Is Japan Actually a Green Laggard?

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Introduction

In 2018, a multiplicity of extreme events, including heatwaves, record rains and forest fires, provided more evidence of accelerating climate change and the risk of overshooting a series of climate tipping points (Nature 2018, Steffen et al 2018, WMO 2018). This disturbing backdrop increased the focus on integrating policies and actions on mitigating and adapting to climate change (Bager et al 2017, Economist 2018, Landauer et al 2018, Reckien et al 2018). This paper examines what Japan is doing in this context. We ask whether Japan is backward on dealing with climate change, a "green laggard," or whether it might be a leader ranking alongside Denmark, Germany and China. There is a surprising divergence of informed opinion on this very important issue, especially within Japan itself.

We first examine the empirical evidence on Japan's decarbonizing performance and other measures to counter climate change. We show that Japan is not a laggard. This paper then asks why there is so much ink spilled on representing Japan as backwards. To this end, we examine two contrasting domestic narratives on Japan's post 3-11[1] energy and environmental governance and policy. Importantly, neither narrative denies climate change and the urgency of rapid decarbonization. In Japan, climate denial is politically marginal, a sharp and important contrast to the power of climate denial in Anglo-America. Rather, the narratives differ mostly in their preferred means of achieving decarbonization, their degree of policy integration and density of governance, and the focus of stakeholder linkage.

As we shall see, the first narrative is idealistic, resolutely anti-nuclear, and advocates a locally-led transition to 100% renewable energy by 2050 (the most common

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1) "3-11" refers to the natural and nuclear disaster that followed the massive earthquake and tsunami on March 11, 2011.

aspiration among idealists). These idealists include activists and scholars, and are among the most vocal proponents of the claim that Japan is a laggard. Their general argument is that climate change can best be addressed, even stopped, by a rapid shift to solar, wind and other forms of renewable energy. Their narrative emphasizes local citizens' groups and local governments, allied behind ambitious targets, as the key governance instruments in displacing both nuclear power as well as coal and other fossil fuels.

The contrasting narrative is pragmatic and technocratic. The energy technocrats include scholars and policymakers. Their arguments diverge most sharply from the idealists in their support for nuclear power and calculations of the capacity of renewable energy and energy efficiency to displace conventional energy. The pragmatists neither oppose nuclear power nor any other low-carbon or decarbonizing option (such as carbon-capture and storage). They are also strong proponents of "whole of government and whole of community" approaches[2]. Diverging sharply from the idealists' reliance on local mitigation projects (esp. the reduction of carbon and other greenhouse-gas emissions via renewable energy), the pragmatists promote integrated measures that maximize both climate mitigation and adaptation through a multiplicity of stakeholders. As we shall see, the pragmatists have already institutionalized an increasingly robust industrial policy to foster further integration. We conclude that this policy integration merits closer inspection.

The Comparative Evidence

We first turn our attention to Japan's comparative performance on deploying renewables, efficiency and otherwise decarbonizing its energy economy. We show that prior to 3-11 Japan was indeed a laggard in these aspects of climate mitigation, opting instead to emphasize nuclear energy as the pillar of its strategy for decarbonizing the energy sector (DeWit 2019). The nuclear paradigm was gravely, perhaps fatally, disrupted through the March 11, 2011 (3-11) natural and nuclear disasters in the

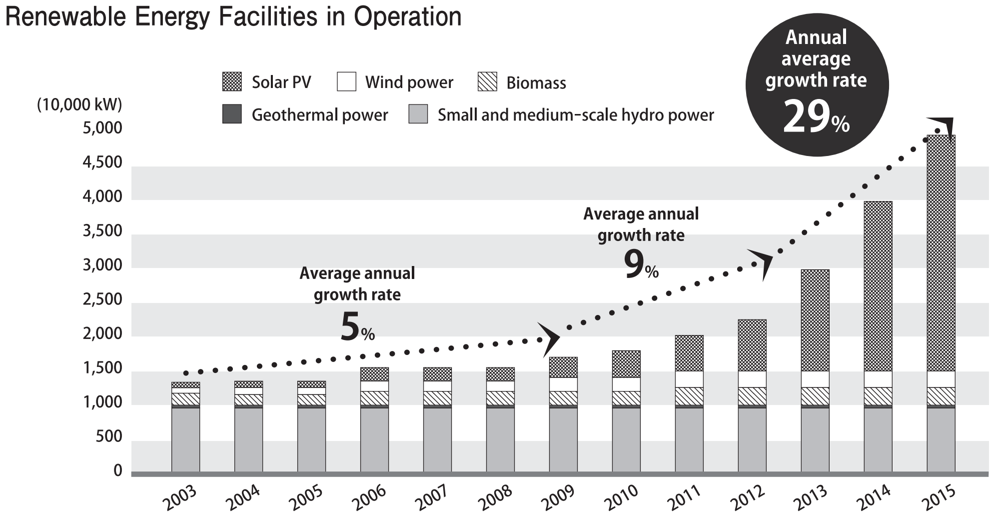
2) One application of the "Whole of Government and Whole of Community" organizational framework is seen in former US Navy Rear Admiral Ann C. Phillips March 5, 2018 article on "Sea Level Rise Preparedness: An Intergovernmental Pilot Project as a Blueprint for Community Resiliency," at the "Resilient Virginia" website: https://resilientvirginia.org/emergency-preparedness/sea-level-rise-preparedness

Tohoku region, after which Fukushima became an icon of nuclear risks (DeWit 2017b). but that it has since become a leader in renewable energy and efficiency. Again, this argument is controversial. One key idealist claim is that Japan is not making significant progress, but is rather a “backward country” (*koushinkoku*). The overriding consensus among idealists is that Japan’s national government is reluctant to expand renewable energy. Many also argue that the national government is more committed to returning to the nuclear paradigm (Asahi Shimbun 2018a, Green Watch 2016, Oshima and Takahashi, 2016: 34, Takao 2016).

