論　文

Japan's Energy Crises and Policy Integration

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Introduction

This paper proposes that Japan's March 11, 2011 (hereafter "3-11") nuclear and natural disasters mark a significant, perhaps profound, point of departure in Japanese energy policy and policymaking. The disasters were history's most costly, and brought protracted disruption to the energy economy, business supply chains, party politics, and other spheres. The severity and urgency of 3-11 make it a crisis by any definition (Grossman, 2015), and one would expect considerable policy change. Yet as we shall see, many analyses of Japan's policy response have overlooked much of 3-11's institutional impact, centring instead on the role of nuclear versus renewable energy. Some authors (IEA, 2016; Vivoda, 2014) have suggested Japan has no realistic alternatives to a large role for nuclear. Others claim the Japanese central government is reluctant to embrace distributed and renewable energy (Oshima and Takahashi, 2016: 34; Takao, 2016).

Herein we step back from the often politicized focus on energy inputs, especially nuclear and renewables, and examine Japan's energy policy and policymaking in its broader, systemic context. Based on generally overlooked but ample evidence, this paper argues that 3-11 has produced a continuing transformation in Japan's energy policies and policymaking institutions. In an ambitious case of "crisis opportunism" (Grossman, 2015: 64-5), Japanese policy entrepreneurs seized the opportunity to act on a variety of fronts. Collaboration has become deliberately encouraged within new and inclusive institutions. These new institutions cross over formerly stovepiped policy regimes and promote an impressive and expanding synergy through policy integration. Thus, after 3-11 Japan's energy policies became increasingly dynamic and explicitly focused on the myriad externalities implicated in the country's geography, geology, demography, innovative capacity, and other variables.

Japan's policy entrepreneurs have melded their response to the energy shock of 3-11 with the related challenge of disaster resilience, including the imperative of adapting to climate change. This adaptation emphasizes smart and compact communities centred on microgrids, smart energy management, and distributed energy. Moreover, policy entrepreneurs are using the crisis to reform not merely the energy mix and its networks, but also integrate the built environment's other critical infrastructures. Critical infrastructure includes energy, water, transport and communications networks. These networks compose the urban community and shape the character and quantity of energy production and consumption. Hence, bringing them all into a common platform of governance, focused on hazards, can enhance the delivery of such important public goods as disaster resilience and energy security (JSBC, 2016).

We begin by situating Japan in the international system, and then go on to show how its energy policymaking is shaped by distinctive geography, geology, and other factors. The first section therefore outlines the hazards driving Japanese policymakers to dramatically renovate the content, context and ambit of energy policymaking. The article then introduces Japan's pre 3-11 energy policy background, and the evolution of policy integration. We then turn to analyze how policy is being changed, by whom, and to what ends.

Japan's Energy Policy Context

Japan is a key part of the international system. Even after two decades of low growth, the Japanese economy remains the world's third largest, at JPY 505 trillion (USD 4.7 trillion) in 2016. And though Japan is depopulating and ageing more rapidly than any other OECD country (Below, 2016), its 127 million citizens make it the world's 11th most populous state.

Even so, Japan's 377,930 km^2 of territory leave it 62nd in terms of size. It also has poor conventional resource endowments and strikingly adverse geography and geology. In addition, for all its economic size, Japan is a geopolitical outlier. Japan has the developed countries' lowest levels of foreign investment, immigration and other indicators of internationalization. Crucially, Japan also has no direct international energy connections through power grids, gas pipelines and other energy networks. The country is also very distant from its principal sources of energy supply.

Table 1 Japan's Total Primary Energy Supply, by Source, 2015

(Units: %)

Oil	42.9
Coal	27.5
Gas	23.3
Hydro	1.7
Other Renewable	4.0
Nuclear	0.6

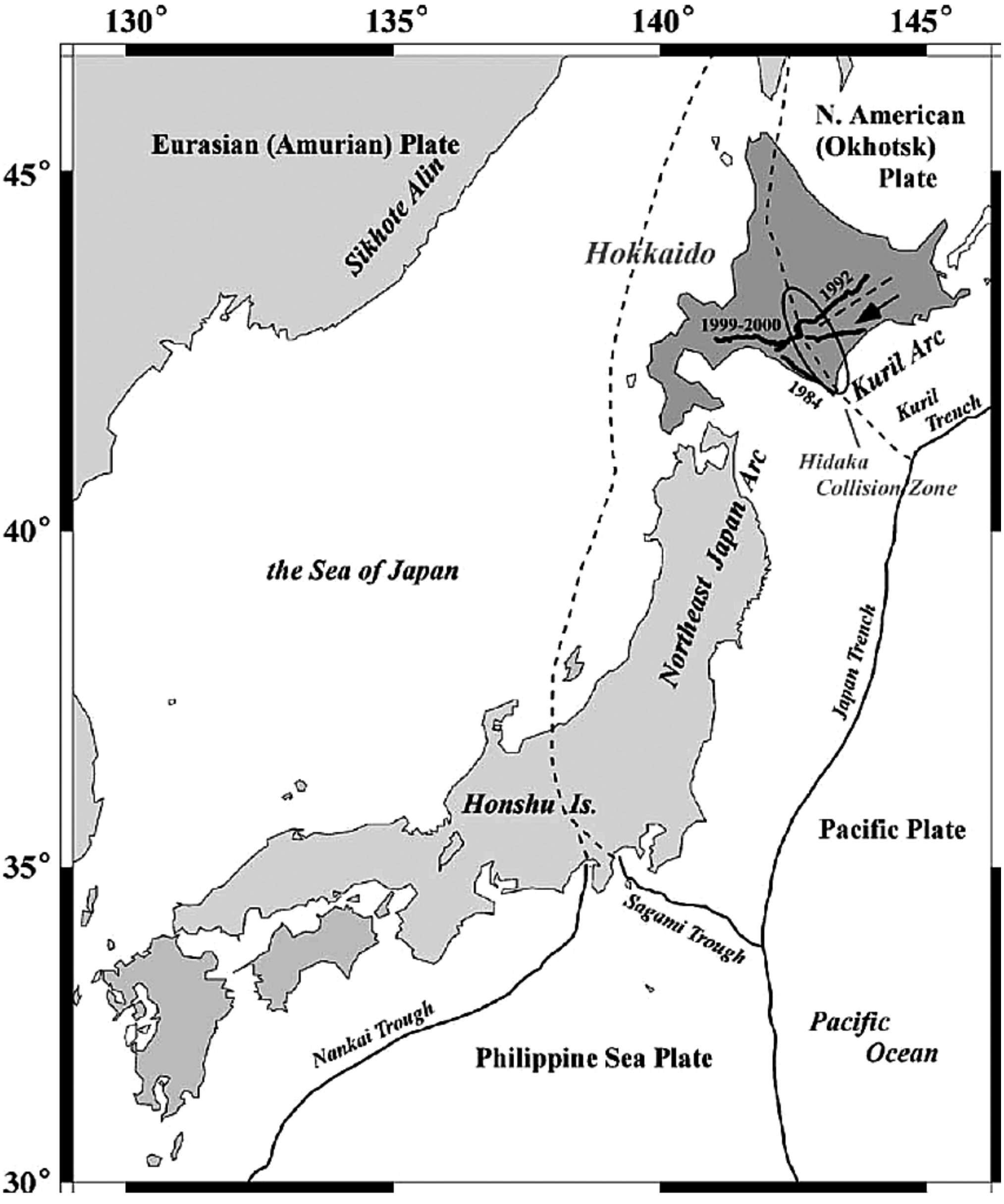
Source : Adapted from IEA, 2016

In 2015, Japan used 436 million tons of oil equivalent (Mtoe), spending at least JPY 40 trillion (USD 360 billion), about 8% of Japan's GDP, on fuel and ancillary costs. Japan's power market was the world's fourth largest in 2015, consuming 921 terrawatt hours and JPY 20 trillion (USD 180 billion) in sales (Enerdata, 2016). **Table 1** shows that in 2015 Japan relied almost exclusively on oil, coal, and LNG for generating power, moving vehicles, producing industrial heat, and other purposes. Japan also imported virtually 100% of the oil, coal, and natural gas it consumed in 2015, making it extremely vulnerable to geopolitical and depletion risks. Reflecting its economic size and extreme dependence on energy imports, Japan was the world's largest importer of LNG and the third largest importer of coal and oil in 2015 (EIA, 2017).

Geology also makes Japan an outlier, in terms of the variety and scale of natural hazards its communities and critical infrastructure confront. The country is essentially a 3,500 kilometer-long, narrow and highly seismic archipelago, an "island arc" of material thrust up from the often violent interaction of four tectonic plates. Japan represents only 0.3% of the terrestrial surface, but is the site of roughly 20% of the world's large earthquakes and 10% of the most active volcanoes (Neall and Trewick, 2008). Japan's sinuous archipelago is marked by a spine of comparatively high mountains running its entire length, and mountainous terrain in fact covers 72% of the country's surface.

Along with seismic threats, water is also prominent on Japan's long list of hazards. Japan's annual precipitation averages 1,690 mm, twice the global average of 810 mm[1]. A lot of rain in such mountainous terrain necessarily leads to rivers; and steep

1) The data are available (in Japanese) on page 2 of the Ministry of Land, Infrastructure and Tourism internet resource "The Status of Water Resources in Japan," available at the following URL: http://www.mlit.go.jp/common/001177455.pdf



Source：Iwasaki, et al, 2004

Figure 1 Seismic Map of Japan

rivers, because no point in the entire archipelago is more than 150 kilometers from the sea. Japan's longest and largest river―the Shinano―runs a mere 367 kilometers, and yet along that distance it plunges a precipitous 2,475 metres. Japan's rivers are in fact more akin to waterfalls than waterways, because they deliver bursts of water.

Indeed, the ratio of Japanese rivers' maximum to minimum discharge (the river regime coefficient) is between 200 and 400, or about 10 times greater than continental rivers (Hayashi, 2010: 123). As a result, Japan's governance has long been focused on controlling water, to alleviate the threat of floods, ensure adequate water flows for

Table 2 Natural Hazard Risk Index for Megacities

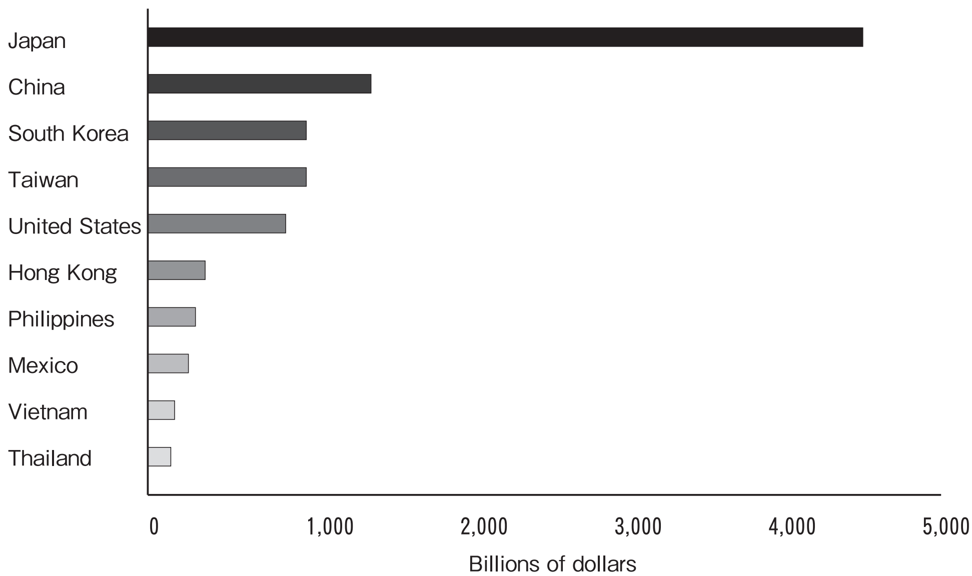
Megacity*	Population* (millions)	Total risk index	Risk index components		
			Hazard	Vulnerabilty	Exposed values
Tokyo-Yokohama	34.9	710.0	10.0	7.1	10.0
San Francisco Bay	7.3	167.0	6.7	8.3	3.0
Los Angeles	16.8	100.0	2.7	8.2	4.5
Osaka-Kobe-Kyoto	18.0	92.0	3.6	5.0	5.0
Miami	4.1	45.0	2.7	7.7	2.2
New York	21.6	42.0	0.9	5.5	8.3
Hong Kong-Pearl River	14.0	41.0	2.8	6.6	2.2
Manila-Quezon	14.2	31.0	4.8	9.5	0.7
London	12.1	30.0	0.9	7.1	4.8
Paris	11.0	25.0	0.8	6.6	4.6
Chicago	9.4	20.0	0.8	5.6	4.4
Mexico City	25.8	19.0	1.8	8.9	1.2
Washington-Baltimore	7.9	16.0	0.6	5.4	4.4
Beijing	13.2	15.0	2.7	8.1	0.7
Seoul	21.2	15.0	0.9	7.2	2.2
Ruhr area	9.6	14.0	0.9	5.8	2.8
Shanghai	14.2	13.0	1.1	7.0	1.7
Randstad	8.0	12.0	0.9	5.6	2.3
Moscow	13.2	11.0	0.7	8.7	1.8
Frankfurt am Main	5.0	9.5	0.7	5.9	2.3
Milan	4.0	8.9	0.6	6.7	2.2
Santa Fe de Bogotá	7.7	8.8	1.9	7.3	0.6
Dhaka	11.3	7.3	4.8	9.6	0.2
Sydney	5.0	6.0	0.6	9.1	1.1
Mumbai	18.2	5.1	0.8	8.6	0.7
Sydney	5.0	6.0	0.6	9.1	1.1

*Relates to the entire agglomeration in each case (i.e. includes adjacent towns and cities)
Source : Munich Re Foundation, 2007

rice-growing, and to generate power (Yamaoka, 2014: 26-70).

Climate change ramps up the urgency in Japan's perennial struggle with water. One reason is that climate change involves not only rising sea-levels, but also the "death of stationarity" in the hydrologic cycle (Milly et al., 2008). This end of stationarity means that past patterns of precipitation are no longer a reliable indicator of the future. That creates great uncertainty in constructing and managing critical infrastructure. In Japan, the increasingly warm and moist atmosphere delivers more intense downpours of rain and snow, worsening the country's already severe risks of floods and other disasters. At the same time, 50% of the Japanese population and 75% of national assets lie within alluvial plains that compose on 10% of the country's terrain (Fudeyasu, 2016; Mochizuki and Ueda, 2003: 2). These facts compel Japanese policymakers to bolster the resilience of energy systems and other critical infrastructure (JSBC, 2016: 7).

There are two very salient reasons to underscore the multiplicity of intensifying hazards impacting Japan's built and natural environments. One reason is that these hazards are considerably worse than those confronting Japan's peer countries. For example, as displayed in **table 2**, the Tokyo-Yokohama city-region's natural-disaster threat (a measure of hazards, vulnerability and potential costs) has been assessed as



Source：Spross, 2014

Figure 2 Projected Losses from Increased Storm Strength by 2090

710 by re-insurance Munich Re Group (Voss, 2006), compared to 167 for San Francisco, 42 for New York, and 15 for both Seoul and Beijing. Moreover, the US National Bureau Economic Research quantifies Japan's risk from typhoon damage alone, from 2014 through to 2090, as USD 4.4 trillion. As is evident from **figure 2**, that level of potential losses is just over half of the projected global total of USD 9.7 trillion (Hsiang and Jina, 2014). And these results, indicating a very high level of risk for Japanese cities, are consistent with similar and more recent comparative surveys, including the Lloyd's City Risk Index 2015-2025[2].

The second reason to highlight hazards is that Japan's post 3-11 energy policy does, within a larger paradigm of "National Resilience." Japanese policymakers recognize that the failure to bolster resilience in the face of the country's severe hazards risks cascading failures. One strikingly consistent theme in Japanese national and subnational resilience reports is that—in addition to its disaster risks—Japan is the developed world's most rapidly ageing and fiscally stressed country. The combination of vulnerabilities means that failure to prepare in advance could leave the national and regional communities with diminishing capacity to recover from the inevitability of future costly disasters. Policymakers also argue that taking action, particularly on building resilient critical infrastructure and distributed energy, is an avenue to sustainable domestic growth and productive external engagement (Kashiwagi, 2016).

