After Fukushima: What's Next for Japan's Energy and Climate Change Policy?

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* Fellow, Brookings Institution – I would also like to thank Amaka Okechukwu for her valuable research assistance.

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1. Introduction

Following the devastating March earthquake, tsunami and nuclear incident at Fukushima Daiichi, the Japanese government has begun a process of reviewing its energy policy and specifically the role of nuclear power in the country. The choices that Japan makes will have important implications for energy and climate change policy for Japan and globally.

Japan is currently the world's third largest economy, with a GDP in 2010 of $5.49 trillion, only slight smaller than China's GDP of $5.87 trillion[1]. The size of Japan's economy and its scarcity of domestic energy sources mean that changes in Japan's energy consumption will have to be realized on world markets and will have implications for the availability and price of these energy sources for other countries.

Currently, 9 percent of Japan's electricity is generated from renewable energy, of which about 8 percent is from hydroelectric power. The rest is generated from nuclear power (26 percent), liquefied natural gas or LNG (28 percent), coal (25 percent) and petroleum (13 percent). Under Japan's Basic Energy Plan that was revised in June 2010, the 2030 targets for Japan's energy sector were for renewable energy to increase to 20 percent of the generation mix, nuclear power to increase to 50 percent, while LNG and coal would be reduced to approximately 10 percent of electricity generation, with oil generating the remainder.

2. Fukushima and Nuclear Power

The nuclear meltdown at the Fukushima reactors has had significant implications for Japan's energy policy— the most important being the future of nuclear power in Japan and how changes in nuclear energy use will affect its consumption of other energy sources.

Currently, 38 of Japan's 54 nuclear reactors are off-line. This is the result of a loss of public confidence in the safety of nuclear power plants in Japan, which has led local governments to prohibit the nuclear plants in their districts from resuming operations after the plants were shut down as part of the regular inspection cycle. As additional reactors are closed for regular maintenance, by around June 2012 all of Japan's nuclear power plants will be closed.

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[1] World Bank Indicators, 2010

The Japanese government has responded to the immediate shortfall in nuclear generating capacity by calling on large energy consumers to reduce their electricity consumption by 15 percent. Business and households have also voluntarily reduced their electricity consumption through such measures as shutting down elevators and using less air conditioning.

In the immediate term, a permanent loss of nuclear generating capacity will have significant economic and social ramifications for Japan. The cuts in electricity are already having adverse impacts on business. And while the electricity cuts have demonstrated the capacity of Japanese society to adjust to using less electricity, these challenges are being born in the spirit of pulling together to address an immediate disaster. However, there remains a big question over their sustainability over time.

Therefore, the most immediate challenge is for the Japanese government to devise a process for restarting the closed nuclear power plants. The current plan appears to be to use computer simulations to stress test the nuclear plants to determine their safety. Assuming these reactors pass this test, the next challenge will be to convince the Japanese people and local governments of the safety of nuclear power. While local governments receive significant fiscal revenue from nuclear power plants, they will need to be responsive to public feelings on this issue - one does not need look further than the ongoing local opposition in Okinawa to relocating the U.S. military base at Futenma to appreciate the ability of strong local opposition to stymie important goals of the federal government.

Convincing Japanese people that nuclear power is safe will be a major challenge. This is not just because of the distrust of Tokyo Electric Power Company (TEPCO) – the company responsible for Fukushima – which in 2002 falsified reports of safety tests and was slow in letting the government know of the unfolding nuclear disaster at Fukushima. The Japanese government has also mishandled the nuclear crisis and it now appears that it was slow to release information on the extent of the nuclear meltdown and on the release of contaminated food from the area around Fukushima into the food supply.

The structure of Japan's nuclear regulatory set-up is also under scrutiny. In particular, there is a growing perception that the revolving door of nuclear officials going into nuclear power companies has created a culture where Japanese nuclear regulators were too close to the nuclear operators, compromising their independence. Moreover, the agency responsible for regulating Japan's nuclear sector – the Nuclear and Industrial Safety Agency - is part of the agency response for promoting nuclear power, the Ministry for Economy, Trade and Industry, creating at least the perception of conflicting interests. This contrasts with the independence of the United States Nuclear Regulatory Commission – the agency responsible for regulating civilian nuclear material and facilities. This has undermined the ability of the Japanese government to renew confidence among the public over the country's nuclear industry.