It is important to point out that this assertion of backwardness is questionable even among some of the “laggard” narrative’s institutional allies. Christine Lins, Executive Secretary of the global renewable energy policy network, REN21, is herself on record (in Japanese, at least) as explicitly denying it. Lins points out that in 2016 Japan was 4th in the world in renewable investment (see the data in FS-UNEP 2017). While 4th is not 1st, it certainly is a striking increase on Japan’s performance in 2009 and earlier. In 2009, Japan ranked 15th among the G20, investing less than USD 1 billion in renewable energy, far less than China’s USD 34.6 billion and Germany’s USD 4.3 billion (Pew 2010). REN 21’s Lins evaluates Japan’s recent increase in investment positively. She suggests it is natural for Japanese renewable enthusiasts to regard their country’s deployment as inadequate, but that viewed internationally Japan is a global leader (quoted in Matsuki 2017).

Of course, the sheer volume of investment is not the only item of importance. There are many more items that can, and need to, be examined alongside the facts adduced by Lins. For example, **figure 1** shows that Japan’s annual deployment of renewable energy was quite modest until 2011. But between 2012 and 2015 that rate accelerated to an annual average of 29%. Over 90% of the new capacity was solar power, however, which brings with it challenges we shall detail below. At this point, it is sufficient to note that Japan’s addition of renewables dramatically increased after 3-11, when the country’s nuclear goals (over half of power generation by 2030) became politically impossible to realize.

This progress on diffusing renewable energy was confirmed by the International Energy Agency’s (IEA) October 2017 comparative report on “Renewables 2017: Analysis and Forecasts to 2022.” The IEA’s study indicates that Japan’s installation of renewable energy was comparatively quite aggressive after 3-11. In 2016, Japan’s solar deployment totaled 8.6 gigawatts (GW), which resulted in a cumulative 42 GWs



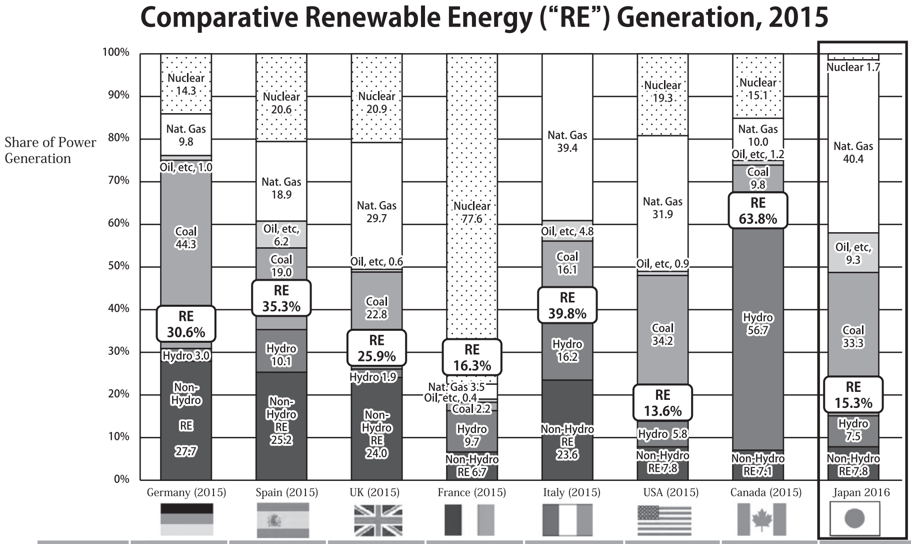
Source: METI, 2017

Figure 1　Renewable Energy Growth Rate in Japan

of solar capacity. Japan therefore bypassed Germany's 41 GW of installed solar capacity. The IEA assessment also anticipates that Japan's annual renewable electricity generation, measured in terawatt hours (TWh) will increase 169 TWh in 2016 to 240.3 TWh in 2022. The IEA anticipates that, over the same period of 2016-22, Japan's 6 % compound average annual growth rate (CAAGR) of renewable capacity will remain above the global CAAGR of 5.2%, outpacing Germany's 4.6% and the China Region's 5.9% (IEA 2017a: 179).

We have seen that, during the 7 years between 2009 and 2016, Japan comparative performance on renewable investment rose from 15th to 4th. To be sure, Japan started from a low base of installed renewable capacity, as is evident in the early years (ie, prior to 2009) portrayed in **figure 1**. Hence Japan's greatly increased investment in renewable energy, particularly after 3-11, did not result in its overcoming the lead of many of its peers' percentage of renewable energy in their power mixes[3]. That fact is apparent in **figure 2**, which reveals that Japan's solar, wind and other renewable energy (in the figure, "RE") installations provided about 7.8% of total power generation in 2016 (preliminary data). The figure shows that this non-hydro renewable generation relied primary on solar (4.8% of total generation). The figure also

3) The "power mix" is the relative shares of energy inputs (eg, solar, coal, nuclear) in the country's electricity-generating capacity.



