11. Japan: Dominated by Fukushima and Tackling Hard Problems in Decarbonisation

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Japan's energy policy remains dominated by the Fukushima nuclear disaster of 2011. While the government continues to be committed to nuclear power, its future is uncertain. Japanese greenhouse gas emissions have increased significantly as nuclear energy has been replaced by gas and coal. Ambitious policies in the transport sector promote battery electric and fuel cell vehicles. The introduction of feed-in tariffs favoured the build-up of non-residential solar photovoltaics. As part of its climate commitments, Japan aims to further expand the use of renewables, improve energy efficiency and restart nuclear energy.

The changing role of nuclear power in Japan's energy mix

Japan's energy policy remains dominated by the tsunami and nuclear disaster of 11 March 2011. The disaster had two effects that continue to reverberate through Japanese energy policy, including on sustainable energy.[2] Firstly, it reduced the share of nuclear power in the electricity system. Secondly, it led to changes in the decision-making process, which increased uncertainty concerning Japan's nuclear power planning and development.

The Japanese Government has long placed security of energy supplies at the centre of energy policy planning, informed by the country's lack of domestic fossil fuel resources. Prior to the 2011 disaster, increasing nuclear power was positioned by the government as the centrepiece of its plans to manage energy security and environmental risks. In 2010, for example, the government announced a target of achieving 70 percent self-sufficiency in energy by 2030. Central to this target – other than equity stakes in upstream oil and gas projects outside Japan's shores – was the extension of "zero-emission" power – defined as renewables and nuclear power – to 70 percent of the total power base by 2030. The plan outlined nine new nuclear units to begin operation by 2020, and a further 14 units by 2030, with plant efficiency also increased from 60 percent in 2008 to 85 percent by 2020 and 90 percent by 2030 (Government of Japan, 2010).

These goals have changed as a result of the disaster. The Japanese Government remains committed to nuclear power; however, the projected share of nuclear power in electricity generation has fallen, and almost all the country's 54 nuclear units remain shuttered five years after the disaster. In the supply–demand projection released in July 2015 that provides the basis for long-term Japanese energy planning, nuclear power is designated as 20–22 percent of total generated electricity by 2030 (Government of Japan, 2015).

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[2] I use the definition of "sustainable energy" adopted by Testar et al. (2005). That is, "A living harmony between the equitable availability of energy services to all people and the preservation of the earth for future generations." (Testar et al., 2005:xxi).

This reduced role for nuclear power is also reflected in the 2014 Basic Plan on Energy. The 2014 Plan notes that overall emissions from Japan increased by 83 million tons of CO_2 equivalent, even while emissions from outside the power sector fell by 29 million tons between 2010 and 2012. The difference, according to the 2014 Plan, was due to the rise in emissions from the power sector as thermal power replaced nuclear in the power mix. The report further notes that the "situation could raise doubt about the attitude of Japan, which has until now led the international fight against global warming." (Government of Japan, 2014: 11).

The government's position towards nuclear power is uncertain. On the one hand, in the 2014 Plan nuclear power was reconfirmed as an "important base-load power source", which caused public controversy, given increased safety concerns in the wake of the Fukushima nuclear disaster. On the other hand, the government recognised the weakened public support for nuclear power, stating that "nuclear power generation will be lowered to the extent possible by energy saving and introducing renewable energy as well as improving the efficiency of thermal power generation." Nuclear power is proposed to be gradually replaced by incremental increases in the use of natural gas and thermal coal, with the latter noted as being "re-evaluated as an important base-load power supply" (Government of Japan, 2014: 25).

Other energy policies remain in place or are receiving greater attention. Long-term energy planning, for example, predicts a 17 percent reduction in total energy demand resulting from energy efficiency measures (Government of Japan, 2015). This builds on the government's long-term emphasis on demand management, implemented through the Act on the Rational Use of Energy, and associated legislation. The centrepiece of Japan's energy efficiency strategy, in addition to tax incentives and subsidies, is the Top Runner programme, which incentivises manufacturers to improve standards to those of the most energy efficient product on the market. The programme is implemented across multiple sectors of the economy, and government data suggest it has been successful in improving energy efficiency using a name-and-shame enforcement mechanism.