The most likely outcome for Japan's nuclear industry will be a successful conclusion of the stress tests, which will provide a path for reopening the current plants and leave

nuclear power to occupy a similar proportion of generating capacity as before the Fukushima disaster– around 25 percent. However, the plans to grow nuclear energy to 50 percent of total electricity supply by 2030, which would have required building an additional 14 plants, will most likely need to be abandoned. And with Japan's electricity growth averaging close to 1 percent annually, the government will have to devise a new energy strategy.

Moreover, any significant changes in Japan's energy policy will require a political leader who can articulate a comprehensive forward looking energy policy and garner enough support in the Japanese parliament to pass the necessary legislation. However, Japan suffers from a lack of political leadership. On 2 September 2011 Yoshihiko Noda was elected as Prime Minster of Japan - the sixth Japanese Prime Minister in five years – and he will lead a weakened Democratic Party of Japan (DPJ).

3. Japan's Energy Sources and Increasing Energy Efficiency

As Japans develops a new energy policy it will need to assess what other sources of energy should replace the gap left by nuclear power. One of the issues that the government will need to consider when formulating its energy policy is the already high cost of energy in Japan and the adverse impact this has had on the competitiveness of the Japanese economy and which has already contributed to the trend for Japan's heavy industry to relocate overseas.

Moreover, any shift away from nuclear power will need to take into account the implications for Japan's energy security. While Japan has no uranium reserves, its capacity to enrich uranium and obtain it from reliable stable countries such as Australia has led to Japan seeing nuclear power as an important source of energy security.[2]

The Japanese government is also likely to craft its energy policy to take into account global climate change policies. However, a lack of progress in the United Nations climate change negotiations and in the United States means that climate change issues are likely to figure less prominently in Japan's energy calculations than was previously the case.

The following provides an overview of Japan's non-nuclear energy sources and the scope for Japan to increase their use.

3.1 Renewable Energy in Japan

Under the June 2010 Basic Energy Plan, renewable energy and in particular solar power was to increase from 9 percent to 20 percent in 2030. While the development of renewable energy will contribute to Japan's energy security, achieving this target will be a challenge.

[2] Japan Ministry of Economy, Trade and Industry, New National Energy Strategy 2006, p. 14

Most of the increase in renewable energy is expected to come from increased solar energy by encouraging the installation of solar panels on roofs and developing some larger-scale solar facilities.

Solar power, however, is a very expensive form of renewable energy in Japan. It is close to twice the cost of electricity faced by households and over five times the cost of electricity paid by large business. Moreover, without adequate subsidies for lower income households to install solar power, Japan's promotion of solar power will be economically regressive as mainly businesses and wealthier households will be able to afford to install solar power and to sell the surplus energy back to the grid, while any increased cost of electricity caused by the uptake of renewable energy will be distributed among consumers.

In contrast, the cost of wind power in Japan is largely economically viable. However, the capacity for Japan to significantly expand its wind power is limited by a lack of space and frequent hurricanes which can damage wind turbines. The scope for further hydroelectric power is also limited.

Japan has significant geothermal potential and some of the world's first geothermal energy was developed in Japan. However, the ability for Japan to develop this energy source is constrained by the location of geothermal sources in its national parks, which have strict limits on their development. While directional drilling has opened the possibility for some additional geothermal development close to these park boundaries, without a significant revision of the restrictions on development in national parks, geothermal energy is unlikely to significantly expand. In addition, the Japanese onsens – spas which rely on underground hot water - are opposing the development of geothermal energy because of concerns it will reduce the availability of hot water.