※2016 data for Japan are preliminary

	Germany (2015)	Spain (2015)	UK (2015)	France (2015)	Italy (2015)	USA (2015)	Canada (2015)	Japan 2016
Main RE Source (Excluding Hydro)	Wind 12.3%	Wind 17.7%	Wind 12.0%	Wind 3.8%	Solar 8.1%	Wind 4.5%	Wind 3.9%	Solar 4.8%
Target Year	2030	2020	2020	2030	2020	2035	— (No National Target)	2030
RE Target	Over 50% (Of Total Generation)	40% (Of Total Generation)	31% (Of Total Generation)	40% (Of Total Generation)	35~38% (Of Total Generation)	80% "Clean Energy" of Total Generation)	— No National Target	22~24% (Of Total Generation)

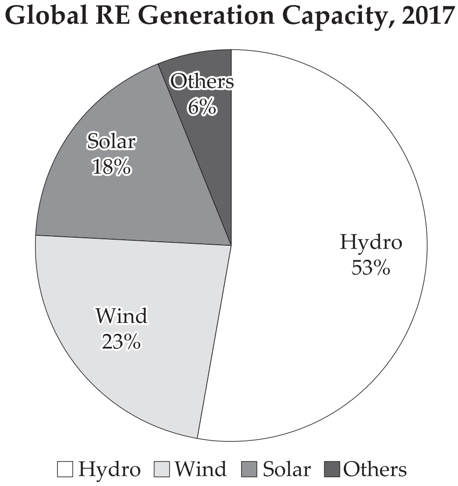
Source: ANRE, 2017

Figure 2 Comparative Renewable Energy (RE") Generation, 2015

shows that the 7.8% non-hydro RE exceeded hydro, whose share was 7.5% of total generation. Japan's non-hydro RE was greater or at least even with the levels in Canada (7.1%), the US (7.8%) and France (6.7%). Japan's non-hydro RE levels were, however, far less than the other EU countries of Germany (27.7%), Italy (23.6%), Spain (25.2%) and the UK (24%).

At the same time, **figure 2** shows us that the impressive non-hydro RE performance of Germany, Spain and the UK relied heavily on wind power. The percentages of wind in these countries' power mixes are portrayed in the figure's horizontal column "Main RE Source (Excluding Hydro)." The data indicate that only Italy was able to achieve a high level of non-hydro RE while relying on solar (8.1%) as its primary source of RE.

Also worthy of note is the key role that domestic large hydro plays in several cases. In Canada, for example, conventional hydro accounts for 56.7% of total power generation. The role of conventional hydro is worth a brief digression. Idealists generally do not view large hydro favourably, pointing to its impact on sensitive



Source: Adapted from IRENA, 2018

Figure 3　Global Renewable Energy Generation Capacity, 2017

ecosystems (Horner 2018)[4]. Yet large hydro has contributed greatly to Canada's ability to reduce its dependence on fossil fuels in the power sector. Plentiful low-cost and non-intermittent, baseload hydro also greatly assisted France, Italy and Spain to balance their intermittent solar and wind generation. **Figure 3** shows that 53% of total global renewable generation capacity in 2017 comprised hydro, compared to 23% for wind, 18% for solar and 6% for others (eg, biomass), according to the International Renewable Energy Agency (IRENA). Whether conventional hydro can grow much further is questionable, though it is growing and becoming increasingly digitized (IHA 2018).

Moreover, there is no question that large hydro has played a strong role in decarbonization. Beyond the countries listed in **figure 2**, we find such cases as Costa Rica. In 2016, Costa Rica's total installed hydro capacity of 2.12 Gigawatts (GW) represented 75% of its renewable power profile. Costa Rica's goal of achieving 100% RE in its power mix by 2030 would be impossible without its hydro assets, and its hydro allows intermittent solar, wind and other renewable to be balanced (IHA 2017).

Returning to the countries listed in **figure 2**, we find additional examples where hydro plays a significant role. Canada's most populous province, Ontario, eliminated

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4) On the other hand, some experts in the World Wildlife Fund have done quite high-quality, pragmatic work on hydro, noting its immense role as a source of renewable energy and other benefits. See, for example, Moncrieff (2017).

carbon-intensive coal from its power mix in 2014, in part by relying on its hydro capacity. In Ontario, hydro increased from 23% to 24% of capacity between 2003 and 2014 (Ontario 2017).

Note also that Ontario's reliance nuclear increased from 42% of total generation in 2003 to 60% in 2014 (Ontario 2017). Among idealists, opposition to nuclear is even more pronounced than that directed at hydro. Yet both power sources are very low carbon and "baseload" (non-intermittent). A close inspection of **figure 2** also suggests that they both underpin the decarbonizing of power mixes in several cases, except in Italy which has no nuclear capacity. Aside from Italy's absence of nuclear generation, only Japan has the lowest level of reliance on nuclear, at 1.7% in 2016. Japan's low share contrasts with Germany's 14.3% reliance on nuclear in 2016 and even higher levels of nuclear in the UK, US, Spain and France.