Japan's Energy Policy History

Japan's story of energy-policy integration starts in the 1870s, shortly after the 1868 founding of the Meiji state ended the feudal era. Coal was the crucial fuel and feedstock, and hence "the first business of the Japanese state" (Samuels, 1987: 68). Intent on fueling industrialization, the Japanese state undertook direct regulation of the coal industry in 1870, nationalizing it in 1872 (Nester, 1991: 126). The state then privatized the mines in the 1880s, opting to regulate an industry that had become robust enough to supply domestic demand and provide export revenues into the 1920s (Iwama, 2011).

From the 1930s, Japanese energy policy shifted. It became increasingly interventionist to support a belligerent foreign policy. The coal industry was cartelized and

2) The Lloyd's City Risk Index 2015-2025 is accessible online at: https://www.lloyds.com/cityriskindex/

Table 3 Changes in Japan's Primary Energy Supply Share, 1940–2014

(Units: %)

	Coal	Oil	Gas	Hydro	Nuclear	Renewable
1940	66.4	7.1	0.1	16.0	0.0	10.4
1950	51.5	6.3	0.1	33.0	0.0	9.0
1960	41.2	37.6	0.9	15.7	0.0	4.6
1970	21.3	69.9	1.3	6.0	0.4	1.1
1973	15.5	75.5	1.6	4.4	0.6	1.0
1980	17.6	64.7	6.4	5.4	4.9	1.1
1990	17.3	56.6	10.6	4.4	9.8	1.4
2000	17.8	49.9	13.7	3.6	12.9	1.4
2010	23.2	41.2	18.6	3.5	11.8	1.7
2013	25.8	43.9	24.1	3.5	0.4	2.3
2014	26.3	42.0	25.1	3.6	0.0	3.0

Source：Adapted from EDMC, 2016：pp. 38, 316

output expanded (Nester, 1991: 127). But Japan's growing appetite for oil, critical to military mobility, depended on imports from America. Japan's desperate gamble to seize alternatives, in the Dutch East Indies and elsewhere, became the primary driver of the December 7, 1941 attack on Pearl Harbor and ensuing Pacific War. With the August 15, 1945 surrender, less than four years after the attack on Pearl Harbor, the country lay in ruins and most of its merchant tanker fleet at the bottom of the sea. What endured was wartime centralization of the energy economy and a deeply embedded emphasis on "comprehensive security" (Samuels, 1998: 48).

Japan's immediate postwar prostration compelled policymakers to deepen the links between energy and industrial policy. **Table 3** shows that coal supplied over 66 percent of energy supply in 1940. But by late 1945, coal output was below one-fifth of pre-war levels. The threat of economic collapse was dire (Johnson, 1981: 181).

Leading energy policy entrepreneurs took action that powerfully shaped policymaking and the political economy. One prominent figure was Tokyo University Marxist economist Hiromi Arisawa, chair of the Coal Committee. In 1946, Arisawa and his colleagues elaborated a "Priority Production System" (PPS), the "first modern Japanese industrial policy" (Gao, 1997: 137–139). Between 1947 and 1949, this highly interventionist strategy "integrated business, bureaucratic and labor concerns" in a pragmatic compromise that entrenched long-term planning in energy policymaking (Hein, 1990: 8). The PPS ramped up domestic coal production for the steel industry, stinting on supplies for transport, households and other sectors. More steel increased the tools for extracting yet more coal, in a reciprocal cycle of capacity expansion. The policy's ambit was then enlarged to include more industries, such as electricity generation.

Yet oil fueled postwar Japan's economic miracle. Japan's energy policy was initially reluctant to embrace oil at the expense of coal, particularly domestic coal. But oil was not only increasingly cheap; it was also plentiful and convenient. By the mid-1950s, oil was also recognized as critical to further growth (Kobori, 2009: 10). Moreover, oil was carried in tankers protected by the overwhelming military supremacy of Japan's American ally, thus alleviating the geopolitical anxiety. Japan's policymakers collaborated on energy and industrial policy, building an energy-intensive, heavy-industry export economy based on oil (Stewart, 2009: 178). **Table 3** shows that in 1948, oil provided 4.6 percent of Japan's primary energy, far less than the 11.1 percent share of that era's "renewable" energy from firewood. Yet by 1970 oil's share had rapidly escalated to just under 70 percent, and then peaked in 1973, at 75.5% of primary energy.

Then in mid-October of 1973, OPEC initiated the oil shock of price increases and embargoes. The crisis hit Japan especially hard, as it was dependent on OPEC for 92.9% of its oil imports. In consequence, Japan's energy policy and policymaking institutions changed with great haste. Industrial and energy policy coordination, between the state and business, saw Japan emphasize energy efficiency and aggressive diversification. The production of energy-intensive inputs was shifted overseas while the country's industrial economy climbed the technological ladder. Dependence on OPEC (and especially Mid-East) oil was cut wherever possible. Legislative changes also encouraged the substitution of oil through coal, natural gas and nuclear energy.

Many of these policies were developed in collaboration between business groups and METI's Agency for Natural Resources and Energy. The Agency was established in 1973, just before the oil shock. During the protracted crisis, it became the "main vehicle" through which the Japanese state worked with domestic oil, gas, nuclear and other interests to respond to the crisis (Samuels, 1998: 49). New institutions, including the New Energy and Industrial Technology Development Organization (NEDO), were also established to build on earlier programmes and foster efficiency as well as the development and deployment of solar power and other renewable energy (Stewart, 2009: 178–82).

The collaboration had powerful consequences. **Table 3** shows that oil's role in Japan's primary energy mix declined from 75.5 percent to 56.6 percent between 1973 and 1990. Over the same period, reliance on coal increased from 15.5% to 17.3%. Most striking is that natural gas and nuclear energy both went from being marginal sources, respectively 1.6% and 0.6%, to each contributing roughly one-tenth of primary energy supply.

Oil prices declined from the mid-1980s, as non-OPEC supplies proliferated. Yet the experience of supply and price shocks continued to reverberate in Japan's energy policy circles. The policy entrepreneurs who profited most represented a growing "nuclear village" of monopoly utilities, power-unit makers (Hitachi, Toshiba, Mitsubishi), compliant regulators, collaborative academe, cooperative media, and other players (Kingston, 2012; Samuels, 2013: 118–122). This nuclear village became a central actor in the national policy of displacing imported oil through maximizing domestic energy self-sufficiency. The intensity of Japan's nuclear effort, and thus the village's influence, is evident in the Japanese state's striking use of fiscal and regulatory tools to develop and deploy nuclear power following the first oil shock.

Table 4 affords one indicator of Japan's heavy investment of fiscal and other resources to nuclear fission RD&D. The table compares Japan's investment with other International Energy Agency (IEA) member countries in the wake of the first oil shock and up to 2014. The IEA was formed in November of 1974, by oil-consuming OECD countries, and Japan quickly became one of its most avid members. The table shows that in 1975 Japan's nuclear RD&D was less than that of Germany the UK, and the USA. Yet in a decade, Japan's effort had more than tripled, and greatly out-

Table 4 Nuclear Fission RD&D Expenditures by IEA Countries, 1975–2014 (2014 USD million)

	UK	France	Japan	USA	Germany	Total IEA
1975	1,027	0	682	2,533	1,246	6,416
1985	702	1,071	2,139	1,462	1,078	8,695
1995	19	729	2,363	121	105	3,803
2000	0	812	2,283	46	37	3,468
2005	5	682	2,307	565	33	4,221
2010	31	530	2,124	503	101	3,936
2014	N/A	N/A	1,145	370	101	1,864

Source: IEA Energy Technology RD&D Statistics paced all other IEA members. A decade later, in 1995, Japan represented 62 percent of all IEA spending on nuclear fission RD&D, a figure that had only declined to 54 percent in 2010, just before 3-11. The data show that Japan's RD&D spending on nuclear in fact rose to 61 percent of all IEA spending in 2014, after 3-11. But the focus of much of this RD&D had turned to plant safety, decommissioning, nuclear waste management, and related research.

Nuclear and the Energy-Environmental Policy Regime

Japan's massive investment in nuclear energy made that technology the pillar of its energy policy, placing the nuclear village at the core of energy policymaking. Nuclear energy came to be seen as crucial to addressing a range of externalities. These included achieving greater energy autonomy, reducing power costs, creating a buffer against price volatility, alleviating geopolitical risks, building a competitive infrastructure export sector, and bolstering environmental credentials. Perhaps the most ambitious and authoritative expression of the nuclear paradigm and its goals can be found in the October 16, 2008 "2100 Nuclear Energy Vision: A Proposal for a Low-Carbon Society," by the Japan Atomic Energy Agency (JAEA). The JAEA vision projected a halving of the Japanese population to 64 million, a decrease of 42% in final consumption, an increase in the economy's electrification from 24% to 62%, and a decline in fossil fuel use from 75% of primary energy to 28%. The role of nuclear in primary energy would rise from roughly 10% in 2008 to 60% in 2100, and CO2 emissions were projected to decline by 90% (JAEA, 2009). This JAEA vision was drawn up as part of the METI Cool Earth 50 energy innovation technology plan in 2008. While the JAEA vision never became official policy, Japan's nuclear strategy was leading in that direction prior to 3-11.

Centred on nuclear energy, Japan's energy policy became even more closely bonded with industrial and environmental policy. Japan's first comprehensive energy-environmental policy was implemented via the Basic Act on Energy Policy, which came into force in June of 2002. The Basic Act broadened the earlier emphasis on energy security with concerns for the environment and economic efficiency (Toichi, 2002). The policy was clearly designed to increase the fiscal and other resources devoted to nuclear energy, which had achieved a 39 percent share in Japan's power generation by 2001.

Japan's 2002 policy also created the legal authority to draft a "Basic Energy Plan" (*kihon enerugii keikaku*). This strategic planning exercise was to be a comprehensive and long-range assessment of energy supply and demand, led by the Ministry of Economy, Trade and Industry (METI). The plan was to be revisited and, if necessary, revised at least every 3 years. Its first version was adopted in October of 2003, and emphasized the role of nuclear power as clean, secure and reliable energy whose safety and public support required significant effort.

The core concern of the 2002 Basic Act on Energy Policy, and the triennial Basic Energy Plans it mandated, remained security of resource supply. This was coupled with as much efficiency, reduction of economic cost and minimization of environmental impact as were perceived feasible in light of increasingly challenging terms of trade for Japanese automobile, steel, cement and other energy-intensive manufactures. There was no specific focus on resilience in the face of disasters. Incorporating resilience was a policy evolution that would emerge after 3-11.

As the 2000s progressed, rising conventional energy prices coupled with geopolitical turmoil exacerbated energy insecurity. Japanese policymakers became increasingly concerned at the prospect of competition for energy resources from the rapidly growing and heavily populated Chinese, Indian and other developing economies of the Asian region. In May of 2006 Japan thus drafted a New National Energy Strategy (*shin kokka enerugii senryaku*) focused on energy security, compiling a "Nuclear Energy National Plan" (*genshiryoku rikkoku keikaku*) in August of 2006 (Kikkawa, 2011: 59).

The core aspect of the 2006 nuclear-energy policy was its clear commitment to 13 new nuclear reactors at existing and greenfield plants by 2030, while raising the capacity utilization ratio of existing nuclear reactors from 60 percent to 90 percent. These ratios had plummeted in the early 2000s due in part to a string of scandals concerning falsified damage reports and safety violations at nuclear facilities. Nuclear was slated to be between 30-40% of power production by 2030. The strategy also aimed at greater efficiency, reduced oil dependence, and increased use of renewable energy for local self-sufficiency.

In June of 2010, less than a year before 3-11, Japan adopted the even more ambitious "Basic Energy Plan 2010." The new plan aimed at cutting reliance on fossil fuels by getting 53 percent of Japan's electricity from nuclear power by 2030, compared to 26 percent in 2010. Realizing that scenario was estimated to require 9 additional nuclear reactors by 2020 and more than 14 by 2030. The focus of energy policymaking was clearly moving in the direction of the JAEA's 2008 "2100 Nuclear Energy Vision."

The 2010 Basic Energy Plan also included targets for conservation and renewable energy. Both of these technological areas had strong advocates in policymaking as well as in industry, dating from the oil shocks. But they were overshadowed by the emphasis on nuclear energy. Even so, Japan's potential in these fields was evident in the 2010 Basic Energy Plan's goal of making LED lights 100 percent of the lighting sales market by 2020 (and 100 percent of all lighting by 2030), increasing renewables (including hydro) to 21 percent of power by 2030, diffusing electric and other second-generation cars to 50 percent of new-cars sales by 2020 (and 70 percent by 2030), and making all new homes net-zero energy by 2030. Moreover, after 3-11, conservation and renewable energy reemerge forcefully, and at the forefront of a rethink of the role of disaster resilience and spatial planning in energy policy.

The 3-11 Disasters and Energy Crisis

The details of 3-11, history's costliest natural and nuclear disaster, have been recounted and extensively examined in a wide range of Japanese and international studies (Baldwin and Allison, 2015; Kingston, 2012; Samuels, 2013). The natural disaster resulted from a magnitude 9.0 earthquake, the largest ever recorded in Japan. It struck at 2:46 pm on March 11, 2011, 130 kilometers east of Sendai City and at a depth of 24 kilometers off the Pacific coast. The seismic shock was severe enough to move the Japanese main island of Honshu 2.4 meters to the east. Roughly half an hour later, it was followed by tsunami waves that caused 15,894 deaths, left 2,558 missing, and 6,152 injured. Over 120,000 buildings were completely destroyed, and a further 1 million structures at least partially destroyed. Damage to all critical infrastructure was also very extensive, with reconstruction expected to cost over JPY 26 trillion. The natural disaster also had cascading effects that included a nuclear disaster, one that appears likely to cost well in excess of JPY 10 trillion once clean-up, compensation, decommissioning and other costs are totaled up (Kushida, 2016). For our purposes here, the crucial aspects are that the shock of 3-11 disrupted the 2010 energy policy, put disaster resilience at the centre of technocratic concerns, and opened up the possibility to radically reconfigure the state and the role of energy policy.

The natural disaster dominated initial coverage of 3-11, with iconic images of roiling black waters overtopping seawalls. But attention soon turned to the nuclear crisis that ensued in the days after the massive tsunami waves struck Fukushima Daiichi and other nuclear plants (Fukushima Daini, Onagawa and Tokai Daini) on Japan's Northeast coast. All operating reactors had successfully shut down at the earthquake's impact, but nuclear plants require continued power supplies in order to cool the fuel in reactors and spent-fuel pools. That need for continued power was not met at Fukushima Daiichi, where three of the plant's six reactors were running (units 4, 5, and 6 were in maintenance mode).

Fukushima Daiichi's lack of power to cool shut-down reactors had two causes. One was that the earthquake had damaged relevant critical infrastructures including the main power grid, transformers and transport networks. The second was that back-up diesel power generators were installed in basements and other vulnerable areas (Kushida, 2016). There were a total of 33 back-up diesel generators at the four nuclear facilities on the Pacific coast, and fully 22 of these were washed away or otherwise put out of operation. Of the 13 back-up generators at the Fukushima Daiichi site, 12 were rendered useless by the 14-meter waves that hit the site. They were thus unable to provide the electric power needed to drive the pumps and other elements of the reactor cooling systems. This cascading failure quickly led to reactor meltdowns at units 1, 2 and 3, making history (Ragheb, 2016; Synolakis and Kanoglu, 2015).

A 2015 review of earlier research on the nuclear disaster determined that it stemmed from a failure to appropriately model tsunami hazards in light of available evidence. Analysts pored over "the thousands of pages" of post 3-11 reports compiled by Japan's National Diet, Tepco (the regional utility), the US National Research Council, the US Nuclear Regulatory Commission and other agencies, and found them all in error: "Conspicuously missing in all of them are analyses of the pre-event tsunami simulations or any analyses of what an appropriate tsunami hazards study should asymptote to" (Synolakis and Kanoglu, 2015). In other words, had the tsunami hazard been assessed on the basis of the best available data, sufficiently resilient critical infrastructure (especially better-positioned back-up generators) would have been in place and there would have been no meltdowns. Japan's post 3-11 energy policymaking would surely have been very different.

