010, the Japanese cabinet adopted a new Basic Energy Plan (BEP). This was the third such plan that the government has approved since the passage of the Basic Act on Energy Policy in 2002, and it represents the most significant statement of Japanese energy policy in more than four years, since the publication of the New National Energy Strategy (NNES) in 2006.[1] Perhaps more than its predecessors, moreover, the new plan establishes a number of ambitious targets as well as more detailed measures for achieving those targets. Among the targets are a doubling of Japan's "energy independence ratio," a doubling of the percentage of electricity generated by renewable sources and nuclear power, and a 30 percent reduction in energy-related CO2 emissions, all by 2030.

This paper explains the origins of the 2010 BEP and why it was adopted. It then describes the content of the plan and how it differs from the NNES. A third section analyzes the appropriateness of the new goals and targets contained in the BEP and their feasibility. It finds that achievement of many of the targets is likely to be quite challenging, all the more so in the aftermath of the March 2011 earthquake, tsunami, and crisis at the Fukushima Daiichi nuclear power plant.

2. **Background**

For most of the postwar era, Japan lacked an overarching energy plan or strategy. Beginning in 1967, the government published every two to five years a Long-Term Energy Supply and Demand Outlook (*Choki enerugii jukyu mitoshi*), which forecast such important indices as energy demand by sector, primary energy supply by fuel, and, in more recent years, energy-derived CO2 emissions based on different sets of assumptions about the policies likely to be in place (IEA

2003, 20; IEA 2008, 21). But the Outlook itself did not contain or determine policy. Instead, Japanese energy policy consisted of a patchwork of laws, regulations, and programs. Many of these measures were adopted in response to the oil shocks of the 1970s, while another round of measures was passed in the late 1990s and early 2000s, largely in response to growing concerns about climate change.

In 2002, however, the Japanese government created a more systematic and comprehensive energy policy planning structure. In June of that year, the Diet adopted a "Fundamental Law on Energy Policy Measures" (*Enerugii seisaku kihon ho*), also known as the Basic Act on Energy Policy (Law No. 71), which set "the general guiding direction for Japan's future energy policy" (IEA 2008, 29).

The origins of the Basic Act were unusual. In Japan, the vast majority of laws originate in the cabinet.[2] Typically, less than 15 percent of bills enacted into law are proposed by members of the Diet, Japan's bicameral legislative body.[3] The Basic Act on Energy Policy, however, resulted from a bill that was sponsored by a group of legislators. In this case, 54 members of the Diet, representing both houses and three different political parties, collaborated in drafting the original bill. Led by Tokio Kano, an upper house member affiliated with the then ruling Liberal Democratic Party and a former electric power company executive, the group first submitted the bill to the lower house, where deliberations took place from May 17 to 28, 2002.[4] After securing lower house passage, the bill was sent to the upper house on June 4, and, four days later, that body also approved what came to be known as Japan's "energy constitution" (*enerugii kenpo*). The Basic Act on Energy Policy was promptly adopted by the cabinet of then Prime Minister Junichiro Koizumi and became law on July 14, 2002.

The Basic Act begins with a short statement of purpose:

> Energy is essential to the maintenance and development of the national economy and enhancing the stability of peoples' lives. Moreover, inasmuch as energy has a major impact on the local and global environments, it is necessary to promote measures concerning supply and demand and to clarify the responsibilities of national and local governments. Establishing measures to ensure long-term, comprehensive, and planned policies for that supply and demand will contribute to the development of the national and world economies, while contributing to the preservation of the national and global environment (Basic Act on Energy Policy, 14 June 2002, Law No. 71; translation by the authors).

The Basic Act then establishes three general goals of energy policy: securing a stable supply of energy, ensuring environmental sustainability, and utilizing market mechanisms (see also IEA 2008, 29). The act also defines the roles and obligations of all the key actors and stakeholders: the central government, local governments, businesses, and the general public.

The Basic Act provides no specifics about energy policy, however. Instead, for that purpose, it requires the government to formulate a basic plan to promote energy supply and demand measures on a long-term, comprehensive, and systematic basis. The government is supposed to review the basic energy plan at least every three years and revise it as necessary in light of changing circumstances and the effectiveness of existing policies. The Ministry of Economy, Trade, and Industry (METI) was tasked with formulating the draft basic energy plan and then seeking cabinet approval before reporting it to the Diet.[5]

The first Basic Energy Plan (*Enerugi kihon keikaku* or BEP) was duly developed and adopted in October 2003. According to the International Energy Agency (IEA), its key points were

to promote nuclear power generation, to enhance efforts to secure a stable oil supply, and to lead the formulation of an effective international framework for enhancing energy conservation and coping with climate change (IEA 2008, 29). A revision of the BEP was prepared in late 2006 and adopted by the cabinet in early 2007, but it was based on and largely overshadowed by another energy policy statement, the New National Energy Strategy (*Shin-kokka enerugii senryaku* or NNES), which was issued by METI in May 2006 (IEA 2008, 59).

In contrast to the BEP, the NNES did not receive broader government approval, but it figured prominently in subsequent energy policy discussions. The NNES was developed in response to renewed concerns about Japan's energy security due, in particular, to rising oil prices, a revival of resource nationalism among foreign energy suppliers, and growing regional competition and conflict over energy resources (ESSG 2006; Christoffels 2007). Thus, in contrast to the Basic Act, the NNES placed primary emphasis on and sought to bring greater attention to the issue of energy security. To promote Japan's energy security, the NNES established ambitious numerical targets to be attained by 2030 (see below), and it went on to elaborate eight specific programs across a wide range of actions for implementing the strategy (METI 2006a, 14).