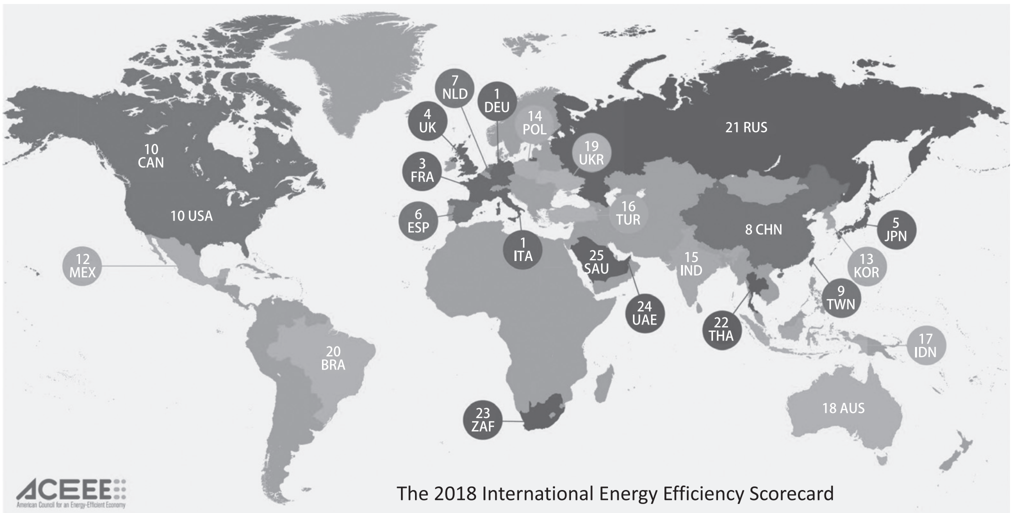
Idealists routinely highlight Germany's commitment to phase out its nuclear fleet by 2022. They generally assert that Japan should also phase out nuclear power, suing Germany as a model of leading via mitigation (Asahi Shimbun 2018a, Green Watch 2016, Oshima and Takahashi, 2016: 34, Takao 2016). But in this respect, it is also worth pointing out that Germany's reliance on coal, the most carbon-intensive fuel, is higher than any of the other countries in **figure 2**. Germany's power mix is 44.3% coal, exceeding even the US (34.2%) and Japan (33.3%). Recently, the international debate has turned critical attention to the German case, as the country is slated to spend USD 580 billion by 2025, primarily to support the diffusion of renewables. The evidence suggests that Germany is unlikely to reach the climate goals (especially mitigation via emissions reduction) that were its primary reasons for aggressive RE targets. Germany's emissions target is to reduce greenhouse gases by 40% between 1990 and 2020, but it seems almost certain to achieve only a 32% cut (Witkop 2018). This is in spite of the massive emissions reductions that followed German reunification and modernization of very carbon-intensive industry in former East Germany during the 1990s (BMUD 2017: 14). Andreas Loeschel, chair of the Energy Expert Commission of the German Government to monitor the country's energy transformation, stated in 2018 that "The challenge looks really difficult……There was too much confidence that renewables would do the trick. It's about getting dirty energy out of the mix" (Wilkes et al 2018). It is clearly an enormous and expensive challenge to decarbonize the power mix using only the solar, wind and other sources preferred by idealists.

Geographical factors also play a very large role. As will be discussed in detail below, an additional factor that aided the EU states to integrate intermittent renewables in their respective power mixes is the presence of an international grid. The power grid allows them to trade power back and forth. In 2015, 725 TWh of power was traded globally, with the world's top power exporters being Germany (12%), France (10%), and Canada (９%) (see Canada 2018).

Energy Efficiency

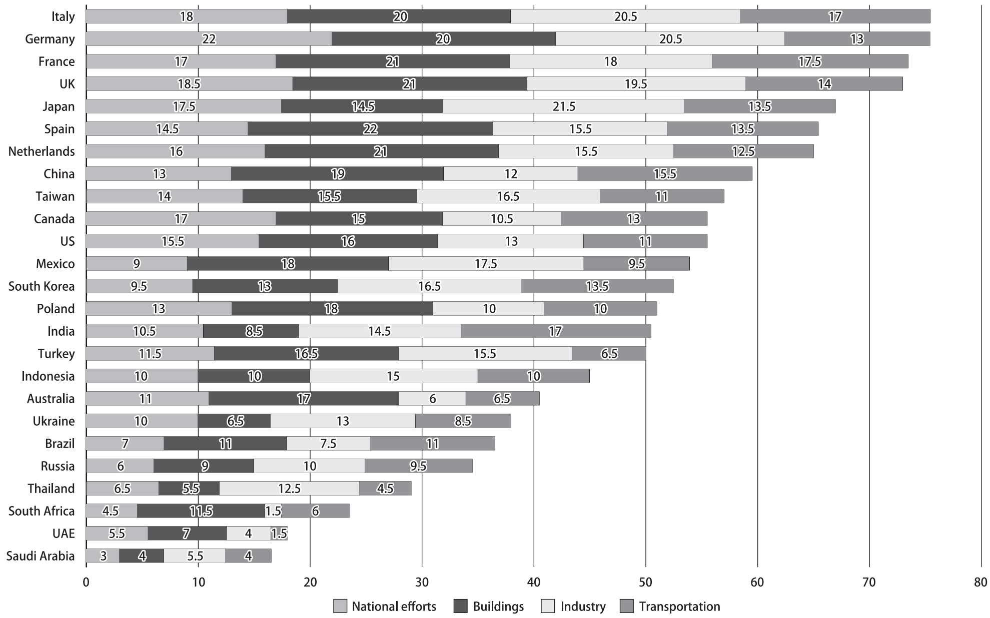
Japan has also made major advances in energy efficiency, relative to peer countries. Since 2012, the American Council on an Energy-Efficient Economy (ACEEE) has published, biannually, an International Efficiency Scorecard. This scorecard appears to be the most authoritative and comprehensive comparison of energy efficiency available. Its breadth is impressive. The 2018 ACEEE scorecard (ACEEE, 2018) assesses 36 separate indicators on efficiency policy and performance in industry, buildings and transportation, based on available data for 2014. The 2018 scorecard compares 25 countries that represent 78% of global energy consumption and over 80% of global GDP.

Contradicting the "laggard" image, Japan's efficiency performance is comparatively high and has remained so over the course of the ACEEE's four international comparisons. The ACEEE ranked Japan's overall efficiency at ４th in 2012 (ACEEE



Source: ACEEE, 2018

Figure 4　The International Energy Efficiency Scorecard, 2018



Source: ACEEE, 2018

Figure 5 Sectoral Scoring in the International Energy Efficiency Scorecard, 2018

2012) and 6th in 2014 (ACEEE 2014). By 2016, Japan had risen to 2nd place, a significant and generally underappreciated achievement (ACEEE 2016). And in 2018, the ACEEE ranked Japan's overall efficiency at 5th (ACEEE 2018), as shown in **figure 4**.