3.2 Natural Gas

Natural gas currently comprises approximately 28 percent of Japan's electricity and was projected to decrease to 10 percent under the 2010 Basic Energy Plan. In the wake of Fukushima, natural gas is likely to be the main beneficiary. It is predicted that should Japan's nuclear energy mix remain similar to its current level and if Japan decides to satisfy its additional energy needs with natural gas, imports of natural gas could increase by as much as 65 million tons (LNG equivalent).[3]

Japan's reconsideration of a role for natural gas in its economy is being taken against the background of the so-called shale gas revolution occurring in the United States where the development of directional drilling and hydraulic fracturing technologies has opened up large sources of shale or so-called unconventional natural gas. These new sources of gas are so significant that the U.S. Energy Information Agency predicts shale gas reserves as high as 862 trillion cubic feet.[4]

[3] Institute of Energy Economics, Japan Energy Brief No. 14, July 2011, p. 5

[4] U.S. Energy Information Administration release, Annual Energy Outlook 2011

There are some environmental challenges to developing these shale gas reserves in the United States. In particular, there are concerns that the fluids used in hydraulic fracturing could contaminate underwater reservoirs of drinking water. Should the United States be able to address these environmental challenges and fully develop this resource, there should be enough gas for the United States to export, some of which could end up in Japan. From an energy security perspective, the ability to source gas from the U.S. combined with LNG from Australia should help strengthen Japan's confidence in its energy supplies.

Moreover, from a climate change perspective, while the CO2 content of natural gas is higher than nuclear or renewable energy, it is better than the CO2 released from burning coal or oil.[5]

3.3 Coal

Most of Japan's coal fired generators are relatively new and efficient and are therefore expected to keep operating. Following the Fukushima incident, there has been some discussion in Japan about increasing imports of coal to maintain its current share of electric power. However, this contradicts the 2010 Basic Energy Plan to reduce coal's share of power generation from 25 percent to 10 percent.

3.4 Oil

Japan is the world's third largest importer of oil after the United States and China. Oil is largely used in the electricity sector as a back-up source of generating power, and is likely to retain this role under any new energy plan.

3.5 Increases in Japan's energy efficiency

Japan is already considered one of the most energy efficient countries in the world and is the fourth most energy efficient country in the G8[6] but there is certainly scope to increase both demand and supply side energy efficiency in Japan. On the supply side, more efficient IGCC units and gas turbines will produce some gains. Moreover, the recent cuts in energy consumption through reduced use of elevators, lifts and air conditioning has demonstrated the potential at least, to reduce energy demand.

Japan's energy consumption, while growing, is also set against a declining population, which is expected to decrease from 128 million in 2010[7] to 115 million in 2030 and to 95 million in 2050.[8] This will also reduce the growth in energy demand in Japan.

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[5] EIA-Emissions of Greenhouse Gases Report 2009, table 6

[6] International Energy Statistics 2008. Energy Efficiency measured as Total Primary Energy Consumption per Dollar of GDP (Btu per Year 2005 U.S. Dollars (Purchasing Power Parities))

[7] Japan National Census 2010

[8] National Institute of Population and Social Security Research in Japan, Population Projections for Japan: 2006-2055

4. Japan's Climate Change Policy

Japan's annual greenhouse gas emissions are approximately 1.2 billion metric tons, making Japan the fifth largest emitter of GHG emissions. Under the Kyoto Protocol, Japan has agreed to reduce its GHG emissions by 6 percent below 1990 levels by 2012. To achieve this goal, Japan introduced the Kyoto Protocol Target Achievement Plan. Some of the initiatives introduced under the plan include the promotion of voluntary action plans by industries and companies, improving the energy efficiency of households, railways, ships and air-crafts, implementing national campaigns to promote green and sustainable practices, forest fostering, as well as introducing a voluntary emissions trading scheme in 2005.[9]

Japan has also sought to reach its Kyoto Protocol target by purchasing certified emission reduction (CER) credits issued by clean development mechanism (CDM) projects. Each CER counts as one ton of C02 and can used by countries to meet their GHG targets under the Kyoto Protocol. Japan has 435 CDM projects which make up 11 percent of all registered CDM projects.[10]

In the UN climate change negotiations, Japan has taken a firm position against agreeing to a further set of targets for a second commitment period under the Kyoto Protocol unless the United States and developing countries like China are also prepared to do their part.[11]

Japan's original plan to increase the role of nuclear power in the economy from 26 percent to 50 percent was largely driven by climate change and the need to reduce greenhouse gas emissions. Without an expansion of nuclear power and given the challenges to developing renewable energy in Japan, the carbon intensity of Japan's economy can be expected to increase. This will make Japan's Copenhagen Accord pledge to reduce its emission by 25 percent below 1990 levels by 2020 increasingly difficult to achieve.