During the following years, however, more of a balance was restored in Japanese energy policy. Concerns about security of supply abated somewhat, despite a continued rise in oil prices, while concerns about environmental sustainability, especially climate change, returned to the fore. In May 2007, then Prime Minister Shinzo Abe announced an initiative, "Cool Earth 50," to reduce greenhouse gas emissions in Japan and globally in the short-, medium-, and long-term.[6] In July 2008, the cabinet adopted a detailed "Action Plan for Achieving a Low-carbon Society."[7] And shortly after taking power in September 2009, the new government led by the Democratic Party of

Japan announced an ambitious goal of reducing greenhouse gas emissions by 25 percent below the 1990 level by 2020 and then prepared a detailed bill on "Global Warming Countermeasures" that it submitted to the Diet the following March.[8]

At the same time, government officials began to fret about the international competitiveness of the Japanese energy industry. For example, Japan's solar cell industry, which had been the largest in the world, was surpassed in 2008 by those of Germany and China.[9] Then, in late 2009, a Japanese nuclear power plant manufacturer was outbid for a contract to build four nuclear reactors in the UAE by a Korean-consortium that had never held an international contract.[10]

3. **The New Basic Energy Plan**

This was the context in which the new Basic Energy Plan was developed in 2010.[11] Under the terms of the Basic Act, the revised Basic Energy Plan adopted in 2007 was scheduled for review. Accordingly, METI began developing a revision of the BEP in February 2010 and presented a draft outline to the Basic Energy Planning Committee, a subcommittee of METI's Advisory Committee for Natural Resources and Energy (ACNRE), on March 24. At the same time, METI posted the draft outline on its website and solicited public comments.[12] On April 19, METI proposed a draft of the revised BEP at the Basic Energy Planning Committee (IEEJ 2010a, 1). A final round of deliberations was held in the subcommittee on June 8, and after minor changes, the final, 66-page plan was approved by the cabinet of then Prime Minister Yukio Hatoyama and released to the public on June 18 (IEEJ 2010b, 7).[13]

3.1. **Overall Goals and Targets for 2030**

The BEP lays out seven general goals (or what it calls "basic viewpoints") of Japanese energy policy:

- Enhancing overall energy security;
- Strengthening policy to counter global warming;
- Achieving economic growth, with energy as a core driver;
- Ensuring the safety of the energy supply;
- Ensuring the efficient functioning of energy markets;
- Restructuring the energy industry; and
- Gaining public understanding.

To achieve these goals, the BEP establishes five ambitious targets for 2030. The first target is to double Japan's "energy self-sufficiency ratio" (currently 18 percent) to about 40 percent and its "self-developed fossil fuel supply ratio" (currently 26 percent) to about 50 percent, and, as a result, to raise its "energy independence ratio" (currently 38 percent) to about 70 percent. The latter figure is currently the average among the members of the Organization for Economic Cooperation and Development (OECD).

The energy self-sufficiency (ESF) ratio is the percentage of Japan's primary energy supply that is produced domestically and consists primarily of renewable energy sources and nuclear power, since Japan produces only very small amounts of coal, natural gas, crude oil, and liquified petroleum gases (LPG). The self-developed fossil fuel supply (SFFS) ratio is the percentage of imported coal, natural gas, oil, and LPG that is produced by Japanese companies. The energy independence (EI) ratio is the percentage of Japan's primary energy supply that consists of either

energy produced domestically or imported fossil fuels that are produced by Japanese companies. It can be calculated approximately as follows:

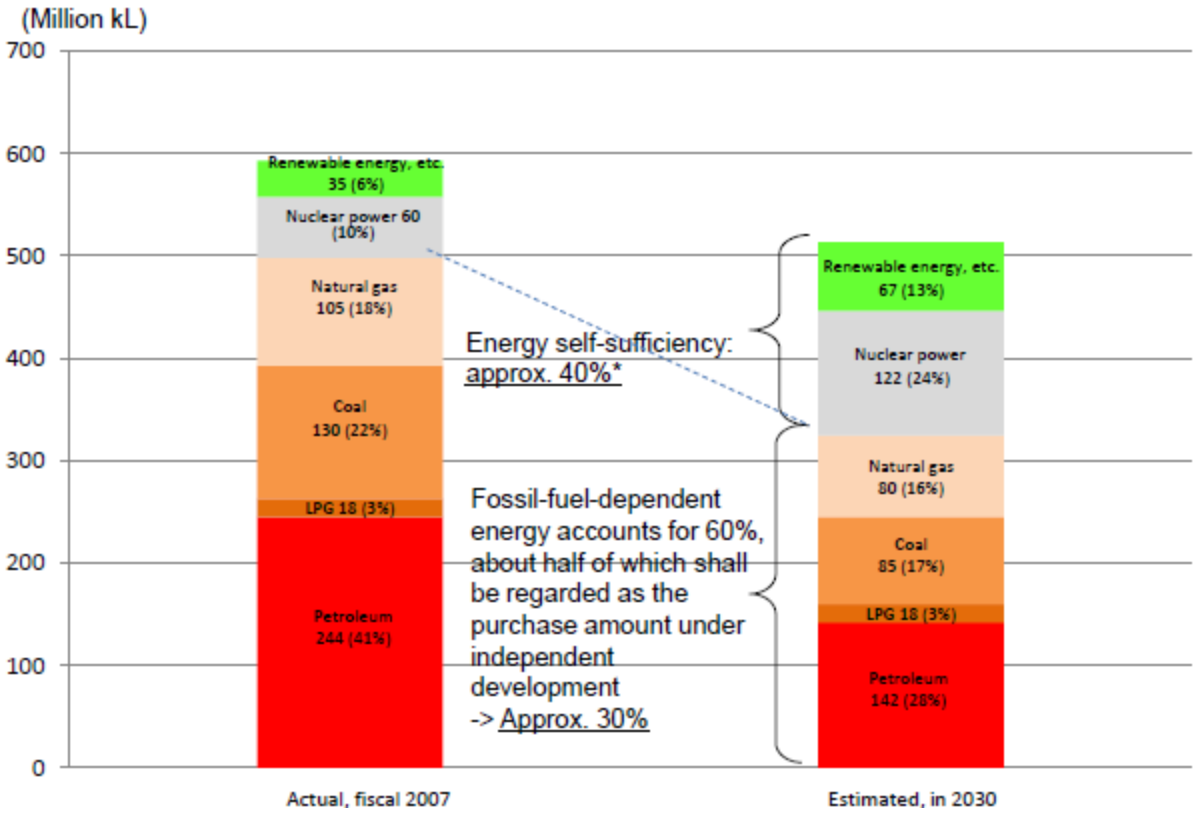
$$EI = ESF + SFFS * (100\% - ESF)$$

To achieve this target, Japan would bring about a substantial change in its energy mix. The shares attributable to renewable energy sources and nuclear power would more than double. Renewables would increase from six percent (in 2007) to 13 percent while nuclear power would increase from 10 percent to 24 percent. Meanwhile, the shares of most fossil fuels would decrease. Natural gas would decline from 18 to 16 percent, coal from 22 to 17 percent, and petroleum from 41 to 28 percent. Only LPG's small share of three percent would remain constant.