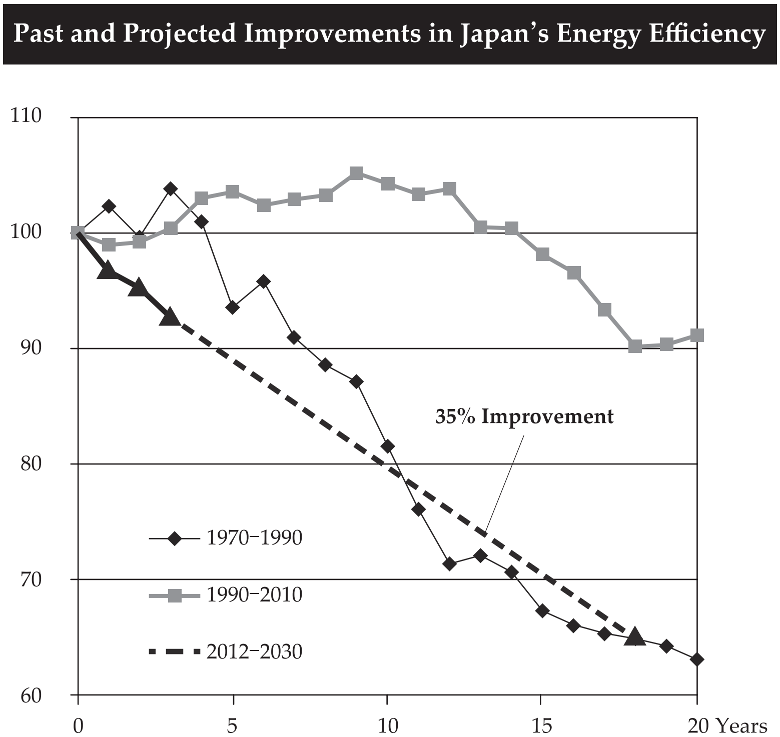
Figure 5 shows how close the top scores are. The two dominant categories in national scoring are national efforts (ie, policy initiatives) and buildings, followed by industry and transportation. Japan's poorest score is in buildings, reflecting the legacy of focusing on disaster resilience as opposed to energy efficiency (Arie 2017). But the figure shows that Japan's performance was generally consistent with the countries deemed global leaders in greening, and that Japan led in the industry efficiency category. Japan's transportation scores are also respectable because of the strong role of public transit. These scores are likely to increase, due to Japan's compact city and other integrated policies. These policies have been accelerated since 2014, the year of the survey data.

Efficiency gains appear evident in Japan's power sector. Between 2010 and 2015 Japan's total primary energy supply dropped from 514.7 million tons of oil equivalent (Mtoe) to 467.0 Mtoe and, over the same period, electricity sales declined from 926.6 terawatt-hours (TWh) to 837.5 TWh (IEEJ 2017).

Of course, Japan's power consumption plunged by 12% in the wake of 3-11, due to the effect of planned power outages and a *setsuden* (power-saving) campaign for the summer of 2011 (Kimura and Nishio 2013). Among other policies, large firms and buildings in Tokyo Electric Power's (Tepco) service area (which includes metropolitan Tokyo) were compelled to cut their July-September power use by 15%. These emergency conservation measures were deployed in particular during 2011 and 2012, but later relaxed and then finally withdrawn entirely in 2016 (IEA 2017d: 32-33).

Even as the emergency power-saving measures were ratcheted down, more deeply institutionalized efficiency standards were being developed and adopted. In 2013, Japan expanded the number of industrial sectors covered by its "top runner" programme, which had been introduced in 1998 following the 1997 Kyoto Conference of the Parties on climate change. The "top runner" system assesses the most energy-efficient products (eg, automobiles, air conditioners), setting them as standards, and then advocates they be met by other firms within three to ten years. The programme requires manufacturers to display the performance characteristics of the particular product, and is backed up by penalties that can be imposed in the event of non-compliance (ANRE 2015). As of January 2018, 32 products are covered by the top runner program. The METI is also organizing linkages among business sectors in order to further develop and diffuse best practices. Japan has also bolstered rules in its building sector. Changes to its efficiency laws in 2014 require all newly constructed public buildings to be net zero in energy by 2020 and average net zero in emissions by 2030 (ANRE 2018b).

These institutional innovations are reflected in new policies. A summary of Japan's overall efficiency policy goals is that they aim to match, at the very least, the 35% gain in energy efficiency that followed the 1970s "oil shock." As seen in **figure 6**, over the 2012-2030 period Japanese policymakers explicitly aim to equal or exceed the country's efficiency performance of 1970-1990. The figure also shows that energy efficiency gains in Japan between 1990 and 2010 were quite limited. This result was not only because of weakened incentives, including the fact that Japanese firms became reluctant to invest in new capital stock due to ageing/depopulation and the after the fallout from the 2008-09 global financial crisis (MoE 2018, 11). It also reflects the fact that Japan is a highly energy efficient economy, especially in industry (as seen earlier in the ACEEE study). This high level of efficiency means that costs increase for achieving each additional percentage of efficiency improvement.



Note: Energy efficiency levels in 1970, 1990, and 2012 are set at 100
Source: ANRE, 2018a

Figure 6 Six Decades of Energy Efficiency in Japan

In order to achieve these ambitious goals in energy efficiency, the Japanese have increased their fiscal support considerably. The FY 2018 METI budget for energy efficiency research was slated to increase to JPY 63.5 billion versus JPY 50.5 billion the previous year. Over the same time period, the MoE budget for promoting the diffusion of energy efficiency increased from JPY 61.4 billion to JPY 81.4 billion (MOF 2017).