However, the 3-11 nuclear disaster did happen, and it quickly came to be interpreted as evidence of the inherent risk of nuclear power. The anti-nuclear narrative came to dominate the discussion, in the media as well as much of academe. The narrative certainly swamped the nuclear village. Responding to public outrage at the scale of the nuclear disaster as well as Tepco's secretiveness, then-Prime Minister Kan Naoto (leading a Democratic Party of Japan government) ordered that stress tests be conducted at all of Japan's nuclear facilities. Those orders were followed by a raft of other measures aimed at rectifying regulatory capture in the highly monopolized power sector. In addition, the world's highest rates of feed-in tariff subsidy for solar and other renewables were implemented in July of 2012, something the utilities had fought for years (DeWit and Iida, 2011).

In short, the collusive structure of energy policymaking came undone. The disaster's larger context, including Japan's prolonged economic malaise, "turned a once technical subject relegated to a select few market participants into a broader political discussion involving suppliers, consumers, new entrants, politicians, bureaucrats, and academics" (Scalise, 2013: 101).

The crisis encouraged a profound transformation in energy policymaking—particularly in the power sector. It went from being very technocratic and corporatist, with marked regulatory capture and minimal input from civil society, to a much more inclusive process. The formerly closed and tightly networked, technocratic institutions were compelled to admit broader participation from previously excluded central agencies and local governments, the business community and civil society. Even the December 24, 2012, return to power of the Liberal Democratic Party (LDP), under the unabashedly pro-nuclear Prime Minister Abe Shinzo, did not lead to the revanche of the old regime.

To be sure, the LDP removed the most outspokenly anti-nuclear activists from energy- and environment-related committees. The anti-nuclear forces then became powerfully incentivized to represent energy policymaking under the LDP as a return to the pre 3-11 status quo, and were quite successful in advancing that narrative internationally. In 2016, Japan was depicted as abandoning renewable energy in favour of nuclear restarts and coal (Beade, 2016; German Watch, 2016). But in fact, the power economy's core vested interests—especially Tepco and the nuclear village—had thoroughly discredited themselves and lost their dominance. Their reluctant disclosures of crucial information, the visible ruins at Fukushima Daiichi, and the corrosive fear of radiation led to very adverse public opinion. This distrust of nuclear power persisted for years and seemed unlikely to abate. Public sentiment became a powerful check on nuclear restarts and efforts to maintain the monopolized status quo. Moreover, there was also a broad pragmatic coalition in favour of reform of the centralized power paradigm. These policymakers' influence vis-à-vis the monopolies was greatly strengthened by Tepco's July 25, 2012 receipt of a capital injection of JPY 1 trillion (Okamoto, 2016).

In consequence, Japan's energy policy regime saw reforms that would have been politically impossible prior to 3-11. Energy policy came increasingly to be shaped in an array of institutions within the central government as well as at the subnational level. Moreover, the regulatory, fiscal and other arms of energy policy were extensively revised. For one thing, the September 19, 2012 inauguration of a new regulatory agency (the Nuclear Regulation Authority) and stricter regulatory standards saw prolonged shutdowns of nuclear assets. On the regulatory front, the April, 2015 institution of the Organization for Cross-Regional Coordination of Transmission Operators launched a 5-year, step-wise programme of deregulating all power markets (along with gas and district heating systems), to be capped by a complete unbundling of power generation, transmission and distribution by 2020. Deregulation of the retail power market from April 1 of 2016 saw the number of new power firms increase from 57 in August of 2015 to 301 by May, 23 of 2016 (METI, 2016b). By the end of August, 2016, 2.7% of consumers nationwide had cancelled contracts with the major utilities in favour of new power firms (*Nishi Nippon Shinbun*, October, 7, 2016).

After an initial period of stasis, from 2011 to 2013, during which the nuclear village sought to regroup and restart assets amid unrelenting public opposition, energy scenarios also became increasingly more dynamic. Japan enacted a new long-term Basic Energy Plan in April of 2014, and in June of 2015 reaffirmed it as the bedrock of its environmental policy, adding explicit targets for the country's 2030 power mix. The most notable of these targets was the revised aim to secure 20-22% of power generation from nuclear energy, illustrated in **table 5**. This new target was a profound retreat from the over 50% reliance on nuclear envisioned in the 2010 Basic Energy Plan. Moreover, the new target was recognized to be fluid, as most expert observers believed Japan would have trouble reaching even 10% nuclear in its power mix by 2030. Japan's nuclear paradigm faces multiple political and legal difficulties, the ageing of installed nuclear assets, and other factors (Economist, 2016; Greenpeace, 2016). Indeed, one of Japan's formerly quite pro-nuclear energy experts publicly pointed out that that the Energy Plan's targets reflected furious lobbying by the nuclear village rather than an objective assessment of Japan's best options on energy

(Kikkawa, 2015).

Table 5 Comparing Japan's Proposed 2030 Power Mixes, 2010-2015

(Units: %)

2010 Basic Energy Plan		2014-15 Basic Energy Plan	
Nuclear	53	Nuclear	20-22
Coal	11	Coal	26
LNG	13	LNG	27
Oil	2	Oil	3
Hydro	11	Hydro	8.8-9.2
Renewable	10	Renewable	13.4-14.4
Total Generation (billion kWh)	1,020.0	Total Generation (billion kWh)	980.8

Source : IEA, 2016

Comparing the Oil Shocks and 3-11

The massive and comparatively rapid changes in Japan's energy policy after 3-11 are somewhat reminiscent of the significant changes that followed the oil shocks. Both crises were rooted in the powerful commitment to a particular energy source, and both required decisive action. They also mark significant ruptures in the political economy.

But there are also profound differences between the two periods of crisis, and these are critical to understanding the evolution of policymaking. One contrast is the post 3-11 lack of consensus, whereas in the mid-1970s, a broad business and societal consensus soon emerged. Most actors in government, business and civil society could agree on the need to reduce the over-reliance on imported oil. Oil supplied three-quarters of Japan's primary energy, an extreme level that most observers could agree had to be reduced. Oil's geopolitical risks and pecuniary costs were rising, and the environmental impact of burning oil to generate power had elicited opposition from women's groups and other elements of civil society since the late 1940s. Moreover, Japan was also not a significant oil producer, whether at home or through investment abroad. Most of Japan's oil demand was serviced by global majors, and the Japanese oil firms were deliberately fragmented in order to foster price competition (Duffield, 2015: 198). Hence, ratcheting down reliance on imported oil did not pose a major threat to a powerful domestic industry. Japan's energy policy changes included turning to alternative fuels, such as coal, LNG and nuclear, whose exploitation offered opportunities to other Japanese firms. Japan's "resource diplomacy" also led to enhanced opportunities for Japanese businesses. On top of that, Japanese businesses were soon finding new markets through energy-efficient vehicles and other manufactures (Vivoda, 2014: 44-8). Japan's energy demand was also growing, making energy policy a matter of allocating shares in an enlarging pie. The post-oil crisis was thus a positive-sum game in which the state and capital were able to collaborate on industrial policy, and civil society's preferences were not especially obtrusive.

Post 3-11 energy politics and political economy offered a sharp contrast. We have seen that regulatory changes and outraged public opinion led to a rather abrupt de-facto withdrawal from virtually all nuclear generation. Civil society's opposition to nuclear offered the prospect of a new consensus, but inadequate grounding for a new energy-centred industrial policy. There was much enthusiasm for an "energy shift" to renewables, patterned on Germany's *energiewiende*. But there was surprisingly little critical analysis of how the Japanese archipelago's profound differences in geography, infrastructure, institutions, resource endowments and other critical variable might require equally divergent governance mechanisms.

And post 3-11 Japan's abrupt withdrawal from nuclear was quite unlike gradually ratcheting down the country's reliance on oil. Unlike oil, Japan's nuclear industry was domestic (if one overlooks imports of nuclear fuel), concentrated, and struggling to survive. As of May 2017, the industry possessed 42 viable nuclear reactors, of which only 4 were in operation. Among other assets, the industry held extensive manufacturing capital in the power-unit producers (Toshiba, Hitachi, Mitsubishi, and related firms) and a vast network of research and development institutions. In terms of human resources, the industry employed 47,757 people in FY 2014. Of this total, 12,420 worked for the utilities and 35,337 were employed at mining and manufacturing firms. These numbers are also relatively stable. Total employment in 2014 was down by 2% from the previous year, but in fact registered a slight increase compared to annual figures for total employment dating back to 2009. As to business scale, the utilities' expenditures on nuclear totaled JPY 1.7 trillion in 2014, while in the same year mining and manufacturing firms spent JPY 1.75 trillion (Miura, 2015).

The above list hardly exhausts the factors underpinning the political difficulty of post 3-11 policy choices. Additional factors include the major utilities' business models: they were dependent on restarting at least some of the 42 viable reactors to achieve profitability, particularly in the face of mounting competition as power de-regulation unfolded. The utilities had indeed bet heavily on restarts. As of March, 2016, they had spent approximately JPY 3.3 trillion on upgrading their nuclear reactors, seeking to comply with new safety regulations (*Nihon Keizai Shimbun*, March 12, 2016).

Japan's energy demand was also not growing. Japan's demand for oil, coal and other forms of energy peaked in 2009, in a sharp rebound from the depths of the 2007-08 global financial crisis, and has been in decline since. Declining energy consumption means a zero-sum game for interests in the energy and power markets.

Added to the above, post 3-11 Japan's abrupt, de facto withdrawal from nuclear power led to enormous increases in fossil fuel consumption. **Table 1** showed that in 2015 the share of nuclear power in Japan's primary energy fell essentially to zero. The result was less the explosion of renewable generation and efficiency confidently forecast by anti-nuclear activists, but rather a massive increase in the use of fossil fuels. In fact, Japan's dependence on fossil fuels rose from 80.9% of primary energy in 2010 to 93.7% in 2015, the highest level among members of the IEA. Moreover, CO2 emissions from Japan's power sector increased by roughly 25%, and power prices for households and businesses rose by 16% and 25% respectively. Making matter worse, over the same 2010-2015 period, Japan's dependence on imported energy rose from 80% to 94%. This outcome stemmed from both the loss of nuclear's role and the only limited gains made by renewable alternatives. According to the IEA's assessment, between 2010-2015 Japan's share of renewables (including hydro) increased only marginally, from 4% to 5.7% of primary energy (IEA, 2016: 9).

Moreover, Japan's nuclear industry was not only large, influential and domestic; it was also the core of industrial policy. It was nurtured through massive investments of public resources and for strategic purposes. Displacing it, particularly while pursuing meaningful environmental goals, would require an entirely new paradigm of policymaking. That paradigm would have to put alternative sources of energy within the embrace of collaborative governance, a governance empowered to act quickly and on a large scale. Getting there would require vision, skillful leadership and political stability, qualities post-bubble Japan was not noted for. Without strong leadership in energy policy, desperately competing demands can overwhelm the capacity for long-term planning. As we shall see below, "smart energy" policy entrepreneurs moved into the analytical void.

Japan's dramatic revision to the 2030 nuclear targets in its 2014-15 Basic Energy Plan was a political compromise rather than leadership. We have sketched the contending forces underlying the compromise, and how the zero-sum game after 3-11 differs from the positive-sum game after the oil shocks. After 3-11, Japan's energy policymakers clearly sought to find some stable ground between public outrage, the perceived needs of the power sector, and the opportunities for the larger political economy. It is hardly surprising that policymakers' targets for nuclear and renewable energy were not a credible assessment of dynamic developments in politics, technology, costs, climate, and other applicable variables.

But the political compromise written into the 2014-15 Basic Energy Plan was clearly unsustainable. Japan's energy economy was increasingly critical to its growth and innovation strategies. The country also had limited endogenous conventional resources and no international power-trading infrastructure, making it very different from the German and the Anglo-American cases that observers tend to offer as models. In other words, Japan lacked some of the essential networks, resource endowments and other advantages for managing intermittent renewable power via international trading networks or simply muddling through with "all of the above." Indeed, Japan had even limited power-trading capacity among its pre 3-11 monopoly domains, due to separate frequencies in the west and east and limited transformer capacity (Stone, 2016). Hence, the projected relative shares of fossil fuels, nuclear, renewables, and efficiency were a vital question.

The Overlooked Impact of Resilience

Throughout 2016, most accounts of Japan's energy policy centred on the 2014-15 Basic Energy Plan. The Plan was not credible, and the government seemed unable to act decisively in the short run to change an energy mix that had become even more dependent on fossil fuels. The anti-nuclear activists and academics derided the energy policy as biased towards nuclear restarts and coal. In turn, the pro-nuclear forces dismissed renewables as intermittent and expensive. Yet both the pro-renewable and pro-nuclear interests were fighting each other over marginal shares of the power market. The lion's share of power was actually being generated by LNG and coal, and fossil fuels were. Indeed, the supporters of LNG looked to pipeline deals with Russia and renegotiated purchase contracts as part of an ambition to make Japan an LNG trading hub (Negishi, 2016). At the same time, the coal interests were intent on maintaining their edge in ultra-supercritical technology over China and other competitors, while also pushing for even greater investment in carbon capture and storage.

The confused state of affairs left even expert observers in the International Energy Agency (IEA), in their 2016 survey of Japan, to recite the content of the 2014-15 Basic Energy Plan and its questionable ambitions. Like investors and environmentalists, the IEA appear to have been transfixed by inputs in the power mix. Whatever the cause, the IEA report paid only scant attention to policy entrepreneurs' resilience paradigm. Yet the EIS had already become de facto policy for restructuring the Japanese energy economy (IEA, 2016).

We have seen that the 2014-15 Basic Energy Plan was a tentative compromise, and that few observers found it credible. But Japanese energy policymakers were compelled to act in the face of multiple externalities. And they did act, using the coordinating power of the state to inject the resilience paradigm into the fraught, post 3-11 politics. While the attentions of critics of Japan's energy policy, as well as observers from the various energy interests, were focused on the problematic 2014-15 Basic Energy Plan, there were significant developments underway elsewhere. One important policy change was METI's April 19, 2016 announcement of an "Energy Innovation Strategy" (hereafter, EIS). This policy was overlooked by the IEA and other observers. But the EIS emphasized deep efficiency (on par with the era of the oil shocks), renewable energy, and the restructuring of the energy system. It aimed at creating a JPY 28 trillion market in these items by 2030 (METI, 2016c).

As METI pointed out in the outline of the EIS, the policy was developed through extensive consultation with the business community's peak associations. The policy included a variety of new approaches to increase the diffusion of distributed-energy alternatives and efficiency. Reflecting the rise of post 3-11 collaboration, the EIS explicitly relied on a coordinated, strategic approach, rather than market mechanisms. Its governance included all levels of the state, business, academe, and civil society, and was backed up by ample fiscal and regulatory action. The policy also sought to exploit potential synergies between sectors. This approach included using local, distributed generation and transmission to encourage enhanced efficiency. It also sought to bring the "internet of things" directly into the energy economy, fostering even greater efficiencies and the uptake of an array of renewables and hitherto wasted heat. Moreover, the EIS expressly committed policy to diffuse smart communities throughout Fukushima Prefecture, a development that was in fact underway nationwide (DeWit, 2014a). This objective reflected an expanding policy of bolstering local government resilience through smart energy systems and their capacity to exploit local energy resources (METI, 2016a).

Many of the energy policymakers involved in designing the EIS were influential actors in the comprehensive resilience strategy that unfolded in Japan after 3-11. To understand the distinctively Japanese roots of this activist policy, it is important to return to 3-11 and recall that it was a *natural* as much as a *nuclear* disaster. And it was history's costliest natural disaster. The Japanese specialist community was primed to respond pragmatically to the natural disaster, as Japan is a global leader in disaster-reduction. Building resilience to climate change and myriad other hazards introduced earlier in this chapter had long been a concern for these technocrats. The shock of 3-11 gave Japanese policy entrepreneurs the legal and administrative infrastructure to undertake a "whole of government" approach to disaster-resilience planning, one that deliberately embraced energy policy. They began collaborating across policy domains, building powerful new institutions to facilitate this. The involvement of "smart community" energy experts in this initiative led to plans that put smart energy systems at the centre of building robust critical infrastructure. That is the paradigm being deployed, and the following sections describe its evolution.