In absolute terms, Japan's primary energy supply would decline by 13 percent, from 592 million kiloliters (mkL) of oil equivalent to 514 mkL. The amount of natural gas, coal, and petroleum consumed would decline by 24 percent, 35 percent, and 42 percent, respectively. In contrast, consumption of renewable and nuclear energy would increase by 91 percent and 103 percent, respectively.

Figure 1

Balance of Primary Energy Supply (in millions of kiloliters of oil equivalent)



Source: METI 2010

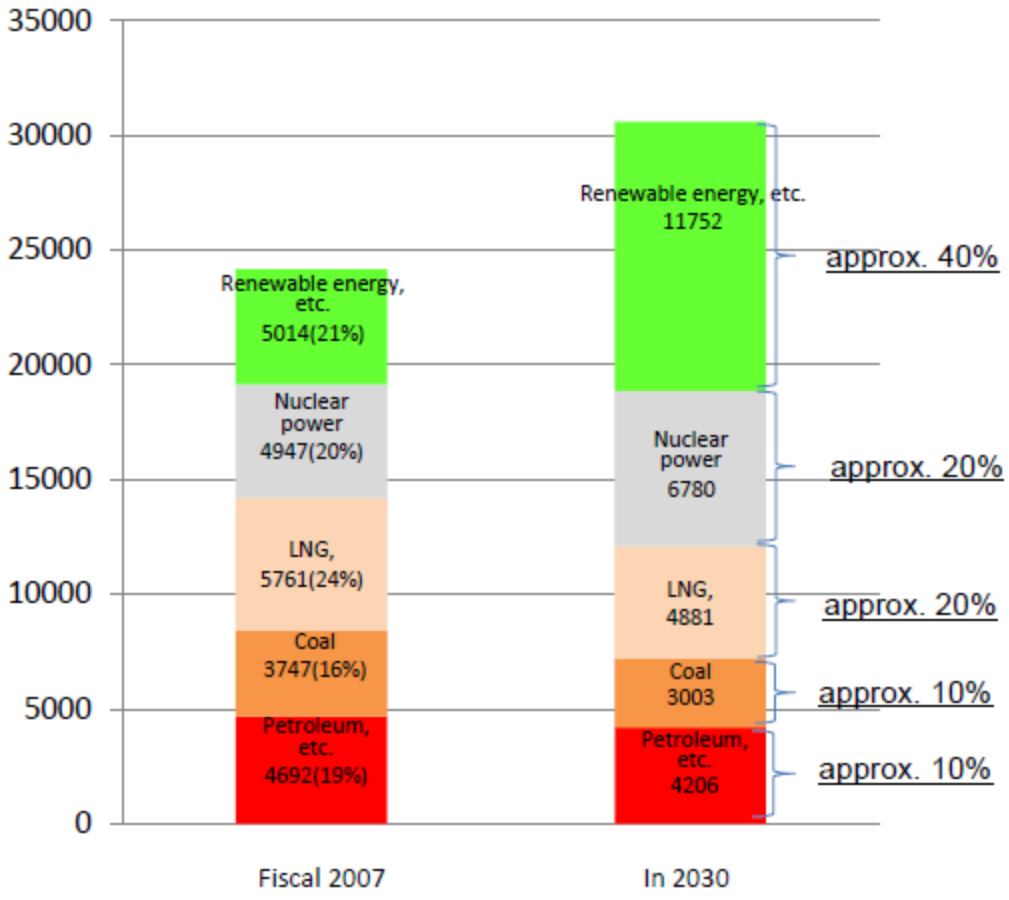
The second and related target is to raise the "zero-emission power supply ratio" from the current 34 percent to 70 percent. The zero-emission power supply ratio concerns the percentage of electric power that is generated by sources that produce little or no CO2. To achieve this goal, Japan will have to increase substantially the amount of electricity provided by nuclear power and renewable sources, especially "new" sources such as wind, solar, and biomass, because the

country's hydroelectric potential has already been largely exploited (IEA 2008, 122). According to the BEP, the shares attributable to renewable and nuclear power will more than double. For renewables, this will mean going from eight percent to 19 percent of electricity generated. For nuclear, from 26 percent to more than 50 percent.

In turn, Japan will have to increase substantially its renewable energy and nuclear power generating capacity. Installed renewable energy capacity would have to rise from 50 gigawatts (GW) to 117.5 GW, an increase of more than 130 percent, and most of this increase would have to come from new sources other than hydropower, which has traditionally been the largest source of renewable electricity and currently provides most of the renewable generating capacity (IEA 2008, 150; EDMC 2010, 187 and 207). Installed nuclear capacity would have to increase from 49.5 GW to 67.8 GW. This increase would be achieved by building 9 more nuclear power plants by 2020 and more than 14 by 2030. In addition, Japan would increase the overall operating capacity of the nuclear sector, which has been as low as 60 percent in recent years, to about 85 percent by 2020 and about 90 percent by 2030.

Figure 2

Electric Power Generation Capacity (in units of 10 Megawatts)



Source: METI 2010

The remaining three targets can be stated much more briefly. One is to halve the CO2 emissions of the residential sector. Another is to maintain and enhance the energy efficiency of the industrial sector. The final target is to maintain or obtain "top-class" shares of global markets for energy-related products and systems.

If these targets are reached, Japan would achieve a significant 30 percent reduction in its

domestic energy-related CO2 emissions, in comparison with 1990s levels, the baseline for the Kyoto Protocol. Since energy-related CO2 emissions actually grew by 15 percent between 1990s and 2007, such a cut would represent a 40 percent decline over 2007 levels. It would also account for approximately half of the reductions to be achieved by 2050, or 80 percent below the 1990 level.[14]

3.2. **Specific Energy Policy Measures**

The bulk of the BEP identifies and proposes a number of specific measures for achieving these targets. The majority (about two-thirds) of the measures fall into three broad categories. The first concerns measures to secure energy resources and to enhance the stability of supply. These include

- strengthening bilateral relations with resource-rich countries through high-level resource diplomacy;
- increasing financial support (so-called "risk money") for Japanese companies seeking to acquire upstream energy concessions; and
- enhancing the development of non-traditional domestic and overseas energy resources.