Japan's next-generation vehicles strategy has also been retained and expanded since initially being announced in April 2010. Battery electric vehicles represented a new demand segment that could also make use of Japan's nuclear capacity during off-peak hours. Nevertheless, the decrease in nuclear capacity has not diminished the government's continued enthusiasm for promoting technologies that reduce the role of oil in the transport sector. The initial strategy aimed for 15–20 percent battery electric and 20–30 percent plug-in hybrid vehicles among new car sales by 2030. The new growth strategy passed by the Japanese cabinet in June 2014 sets a target of 50–70 percent of new vehicle sales to be from next-generation vehicles, such as battery electric and plug-in hybrids, by 2030. The government continues to support the roll-out of these vehicles by subsidising the development of next-generation vehicle-related charging infrastructure, although their efforts are complicated by the differing technological choices made by Japanese auto manufacturers, with some focusing on fuel cell technologies or battery electric vehicles, and others adopting a portfolio approach by investing in both.[3]

The nuclear disaster has thus had mixed effects on Japan's energy sustainability policies. On the one hand, it reduced the role of nuclear power in the electricity mix, which increased the use of fossil fuel – including thermal coal – in power generation. Japan's power utilities announced almost 12 000 MW of new thermal capacity between July 2011 and August 2016, with the majority natural gas. This has led to a marked increase in Japan's measured CO_2 emissions relative to the year prior to the disaster.

While the government remains focused on nuclear restarts, institutional changes and the rise of local politics represent continuing barriers to increasing the role of nuclear power. Indeed, a June 2016 report by Japan's influential Council of Business Executives *(Keizai Doyukai)* expressed doubt that the more modest goal for nuclear restarts can be met, because of

[3] The 2016 government budget includes, for example, a new budget item of 2.5 billion yen for subsidising charging infrastructure.

decreased social acceptance and the increased safety requirements put in place by the safety regulator (Japan Association of Corporate Executives, 2016).

Revising incentives for renewable energy

The second important issue facing the government is to reform incentives for the uptake of renewable energy. Japan introduced a feed-in tariff in 2012, targeting solar photovoltaics (PV), wind, geothermal, hydropower and biomass. Tariff rates for solar photovoltaics, both residential and non-residential (defined as equal to or greater than 10 kW), have been reviewed annually. Utility-scale solar PV rates, for example, fell from 40 yen/kWh in 2012 to 24 yen/kWh in 2016, reflecting rapid falls in system prices, while the rates for other systems have largely remained unchanged[4] Other types of renewable energy installations have lagged solar photovoltaics. Since the introduction of the feed-in tariff in 2012, non-residential solar photovoltaics have taken up 87.4 percent of installed capacity registered under the feed-in tariff, with residential solar making up 5.2 percent, biomass 3.4 percent and wind power 3 percent (Agency of National Resources and Energy, 2016).

The reasons for this imbalance in the effect of the incentive are various, including the lack of suitable locations for onshore wind in close proximity to the population centres of the Tokyo and Kansai regions, and the comparative lack of capacity in regional interconnects in Japan's regionalised high-voltage transmission lines.

An expert performance review of the feed-in tariff identified a number of other issues with the existing incentives. Firstly, the structure of the feed-in tariff gave an incentive for market participants to register projects even if they were far from the development phase. This meant there were a large number of projects that were yet to begin development even though they had been registered under the feed-in tariff (METI 2016a).

Secondly, the annual review of tariff rates created uncertainty for projects with long lead times, even though they remained unchanged for most power sources other than solar photovoltaics. The revision thus enables rates to be set on a multi-year basis, in order to reduce regulatory uncertainty. The government also intends to provide estimates of its projected prices on a fuel-basis for industrial customers.