Whether Japan's post-2014 accelerations of efficiency policies will outpace those of other countries remain to be seen. But Japan's consistently high sores in the previous results of the ACEEE comparisons suggest that the country will likely remain among the top 5.

Energy Management Systems

Japan is also a leader in the development and deployment of smart energy systems, which monitor and control power flows at the local level as well as inside houses, office building, factories, and other assets. Evidence of Japan's ranking is available from the Smart Energy Group of the Japan Economic Center (JEC), which regularly surveys the Japanese and international markets. The JEC's 2017 surveys indicated that Japan is a global leader in deploying the smart energy management systems that are central to the smart community. **Table 1** displays the JEC survey results and projections for Home Energy Management Systems (HEMS) sales. The table reveals that 75,000 units were installed globally in 2011, and that fully 15,000 (20% of the global total) were in Japan. By 2015, the number of HEMS had increased to 870,000 globally, with 150,000 (17.2% of the global total) in Japan. For 2020, the JEC projected a worldwide diffusion of 1.632 million HEMS, with 240,000 (14.7% of the global total) in Japan. The results for Japan are roughly consistent with an August 2016 Fuji Keizai survey of the Japanese domestic market for energy management systems (Fuji Keizai, 2016).

Table 1 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, 2017

Also impressive was the JEC survey concerning the "smart house" market, another segment that is a core element of the smart community. **Table 2** shows the JEC's results indicated that Japan represented over half of 2011 total global value of JPY 150 billion. The survey also revealed that Japan had held this share in 2015, when total global sales 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.

Table 2 Smart House Markets, Global and Japan, 2011–2020 (Units: JPY billion)

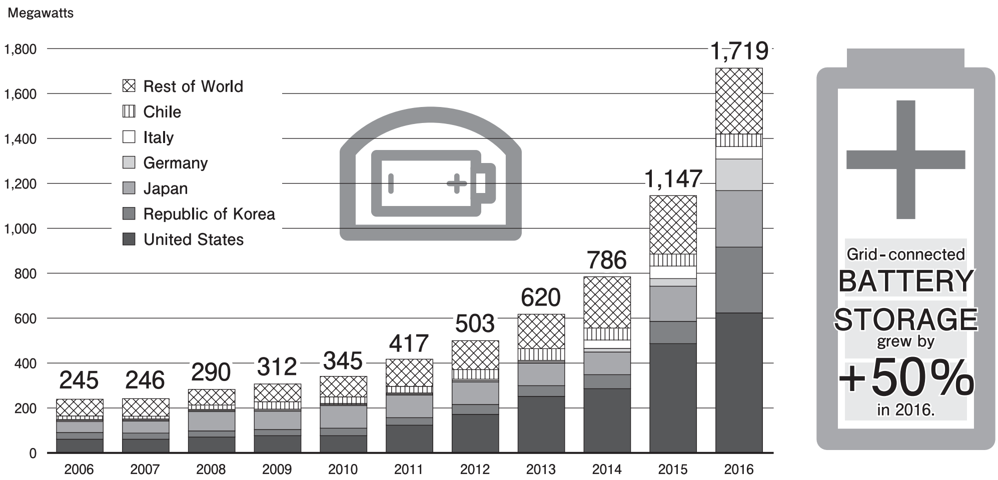
Year	Global	Japan
2011	150	80
2012	180	95
2013	220	115
2014	260	140
2015	310	160
2020	990	390

Source: Japan Economic Center, 2017

Energy Storage

Another area where Japan's performance needs a more rigorous empirical assessment is in energy storage technology and deployment. Storage is critical to handling the intermittent flows of power from solar and wind generation. Batteries and other forms of energy storage (eg, pumped hydro, production of hydrogen) allow renewable and other power generation to be stored for later use, thus smoothing the relationship between power generation and its consumption to match supply. **Figure 7** shows that Japan was a significant player in grid-connected stationary battery storage even before 3-11, but that its deployment expanded after 3-11. Global storage also increased greatly, nearly quadrupling from 417 megawatts (MW) in 2011 to 1,719 MW in 2016. As the Renewable Energy Policy Network for the 21st Century (REN21 2017) argued, "[f] ollowing the March 2011 earthquake, Japan's government began to explore options to increase power system reliability and cross-regional co-ordination of the electric grid through market liberalization. Energy storage has been deployed to provide flexibility to the country's rapidly increasing output of variable renewable energy (particularly solar PV)." Japan's percentage share of this mushrooming storage market declined even as the country's overall deployment increased. But Japan's technological lead in batteries and other storage solutions saw it able to secure a significant share of increases elsewhere. One example of this was seen in the fact that Japan's Panasonic is the world's largest maker of batteries for electric vehicles.

This paper has cast doubt on the claim that Japan is "a laggard." We have shown that post 3-11 Japan has implemented a host of generally overlooked energy-environmental strategies. We could have added more, such as Japan's ambitious



Source: REN21, 2017: 139

Figure 7　Global Grid-Connected Stationary Battery Storage Capacity, by Country, 2006-2016

"Society 5.0" energy-industrial policy (Kashiwagi 2018c), but believe the above suffice at present to make the case that Japan is not a laggard. In the following, we will show that Japan's climate and energy measures were taken in the face of quite difficult fiscal, topographical, resource, demographic and other impediments. Our thesis is that these challenges have led to a distinctive policy regime. This regime emphasizes integrating adaptation and mitigation, along with multiple other goals, in a multi-stakeholder approach. It therefore seems difficult to understand for idealists who emphasize 100% RE targets and champion a restricted range of stakeholders.