Moreover, there is a sense in Japan that the Copenhagen Accord pledge made by Prime Minister Hatoyama was done without sufficient domestic consultation. Consequently, there does not appears to be a broad domestic consensus on whether this is an appropriate GHG mitigation target for the country.

The outcome of Japan's review of its energy policy will be an important indicator of whether Japan will be able to make the type of cuts to its GHG emissions that would be

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[9] See Kyoto Protocol Target Achievement Plan, 2008.
http://www.kantei.go.jp/foreign/policy/ondanka/KP_Achievement_Plan_Text.pdf

[10] See UNFCCC statistics website.
http://cdm.unfccc.int/Statistics/Registration/RegisteredProjAnnex1PartiesPieChart.html

[11] See release by Japan's Ministry of Foreign Affairs on "Japan's position regarding the Kyoto Protocol" http://www.mofa.go.jp/policy/environment/warm/cop/kp_pos_1012.html

required to reach their Copenhagen Protocol pledge. For instance, an inability to overcome public opposition to nuclear power would likely doom these targets. Even should the government be able to retain nuclear energy at its current rate, Japan will need a range of other climate change measures to reach this target.

The Japanese government has been considering a range of measures that should help reduce Japan's GHG emissions. For instance, a recently passed feed-in tariff (FIT) will support the government's renewable energy targets. However, whether this FIT will be high enough to overcome the abovementioned barriers to developing renewable energy in Japan remains to be seen. Japan is also considering a tax on carbon as part of comprehensive tax reform, though the tax will likely be small and its impact on Japan's GHG emissions will be marginal. The DPJ had originally said it would also consider a cap and trade system but this policy now appears to have been shelved. It appears unlikely that these policies alone will be enough to reduce Japan's GHG emissions consistent with its Copenhagen Accord pledge.

5. Conclusions and Recommendations

Japan has recently confronted a series of catastrophes from the earthquake, the tsunami and the meltdown of the nuclear reactor at Fukushima. The Japanese people have shown an admirable ability to address these challenges. These disasters have forced a rethink of Japan's energy policy going forward, and have revealed weaknesses in Japan's energy structure, including its nuclear regulatory framework.

Moreover, the strong link between energy consumption and greenhouse gas emissions means that Japan's review of its energy framework will have important implications for its ability to reduce its GHG emissions. In many respects, climate change policy has already become energy policy. For example, in the United States climate change policy has largely been about developing and promoting clean energy sources, such as renewable energy, carbon capture sequestration and hybrid vehicles. There is a similar focus on energy in China and other countries.

The Fukushima nuclear incident has also already affected the energy policy of other countries. For example, it has heightened concerns in the U.S. about the government's efforts to re-start its nuclear power industry and the German government has closed down its older nuclear power plants.[12] However, at the same time China is forecasted to launch nuclear power projects with a combined generation capacity of 40 million kw.[13]

The challenges presented by nuclear power, its safety and potential contribution to addressing climate change should be part of a broader discussion of the role of energy and energy markets in helping countries achieve energy security and reduce their GHG

[12] See release by the German government on May 30th 2011 on "The way toward the energy of the future". http://www.bundesregierung.de/nn_6562/Content/EN/Artikel/__2011/05/2011-05-30-energiewende-energiekonzept__en.html

[13] See release published on the Chinese Government Official Website on March 12th 2011, "China not to change plan for nuclear power projects". http://english.gov.cn/2011-03/12/content_1823434.htm

emissions. This could include discussions under the U.S.-Japan Joint Nuclear Energy Action Plan on how to increase the safety of nuclear power, including the role for nuclear power in reducing GHG emissions. On a multilateral level, the G20 could usefully explore ways of increasing the transparency and predictability of energy markets and their implications for climate change policy.