Thirdly, capital and operating costs are high relative to other countries, with one estimate putting solar PV and wind power at USD 218/MWh and USD 155/MWh respectively, compared with USD 106/MWh and USD 80/MWh in Germany (Government of Japan, 2016a). Concern within the government regarding the household costs of the feed-in tariff led it to plan the implementation of capacity tenders for non-residential solar photovoltaics, following the German example. Given the concern with costs, and issues with the design of the feed-in-tariff system, the government is increasingly concentrating on reducing the potential costs for households of promoting renewable energy, while also seeking to meet the long-term goal of increasing renewable energy in the power mix to 22–24 percent by 2030. Revisions to the feed-in tariff incentives take effect from 1 April 2017 and are designed to resolve the issues outlined above.

Future choices concerning generation investment will be influenced by the effects of power market liberalisation on the investment choices of incumbent power utilities and new market entrants, in addition to revisions to the feed-in tariff incentives and the ongoing effect of the nuclear disaster. In general terms, there is some evidence that liberalised markets drive greater investment in natural gas, although this outcome is affected by the policy setting of government in addition to the economics of power plant development (Roques et al., 2008). In the case of Japan, the data show that utility companies are overwhelmingly investing in natural gas facilities. New market entrants, on the other hand, have invested in significant volumes of thermal coal.

Government efforts to introduce competition into the power and gas sectors predate the March 2011 disaster. Japan's power market has traditionally been dominated by regional power utilities, which were

[4] Exceptions are offshore wind, for which a new tariff was introduced from 2015 at 36 yen/kWh, and small-scale (2000 kW) biomass, which saw its tariff increase from 32 to 40 yen/kWh.

regulated monopolies within their service areas. Previous efforts at liberalising the power sector enabled competition in the industrial and commercial segments of the market, but led to few customers to change providers, and volumes in the wholesale power market remained low.

The government has now committed to a three-stage plan to liberalise the power market, with the first two stages already passed into law. In phase one, a system operator was established to oversee the management of power flows between the Balkanised service areas of the power utilities, and to enable the neutral treatment of new generation to the transmission grid. In fiscal year 2015 – the first full year of operation – the organisation received 2,300 requests for connection, 75 percent of which were from solar photovoltaic projects (Organization for Cross-regional Coordination of Transmission Operators, 2016). In the second phase, the power sector was opened to competition at the residential level, with competition beginning from 1 April 2016. In the third stage, slated for 2018–2020, utility companies will be required to separate the operation of transmission and distribution from generation and sales, with the goal of ensuring neutral operation of the transmission grid. The implications of these reforms for the final power mix will be determined by their effects on the investment choices of the incumbent utilities, the amount of competition introduced into the generation market and the effects for third-party access to the transmission grid.

Japan and international energy cooperation: between security and sustainability

Japan is a member or party to numerous international agencies and agreements related to energy cooperation, such as the International Energy Agency (IEA), the International Renewable Energy Agency, Asia-Pacific Economic Cooperation (APEC), the G20, the World Trade Organization and the United Nations Framework Convention on Climate Change (UNFCCC). The Japanese Government also supports private sector initiatives in standards and code-setting activities, through the International Organization for Standardization and other bodies.

The Japanese Government also plays a significant role in providing development assistance in the energy sector, particularly to the Asia-Pacific region. Between 2010 and 2014, Japan was the worldwide largest bilateral donor in the energy sector (own calculation, based on data from OECD.stat). Much of its energy-related development cooperation focuses on infrastructure development, with the largest share of assistance going to investments in electricity transmission and distribution, followed by hydropower, coal and gas-fired power generation. Energy diplomacy is also a core part of the Japanese Government's portfolio of activities in international cooperation, informed by its concerns about enhancing energy security. In addition to participating in IEA stockholding obligations, the government also developed a programme to provide international support for the fossil fuels exploration and production activities of Japanese companies, with the goal of diversifying their geographic supply and improving the competitiveness of Japanese resource companies.