Japan's Dueling Narratives

At the outset, we would note that this paper should not be viewed as an attack on the idealistic, anti-nuclear/100% renewable position. In fact, Japan's idealistic narrative has provided many useful critical insights. For example, scholars and activists associated with this narrative introduced important aspects of the German *energiewiende*, or "energy transition," model to Japan, especially the advanced feed-in tariff, or FIT (Iida 2011). Also, prior to and immediately after 3-11, the idealists were a significant source of objective information concerning the political economy of Japan's "nuclear village" and renewable energy options (Kaneko 2013; Oshima 2010). Indeed, the present author has been fortunate to participate in articulating the idealistic narrative (eg, Kaneko and DeWit 2007; DeWit 2009; Iida and DeWit 2009; DeWit and Iida 2011; DeWit and Saaler 2011; DeWit, Iida and Kaneko 2012; DeWit 2012; DeWit 2013).

But in recent years, the narrative has come to disregard, if not deny, important hurdles that any Japanese government would have to confront in undertaking an energy transition. The idealistic critique remains informative in many respects, yet focuses on ambitious targets at the expense of addressing the difficult infrastructural, institutional and organizational realities of undertaking an energy transition. That is, it advocates an unprecedentedly massive and rapid transformation of the energy economy, but underestimates the enormity of the challenge of undertaking it in Japan. Moreover, the idealists' preferred agency for this transformation centres on community power and distributed energy. In large part, their vision of aggressive environmental action is rooted in popular movements and anti-establishment activism (Cassegard, 2017). At the same time, this idealistic vision of agency and scale underplays (or simply ignores) the ongoing expansion of integrated planning, inter-agency collaboration, and large-scale industrial policy.

Indeed, the idealistic narrative almost wholly ignores Japan's post 3-11 technocratic governance and system-integration. For example, as we shall see, the idealists claim that Japanese governance is top-down and sectionalist, even though there is significant and expanding inter-agency collaboration. The narrative's failure to analyze post 3-11 changes in Japan is lamentable. Any change in government would almost certainly be compelled to build on the technocrats' structural reforms rather than merely abolish them. But the idealists' dominance of the debate has left us without a proper understanding of what the technocrats have accomplished.

To remedy this hiatus in the literature, we show how Japan's technocratic policymaking uses collaboration and domain-integration (eg, energy and spatial planning), to cope with the fact that Japan confronts the developed world's most bracing combination of dependence on energy imports, rapid ageing and depopulation, climate-change hazards, comparative economic decline, fiscal crisis, and other stressors. All of these challenges are addressed by Japan's well-financed and very ambitious "Society 5.0" industrial policy. This paper describes one of the key pillars of Japan's Society 5.0 as smart communities, as these are the locus for coping with energy, ageing, disaster threats and related societal problems (Kashiwagi 2018a). Smart communities are also where energy, spatial, and other planning intersect. The paper also demonstrates that Japan's technocratic industrial policy displays a striking level of coordination across critical infrastructure networks, policy domains, agencies, business and civil society, and even multipurpose dam systems. We also argue that Japan's solutions have important lessons for other countries, including the Germans and Danes posited as climate leaders.

The Narratives

Below, we briefly outline the competing narratives in general terms, rather than exhaustively itemize all the idealist arguments and critiques, then follow that up with extensive detail concerning what the technocrats are doing on integrated planning, fiscal, and regulatory reforms. We shall turn to those matters in a later section. At present, it is more apt to compress the narratives into stories due to space restrictions and because they are told by two distinct groups of policy entrepreneurs. The first group, which includes former Democratic Party of Japan (DPJ) Prime Minister Kan Naoto and former Liberal Democratic Party (LDP) Prime Minister Koizumi Junichiro, who continue to argue that "apan is a laggard" and advocate a quick end to nuclear power (Asahi Shimbun 2018b). The second group is the "technocratic resilience" school. They built the smart community, national resilience, and Society 5.0 programmes and have accelerated their development.

Figure 8 outlines the main themes of these two generalized narratives. The figure shows that the idealists champion mitigation in the face of climate change, notably through carbon neutral or low-carbon renewable energy (particularly solar power, as we shall discuss in detail below). The idealists are resolutely anti-nuclear. There is some diversity in their ranks as regards the timing of a complete withdrawal from nuclear, but they are virtually all committed to eliminating nuclear energy from Japan's power mix. Some of them insist on an immediate shut-down of all Japan's nuclear capacity (at present, 5 reactors are in operation) or a German-style commitment to exiting nuclear power by a specified, near-term date, generally about 2030.

By contrast, the technocrats emphasize adaptation (or "resilience") to climate change. Some of them are not much interested in energy, per se, beyond the stipulation that it be available during emergencies. However, the leading technocrats use adaptation as a wedge for achieving mitigation, and advocate a broad portfolio of decarbonizing energy inputs, including some nuclear (Kashiwagi 2018a). The pragmatists are at least equally concerned to maximize incentives and infrastructures for

Dueling Narratives

· Japan is a laggard:	**· Technocratic resilience**
· Climate Change Mitigation	· Climate Change Adaptation
· Feed in Tariff	· Integrated Industrial Policy
· NGOs, Local Governments	· Whole of Government
· “Community Power”	· Smart Communities

Source: Author

Figure 8 Japan's Dueling Narratives on Energy-Environmental Policy

efficiency and conservation, together with the synergies from broad organizational collaboration and policy coordination.

Second, the idealists premise their energy transition on subsidy mechanisms, especially the FIT, together with carbon pricing and trading (DeWit 2014a). This emphasis on the FIT, and especially its still-generous subsidies for solar, perhaps reflects the character of their constituency as much as perceived best-available policy and technological options. The idealists’ domestic audience is largely composed of interests whose limited organizational, financial and other resources predispose them to seek fiscal support for comparatively costly but easily deployed, low-maintenance solar (along with some small hydro and biomass projects).