Mainstreaming Disaster Resilience

Japan is a global leader in building the institutions and technologies of disaster resilience (Edgington, 2016). In our earlier review of hazards, we saw that Japan has always confronted earthquake, tsunami, flood, fire and other hazards. The country is populous, rich, and scientifically sophisticated, and has therefore developed considerable human and technical resources to cope with the hazards. Japan has also made disaster reduction a key avenue of external engagement. In fact, the 3rd World Conference on Disaster Risk Reduction (WCDRR) was held in Sendai City, at the centre of 3-11, from March 14-18 of 2015. The conference included over 6,500 participants from 187 member states, along with over 150,000 visitors[3]. It also agreed

3) An overview of the conference is available at the following United Nations Office for Disaster Risk Reduction website: http://www.wcdrr.org

on the Sendai Framework for Action, 2015–2030, to succeed the Hyogo Framework for Action, 2005–2015, decided at the 2nd World Conference at Kobe City in Hyogo Prefecture[4]. This framework in turn succeeded the more lengthily named 1994 "Yokohama Strategy for a Safer World: Guidelines for Natural Disaster Prevention, Preparedness and Mitigation and its Plan of Action." The Yokohama Strategy was decided by the 1st World Conference, held at Yokohama City[5]. The fact that all three sites for the world conferences on disaster reduction were in Japan, and that the frameworks are named after the Japanese sites, speaks to Japan's central role in international disaster-resilience initiatives.

Moreover, comparing the Hyogo and Sendai frameworks for action reveals the evolution of the disaster-resilience debate due to 3-11 and other events, coupled with the powerful Japanese role. The Hyogo Framework paid significant attention to the threat climate change posed to infrastructure. But the Sendai Framework builds on lessons learned during the Hyogo Framework's implementation, and goes many steps further. Stakeholder negotiations for Sendai Framework began in March of 2012, only a year after 3-11. The Sendai framework places special emphasis on the urgency of climate change and the vulnerability of people as well as critical infrastructure. Japan's proposals, incorporated in the framework, focused on the need for "prior investment," so as to build resilience in the face of multiple hazards and reduce their impact. Another of Japan's proposals was to refine the concept of "build back better" (as opposed to merely rebuilding), through such initiatives as widening arterial roadways for emergency vehicles as well as relocating communities threatened by tsunami, floods, or other hazards. Japan also emphasized the need for "mainstreaming disaster risk reduction," calling for a whole of government approach that makes coping with hazards a priority in all planning initiatives. Of great importance for any discussion of what happened in Japan, administratively, after 3-11, the Sendai Framework calls for "the full engagement of all State institutions of an executive and legislative nature at national and local levels and a clear articulation of responsibilities across public and private stakeholders, including business and academia, to ensure mutual outreach, partnership, complementarity in roles and accountability and follow-up" (UN, 2015:

4) An overview of the Hyogo Conference is available at the following United Nations Office for Disaster Risk Reduction website: https://www.unisdr.org/2005/wcdr/wcdr-index.htm

5) On the Yokohama Strategy, see the following United Nations Office for Disaster Risk Reduction website: https://www.unisdr.org/we/inform/publications/8241

13). The above items—from smart investment through to robust and inclusive governance—closely resemble the institution-building and programme-implementation that the "National Resilience" policy entrepreneurs are undertaking in Japan.

The Policy Entrepreneurs

The full account of how post 3-11 Japan came to institutionalize a resilience paradigm that embraces energy remains to be written, even in Japanese. But the broad outlines can be gleaned through reading the plans and budgets as well as the specialist debate. One of the most important post 3-11 policy entrepreneurs was Fujii Satoshi, an urban studies specialist at Kyoto University. Fujii's academic emphasis had long been on the need to reduce Tokyo's concentration of administrative and other functions via upgrading transport networks. He was a strong advocate of using public works to promote economic recovery (Fujii, 2010). In the wake of 3-11, on March 22, he gave a powerful talk to the Japanese Upper House Budget Committee[6], and outlined a programme of resilient reconstruction. He followed that up with several other talks as well as books, emphasizing the role of infrastructure as an opportunity for Japan to build resilience and return to a self-sustaining growth trajectory.

Fujii's activism was generally dismissed in academic and media circles as advocacy for a return to Japan's much-derided emphasis on public works. Japan has repeatedly been dubbed a "construction state", due to the use of public works in counter-cyclical fiscal policy as well as clientelist politics (McCormack, 2002). The egregious failure of the public-works model to jump-start Japan's moribund, post-bubble economy in the 1990s had led in large part to the August 2009 election of the Democratic Party of Japan (DPJ). The DPJ put the long-governing LDP out of power, campaigning on the slogan "from concrete to people." The DPJ promised that they would restructure state expenditures, reducing investment in infrastructure in favour of greater spending on daycare and other social services. It was plain bad luck for the DPJ that they were in power during 3-11, and put in place several key reforms upon which the LDP later built a new paradigm.

This paradigm came into place because one important actor who did not dismiss Fujii was Nikai Toshihiro, a prominent LDP politician with previous experience lead-

6) The talk (in Japanese) to the Japanese Upper House Budget Committee can be viewed at the following internet link: https://www.youtube.com/watch?v=KbtIlsPLnds

ing METI, MLIT and other agencies as well as chairing powerful intraparty councils. On October 7, 2011, following 3-11 and then several typhoons in late summer, Nikai was made chair of the newly organized "National Resilience Research Commission." This commission was tasked with researching measures against disaster. Naturally, most observers reflexively dismissed it as a revival of the LDP "Roads Commission" from the period when the party was in government (*Nihon Keizai Shimbun*, October 7, 2011). Reflecting the prominent role Fujii had attained in the public debate, he was the Commission's first invited speaker. On October 27, 2011, he gave a talk on his proposals for building "national resilience." Fujii highlighted the threat of a devastating earthquake, and argued that heavy investment in transport networks would alleviate the disaster risk while also providing an important economic stimulus (LDP, 2011).

The "National Resilience Research Commission" met a total of 38 times, from October 27 of 2011 to September 6, 2012. It heard expert lectures on the resilience of critical infrastructures, including several dealing with smart energy systems. It also deliberated on the resilience of society as a whole and the prospect of using industrial policy to foster greater resilience domestically and regionally. In addition, Nikai and the commission were instrumental in drawing up the basic law for National Resilience as well as in designing its institutions. The law and institutions were implemented after the LDP was returned to power by the December 24, 2012 general election. The administrative machinery of National Resilience went on to undertake extensive analyses of overseas disaster-resilience governance and methods. It also generated a large, and increasing, number of working groups, to bring together the public sector, business, and civil society in collaboration over building resilience in the face of a multiplicity of hazards. As was discussed in the introduction, Japanese geography and geology render the archipelago especially exposed to disasters. And climate change has made the hydrologic hazards especially acute. The 3-11 disaster and its impact on institutions afforded the opportunity to introduce a new dynamic, one centred on restructuring the energy economy to address these externalities.

The National Resilience initiative started in early 2013 with only three items on the table: the linear shinkansen, cross-laminated timber, and methane hydrates. But the involvement of a broad range of energy and disaster expertise has progressively expanded the initiative's ambit. Notably, planning and financing smart energy systems became central to resilience in large part due to the role of Kashiwagi Takao. Kashiwagi is Japan's foremost energy policy expert, and is the central figure in an influential intellectual community. Kashiwagi designed Japan's first smart community, a 100 percent renewable microgrid project, for the 2005 Aichi World's Fair (Kashiwagi, 2011). He had consistently argued that the focus of Japan's public works should shift from roads and bridges to resilient, smart energy systems that maximize efficiency and the uptake of renewable energy (Kashiwagi et al, 2001; Kashiwagi, 2009; Kashiwagi, 2010: 10–15; Kashiwagi, 2016: 178–79). After 3-11, Kashiwagi's main contribution, as a policy entrepreneur, has been to forge a broad public-private coalition that links decarbonizing smart energy systems (heat and power grids) with disaster resilience, spatial planning and local economic development.

Kashiwagi was ideally positioned, organizationally and intellectually, when the 3-11 crisis erupted. He possessed a rare combination of credibility with the business community as well as a thorough understanding of evolving energy paradigms and the crucial role of integrated policy. As an academic, Kashiwagi was professor at the Tokyo Institute of Technology from 2007, in 2012 becoming specially appointed professor and head of International Research Center of Advanced Energy Systems for Sustainability (AES Center)[7]. The AES Center was inaugurated in September of 2009, with funding from some of Japan's largest firms. Its 200 specialist researchers in environment and energy are focused on solar and fuel cells. As importantly, it also collaborates with the smart-energy divisions of the leading power, gas and other firms in Japan's energy business, along with blue-chip firms in construction, home-building, engineering, auto-making, and other areas. Moreover, the AES Center includes 15 local governments (prefectures and cities), many of which are exemplar smart communities. After 3-11, AES Center represented the crisis as an opportunity to accelerate the deployment of smart communities that maximize renewable energy, local leadership, resilience, and other priorities.

Kashiwagi was also a top-rank policy advisor. In the years preceding 3-11, he had served as a member or chair of the ANRE's main energy policymaking councils, including the Advisory Committee for Natural Resources and Energy (ACNRE), the Strategic Policy Committee of the ACNRE, the Energy Efficiency and Renewable Energy Committee of the ACNRE, in addition to numerous other national and subnational bodies. From 2011, he became Chairman of the Green Investment Promotion Organization (GIO), a quango set up by METI in September of 2010 to

7) The English-language version of the AES Center's website is available at the following internet URL: https://aes.ssr.titech.ac.jp/english

manage low-carbon subsidies and promote such investment. The GIO members and co-operating businesses include several of Japan's major insurance firms together with a large number of business associations in energy (conventional and renewable), ICT, engineering and electrical equipment[8].

Right after 3-11, Kashiwagi served as the chair of Research Commission on Urban Planning and Integrating the Effective Use of Heat Energy, one of the emergency environmental and energy research efforts that METI undertook. The Commission included several other specialists and its proceedings were observed by several national and Tokyo Metropolitan Government infrastructure, environment and energy-related bureaucracies. It began its deliberations on May 17 of 2011, and then quickly met six additional times, delivering a report on August 1 of the same year[9]. The report underscored the merits of integrating energy and urban planning, so as to realize the diffusion of smart communities and distributed energy. It also advised that smart heat and power networks be deployed as the core of a larger, strategic initiative to maximize disaster resilience, efficiency, decarbonization, the uptake of local energy resources, and local energy security (METI, 2011).

When the LDP returned to power in the December, 2012 election, it was quick to call on Kashiwagi's expertise. For example, the Ministry of Internal Affairs and Communications (MIC), which—in a decidedly fortuitous combination of responsibilities—both oversees Japan's 1719 local governments and the country's ICT infrastructure, wanted to use the crisis as an opportunity to expand local governments' energy initiatives. Hence, then-MIC Minister, Shindo Yoshitaka (2012-2014), brought Kashiwagi into the MIC as chair of a special research commission on diffusing smart energy systems as one means of revitalizing local areas (DeWit, 2014a).

Kashiwagi was also named to several major committees. For example, he chaired METI's Hydrogen/Fuel Cell Strategy Council, from its first meeting on December 19, 2013[10]. He was also named as a member of the Cabinet Office's Specialist

8) The GIO's website (in Japanese) is available at the following internet URL: http://www.teitanso.or.jp/index

9) The membership, minutes and materials studied by the Research Commission on Urban Planning and Integrating the Effective Use of Heat Energy are available (in Japanese) at the following internet URL: http://www.meti.go.jp/committee/kenkyukai/energy/nestu_energy/001_giji.html

10) The membership, minutes and materials studied by the Hydrogen/Fuel Cell Strategy Council are available (in Japanese) at the following internet URL: http://www.meti.go.jp/

Deliberation Committee on Important Issues, whose first meeting took place on October 11 of 2013[11]. This committee is one of the main advisory organs for the Council for Science, Technology and Innovation, chaired by the Prime Minister. And from November 18 of 2013, Kashiwagi also became chair of the Energy Strategy Conference, one of the Specialist Deliberation Committee's working groups[12]. The Energy Strategy Conference groups key scholars and business interests involved in smart energy and climate change. It evaluates the role of energy within Japan's overall "Society 5.0" innovation strategy, paying increasingly close attention to smart networks and resilience. Akin to Germany's Industry 4.0 initiative, Japan's Society 5.0 project seeks to harness the technologies of the 4th industrial revolution. But incentivized by disasters, demographics and other challenges, Japan's effort transcends Germany's smart factories and aims to deploy smart systems throughout the entire society (Sayer, 2017).

In addition to his prominence in academe and policymaking, Kashiwagi is also directly involved in business circles that embody the ongoing revolution in smart energy. Particularly noteworthy is his chairmanship of the Advanced Cogeneration and Energy Utilization Center (ACEJ). The ACEJ is dedicated to promoting cogeneration systems (district heating and cooling as well as fuel cells) and the use of renewable energy. In September of 2011, it revised its name from the "Japan Cogeneration Center" to reflect this larger purpose. After April of 2014, the ACEJ's membership also expanded, to encompass not just energy firms but also electronics, construction, design and other firms, reflecting cogeneration's increasing sophistication and diffusion in Japan.

Kashiwagi's multiple roles in academe, policymaking and business placed him at the intersection of the Japanese public and private sectors. As we shall see, it is difficult to exaggerate his coordinating role in Japan's post 3-11 energy policymaking circles and policy changes. Moreover, Kashiwagi's emphasis on smart-energy networks is similar to Nicholas Stern's arguments in his 2015 book *Why Are We Waiting? The*

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committee/kenkyukai/energy_environment.html

11) The membership, minutes and materials studied by the Specialist Deliberation Committee on Important Issues are available (in Japanese) at the following internet URL: http://www8.cao.go.jp/cstp/tyousakai/juyoukadai/index.html

12) The membership, minutes and materials studied by the Energy Strategy Conference are available (in Japanese) at the following internet URL: http://www8.cao.go.jp/cstp/tyousakai/juyoukadai/wg.html

Logic, Urgency, and Promise of Tackling Climate Change. Stern is the world's leading economist on climate change and energy, with a profound understanding of history and institutions. He presents the core network infrastructures of the smart energy economy as comparable to the roads that were core networks for the development of the Fordist economy and the railroads that were central to the steam-based economy.

For example, Stern argues that "[e] conomic history tells us that networks, be they power grids or railways, played a central role in past economic transformations: grids enabled great surges of creativity and innovation and led to opportunity and growth across the economy......More effective temporal and spatial management of the energy system, for instance with smart technologies or increased flexibility of the energy markets, could aid in the management of low-carbon generation, reduce the need for extra infrastructure, and unlock the potential for renewable energy to meet both base and peak demand for energy" (Stern, 2015: 48-9). This understanding of strategic structural reform, through smart energy systems, is what Kashiwagi brought into the heart of Japan's post 3-11 resilience and spatial planning.

Lamentably, the vast majority of academic and media attention given to "National Resilience" derides it as wasteful public works (Igarashi, 2013, George Mulgan, 2013, McCormack, 2016). But apparently without exception, the critics fail to analyze the background and budgets of Japan's National Resilience. Moreover, they neglect to investigate how and why the institutions of resilience have evolved. They also pay no attention to the expertise of the individuals playing key roles in those institutions.

Hence the critics' approach conspicuously lacks both comparative and historical perspectives. For one thing, they do not compare Japan's National Resilience initiatives with those undertaken by its peer countries as well as regions in those countries. One pertinent example is the profound impact that 2012 Superstorm Sandy had on New York state's approach to resilience in general and the power sector in particular (Lacey, 2014). The derisive dismissal of Japan's National Resilience also fails to analyze it in terms of the evolution of the global disaster-resilience paradigm, as expressed in the Yokohama, Hyogo and Sendai frameworks. These frameworks' concern for climate change, critical infrastructure and comprehensive governance are the fruits of a public debate among the world's best disaster experts. Japan's paradigm is a core part of this global initiative, the 2030 Agenda for Sustainable Development, and ought to be critically assessed as such.