The second category consists of measures to create an independent and environmentally-friendly energy supply structure. This category includes measures to expand the introduction of renewable energy sources, to promote nuclear power generation, and to achieve advanced utilization of fossil fuels, especially coal.

To increase the use of renewable energy, the government would expand the recently introduced feed-in tariff system, which currently applies only to small-scale electricity generation

by photovoltaic (PV) cells, to include wind, geothermal, biomass, and small- to medium-scale hydroelectric plants. The government would increase its support for the introduction of new renewable technologies, through such means as tax reductions, subsidies, and support for research and development. And it would take steps to deregulate the domestic energy market and prepare the power grid for intermittent sources of supply. Other measures that were considered by METI include introducing sustainability standards for biofuels and expanding the introduction of renewable thermal energy.[15]

To promote nuclear power generation, the government would seek to extend the time between routine power plant inspections and to shorten shutdowns during inspections.[16] It would improve the "power source location" subsidy system, which it uses to gain acceptance by local authorities and communities for nuclear power facilities. And it would take steps toward the establishment of the complete nuclear fuel cycle, including the development of "pluthermal" light-water reactors, which can use plutonium fuel, and fast breeder reactors.

Regarding the final set of supply-related measures, the BEP recognizes that Japan will still have to rely to a substantial extent on coal, which produces the most CO2 per unit of energy. But the government would take several steps to reduce CO2 emissions from coal. It would promote the commercialization of new, more efficient coal burning technologies, such as integrated gasification combined cycle (IGCC), and require that all new coal plants achieve emissions levels comparable to IGCC. It would also accelerate the development and commercialization of technology for carbon capture and storage (CCS) technologies and require that new coal plants be CCS-ready and then be equipped with CCS technology as soon as it became available.

The third category consists of measures for "realizing a low carbon energy demand

structure." These are divided into the traditional energy-consuming sectors – industrial, transportation, residential, and commercial – as well as cross-sectoral efforts.

To reduce carbon emissions in the industrial sector, the government would promote the substitution of natural gas for coal and petroleum. It would enforce more stringently the Energy Conservation Law (*Sho enerugii ho*). And, although Japanese industry already leads the world in energy efficiency, the government would promote the maximum introduction of state of the art technologies for increasing energy efficiency yet further (see also IEEJ 2010a, 3). Assuming no increase in steel production, which is a major source of Japanese CO2 emissions, the BEP anticipates that the industrial sector could achieve a 25 percent reduction in CO2 emissions by 2030.

To reduce CO2 emissions in the transportation sector, the government would mobilize all possible policy measures to increase the share of new vehicles sales held by next-generation low emission vehicles, such as hybrids, electric vehicles, and vehicles that run on fuel cells, from the current 10 percent to up to 50 percent by 2020 and up to 70 percent by 2030. It would seek to expand the use of biofuels to around three percent of gasoline consumption by 2020 and higher thereafter (IEEJ 2010a, 2). And it would seek to increase the share of mid- and long-distance transportation held by rail and coastal shipping from the current 55 percent to 80 percent by 2030 (IEEJ 2010a, 3). Assuming no increase in the number of miles driven, the BEP estimates that the transportation sector could achieve a 38 percent reduction in CO2 emissions by 2030.

The greatest potential for reductions in CO2 emissions on a percentage basis, however, lies in the residential and commercial sectors, which saw large increases in emissions of 42 percent and 48 percent, respectively, between 1990 and 2007 (METI 2010; see also EMDC 2010, 47). To

reduce CO2 emissions in these sectors, the government would promote the development of net-zero-energy houses and buildings by 2020 and make them the norm for new construction by 2030. It would set compulsory energy-savings standards. It would promote the widespread use of highly efficient water heaters (80 to 90 percent of all houses by 2030) and the replacement of all lights with high-efficiency lighting. And it would enhance financial support and regulatory measures to diffuse energy-saving equipment and products. Assuming only modest increases in the number of households and commercial floor space, the BEP calculates that the residential and commercial sectors could achieve reductions in CO2 emissions by 2030 of 52 percent and 57 percent, respectively.

Other specific measures contained in the BEP concern building next-generation energy and social systems, expanding the use of innovative energy technologies, promoting international energy and environmental cooperation, reforming the structure of the energy industry, and promoting public understanding and human resource training. They include achieving the smart grid and smart communities, promoting the development and installation of smart meters and other energy management systems, diffusing fuel cells and developing a hydrogen supply infrastructure, and accelerating the development and dissemination of innovative energy technologies.

4. **Analysis**

The adoption of a new BEP raises at least several questions. How has Japanese energy policy changed? How appropriate are the new targets? What challenges do they face, and how likely is it that the new targets will be realized?

4.1. **Changes in the Goals and Targets of Japanese Energy Policy**

In terms of the basic goals it establishes, the new BEP offers considerable continuity with previous statements of Japanese energy policy. It maintains the traditional goals, the so-called "3 E's": energy security, environmental sustainability, and economic efficiency. In addition, it reiterates two other goals that have been associated with Japan's controversial nuclear power program: safety and public understanding.

In several other important respects, however, the BEP represents a departure from past policy. It includes for the first time two other goals. One is the use of energy policy to promote more general economic growth. The other is the need to restructure the energy industry. In addition, the BEP places much more emphasis on fighting climate change than did the NNES, which was primarily concerned with energy security. Indeed, if one is to judge the BEP by the summary published on the METI website, one might easily reach the conclusion that the most important objective of Japanese policy is to reduce energy-related carbon emissions. It is likely that this apparent obsession is in response to former prime minister Hatoyama's 2009 pledge to reduce Japan's greenhouse gas emissions substantially by 2020.

The BEP also offers significant changes in the key targets of Japanese energy policy. Like the BEP, the 2006 NNES had established five specific, numerical targets (METI 2006a, 14):

- a further 30 percent improvement in energy efficiency (over 2003);
- a reduction in Japan's oil dependence from nearly 50 percent to less than 40 percent of the total energy mix;
- a reduction in the oil dependence of the transportation sector from nearly 100 percent to around 80 percent;

- a preservation or increase in nuclear power's share of electricity generation to 30 to 40 percent or more; and
- an increase in the amount of oil produced by Japanese energy companies from 15 percent to around 40 percent of total oil consumption.