In sustainability terms, the most important recent international commitment made by the Japanese Government is the Intended Nationally Determined Contribution (INDC) submitted in July 2015. While the ambition of Japan's INDC has been criticised, its credibility is relatively high, given that it was developed through a bottom-up process of coordination between the government and industry. The figures reached on an industry basis can thus be understood as consensus figures reached through negotiation between business and government. It sets a post-2020 target to reduce greenhouse gas emissions by 26 percent by 2030 relative to 2013, equivalent to a 25.4 percent reduction compared to 2005. In terms of energy, which makes up 90 percent of national greenhouse gas emissions, the INDC commits to a reduction of 25 percent relative to 2013 (24 percent reduction relative to 2005). The majority of these initiatives are domestic in nature, and focus on expanding the use of renewable energy, restarting nuclear power, and increasing the efficiency of thermal power generation (2030 emissions target of 73 million tons of CO_2 equivalent, compared to 104 million tons in 2005) and other measures.

Crucial areas identified by the government are to improve energy efficiency in the industrial sector (2030 emissions target of 401 million tons of CO_2 equivalent, compared to 457 million tons in 2005) and promoting energy saving in the residential sector (2030 emissions target of 122 million tons of CO_2

equivalent, compared to 180 million tons of CO_2 equivalent in 2005). These are ambitious targets, given Japan's low energy intensity. The government focuses on achieving them through incremental improvements across the industrial, commercial and residential sectors, through encouraging improvements in manufacturing processes, supply chain management and building construction. Japan's energy efficiency law is notable in that it has been revised numerous times as successive governments have sought to improve the incentives to industry, particularly to use energy more efficiently.

Japan's commitment made through the INDC does not focus on domestic measures alone. In addition to measures related to land use, land use change and forestry, the Japanese Government is promoting a Joint Crediting Mechanism (JCM) with the stated goal of reducing emissions globally on a least-cost basis through the implementation of projects outside Japan, while crediting marginal emissions reductions through these schemes to Japan. As of June 2016 Japan had signed bilateral agreements with 16 countries, with a large number of projects focused on energy infrastructure.[5] The JCM is not counted within the bottom-up calculation required to achieve the commitment under the INDC, but the Japanese Government does state that it will claim emissions credits from projects carried out under the JCM (Government of Japan, 2016b). It is able to do so under Article 6 of the Paris Agreement, which allows for international transfer mechanisms in order to enable countries to meet their INDC targets.

The lessons from Japan's transition towards sustainable energy?

The ongoing review process, which is a component of the Paris Agreement, offers an important opportunity for all countries to assess the performance of measures introduced to meet their commitments, as well as to disseminate information on which policies (ranging from market-based policies to command-and-control regulations) might be useful to other countries as they seek to develop their own sustainable energy strategies. An early and systematic cost–benefit analysis of Japanese sectoral measures as part of the UNFCCC process would be useful for identifying those measures that are most effective in terms of sustainability outcomes in the energy sector. Japan's Joint Crediting Mechanism has attracted some controversy. A review of the policy's effects on the sustainable energy policies adopted in partner countries would be useful for determining whether appropriate design can deal with measuring, reporting and verification issues; and the extent to which such measures function as complements to – or substitutes for – measures in the partner country; and on the ambitions of Japan's policy itself.

More importantly, Japan's commitment under its INDC also includes a large number of policy measures focused on shifting the supply of, and demand for, a range of different energy products and services, and here some measures could be relevant to global efforts to transition towards sustainable energy. Japan's commitments build on existing legislation implemented domestically, and negotiated with industry and other stakeholders. In the case of hydrofluorocarbon phase-outs, for example, the Fluorocarbon Emissions Reduction Act came into force on 1 April 2015 and includes a range of agreements on a sectoral basis designed to promote the introduction of low-Global Warming Potential gases.[6] It also forms the basis for subsidy schemes that support industry, as it makes investments in equipment in order to meet agreed-upon targets. In seeking to decarbonise the transport sector, the government is using a mix of subsidies for infrastructure investment, along with tax measures, to support the deployment of battery electric vehicles and fuel cell vehicles. Finally, Japan's efforts to promote energy efficiency build on incentives that appear to have successfully reduced energy intensity across a range of products in the economy.

[5] For a list of projects implemented under the JCM see http://gec.jp/jcm/projects/index.html.

[6] Global Warming Potential (GWP) measures the heat-trapping capacity of different atmospheric gases, normalised to carbon dioxide, which has a GWP of 1.

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