In addition, none of the critics mentions that Japan's evolving paradigm of policy collaboration and integration includes the Japan Academic Network for Disaster Reduction (JANET-DR)[13]. The JANET-DR groups 54 academic associations, crossing multiple disciplinary boundaries (including energy and spatial planning), and cooperates with the prestigious Science Council of Japan. The JANET-DR was formalized on January 9, 2016, building on an ad-hoc 30-association liaison that emerged in May of 2011, shortly after 3-11. The liaison played a large role in shaping Japan's resilience debate, through 11 major events and several publications. On November 1, 2016, the JANET-DR held their second Disaster-Resilience symposium, analyzing the worsening threat of typhoons and intense rain (JANET-DR, 2016). They also published a detailed specialist volume exploring water and landslide hazards in the context of climate change (Ikeda, et al, 2016). And the JANET-DR appear to have a valuable role in encouraging the resilience paradigm to increase its use of green infrastructure (Tsuboyama, 2016).

Implying that Japan's top-rank disaster experts are coopted in a porkbarrel Potemkin Village betrays a lack of awareness of the real content of the paradigm as well as the urgency of the 2030 Agenda. And merely dismissing National Resilience as wasteful public works forfeits the opportunity to contribute to enhanced transparency, increased emphasis on green infrastructure (as opposed to gray), and other traditional objectives of critical scholarship.

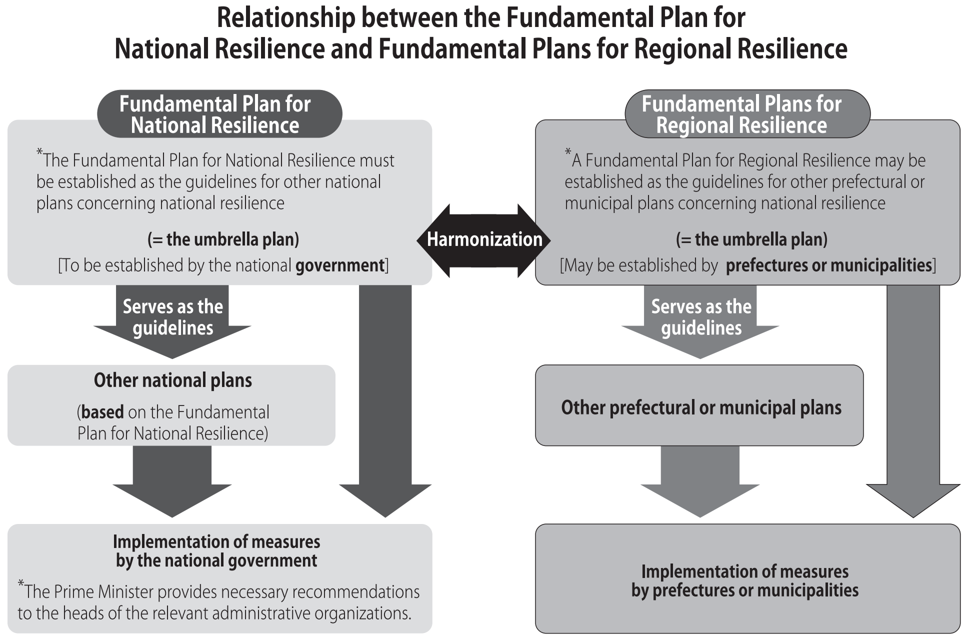
The Resilience Institutions

The AES Center that Kashiwagi chairs is well-represented on Japan's key post 3-11 planning initiatives, such as "National Resilience," the "National Spatial Strategy," and others.

Japan's National Resilience Plan (NRP) is based on the National Resilience Law passed by the Diet on December 4 of 2013[14]. The NRP is very ambitious, inclusive and transparent. It is aimed at bolstering the country's resilience to natural and other disasters, as well as fostering the capacity to recover from such disasters when they occur. It is also explicitly addressed to demographic and other challenges. Based on the

13) The website of the Japan Academic Network for Disaster Reduction is available at the following internet URL: http://janet-dr.com

14) The National Resilience Plan and related materials are available (in Japanese) at the following internet URL: http://www.cas.go.jp/jp/seisaku/kokudo_kyoujinka/



Source：Japan Cabinet Secretariat (nd：9)

Figure 3 National Resilience Planning

best national and international evidence, it expertly evaluates risks and vulnerabilities, selects and prioritizes countermeasures, and then evaluates progress on these measures (Nakazato, 2013). Particularly impressive is the NRP's use of the most advanced climate science as well as its emphasis on critical infrastructure and smart communities/smart energy. National Resilience itself is under the authority of a State Minister, a new position announced during the December 26, 2012 inauguration of the first cabinet of PM Abe Shinzo. The position is combined with the Chairman of the National Public Safety Commission and Minister of State for Disaster Management.

As **figure 3** on "National Resilience Planning" indicates, the NRP is also a "whole of government" approach to planning. The NRP was worked up into a plan by the governing LDP politicians and disaster-resilience technocrats in the Cabinet Secretariat's National Resilience Promotion Office (NRPO). It was also studied by the National Resilience (Disaster Prevention and Reduction) Deliberation Committee (NRDC). The NRDC first met on March 5, 2013 and continues its deliberations as of this writing. Its membership is drawn primarily from the top ranks of Japan's academic community, including Kashiwagi Takao, who advises on energy. Other specialists advise on ageing, primary industries, local communities, local administration, risk communication, industrial structure, the environment, disaster prevention, finance, national lands, and information services. In a laudable exercise in transparency, the minutes from NRDC meetings and the materials it deliberates are uploaded to its dedicated web site, generally within a week of its 7-9 meetings per year[15].

Other advisory bodies for formulating the NRP include the "Liaison Committee Among Central Agencies Concerned with Promoting National Resilience." This committee first met on March 19 of 2013, and evidently performs a communication role that helps break down silos[16]. Its meetings are short, at roughly 30 minutes, and infrequent, having become semi-annual since 2014 after 6 meetings in 2013. Also, the committee deliberates materials already considered by the above National Resilience (Disaster Prevention and Reduction) Deliberation Committee.

A further forum for promoting the NRP is a "Japan-US National Resilience Workshop." This workshop was undertaken on July 7 of 2014. It does not appear to be institutionalized as a recurrent event, but is featured as one of the National Resilience-related committees by the Japanese Cabinet Office's National Resilience Promotion Office[17]. The workshop centred on lessons learned from the US-Japan cooperation after 3-11, in the "Operation Friendship" (*tomodachi sakusen*). Presentations at the workshop included the US Department of Homeland Security, which provided an overview on "national protection." Other presentations included talks by Japan's local government leaders, including the Mayor of Ofunato City and the Governor of Koichi Prefecture[18].

The NRP that these and other committees produced was given cabinet assent on June 3 of 2014, in tandem with an "National Resilience Action Plan." The Action Plan is updated annually, resulting in close monitoring and flexibility[19]. These plans are

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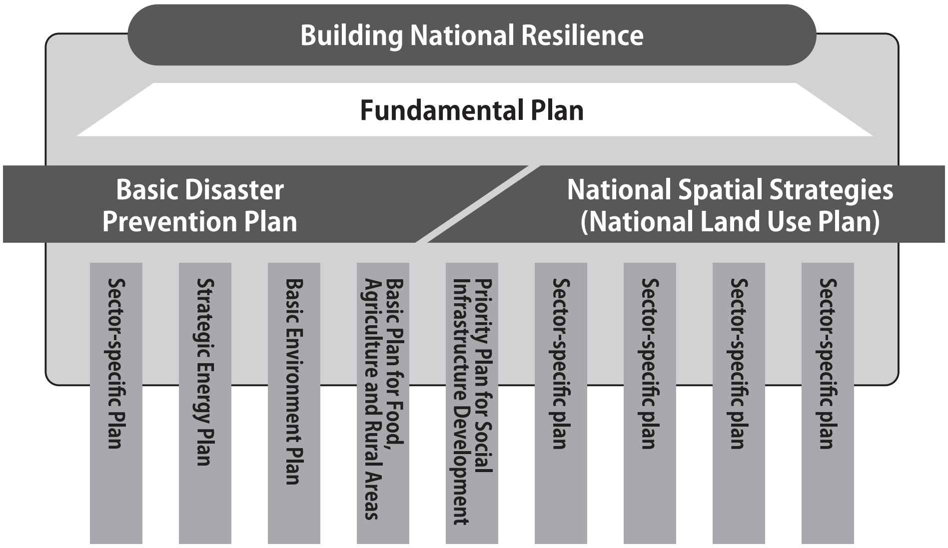
15) The membership, minutes and materials studied by the National Resilience (Disaster Prevention and Reduction) Deliberation Committee are available (in Japanese) at the following internet URL: http://www.cas.go.jp/jp/seisaku/resilience/

16) The particulars concerning the membership and deliberations of the Liaison Committee Among Central Agencies Concerned with Promoting National Resilience are available (in Japanese) at the following URL: http://www.cas.go.jp/jp/seisaku/kyoujinka/index.html

17) The list of National Resilience-related committees is available (in Japanese) at the following URL: http://www.cas.go.jp/jp/seisaku/kokudo_kyoujinka/kondankai.html

18) The overview and presentation materials (some in English) of the Japan-US National Resilience Workshop are available at the following URL: http://www.cas.go.jp/jp/seisaku/kokudo_kyoujinka/workshop/h260707.html

19) The list of National Resilience Action Plans is available (in Japanese) at the following



Source : Japan Cabinet Secretariat (nd : 9).

Figure 4 National Resilience as an Umbrella Plan

also readily available and open to public comment and input, a sharp contrast to disaster planning in almost all other countries including the United States. **Figure 4** illustrates how the NRP serves as an "umbrella plan." The figure shows that the NRP has de jure administrative authority over other national plans, including energy plans.

National Resilience Plan and Regional Plans

By May 2017, all of Japan's 47 prefectural governments, along with 62 cities and towns, had adopted, or were in the process of adopting, local versions of the NRP[20]. These local plans differed in their respective lists of hazards and energy inputs, reflecting local circumstances. But they were all consistent in the emphasis on exploiting local energy resources to bolster resilience. The large number of subnational plans, only three years after formal passage of the NRP, is suggestive of its legitimacy among subnational policymakers.

As with the NRP and its annual follow-up plans, the subnational plans are freely available and open to public comment. These comments are also addressed by

URL: http://www.cas.go.jp/jp/seisaku/kokudo_kyoujinka/kihon.html

20) The list of Local National Resilience Action Plans is available (in Japanese) at the following URL: http://www.cas.go.jp/jp/seisaku/kokudo_kyoujinka/tiiki.html

the relevant authorities. Again, this openness and comprehensiveness contrasts with almost all other jurisdictions. For example, in 2016, the US state of Maryland was the first American state to factor climate change into its disaster planning. But it neglected to consult the public and failed to do more than a cursory study of climate impacts (Bolstad, 2016; Hammer, 2016). China seemed even less scientific and responsive. The country's industrial heart is the Zhujiang River Delta/Pearl River Delta (PRD), home of 65 million people, 20% of GDP and 40% of its export capacity. The PRD is very vulnerable to flooding, but there is little attention to strategic flood risk management. Observers suggested this was due to failure to keep abreast of the rapidly evolving science as well as a lack of coordinated governance between planning and hazard management (Spratt and While, 2016).

Indeed, Japan's climate-change adaptation (as opposed to mitigation) initiatives have become at least as—if not more—ambitious and rigorously evidence-based as those of the US military, whose far-flung infrastructures and intense sensitivity to threats make it a leader in supporting climate science and acting on it (eg, SERDP, 2016, DoD, 2016).

The above has shown that, in 2016, the NRP was an authoritative plan and that it was being adopted and implemented at all levels of government. The NRP was also well-funded, as Japanese government spending for FY 2016 on national resilience was JPY 4.34 trillion, including the initial budget plus supplementary budgets. Spending for FY 2017 on national resilience is projected to be JPY 3.7 trillion, based on the initial budget. It is, however, quite likely that the FY 2017 spending will be considerably larger than the initial budget, once supplementary budgets are added. This likelihood reflects the fact that Nikai Toshihiro, the main proponent of National Resilience, was appointed LDP Secretary General on August 3 of 2016. The role of Secretary General is the second most powerful position in the Japanese government (*Nikkei Asian Review*, September 1, 2016).

Importantly, Tokyo Metropolitan Government (TMG) also embraced National Resilience in 2016. TMG is the effective leader of Japan's 1719 local governments, through such institutions as the 6 local agencies of subnational government (*chihou roku dantai*). In TMG's November 22, 2016 suggestions to the central government concerning the proposed FY 2017 budget, TMG argued that National Resilience should be made part of Japan's very large (JPY 16 trillion) and politically important system of fiscal equalization (TMG, 2016: 14). In effect, TMG was matching the central government's already profound institutional reforms with a proposal to deepen them yet further. That response attested to the scientific pragmatism of National Resilience as well as its urgency. The TMG document in fact detailed its disaster hazards over dozens of pages (TMG, 2016: 15-55).

The next section shows the NRP is in fact credible and that it is shaping the political economy, particularly the energy system.

The Impact of the NRP

The first of these two issues, the relevance of the NRP, has an inescapably political dimension. As noted earlier, there are few objective political economy assessments of the NRP. But one useful check of the NRP's content is to compare it with what was recommended by the OECD's 2009 "Review of Risk Management Policies, Japan: Large-Scale Floods and Earthquakes" (OECD, 2009). The OECD Review is important for three major reasons. First, it was produced by internationally recognized and unbiased experts. Second, it predates the trauma of the 3-11 natural and nuclear disasters as well as the December 2012 return to power of the LDP under PM Abe Shinzo. Third, the OECD Review covers the two major threats addressed by the NRP, and is as deeply concerned by the acceleration of climate change as the Japanese. In short, the OECD Review is a well-informed, impartial study that remains relevant.

Among other things, the OECD Review recommended that the Japanese government undertake greater investment in resilient infrastructure, adopt a more powerful coordinating role for the central government, and institute a more systematic evaluation of options. The NRP spending on resilience and its emphasis on the agency of the central government are very unwelcome to its critics. These critics, such as Igarashi Takayoshi (former cabinet advisor to the Democratic Party of Japan), warn that the spending heralds the return of the "construction state" and that a stronger coordinating role of the central government threatens local autonomy. But neither Igarashi nor any other critics reference the OECD Review (Igarashi, 2013). The assertion that local governments are best left to develop and deploy their own disaster counter-measures seems most unwise. The scale and scope of the externalities posed by climate change, energy risks, and the other threats the NRP addresses are beyond the competency of local authorities' fiscal, regulatory and other powers. Incredibly, Igarashi and other critics do not even mention the accelerating threat of climate change. Igarashi and others also downplay the threat of earthquakes, a complacency that was challenged by the unanticipated string of major earthquakes that struck Kumamoto Prefecture and nearby regions on April 14 and 16 of 2016[21].

The NRP also shapes the energy system. One way it does this is by emphasizing the role of local energy resources and infrastructure (such as microgrids and district heating systems) in securing resilient, back-up power for emergencies. The NRP, and its local versions, all stress the role of such distributed energy resources, and especially renewable energy. And the explicit integration of national resilience with local revitalization (*chihou sousei*) has further intensified the volume of fiscal, administrative and other resources being deployed to this end. It reflects Japanese policymakers' aim to foster a very broad portfolio of new smart community business models and infrastructures appropriate to a resource- and carbon-constrained era.

This pragmatic emphasis on bolstering local resilience has a powerful reformist potential. Nowhere in the specialist literature and commentary on the NRP is it suggested that the NRP is a "Trojan Horse," so to speak, for reforming the still de facto monopolized utilities. But it is surely difficult for vested energy interests to oppose distributed-energy systems, focused on resilience. After all, it was the lack of adequate back-up generation at Fukushima Daiichi that led to the nuclear disaster and the disruption of the nuclear paradigm. Moreover, the smart-energy divisions of Tepco and the large power-unit makers (Hitachi, Toshiba, Mitsubishi) are collaborators with the AES Center, led by Kashiwagi Takao.