One can readily detect a number of differences between the NNES and the BEP in this regard, however. One is a shift in emphasis from improving energy efficiency, which was the first target of the NNES, to reducing energy-related carbon emissions. Obviously, these two goals are related, but they are not identical. Related to this change is increased emphasis on the residential sector, reflecting the fact that CO2 emissions in the residential and commercial sectors have grown by nearly 50 percent since 1990 while those from transportation and industry have declined over the past decade.

A second difference is a shift in the conceptualization of energy security and independence. The NNES was focused primarily on oil, which figured in three of the five targets. In contrast, the 2010 BEP employs broader measures: an overall measure of energy-self sufficiency and a comprehensive measure of the share of all fossil fuels that are supplied by Japanese companies. It also offers a new measure of overall energy independence that combines the two other ratios.

Third, the BEP contains much more ambitious and detailed targets for nuclear power. The new target represents an increase in the share of nuclear generated electricity of at least 10-20 percent over that contained in the NNES. In addition, and in contrast to the NNES and its associated "Nuclear Energy National Plan" (METI 2006b), the BEP contains very specific figures for the number of new nuclear power plants to be built and the level of capacity utilization to be attained.

Fourth, the BEP likewise contains more ambitious and detailed targets for renewable sources of energy. In fact, the NNES contained no specific targets for renewable energy. Because of growing concerns about climate change, the government had subsequently (by 2009) established a goal of increasing the share of renewable energy in the primary energy supply from six percent (2005) to 9.0 percent in 2020 and 11.6 percent in 2030.[17] But the BEP raises these targets even higher, to 13 percent. According to one government estimate, a comprehensive feed-in tariff could increase electricity production from new sources by 40 to 50 billion kilowatt hours (kWh) or more (roughly four to five percent of Japan's current output) in 10 years.[18] But as of early 2011, the comprehensive feed-in tariff had not yet been introduced (IEEJ 2011), and presumably additional measures would still be required if the targets contained in the BEP are to be achieved.

Finally, the BEP contains a completely new type of target - concerning the global market shares of Japanese energy companies - that reflects the new emphasis on economic growth and industry restructuring contained in the plan.

4.2. **Appropriateness: Are These the Right Goals and Targets?**

One question that can be immediately raised about some of the goals and targets contained in the BEP concerns their suitability. Two in particular merit scrutiny. One is the reconceptualization of energy security and independence. In particular, the introduction of the concept of the self-developed fossil fuel supply may obscure important differences in the markets for oil, natural gas, and coal and Japan's corresponding vulnerabilities. Until now, Japan's principal concern has been with access to oil, and the government has been trying to raise the level of so-called "equity oil" (oil produced by Japanese companies) since the 1970s, although without

much success. In 2003, the percentage of oil imports provided by Japanese companies stood at 10.8 percent, just one percentage point higher than the corresponding figure for 1970 (Koike et al. 2008, 1767).

The new measure suggests, intentionally or not, that coal, natural gas, and oil are ready substitutes. This may be true to an important extent in the generation of electric power, where the share accounted for by oil has dropped from around 75 percent in 1973 to about 12 percent in 2007 (EDMC 2010, 188). But it is less true of industry, where the share of energy provided by oil declined from 61 to 43 percent over the same period (EDMC 2010, 66). And it is not at all true of transportation, which remained entirely dependent on oil in 2007. Not only that, but industry and transportation together account for more than 80 percent of oil consumption, not including the relatively small amount used to generate electricity (EDMC 2010, 166).

Traditionally, moreover, Japan has worried most about the security of its foreign oil supplies. To be sure, its imports of natural gas have not been immune to disruption; in 2001, an important LNG plant in Indonesia, which provided about 30 percent of Japan's LNG imports at the time, was closed for seven months because of political unrest (IEA 2002, 78). But nearly 90 percent of Japan's oil comes from the Middle East and must pass through vulnerable choke points (EMDC 2010, 154; interview with METI officials, Tokyo, May 26, 2010). Japan's particular vulnerability to disruptions in foreign oil supplies will be less of an issue as its overall oil consumption and the oil dependence of the transportation sector decline, but it will not go away completely.

Another issue concerns the focus on improving energy efficiency in the industrial sector. There may be significant efficiency gains to be made, but the industrial sector may not be the best

place to look for them. To be sure, industry remains the largest energy consumer, at 46 percent in 2008 (EDMC 2010, 38). But it has also been the principal target of government efforts to increase energy efficiency since the 1970s -- approximately 90 percent of the energy consumption in the sector has long been covered by the Energy Conservation Law and, partly as a result, the share of energy consumption attributable to the industrial sector has steadily declined, from nearly two-thirds in 1973 (EMDC 2010, 38; ECCJ 2009, 3).[19] Thus most of the easy savings in industry have already been exploited (see also Niquet 2007, 8).

4.3. **Feasibility**

The other question that might be raised concerns the feasibility of the new BEP. What are the prospects for achieving the ambitious targets it sets forth? This question is necessarily more difficult to answer with any certainty. Much can change over the next 20 years, and the BEP is likely to be revised multiple times accordingly. In addition, the achievement of several of the targets will be sensitive to progress in attaining other targets. At a minimum, however, one can say that attainment of the targets is likely to be challenging, especially given the deep-seated doubts concerning the future of Japan's reliance on nuclear power brought to the fore by the March 2011 earthquake and tsunami that severely damaged the Fukushima Daiichi nuclear power plant and released radioactive elements into the environment.

Let us start with the issue of achieving a much higher level of energy independence, as defined by the "energy independence ratio." Much will depend on how rapidly Japan is able to raise the production of electricity (and heat) from renewable sources and nuclear power and reduce the overall level of energy consumption. The lower the level of energy consumption and the higher

the level of domestic energy production, the less fossil fuel Japan will have to import and the easier it will be to raise the self-developed fossil fuel supply (SFFS) ratio.

According to the figures supplied by METI, Japan consumed 497 mkL of oil equivalent in fossil fuels in 2007, while Japanese companies produced the equivalent of 26 percent of that amount, or 129 mkL of oil equivalent. METI projects that Japanese fossil fuel consumption will decline to 325 mkL in 2030. In that case, Japanese companies would have to produce 162 mkL to achieve the target of a 50 percent SFFS ratio, or an increase of just 33 mkL (25 percent) over the 2007 level. That may be a feasible figure, although, as noted above, Japanese oil companies have not been very successful in increasing the amount of oil they produce over the years. And, needless to say, if the reduction in fossil fuel consumption falls short of that projection, the challenge for Japanese companies will be that much greater.

A second issue concerns the feasibility of substantially reducing energy-related CO2 emissions. There certainly would seem to be considerable potential for doing so, especially in the residential and commercial sectors, which have seen significant increases in emissions since 1990 despite the overall stagnation of the Japanese economy. But the achievement of this goal, too, will depend on how quickly ever greater levels of renewable and nuclear energy can be introduced (more on this below). And the recent history of independent efforts to reduce greenhouse gas emissions affords few grounds for optimism. The new Democratic Party of Japan (DPJ)-led government made fighting climate change a high priority and soon after taking office in the fall of 2009 announced an ambitious goal of reducing greenhouse gas emissions by 25 percent by 2020. The legislation that it introduced the following March on "global warming countermeasures," however, faced strong opposition from the business community and remained unfinished in July

2010, when the DPJ suffered losses in the upper house elections, putting the ultimate fate of the legislation in doubt (IEEJ 2010b, 8).[20]

Closely related is the goal of making improvements in energy efficiency, especially in the industrial sector. Here the difficulty lies in the fact that Japan's overall energy efficiency, as defined by the ratio of primary energy consumption (PEC) over GDP, is already the world's lowest, and is even significantly lower – by approximately 50 percent -- than that of the EU or the United States (Masaki 2006).[21] Yet most of the drop in Japan's energy intensity occurred by the mid-1980s. In fact, between 1990 and 2005, it declined by less than three percent (EDMC 2010, 32). Thus it appears that many of the easiest gains have already been made, and the particular challenges of increasing energy efficiency in the industrial sector have been noted above.

Turning now to the supply side, the central issue, which has been raised already, is the potential to expand the amount of energy provided by renewable sources and nuclear power. On the positive side, the amount of renewables has grown rapidly over the past decade. Between 1998 and 2008, installed generating capacity of wind and solar grew from 170 megawatts (MW) to 4.0 GW (EMDC 2010, 207). In late 2009, the government established a buy back program for surplus electricity generated by PV installed at residences and other entities, with a target of increasing the amount of installed PV capacity more than 20-fold (from 2.1 GW in 2008 to 28 GW) by 2020.[22] According to one government estimate, moreover, a comprehensive feed-in tariff covering all small sources could increase electricity production from new sources by 40 to 50 billion kWh or more (roughly four to five percent of Japan's current output) in 10 years, or approximately half of the increase desired by 2030.[23]

On the other hand, the challenges that would be posed by widespread reliance on new

sources still must be overcome. Because Japan's hydroelectric potential is already largely exploited, virtually all of the additional renewable generating capacity called for in the BEP, some 67 GW, would have to come from other sources. And concerns remain about the ability of the electricity grid to handle more than a certain amount of electricity from intermittent sources, such as solar and wind (interview with non-governmental experts, Tokyo, June 4, 2010). For example, the existing power system could accommodate enough photovoltaic generating capacity to provide only about six to eight percent of the electricity supply (interview with academic expert, Tokyo, May 31, 2010; interview with non-governmental experts, Tokyo, June 4, 2010). Thus greater penetration by renewables may depend on the development of cost-effective, large-scale electric storage capacity (interview with METI official Tokyo, May 27, 2010). In addition, the most productive sites for wind power tend to be located far from where the electricity is needed, necessitating the construction of new power lines often in the face of local resistance (interview with academic expert, Tokyo, May 31, 2010). Finally, given the intermittent nature of many renewables, the amount of capacity that must be built to produce every kWh of electricity will be several times greater than for other sources, greatly reducing their cost-effectiveness.[24] Thus, according to one estimate, even 100 GW of installed photovoltaic capacity, or the equivalent of nearly 40 percent of the current power generating capacity, would meet just 12 percent of Japan's electricity demand (interview with academic expert, Tokyo, May 31, 2010). And a recent METI electricity supply plan projects that total power generation by hydroelectric and "new-energy" plants in 2019 will be just 29 percent higher than the 2007 level, well short of the 142 percent increase called for in the BEP.[25]

A different set of problems is likely to limit the potential for the introduction of biofuels,

even at the modest target of three percent of the gasoline supply. In recent years, concern about the environmental sustainability of biofuels production has grown (e.g., EPA 2009). If the goal is to reduce CO2 emissions by 50 percent in comparison with gasoline, then that leaves few potential sources of supply, given current technologies. According to one government estimate, the domestic supply of biofuels could be increased to only 400,000 kiloliter crude oil equivalent (COE, or about 0.343 MTOE) (IEEJ 2010a, 7), which would amount to less than 0.5 percent of current domestic demand. At the same time, the potential for expanding environmentally sustainable imports from Brazil, the world's largest biofuels exporter, is limited to about 200,000 kiloliter COE (about 0.172 MTOE) (IEEJ 2010a, 7).

For all these reasons, METI predicted in 2009 that the share of the primary energy supply provided by renewables in 2030 would reach only 11.6 percent, less than the 13 percent called for in the BEP, even with "maximum introduction of technology."[26] And as challenging as achieving the targets for renewable energy may be, even more controversy is likely to attend the targets for nuclear power. Here, two distinct issues are involved: increasing the amount of electricity generating capacity, chiefly by building more power plants, and raising the capacity utilization (utility factor) of the nuclear power plants. In both cases, at least the short- to medium-term outlook is not encouraging. Indeed, one nuclear industry expert admitted in an interview, "no one thinks they will be achievable" (interview with non-governmental experts, Tokyo, May 25, 2010].