Figure 5 shows that the locus of Japan's distributed energy transition is the "smart community." In Japanese usage, the smart community can be a residential district, public facilities, a factory cluster, a commercial sector, or any other zone where there is sufficient density of demand for energy and disaster-resilience. The smart community is where disaster-resilience, energy efficiency and the uptake of renewable energy are maximized by smart-energy systems, including virtual power plants, power microgrids, DHC networks, home/building/factory/community/mansion energy management systems (respectively, HEMS, BEMS, FEMS, CEMS, MEMS), advanced energy storage, LED lighting, waste-heat recovery, and other infrastructure. All of these components represent the ongoing convergence of energy, new materials, and

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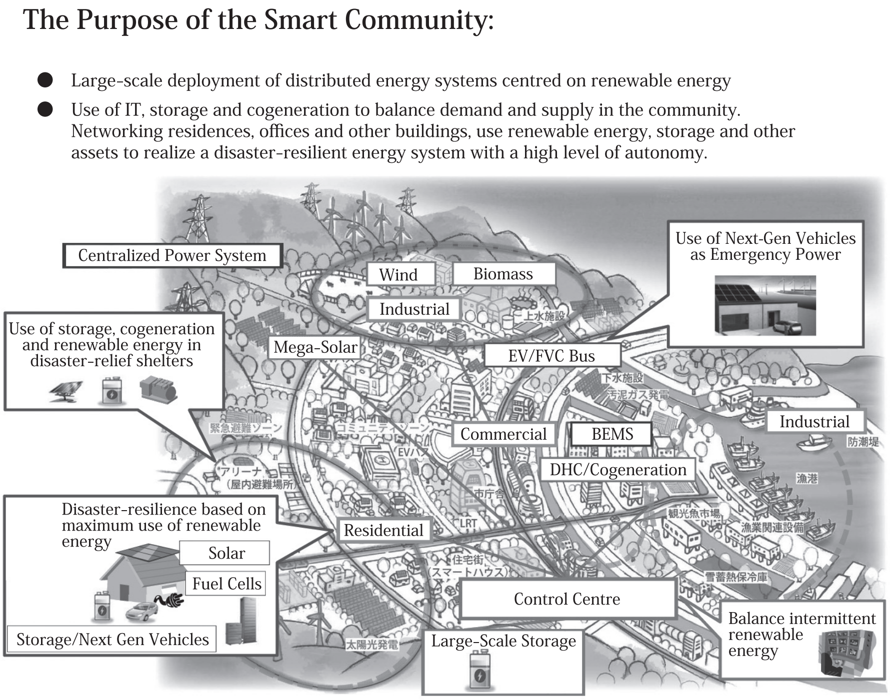
21) An English-language overview of the 2016 Kumamoto Earthquakes is available at the following Geological Survey of Japan URL: https://www.gsj.jp/en/hazards/kumamoto2016/index.html



Source : Adapted from METI, 2016a : p 11

Figure 5 Japan's Distributed Energy Paradigm and Smart Community

ICT/robotics.

Japanese policymakers are quite explicit that their smart-energy approach aims to maximize the diffusion of renewable energy and efficiency, while encouraging densification, so as to increase disaster resilience, economic revitalization, national security, socioeconomic equity, and related public goods (Kashiwagi, 2016). And the integration of these discrete smart community districts is the basis for building the overall smart city (Murakami, 2017).

Research by private-sector agencies suggests that Japan's approach is bearing fruit. For example, the Smart Energy Group of the Japan Economic Center (JEC), a market research firm established in 1966, regularly surveys the Japanese and international markets. The JEC's 2016 surveys indicated that Japan had become a global leader in deploying smart energy management systems. For example, as seen in **table 6**, the JEC assessment of Home Energy Management Systems indicated that 75,000 units were installed globally in 2011, and that 15,000 were in Japan. The figures for 2015 were 870,000 globally, with 150,000 in Japan. And the projection for 2020 was 1.632 million globally, with 240,000 in Japan.

The JEC survey concerning the “smart house” market was also impressive. **Table 7** shows the JEC’s results indicated that Japan represented over half of 2011 total global value of JPY 150 billion, and that it had held this share in 2015, when global value had doubled to JPY 301 billion. Projections for 2020 indicated that Japan’s share would decline to just below 40 percent as the total market enlarged to JPY 990 billion.

Moreover, as part of the resilience project, the NRDC undertook a survey of private-sector firms’ current and projected spending in late 2015 (NRDC, 2016: 5). The survey determined that private-sector spending on resilience was about JPY 11.9 trillion market in 2013. That total was broken down into “core” markets segments (goods and services) directly focused on resilience, and “related” market segments (again, goods and services) that addressed aspects of resilience. The survey found that the core markets totaled roughly JPY 8 trillion and the related markets a further JPY 4 trillion.

The NRDC’s analysis also estimated that the core and related markets would

Table 6 HEMS, Global and Japan, 2011–2020

(Units: 1,000)

Year	Global	Japan
2011	75	15
2012	156	30
2013	243	45
2014	448	80
2015	870	150
2020	1,632	240

Source：Japan Economic Center, 2016

Table 7 Smart House Markets, Global and Japan, 2011–2020

(Units: JPY billion)

Year	Global	Japan
2011	150	80
2012	180	95
2013	220	115
2014	260	140
2015	310	160
2020	990	390

Source：Japan Economic Center, 2016

likely double in size by 2020. As can be seen in **table 8** on Japan's Private-Sector Spending in Core and Related Resilience Markets, 2013-2020, the three biggest (core and related) sectors are:

1) electric vehicles, at JPY 2.6 trillion in 2013 and projected to be JPY 6.13 trillion in 2020
2) renewable energy (solar), at JPY 2.26 trillion in 2013 and JPY 3.88 trillion in 2020 (high estimate)
3) power generation and transmission bolstering, JPY 958 billion in 2013 and JPY 1.02 trillion in 2020

Table 8 shows that if one excludes electric vehicles and other "related" market segments, then renewable energy is the largest market in Japan's private-sector spending. And renewable energy-related spending is even larger than the solar numbers indicate. This is because the JPY 2.26 trillion spent on solar systems in 2013 was accompanied by JPY 59.5 billion on biomass, JPY 23.5 billion on geothermal, and JPY 22.3 billion on wind power, for a total of JPY 2.37 billion on renewable energy generation systems. In addition, batteries and other energy storage equipment totaled just over JPY 103 billion, while efficiency-enhancing energy management systems amounted to just under JPY 334 billion.

Moreover, using the NRC's high estimate of JPY 3.88 trillion for the solar market in 2020, Japan's total resilience-centred renewable market was projected to increase to JPY 4.04 trillion by 2020. In addition, the markets for batteries and other storage equipment was slated to expand to JPY 469 billion. And spending on energy management systems was expected to grow to just under JPY 570 billion.

In other words, Japan's total private-sector investment in disaster-resilient renewable energy, storage and energy management was estimated to be a JPY 4.92 trillion market by 2020. That figure seems likely to be an underestimate, in light of global trends, but even so it marks an impressive increase from the JPY 2.81 trillion in 2013. Note also that the NRC also projected that the core market in National Resilience would total between JPY 11.8 and 13.5 trillion in 2020. Thus, renewable energy generation, storage and management were estimated to be between 36% to 42% of core markets in Japan's private-sector expenditures on National Resilience.

The NRC's documents also reveal that public-sector spending on National

Table 8 Japan's Resilience Markets, 2013–2020

Japan's Private-Sector Spending in Core and Related Resilience Markets, 2013–2020 (Units: JPY100mil.)

Market Segments		2013	2020	Growth, %/yr
■ Resilience against long-period earthquakes, for very tall buildings	High	0	4,448	∞
	Low	0	2,224	∞
■ Disaster-relief robotics		0	1,639	∞
■ Energy-storage equipment		1,035	4,691	50.5%
■ Earthquake-proofing of non-resistant dwellings	High	502	1,918	40.3%
	Low	502	1,130	17.9%
■ Rebuilding of dwellings non-resistant to earthquakes	High	2,697	10,307	40.3%
	Low	2,697	6,069	17.9%
■ Training of crisis-management leadership		9	26	27.0%
■ Reinforcement of private road assets (tunnels, bridges, etc) against disasters (earthquakes, floods) and aging		2,133	5,467	22.3%
■ Clearing of wooden-structure-intensive urban districts		2,706	6,666	20.9%
■ Stockpiling of emergency supplies (water, food, sanitary, etc)		288	702	20.5%
■ Development of subterranean energy (geothermal)		235	434	12.1%
■ Diagnostics of non-residential building earthquake resilience		116	209	11.5%
■ Renewable energy systems (solar)	High	22,634	38,812	10.2%
	Low	22,634	29,460	4.3%
■ Renewable energy systems (biomass)		595	915	7.7%
■ Renewable energy systems (wind)		223	268	2.9%
■ Energy management systems		3,336	5,697	10.1%
■ Anti-liquefaction (in earthquakes) of residential areas	High	1,220	1,996	9.1%
	Low	1,220	1,597	4.4%
■ Fire and earthquake-resilient circuit-breakers, etc		98	141	6.3%
■ Reinforcement of gas pipelines and other facilities		1,010	1,353	4.9%
■ Equipment for back-up of records		86	112	4.3%
■ Business investment in measures to prevent seismic-induced equipment slippage, overturning		6,861	8,919	4.3%

Market Segments		2013	2020	Growth, %/yr
■ Earthquake-proofing of appliances		267	342	4.0%
■ System-security resilience (cyber multiplexing, disaster-proofing)		1,202	1,514	3.7%
■ Consulting, training related to Business Continuity Planning		148	184	3.5%
■ Rebuilding of condominiums non-resistant to earthquakes		71	86	3.0%
■ Reinforcement of condominiums non-resistant to earthquakes		55	67	3.1%
■ Disaster-proofing of information communications networks (multiplexing, networking)		3,380	3,884	2.1%
■ Reinforcement of private railroad assets (tunnels, bridges, etc) against disasters (earthquakes, floods) and aging		8,141	8,763	1.1%
■ Reinforcement of power generation and transmission assets		9,587	10,249	1.0%
■ Earthquake reinforcement of non-residential, non-resistant structures	High	2,602	3,252	3.6%
	Low	2,602	2,708	0.6%
■ Rebuilding of non-residential structures non-resistant to earthquakes	High	4,518	5,648	3.6%
	Low	4,518	4,702	0.6%
■ Electricity self-generation facilities		2,285	2,244	−0.3%
■ Data back-up equipment (data centres)		1,471	1,367	−1.0%
○ CLT (Cross-Laminated Timber) buildings	High	0	5,448	∞
	Low	0	1,870	∞
○ Drones		0	160	∞
○ Linear bullet train		487	4,169	108.0%
○ Relocation of offices, etc from Tokyo and other city-regions		85	299	36.0%
○ Electric vehicles		26,000	61,300	19.4%
○ Earthquake insurance		881	1,912	16.7%
○ Information security software and services		7,770	10,883	5.7%
○ Fire insurance		4,378	5,240	2.8%

Legend:
■ : Core Market
○ : Related Market

Source : National Resilience Council, Cabinet Secretariat, Japan (February 1, 2016)

Resilience totaled JPY 12.4 trillion in 2013. Much of that investment was also devoted to renewable-energy generation, transmission and storage, in Japan's profusion of smart communities, disaster-relief shelters, and other applications (DeWit, 2014b). In post 3-11 Japan, building resilience became explicitly and powerfully linked to renewable energy systems and their enabling storage and transmission technologies. Indeed, Furuya Keiji, the LDP's first cabinet minister of National Resilience and Disaster Reduction (2012–2014) devoted an entire section of his June 2014 book on National Resilience to distributed, renewable energy (Furuya, 2014: 157–70).

Collaborating in the Association for Resilience Japan

A further institutional element of the institutional regime that developed with the enactment of the National Resilience Law is the Association for Resilience Japan (ARJ). The ARJ was formally inaugurated on July 1 of 2014. Its purpose is to bring business, academe, and other interests into the resilience paradigm. As of May 2017, its Chair was Miura Satoshi, Chairman of the Board of NTT. Its Vice-Chair was Fujii Satoshi, one of the key policy entrepreneurs. The ARJ leadership included 38 other directors, all top-ranked experts drawn from an array of areas. For example, the directors included Kashiwagi Takao in energy. There were also two special advisors, one being Nikai Toshihiro, Secretary General of the LDP and the predominant figure in the post 3-11 resilience movement[22].

As of May, 2017, the ARJ includes 16 working groups in which politicians, bureaucrats, academics, business and representatives from subnational governments collaborated[23]. These working groups addressed the myriad aspects of resilient communities, from smart energy systems through to building sustainable and equitable local economies.

One important working group, WG3[24], focused on "building resilient smart communities that include V to X (vehicle to power)." This WG3 was chaired by Kashiwagi Takao, and included several other ranking academics as well as a mix of energy and smart city businesses. The energy businesses included Osaka Gas, Chiyoda Corporation's hydrogen chain promotion unit as well as JX Nippon Oil and Energy. The latter comprised Honda's Smart Community planning division, Japan IBM's Smart City division, as well as Toshiba's Community Solutions, Nissan Motors, and Mitsubishi Motors.

Among the observers in WG3 were the Global Environment Division of the Ministry of the Environment, several divisions of METI, the Urban Planning section

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22) The list of the Association for Resilience Japan's officers is available (in Japanese) at the following URL: http://www.resilience-jp.org/officer/

23) The list of Association for Resilience Japan working groups, their members and respective mandates is available (in Japanese) at the following URL: http://www.resilience-jp.org/wg/

24) The particulars concerning the Association for Resilience Japan's working group 3 is available (in Japanese) at the following URL: http://www.resilience-jp.org/wg/wg3/

of MLIT, the Ministry of Internal Affairs and Communication's (MIC) Local Policy division, the National Resilience Promotion Unit in the Cabinet Office, the Biomass Sustainable Resource Division in the Ministry of Agriculture, Fisheries and Farms, and various divisions from the cities of Toyama (Toyama Prefecture), Saitama (Saitama Prefecture), Hamamatsu (Shizuoka Prefecture), Yokohama (Kanagawa Prefecture). All these cities are sites for advanced initiatives for building smart communities. Their projects combine robust targets for distributed energy and efficiency along with significant cuts in emissions of greenhouse gases.

The mandate of WG3 aimed at clarifying how to promote the smart community within the NRP. The agenda noted that deregulation of the power system ushered in the implementation phase of the smart community. In tandem with that implementation, WG3 was tasked with examining the following areas:

1) V to X as they relate to power generation and storage as part of mobility. This means using the FVC or EV vehicle as a means of power generation as well as storage in emergencies
2) autonomous and distributed energy that is resilient to natural disasters
3) regional disaster reduction and evacuation
4) diversification of energy supplies through hydrogen technology and renewable energy
5) creating local sustainability through local government led energy infrastructure as well as regional energy companies

WG3's purview embraced all of the above as elements required for the design of smart communities that are both robust against disasters and can recover quickly. The working group focuses on energy systems, energy supply chains and related critical infrastructure.

WG3 was also aimed at deliberating on the mechanisms for defusing the resilient smart community together with encouraging private investment in them. The working group terms of reference described the smart community as an approach that is very important in finding the most suitable balance between supply and demand for energy in light of economic, environmental and other challenges. But it noted that the interruption of power supplies through natural disasters means that lives are put at risk, both during the disaster and immediately in its wake. It also warned that a delayed recovery from disaster impairs the region's inhabitants as well as businesses and other parties' capacity to plan for resumption of their normal activities, impeding post-disaster recovery. For these reasons, WG3 aimed at examining the development of resilient smart communities that can quickly recover from disasters as well as are economically and environmentally superior under normal, non-disaster circumstances.

In addition to its multiple working groups that include government, business, academe and civil society representation, the ARJ organizes civil society. One example was the "National Resilience Community" that had its kickoff meeting on February 20 of 2016[25].

The ARJ also held regular conferences open to all interested observers. One example was the February 2, 2016, "Advanced Energy Local Government Summit 2016[26]," which highlighted local projects on solar, wind, biomass, geothermal, small hydro and other resilient, local clean power and energy efficiency. The event also included a presentation by the MIC, which oversees local governments, on the important role of local-government-led energy. The ARJ also awarded projects for especially noteworthy models of resilience in local government, academe, business and civil society.