As noted above, the BEP calls for the construction of at least 14 more nuclear reactors by 2030, with a combined capacity of 18 GW, assuming none of the 54 existing reactors is decommissioned in the meantime. The construction of new reactors has slowed greatly in the last decade, however, because of safety concerns and local opposition, and the crisis caused by the

March 2011 earthquake and tsunami at the Fukushima Daiichi nuclear power plant, which will result in the loss of at least four reactors with a combined generating capacity of 2.8 GW, is likely to greatly compound those concerns. A major reason behind the waning enthusiasm for new nuclear power plant construction derives from the anxieties generated by a series of mishaps (IEA 2003, 105-106). Until the crisis at the Fukushima Daiichi plant, the most notorious of these were a 1981 incident in which nearly 300 workers were exposed to dangerous levels of radiation after a fuel rod ruptured at the Tsuruga nuclear power plant and the death of five workers in 2004 as a result of a steam explosion at the Mihama-3 station. A subsequent investigation into the causes of the Mihama incident revealed serious deficiencies in the inspection procedures for nuclear facilities that led to a through reconsideration of policy (Buckley 2006). The anxiety generated by these mishaps is magnified by the citizenry's "nuclear allergy" as a result of the atomic bombing of Hiroshima and Nagasaki (Berger 1998), and the fact that earthquakes frequently rattle the Japanese archipelago. Actual and potential public opposition to new nuclear power plants, which could result in long delays in the licensing process, has in turn made the utilities reluctant to invest heavily in them, given the high costs of construction (interview with non-governmental experts, Tokyo, May 25, 2010; interview with academic expert, Tokyo, May 31, 2010). The 2006 NNES effectively called for an increase in the number of nuclear facilities, yet as of early 2010, only one reactor had been completed since the NNES was issued, and all of the reactors planned in 2006 were as many as three to five years further behind schedule.[27] Thus, the Japan Atomic Energy Commission concluded in 2009, "No considerable growth is expected for the present regarding activities to construct new or additional plants in Japan" (JAEC 2009, 21).

Increasing capacity utilization is not likely to be much easier. From the mid-1990s to the

early 2000s, nuclear capacity utilization in Japan hovered around 80 percent, and during the past five years, it has been consistently below 70 percent and fallen as low as 58 percent. In contrast, the nuclear utility factor in the United States, South Korea, and Finland has fluctuated between 90 and 95 percent in recent years (Nagatomi et al. 2010). The reasons for the relatively low utility factor in Japan include shorter operational cycles between routine inspections and maintenance, longer outage times for maintenance and repairs, and extensive unplanned outages due to accidents, including a 2007 earthquake that shut down seven reactors, and other safety concerns (interview with non-governmental experts, Tokyo, IEEJ, May 25, 2010). The higher utility factors in other countries suggest there is considerable potential for raising Japan's by following similar practices. But the potential for earthquakes affecting nuclear sites remains relatively high in Japan, as illustrated most dramatically by the March 2011 temblor and tsunami that caused the reactor cooling systems to malfunction at the Fukushima Daiichi nuclear power plant, and local governments continue to have a say in the length of the operational cycle as well as when plants can resume operation after planned and, especially, unplanned outages (interview with non-governmental experts, Tokyo, May 25, 2010; interview with academic expert, Tokyo, May 31, 2010).

Finally, we must consider the general level of support likely to be had by the BEP. To be implemented, it will require the cooperation of industry and the general public. Here, too, however, there are grounds for concern, which were raised in the discussions of the METI energy advisory committee prior to the BEP's adoption. At least one member expressed the view that since the government is planning to tighten regulations to a substantial extent, it is questionable whether industry would agree to go along with the plan (IEEJ 2010b, 7). And another committee

member reportedly commented that consumers may not be able to afford many of the innovations required to achieve the targets of the plan, such as zero-emission houses, high efficiency water heaters, and next-generation automobiles (IEEJ 2010a, 4).

Such reservations, especially those of industry, are likely to carry considerable weight. Traditionally, energy policy has been the purview of METI, which has close ties to the business community. Among METI's chief private-sector allies are the ten regional utility monopolies (e.g., Tokyo Electric Power Company and Nippon Keidanren, the umbrella organization for major corporations and nation-wide industrial federations. It is common for METI bureaucrats – as well as other government officials – to retire from the government service and "descend from heaven" (*amakudari*) into "second careers" with private- or quasi-governmental companies. Policy proposals typically originate in "deliberative councils" (*shingikai*) organized under a particular ministry with members drawn from the private sector, think tanks, academia, and the mass media. Not surprisingly, it is rare that a council proposes policies that are not supported by the parent ministry.

In more recent years, METI has had to compete within the bureaucracy with the Ministry of Environment (MOE) to shape government policy and strategy (Lam 2009), but the playing field remains tilted in METI's favor. Although the MOE's position has been backed the Ministry of Foreign Affairs, which enjoys championing the Kyoto Protocol and other global causes, as well as environmental groups such as Eco-Japan, METI is universally regarded as one of the country's elite economic ministries (Johnson 1982), while the MOE did not achieve full ministerial status until 2001. Also, the deep-pocketed regional utility monopolies and industrial energy users have cultivated salubrious ties with influential politicians through generous campaign contributions that

far outpace the resources available to environmental groups.

5. **Conclusion**

Japan is to be commended for having such a systematic and comprehensive energy planning process. None of the other major advanced industrialized countries produces a comprehensive national energy plan on such a regular basis. The Japanese government is also to be commended for taking the issues of energy security and climate change so seriously. And government leaders such as former prime minister Hatoyama are to be commended for having the courage to pledge significant cuts in energy-related carbon emissions.

Nevertheless, the 2010 BEP, like the NNES before it, is a highly ambitious document. It sets very challenging targets for 2030. Being ambitious is not in and of itself to be faulted, but it does raise the potential for provoking negative reactions by affected parties and, ultimately, a disappointing gap between its aspirations and achievements. For example, a number of knowledgeable insiders believe that Hatoyama's pledge to cut energy-related carbon emissions by 25 percent by 2020 is unattainable.[28] Indeed, at the United Nations Climate Change Conference held in Cancún in late 2010, the Japanese government reversed its stance and indicated its opposition to extending the Kyoto protocol. The likely impetus for this policy flip-flop was the desire to avoid disadvantaging Japan vis-à-vis countries such as China and India that are not bound to make similar carbon emissions cuts (Vidal 2010).

Compounding the inherent difficulty of achieving the targets set by the BEP is the fact that the Japanese political scene remains highly unsettled. Japan has had five prime ministers since the announcement of the 2006 Basic Energy Plan. It also saw the most decisive shift in electoral

fortunes in decades in 2009, when the DPJ unseated the long-ruling Liberal Democratic Party (LDP). But the DPJ itself lost its hold on one of the two houses of the Diet as a result of the July 2010 elections. With a "twisted parliament," in which the DPJ controls the Diet's lower house but not its upper house, it is likely that Japan will face a prolonged period of political gridlock. And there is the additional problem of the DPJ's lack of policymaking expertise as a result of the many years it spent in opposition while the LDP wielded a virtual monopoly on parliamentary power.

The economic setting is no more auspicious. For the past two decades, after the collapse of the Japanese bubble economy, real GDP per capita has grown at a rate of less than one percent per year. Given the current depressed state of the world economy, a rapid economic recovery is not likely to be in the cards. It is important to recall that it was the oil shocks of 1973 and 1979 that brought down the curtain on Japan's postwar economic boom, which was characterized by double-digit annual rates of growth. In response, the government enacted energy conservation measures which are among the most stringent in the industrialized world, leading some to dub Japan a "superpower" in energy efficiency (Stewart and Wilczewski 2009). Thus the resources needed to pay for significant changes in the energy supply and demand structures as well as energy industry are likely to be hard to come by. And, at the very least, the massive damage inflicted by March 2011 earthquake and tsunami will prompt soul-searching about the future of nuclear power as a component of Japan's overall energy policy.

Nevertheless, 20 years is a long time in policy circles. Much could happen between now and 2030, the target year for the achievement of the goals contained in the BEP. Thus it is far too soon to pronounce the new BEP unachievable.

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Notes

[1] An excellent analysis of the NNES is Peter 2006.

[2] Interview with Keiji Kanda (Professor Emeritus, Kyoto University and Director of the Energy Policy Research Institute) published on the website of METI's Hokkaido Economy and Industry Bureau at http://www.hkd.meti.go.jp/hokpp/humanenergy/070304/about.htm.

[3] The Diet (*kokkai* – literally, "national assembly") is composed of a House of Representative and a House of Councillors. Members of both houses are popularly elected. The Diet gets its name from the nineteenth century Prussian body after which it was partially modeled, although its 1947 reconfiguration was inspired by Britain's parliamentary system. According to the Constitution of Japan, the Diet is "the highest organ of state power" and "the sole law-making organ of the State" (Article 41).

[4] In a published interview, Kano observed that his background as an executive of an electric power company sensitized him to the absence of a meaningful energy policy in the ruling LDP's platform. After gaining election to the upper house in 1998, Kano made a strong effort to realize a "debate on energy policy within the Diet for the citizenry to behold" (Kano 2002, 68).

[5] METI is the direct organizational descendent of "notorious MITI" (Ministry of International Trade and Industry), which was the cockpit of policy for strategic industries during Japan's high-speed growth era (mid-1950s through the end of the 1970s). In contrast, the MOE's organizational predecessor was the Environment Agency, which operated under the Prime Minister's Office.

[6] http://www.kantei.go.jp/foreign/abespeech/2007/05/24speech_e.html (accessed Oct. 27, 2010).

[7] http://www.kantei.go.jp/foreign/policy/ondanka/final080729.pdf (accessed Oct. 27, 2010).

[8] http://www.env.go.jp/en/earth/cc/bagwc/overview_bill.pdf (accessed Oct. 27, 2010).

[9]"Annual Solar Photovoltaics Production by Country, 1995-2009," Earth Policy Institute Data Center, available at http://www.earth-policy.org/index.php?/data_center/C23/ (accessed Oct. 1, 2010).

[10] Margaret Coker, "Korean Team to Build U.A.E. Nuclear Plants," Wall Street Journal, 28 Dec. 2009, available at http://online.wsj.com/article/NA_WSJ_PUB:SB10001424052748704905704574621653002992302.html (accessed Oct. 27, 2010).

[11] The 2010 plan is sometimes referred to as the "Strategic Energy Plan."

[12] http://www.meti.go.jp/english/press/data/20100326_03.html (accessed Oct. 27, 2010).

[13] The plan is available at http://http://www.enecho.meti.go.jp/topics/kihonkeikaku/index.htm (accessed August 3, 2010). Except where otherwise noted, the following description of the plan is based on the authors' translation of the plan and METI, "The Strategic Energy Plan of Japan: Meeting Global Challenges and Securing Energy Futures (Revised in June 2010) [Summary]" (June 2010), available at http://www.meti.go.jp/english/press/data/pdf/20100618_08a.pdf (accessed August 3, 2010). See also the accompanying press release at http://www.meti.go.jp/english/press/data/20100618_08.html (accessed August 3, 2010).

[14] According to one source, the target of a 30 percent reduction by 2030 was added at the time of the cabinet approval of the BEP (IEEJ 2010b, 7). It would be a logical extension of former prime minister Hatoyama's pledge, famously made at the United Nations in September 2009, to cut

Japan's greenhouse gas emissions by 25 percent from their 1990 levels by the year 2020. See "Statement by Prime Minister Yukio Hatoyama at the United Nations Summit on Climate Change," 22 Sept. 2009, available at http://www.kantei.go.jp/foreign/hatoyama/statement/200909/ehat_0922_e.html (accessed Oct. 2, 2010).

[15] Ministry of Economy, Trade and Industry, "The Outline on Revision of Natural Resources and Energy Policy (Draft) (Toward Revision of Basic Plan for Energy) [Summary]" (April 2010).

[16] Specifically, the plan seeks to increase the operating cycle from the current 13 months maximum between inspections to 18 months or longer by 2030 (IEEJ 2010a, 6).

[17] "Policies on New & Renewable Energy in Japan," unpublished document provided by METI officials, June 2010.

[18] "Potential scenarios about feed-in tariff scheme of renewable energy," unpublished document provided by METI officials, June 2010.

[19] See also "Energy Efficiency Policies & Measures in Japan," unpublished document provided by METI officials, June 2010. For detailed descriptions of the extensive conservation measures that the government has taken in the industrial sector since the 1970s, see IEA 2008, 67-69, and ECCJ 2009, 72-86.

[20] A summary of the bill is available at http://www.env.go.jp/en/earth/cc/bagwc/overview_bill.pdf (accessed August 5, 2010).

[21] "Energy Efficiency Policies & Measures in Japan."

[22] "Policies on New & Renewable Energy in Japan."

[23] "Potential scenarios about feed-in tariff scheme of renewable energy."

[24] Based on the figures provided by METI, the utilization capacity of renewables will be just 20 percent.

[25] METI, "Outline of FY 2010 Electricity Supply Plan," cited in Koji Morita, "The Current Status of LNG: Uncertainty from Japan," 29 Sept. 2010, available at http://eneken.ieej.or.jp/data/3469.pdf (accessed March 11, 2011).

[26] "Policies on New & Renewable Energy in Japan."

[27]Based on a comparison of WNA 2010, 6, and METI 2006b, 26.

[28]Interviews with Japanese policymakers, Tokyo, May-June, 2010.