Indeed, perhaps one of the most important initiatives undertaken by the ARJ is the design of a system for "Resilience Certification" (*rejiriensu ninshou*). This certification began from February of 2016. Its purpose is to encourage business and other organizations (such as schools and local governments) to develop business continuity plans in advance of disasters. As of May, 2017, 71 organizations have received certification[27]. And smart, distributed energy systems, including smart communities, are a core feature of the resilience assessment (Kanaya, 2016).

In short, the NRP and its associated institutions, such as the ARJ, are broadly collaborative, comparatively well-funded, and focused on diffusing a distributed energy paradigm. The initiative is explicitly engaged with the range of externalities confront-

25) An overview (in Japanese) of the National Resilience Community's kickoff meeting is available at the following internet URL: http://www.cas.go.jp/jp/seisaku/kokudo_kyoujinka/kouhou/sp_3/hitokoto.html

26) An outline (in Japanese) of the Advanced Energy Local Government Summit 2016 is available at the following internet URL: http://www.resilience-jp.org/20160324141803/

27) A description (in Japanese) of the Resilience Certification is available at the following internet URL: http://www.resilience-jp.org/certification/about/

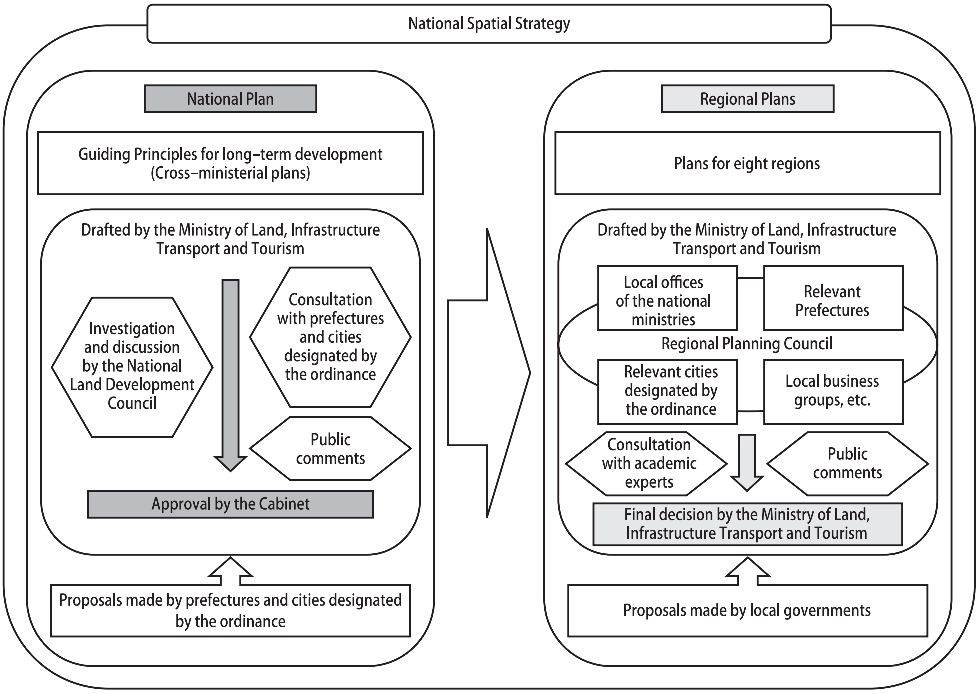
ing contemporary Japan. It is pursuing an adaptation approach that had powerful participation by all levels of government, business, civil society, and the top ranks of academe. Moreover, the NRP has had a significant influence on other planning initiatives, such as Japan's National Spatial Strategy (NSS).

Japan's National Spatial Strategy

Japan's shifting priorities on energy policy and infrastructure are also clearly evident in the new National Spatial Strategy (NSS), adopted in August 2015. As the OECD emphasized in its *Territorial Review of Japan, 2016*, the NSS "is the most important of a number of key planning documents." One reason is evident in **figure 6**, on "Japan's National Spatial Strategy." The figure shows that unlike prior spatial plans, the NSS was a "truly horizontal initiative." It was built on the basis of "an intensive exercise in inter-ministerial co-ordination and consultations extending beyond the government itself under the aegis of the National Land Council, which brings together parliamentarians, academic experts, representatives of the private sector, elected officials from the cities and regions, and others." Like the NRP, the NSS was thus distinctive from Japan's previous top-down planning strategies. The NSS was composed in a "whole of government" approach that brought together the MLIT and the other central agencies as well as the subnational governments. In addition, the consultation with civil society was also unprecedented in its breath. This degree of consultation gave the NSS a legitimacy that transcended its predecessor documents. On top of that legitimacy was legal authority: at least 20 other national laws are obligated to refer to the NSS (OECD, 2016: 79-80). In turn, the NSS was obliged to reference the NRP.

The 2015 NSS also paid careful attention to smart communities, renewable energy, climate change, resilience and other factors as the context for urban policy. This shift is displayed in **figure 7**, which measures the frequency of several keywords in the 2008 NSS and compares the numbers with the 2015 NSS. For example, the word "energy" appeared only 54 times in the 2008 NSS, but the 2015 NSS included 207 references to "energy." Similar results were seen for "compact" (as in spatial densification), "renewable energy," "smart community," and "distributed" (in reference to distributed energy).

The comparison, coupled with a thorough reading of the two texts, shows that the 2008 NSS was concerned with disasters and the transport and other networks that



Source : OECD, 2016: 88

Figure 6 Japan's National Spatial Strategy

Changing Priorities in Japan's "National Spatial Strategy"

2008 NSS	2015 NSS
"network" 111x	"network" 185x
"disaster" 146x	"disaster" 228x
"climate change" 5x	"climate change" 15x
"energy" 54x	"energy" 207x
"compact" 2x	"compact" 67x
"renewable energy" 1x	"renewable energy" 33x
"smart community" 0x	"smart community" 7x
"distributed" 0x	"distributed" 13x

Source : Compiled from keyword searches in NSS 2008 and NSS 2015

Figure 7 Japan's National Spatial Strategies, 2008 and 2015

are critical to economic activity and responding to crises. But the 2015 NSS displayed a far greater concern for climate and other disaster threats, as would be expected for a plan developed in the wake of the 3-11 disaster. Yet the NSS 2015 also reflected the emergence of a very different, distributed network paradigm for coping with disaster threats as well as the rapid ageing and other challenges noted in the introduction to this chapter.

One reason for the attention to smart and distributed energy in the 2015 NSS was that the planning initiative included its first-ever energy expert, Kashiwagi Takao[28]. As noted earlier, Kashiwagi was long an advocate of smart communities and exerted a powerful influence on the NRP.

Fiscal and Administrative Support for Distributed Energy

We have seen that critics of National Resilience depicted it as wasteful and unwarranted. The integration of policy regimes via the NRP and NSS appears to be not very well understood by many scholars, who dismiss them as top-down and wasteful without discussing specifics (Igarashi, 2013; McCormack, 2016). Many also denied that Japan's national government was aggressively funding distributed energy (Kanie, 2016; Oshima and Takahashi, 2016), in spite of the institutions and programmes described earlier.

But the evidence indicated otherwise. Smartly targeted subsidies for critical infrastructure helped drive the spending. One example was the METI New Energy and Industrial Development Organization (NEDO) "Subsidy for the Promotion of Local Production-Local Consumption Style Renewable Energy Areal Use Projects." This subsidy began in Fiscal Year 2016 with a total value of JPY 4.5 billion and funded 28 separate local projects in the first round for 2016. METI's outline of the programme's purposes described it as aimed at fostering the diffusion of distributed energy. As to why, METI portrayed the 3-11 nuclear and natural catastrophes as having led to an increased understanding of the risks of reliance on centralized generation systems. It stated that in consequence Japan needed to promote the diffusion of decentralized energy, particularly systems centred on renewable energy. METI added that the use of energy management and other technologies, in tandem with the spatial deployment of energy systems, could help maximize the effective use of local energy resources. Moreover, the local-production/local-consumption model could lead to significant cuts in energy use and costs in normal, non-disaster circumstances. The system's disaster-

28) The list of members (in Japanese) on the Planning Subcommittee of the National Land Council is available at the following internet URL: http://www.mlit.go.jp/policy/shingikai/s103_kokudo_keikaku.html

resilience role was described as providing the community with a source of energy in emergencies.

The METI cautioned that these systems were challenged by relatively high costs. Hence the subsidy programme aimed at facilitating the diffusion of these advanced energy systems, commensurate with local conditions. The goals included reducing the unit costs of these microgrids and other energy systems through greater economies of scale, the creation of new business services linked to demand response and other energy-related services, and the development of energy systems that could be deployed nationwide.

The METI subsidy programme period was five years, from 2016 to 2020, and the primary criterion for assessing the performance of supported projects was whether overall system efficiencies of 20% or over were achieved. The METI also pointed out that the renewable generating capacity eligible for inclusion was not to be covered by Japan's feed-in tariff (FIT). The end of the FIT was in sight, and hence another aim of the subsidy was to foster the non-subsidized diffusion of renewable-energy.

Moreover, the METI subsidy project was only one of many. From FY 2015, the Ministry of Internal Affairs and Communications (MIC) began implementing a similar fund, the "Distributed Energy Infrastructure Project," for encouraging the deployment of heat and power grids. This programme was developed by a special MIC study group, one chaired by Kashiwagi Takao from November of 2014 to the spring of 2015. Similar to the METI subsidy, MIC's programme seeks to foster renewables, particularly biomass, geothermal, and other 24/7 "baseload" energy, with the local community as the lead agent in the project. The MIC programme also explicitly looked to community use of FIT-subsidized heat and power generation as a mechanism of interregional redistribution and local revitalization. The MIC subsidy's inclusion of FIT-incentivized renewables was a sharp contrast to the METI programme, showing that central agencies were collaborating by dividing the labour in fostering different areas of the smart community paradigm.

Additional finance for related smart-energy systems comprised cogeneration-related subsidies managed by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) as well as the Ministry of the Environment (MOE). In the FY 2015 supplementary budget and the FY 2016 initial budget, these subsidies total JPY 167.94. Moreover, the governing LDP (through its Study Commission on Resources and Energy Strategies) maintain a comprehensive list of 46 national-level distributed

–energy subsidies, categorizing them by their respective central–agency funder[29]. It is not possible to calculate the total monetary value of these individual subsidies, as many of them are part of much larger programmes that are not solely focused on energy.

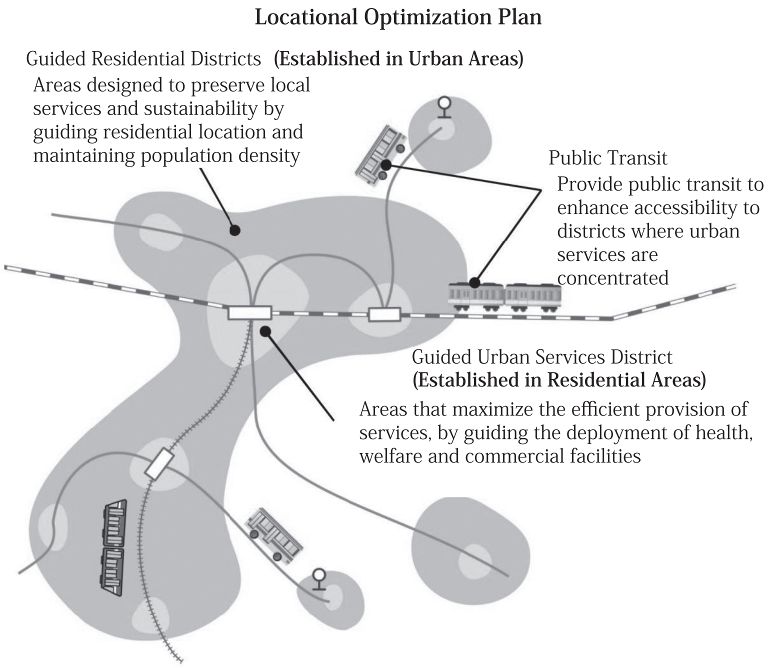
To take one example of the above, the MLIT offered fiscal support for local governments that wanted to harness waste–heat energy resources in their sewage networks. Japan's potential for waste–heat capture in the best areas of its 460,000 kilometers of sewerage has been assessed at 15 million households' worth of heat–energy use, so this programme was potentially quite significant. But the MLIT's support was part of the JPY 898.3 billion comprehensive disbursement for social infrastructure (*shakai shihon seibi sougou koufukin*). There was no indication of how much of the total disbursement would go to waste–heat recovery. Moreover, the MLIT supplemented this particular initiative on waste–heat recovery from sewers with the offer of sending expert staff to advise local governments and other actors (such as private firms and public–private collaborations), to assist the latter in working up project proposals and other pertinent items. This deployment of expert assistance had a monetary value that also cannot be quantified.

Policy Integration on the Compact City

Policy integration on building compact cities is an additional development that is amplifying collaboration and the effective use of scarce fiscal, human and other resources. **Figure 8** outlines Hirosaki City's spatial planning, or the "Locational Optimization Plan." This plan is an element of the city's overall smart city plan, and is integrated with it[30]. As in virtually all Japanese smart community projects, policy–integration between energy and spatial planning has encouraged robust policies to foster densification, to help cope with depopulation and ageing in the context of accelerating climate change and other hazards. Between December 2014 and December 2016, the number of subnational governments designing these spatial plans increased from

29) The LDP list (in Japanese) is available at the following internet URL: https://www.jimin.jp/policy/policy_topics/energy/131871.html

30) For the details (in Japanese), see Hirosaki City's October 4, 2016 draft proposal for its Locational Optimization Plan, especially p. 16, which is available at the following internet URL: http://www.city.hirosaki.aomori.jp/oshirase/jouhou/soannzennpenn.pdf



Source : Hirosaki City Locational Optimization Plan, Hirosaki City, October 4, 2016: http://www.city.hirosaki.aomori.jp/oshirase/jouhou/soannzennpenn.pdf

Figure 8 Hirosaki City Locational Optimization Plan

62 to 309[31].

The administrative agency to achieve this integration is also in place, via the Compact-City Design Assistance Team (CCDAT). The CCDAT was developed in March of 2015 under the auspices of the Comprehensive Strategy for Regional Development, which itself was given Cabinet assent on December 27, 2014. The CCDAT is centred on the MLIT, but also includes representation from the Cabinet Secretariat, the Reconstruction Agency, MIC, MOF, The Finance Agency, MEXT, MHWL, MAFF, METI, and MOE. This broad representation is deliberate because designing the compact city includes addressing disaster resilience, regional cooperation, urban farming, education, health and welfare, urban revitalization, local transport, revising local facilities, residential areas, and schools. The CCDAT's role is to deliberate with the specific local government concerning such matters as issues relating to the relocation of local facilities. The CCDAT then integrates how to relate policies (eg, energy, trans-

31) The data and other relevant information concerning Locational Optimization Plans are available (in Japanese) at the following internet URL on the MLIT's website: http://www.mlit.go.jp/toshi/city_plan/toshi_city_plan_fr_000051.html

port, disaster resilience) into an overall package of institutional reforms and fiscal measures to achieve greater densities in tandem with better livability.

These plans are already guiding the relocation of hospitals, schools, elderly care, and other public services, a relocation that in turn increases the cost-benefit performance of smart energy networks and inputs at the same time as it reduces energy use. That reduction in energy use is achieved via the reduced need for motorized (especially single-car) transport in favour of public transit, cycling, and walking. The reduced spatial footprint of the community also leads to less energy used to move water around, plus lower per-capita costs to maintain roads and other critical infrastructure, in addition to other energy savings. This integration of spatial planning with energy has been underway over the past three years, and has linked most of the central agencies together, enhancing the effectiveness of planning and spending through reducing overlap and other sources of administrative inefficiency[32].

What can be said with confidence is that, in 2016, many of the Japanese gove rnment's central agencies were aggressively promoting distributed energy, especially renewable systems. They did this for a variety of reasons, with disaster resilience most prominent. They also collaborated on doing so. Moreover, this collaboration among central agencies was formalized from 2017 to 2022, via the April 11, 2017 meeting of the of the "Cross-Agency Council on Renewable Energy and Hydrogen[33]." This meeting was the Council's third, and it detailed fully 12 inter-agency collaborations to foster the deployment of renewable energy (EIC, 2017).

This expanding collaboration is a sharp contrast to the top-down, stovepiped paradigm that was true prior to 3-11 and remains the model through which many scholars and others understand Japanese policymaking[34]. For example, on May 14 of 2016, Japan's Institute for Sustainable Energy Policies (ISEP) and 74 other green organizations released their first "Green Watch Community Power Environmental White

32) An explanation of the Compact-City Design Assistance Team and related institutions is available (in Japanese) at the following internet URL on the MLIT's website: http://www.mlit.go.jp/toshi/city_plan/toshi_city_plan_tk_000016.html

33) The particulars concerning the membership and deliberations of the Cross-Agency Council on Renewable Energy and Hydrogen are available (in Japanese) at the following URL: http://www.cas.go.jp/jp/seisaku/saisei_energy/

34) For example, Omori (2016: 118) argues that METI and MOE have very poor collaboration, when in fact they are collaborating on 6 of 12 measures to foster the deployment of renewable energy (EIC 2017).

Table 9 Japan's Infrastructure Exports, By Sector

(Units: JPY 100 million)

<table>
<tr><th colspan="3" rowspan="3">Sector</th><th colspan="2">Current</th><th>Projections</th></tr>
<tr><th colspan="2">Approximations</th><th>Estimates</th></tr>
<tr><th>2010</th><th>2014</th><th>2020</th></tr>
<tr><td rowspan="5">Energy</td><td colspan="2">Power(Conventional)</td><td>22,000</td><td rowspan="5">56,000</td><td rowspan="5">90,000</td></tr>
<tr><td colspan="2">Nuclear Power</td><td>3,000</td></tr>
<tr><td colspan="2">Oil/Gas Plant</td><td>5,000</td></tr>
<tr><td colspan="2">Smart Community</td><td>8,000</td></tr>
<tr><td colspan="2">Subtotal</td><td>38,000</td></tr>
<tr><td rowspan="9">Transport</td><td colspan="2">Rail</td><td>1,000</td><td rowspan="9">10,000</td><td rowspan="9">70,000</td></tr>
<tr><td colspan="2">Next-Gen Auto mobiles</td><td>10</td></tr>
<tr><td colspan="2">Asv. Safety Vehicles</td><td>—</td></tr>
<tr><td colspan="2">Roads</td><td>2,000</td></tr>
<tr><td rowspan="2">Harbours</td><td>Construction</td><td>500</td></tr>
<tr><td>Operation</td><td>500</td></tr>
<tr><td rowspan="2">Aviation</td><td>Airports</td><td>500</td></tr>
<tr><td>Control</td><td>1</td></tr>
<tr><td colspan="2">Subtotal</td><td>4,511</td></tr>
<tr><td>ICT</td><td colspan="2">Subtotal</td><td>40,000</td><td>91,000</td><td>60,000</td></tr>
<tr><td rowspan="3">Infrastructure</td><td colspan="2">Industrial Parks</td><td>100</td><td rowspan="3">18,000</td><td rowspan="3">20,000</td></tr>
<tr><td colspan="2">Construction</td><td>10,000</td></tr>
<tr><td colspan="2">Subtotal</td><td>10,100</td></tr>
<tr><td rowspan="3">Living Environment</td><td colspan="2">Water</td><td>2,000</td><td rowspan="3">4,000</td><td rowspan="3">10,000</td></tr>
<tr><td colspan="2">Recycling</td><td>1,000</td></tr>
<tr><td colspan="2">Subtotal</td><td>3,000</td></tr>
<tr><td rowspan="6">New Sectors</td><td colspan="2">Medical</td><td>5,000</td><td rowspan="6">11,000</td><td rowspan="6">50,000</td></tr>
<tr><td colspan="2">Agriculture and Food</td><td>1,000</td></tr>
<tr><td colspan="2">Space</td><td>200</td></tr>
<tr><td colspan="2">Marine Infra/Ships</td><td>1,000</td></tr>
<tr><td colspan="2">Postal</td><td>150</td></tr>
<tr><td colspan="2">Subtotal</td><td>7,350</td></tr>
<tr><td colspan="3">Overall Total</td><td>102,961</td><td>190,000</td><td>300,000</td></tr>
</table>

Source : adapted from Tomigahara, 2016: 2

Paper." Their document's 128 pages completely ignore the role that policy integration plays in fostering such technology as microgrids and smart communities. Instead, it depicts a top-down (*tatewari gyousei*) sectionalist state that favors big business (Green Watch, 2016: 63-4) at the expense of the citizens, the latter allegedly being excluded from policymaking (Green Watch, 2016: 63-67). Moreover, as of this writing, Japan's most recent introductory text on environmental and energy economics, published in November of 2016 overlooks the role of microgrids and smart communities. It also describes Japan's policymaking as being an outlier, marked by struggles rather than cooperation between the METI and MOE (Omori, 2016: 118).

The smart communities fostered by the resilience paradigm are also important to Japan's plans to increase infrastructure exports from JPY 10 trillion in 2010 to JPY 30 trillion in 2020. As seen in **table 9**, Japan's infrastructure exports in 2010 totaled just under JPY 10.3 trillion. Fully JPY 3.8 trillion of that total was energy-related, the bulk of it being the JPY 2.2 trillion in coal ("conventional power"). The distributed energy and other systems of the smart community composed JPY 800 billion, more than the JPY 300 billion in nuclear sales and the JPY 500 billion in gas and oil plant exports. The Japanese government aims to triple infrastructure exports to JPY 30 trillion, by 2020, with energy infrastructure more than doubling, to JPY 9 trillion. It achieved JPY 19 trillion in 2014, suggesting that the 2020 target is realistic. What remains to be seen is how much the relative shares of smart community exports increase versus the proportions for coal and other fossil-fuel plant as well as nuclear. One powerful determinant of the shift is likely to be the domestic deployment of smart communities, including microgrids, energy management systems, and the array of distributed energy inputs being developed.

Aiding in this effort to export smart communities was harnessing them to the Japan International Cooperation Agency (JICA), Japan Overseas Infrastructure Investment Corporation (JOIN), and other export-promotion networking and finance facilities[35]. The Japanese also began working through the International Council for Local Environmental Initiatives (ICLEI) on this goal. Japan appears to have been advantaged by the Sendai Framework, which helped to disseminate the concept of disaster-resilient smart communities and Japan's collaborative governance. Further to

35) On this objective, see (in Japanese) the Japanese Government's revised 2016 "Infrastructure Export Strategy" at the following internet URL: http://www.kantei.go.jp/jp/singi/keikyou/dai24/kettei.pdf

this end, Japan's MOE set up the "Asia Low-Carbon Cities Platform" (MOE, 2016). It listed 25 of Japan's smart communities, with clickable summaries of their programmes for smart energy systems and other critical infrastructures. The site thus summarized the core infrastructures of Japan's smart community and then showed potential customers how they could arrange consulting, financing, and other assistance.

Another important influence on export possibilities is that the main proponent of national resilience, Nikai Toshihiro, was appointed Liberal Democratic Party Secretary General on August 3 of 2016. Nikai is influential and internationalist. He has long emphasized cooperating with regional countries, particularly China and Korea. Nikai has made it clear that he is committed to leveraging Japan's expertise on disaster resilience and renewable energy. He has called for using it to expand external engagement and exports, combining domestic security and economic goals (in Kashiwagi, 2016: 177-78). At Hawaii University on May 4, 2017, Nikai argued for the deployment of renewable energy in Pacific island states as one measure to bolster their resilience against climate change (*Kyoto Shimbun*, May 4, 2017). The evidence thus suggests that smart community and associated exports are increasingly prioritized in the infrastructure export strategy.

Post 3-11 Stakeholder Support

Another important change is the degree to which the 3-11 disaster has fostered subnational government and popular support for energy alternatives and smart communities. Pre 3-11 Japan did have distributed energy initiatives aimed at increasing local energy autonomy through biomass, geothermal and other projects. Yet these "local production and consumption" programmes gained minimal traction due to the ambivalence of local communities, the disinterest (or outright opposition) of the regional power monopolies, the lack of incentives for local leaders, byzantine regulatory regimes, and other hurdles. However, after 3-11 virtually all public and private-sector stakeholders, together with most of civil society, were able to agree on the need to bolster resilience against hazards.

For example, a March 2014 Japanese METI survey of smart communities showed that 82.2% of surveyed local governments listed resilience against disasters as their top priority for undertaking a smart community project, with energy autonomy second, at 73.3%, and the creation of new local services and businesses third at 71.1% (Oguro, 2014). Moreover, Japan's annual and authoritative "Environmental Consciousness Survey," released in September of 2016 by the National Institute for Environmental Studies showed that the country's strongest level of consensus for any initiatives related to energy and the environment was the 77.8% support for using public funds to build resilience in the face of climate change. And 68.1% supported using ODA to build resilience in developing countries (NIES, 2016: 20). In short, Japanese local governments and the public were quite amenable to changing the built environment as an adaptation response. They were also willing to foster resilience in developed countries.

It is possible that the adaptation response offers a distinct and decarbonizing narrative for dealing with climate change. This is a contrast with the focus on the German model, which emphasizes mitigation via renewables. Much of the post 3-11 literature on Japan and energy policy clearly wanted it to be denuclearizing Germany (Oshima and Takahashi, 2016). Japan's "energy shift" advocates insisted that Japan's geography was not a significant problem for the diffusion of renewables. They declared that other archipelagos (New Zealand), islands (Iceland), and relatively isolated energy economies (Iberian Peninsula, Ireland) had achieved high levels of renewables (Yamaka, 2017: 350). But they failed to follow their assertions up by engaging with the fact that in 2015 fully 56 percent of New Zealand's power was generated by large hydro projects, which elicit strong local opposition in Japan. And while Iceland indeed secures 85 percent of its primary energy from renewable sources, these are largely geothermal followed by hydro. And in Japan, geothermal development is strongly opposed by hotspring owners and environmental interests.

Hence this paper has emphasized that Japan is not Germany, with its advocacy coalitions and *energiewiende*, contingent on continental energy-trading infrastructures as well as a very activist civil society. Nor is Japan one of the Anglo-American regimes, with their generally plenteous resource endowments, competitive party politics, growing populations, and capacity to rely on market-led solutions. Japan is instead an East-Asian developmental state, now shorn of "the insulation of state bureaucrats" (Pempel, 1999: 146). The country's business model—so to speak—has long been one of paying for imported energy and other inputs by maintaining an export surplus (Morse, 1981: 26). Japan's incentive to reduce energy imports with domestically sourced (or at least domestically controlled) alternatives increases with mounting uncertainty of external supplies, prices, and geopolitical stability. Now population density, technical strengths, and the imperative of disaster resilience are being used to modernize the energy economy with distributed energy.

Conclusions

In 2017, Japan's National Resilience initiative was focused on energy, and was bigger and better-funded than its counterparts overseas. Overseas programmes were hindered by climate denial, fiscal austerity, inadequate resources, poorly coordinated governance, and other hurdles. Japan's programmes did not have such hurdles, and included its most prominent experts on energy, disaster studies, engineering, spatial planning, and other critical areas. These experts were world-class, and increasingly networked in new and interdisciplinary governmental and quasi-governmental institutions.

But the role of resilience in reshaping Japan's energy and other policies went overlooked for several reasons. One reason was the nuclear disaster overwhelmed the natural disaster, in most academic work, media coverage and other venues. For example, "Fukushima" dominated the newspaper headlines and academic conferences that spiked in frequency around anniversaries of 3-11. And all coverage relegated the earthquake and tsunami to the opening act. They then turned the focus to Fukushima, with the iconic reactor explosions, the incredible chaos and outright lies, the continued difficulty in finding the molten reactor cores, and the inevitable questions about the prospects for renewable energy.

A second reason, related to the above, was that the ensuing debate pit pro-nuclear and anti-nuclear lobbies against one another. Their dueling narratives were ever-alert to tactical advantage and thus impatient with complexity and more comprehensive analyses. From 3-11 on, pro and anti-nuclear forces devoted much time and energy to the question of relative costs and reliability. Pro-nuclear interests were incentivized to discredit renewable and other alternatives as too costly and intermittent. In contrast, anti-nuclear advocates debated the cost estimates for nuclear power. They argued that its costs were rising, through regulation and other factors, while the costs for renewables were plunging globally. Yet both of these positions overlooked the crucial role of critical infrastructure and the shape of the spatial economy. The struggle also led to a great deal of motivated reasoning on both sides, obscuring important developments in energy policy, policymaking institutions, and the expanding implementation of the post 3-11 paradigm.

A third reason concerns governance. The anti-nuclear groups, and many like-minded academics (Green Watch, 2016; Oshima, 2016; Takao, 2016), generally privilege community-led power projects and greatly distrust the central state. Their work shows that they regard the state as top-down and committed to nuclear power. They do not investigate the post 3-11 NRP, ARJ, and other institutional changes which suggest the Japanese state has become very collaborative. Anti-nuclear environmentalists and academics have made good use of the stubbornness of majority public opposition to restarts, and that opposition's repeated expression in important prefectural elections. Yet they seem stymied by the fact that public opinion does not provide a clear mandate for what to do instead. Opinion polling routinely showed that majorities desired more renewable energy. But public opinion also opposed additional costs. And the Japanese public has always been very quick to block local development, whether that be roadways, gas pipelines, wind turbines, geothermal facilities, and even solar installations (Scalise, 2013).

A fourth reason is that the resilience institutions were so recent. Though there is a plentiful descriptive literature on them, from within the bureaucracy, there was little analytical work. Uncovering the new institutions' role and the linkages among them thus required reading through a myriad of administrative planning documents, searching through fiscal and regulatory releases, tracking the academic and other backgrounds of experts involved in the NRP, ARJ, NSS and other initiatives. And that in-depth research had to be done comparatively as well, to check that Japan's project was indeed necessary and not simply a trumped-up disguise for pouring yet more concrete.

A fifth reason for the lack of attention to Japanese resilience appears to be that the Japanese and international debates on climate change continued to emphasize mitigation over adaptation. Though microgrids, district heating and other smart energy systems clearly achieve both (Udvardy and Winkelman, 2014; UNEP, 2015), there is not yet a well-developed literature on this fact. Research does suggest that confronting publics with the need to adapt to extreme weather and other hazards can lead to greater engagement with climate change mitigation. But there is as yet little work in this area internationally (Howell, et al., 2016) and not a great deal in Japanese (Hasegawa, 2016).

As noted earlier, the 3-11 natural disaster was unprecedented in scale. But it produced a sharply contrasting politics to the nuclear disaster. Instead of the intensely ideological fight over nuclear versus solar, the natural disaster elicited a quieter, pragmatic disaster-resilience policy response, one that appears to be having more influence on the energy economy and an array of related policy regimes. In behind the public struggle between nuclear versus renewables, policy entrepreneurs in the energy community began working closely with the disaster specialists, forging a more dynamic and collaborative approach that is increasingly shaping energy and associated policies.

We have seen that Japan's energy policies have long been influenced by crises and other challenges. As a crisis, the 3-11 natural and nuclear disasters appears to have become the key drivers in Japanese energy policy. They certainly disrupted the nuclear paradigm that lay at the heart of Japan's energy, environmental and industrial policies. But perhaps more importantly, the disasters opened space for policy intellectuals to enter and elaborate a roadmap towards revised urban forms centring on disaster resilience, distributed energy, in addition to smart and compact cities. This seems no surprise: the nuclear disaster itself was, after all, brought on when the 3-11 tsunami submerged back-up diesel generators unwisely located in the basements of Fukushima Daiichi. It was thus an instance of the kind of cascading failures in critical infrastructure that result from the combination of continuing urbanization, worsening climate change, and other variables.

Jolted by the crisis, Japan's post 3-11 energy policymaking is increasingly integrated, collaborative, smart and growth-oriented. It uses crises—both chronic and punctuated—to evolve governance and grapple with unprecedented externalities. The major question appears to be the pace and extent to which Japan's local resilience model diffuses and displaces centralized power and conventional energy.

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