As for the technocrats, they incorporate subsidies and carbon pricing into a larger, integrated industrial policy. For them, the FIT is particularly important as a means to foster renewables in smart communities or as a redistributive mechanism between Japan’s rural and urban districts (Kashiwagi 2016). The technocrats recognize the usefulness of solar, and depict it as a key energy source in smart communities, or more recently “smart and micro communities.” The communities integrate heat networks (cogeneration), the internet of things (IoT) and artificial intelligence (AI) (Kashiwagi 2018b). But the technocrats are concerned to reduce reliance on expensive and intermittent solar by expanding the portfolio of renewables. Compared to the idealists, the technocrats are far less constrained by organizational and other resources.

They are thus able to undertake long-term and comprehensive planning that includes smart-energy networks and the exploitation of waste heat in sewerages and other l arge-scale infrastructure.

In terms of agency — ie, which should be the main sector driving the transition, state, market or civil society? — Japan's idealists generally distrust the state and thus look to NGOs and local governments, in alliance with small business and farmers. They often emphasize the individual citizen and direct participation in deliberation as the basis for forging community consensus (Matoba 2018: 13) and durable alliances between NGOs and local governments.

In some respects, it does not seem inapt to suggest that the idealists' approach is a species of the "folk politics" described by progressive intellectuals Nick Srnicek and Alex Williams:

> "folk politics privileges the local as the site of authenticity (as in the 100-miles diet or local currencies); habitually chooses the small over the large (as in the veneration of small-scale communities or local businesses); favours projects that are unscalable beyond a small community (for instance, general assemblies and direct democracy); and often rejects the project of hegemony, valuing withdrawal or exit rather than building a broad counter-hegemony. Likewise, folk politics prefers that actions be taken by participants themselves — in its emphasis on direct action, for example — and sees decision-making as something to be carried out by each individual rather than by any representative. The problems of scale and extension are either ignored or smoothed over in folk-political thinking" (Srnicek and Williams 2015: 31).

The Japanese energy idealists certainly do privilege small-scale, distributed energy, in spite of the enormity of the energy transition they insist be done in a few decades. Consistent with the above definition of "folk politics," their emphasis on "consensus-building" in the local community is also premised on extensive direct action and consultation with residents rather than via representatives. They assume that maximizing consultation, in tandem with rules to secure local participation in energy projects, will lead to local acceptance of wind, solar and other renewable installations.

More generally, the idealist narrative is a classic expression of civil society (or those who believe they represent civil society) seeking to lead a transition. In their emphasis on anti-establishment opposition, and their antipathy to outside, "colonialist" renewable projects in the local community (Daimon 2016: 155-7; ISEP 2014: 47; Nishikido 2014: 1-2; Takahashi 2017), they resemble the "blockadia" advocated by Naomi Klein (Klein 2015).

The idealists' audience is often well-meaning citizen groups who, as Mark C. Thurber suggests (Thurber 2016), simply want to see more solar panels and wind farms. As Thurber and others argue, far too many NGO reports and conference presentations rely on assertions about what is deemed technically possible, given the bounty of renewable resources, yet omit serious discussion of the governance changes, infrastructural investments, and other heavy-lifting required to achieve an energy shift. This problem is so acute that, in June of 2016, highly regarded energy experts Richard Heinberg and David Fridley published a thorough critique in *Our Renewable Future: Laying the Path for One Hundred Percent Clean Energy*, and made the book freely available via the internet (Heinberg and Fridley 2016)[5].

By contrast, the technocrats include a broader range of NGOs (albeit with the exception of anti-nuclear NGOs), local governments and business (large and small) in a larger "whole of government" or, more accurately, a "whole of nation" approach. The primary coordinating institutions are the governing Liberal Democratic Party (LDP) Cabinet Secretariat's National Resilience Council (NRC)[6], the "National Resilience (Disaster Prevention and Reduction) Deliberation Committee[7]," and the Association for Resilience Japan (ARJ)[8]. Politicians and disaster-resilience technocrats collaborate with other stakeholders in these and other institutions to build an economic paradigm based on National Resilience. For example, the ARJ was formally inaugurated on July 1 of 2014, and (as of August 2018) includes 19 working groups in which cabinet appointees, bureaucrats, academics, business and representatives from subnational governments collaborate. On many of the working groups, the local government representatives are mayors from such cities as Yokohama, Sendai, and other

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5) See Heinberg, Richard and David Fridley, *Our Renewable Future: Laying the Path for One Hundred Percent Clean Energy*: http://ourrenewablefuture.org/introduction/

6) See (in Japanese) Nakazato Kousei, "National Resilience Begins, with the Passage of the Basic Law," Daiwa Institute of Research, December 13, 2013: http://www.dir.co.jp/research/report/capital-mkt/20131213_008009.pdf

7) See the Cabinet Secretariat's National Resilience Council's website: http://www.cas.go.jp/jp/seisaku/resilience/

8) See the Association for Resilience Japan website: http://www.resilience-jp.biz

significant actors, which adds to the evidence that National Resilience is more collaborative than top-down. These working groups address the myriad aspects of resilient communities, including smart energy systems; green resilience; use of new materials (particularly cross-laminated timber) ; local revitalization; resilient housing; resilient business management; resilience against tsunami, mudslides, floods, and other hazards; use of smart technology to monitor and manage ageing infrastructure; and other areas[9]. The technocratic paradigm thus melds the state, civil society, and the private sector. Its inclusivity is reflected in the multiplicity of organizations they have implemented or expanded in the wake of 3-11 in addition to the preferential tax breaks and other supports for small businesses' renewable and other energy-related projects (DeWit 2018). The technocrats also centre their approach on smart communities as the locus of a larger, more inclusive transition that encompasses transport, communications, water systems and other critical infrastructures involving government, the private sector, and NGOs (DeWit 2019).

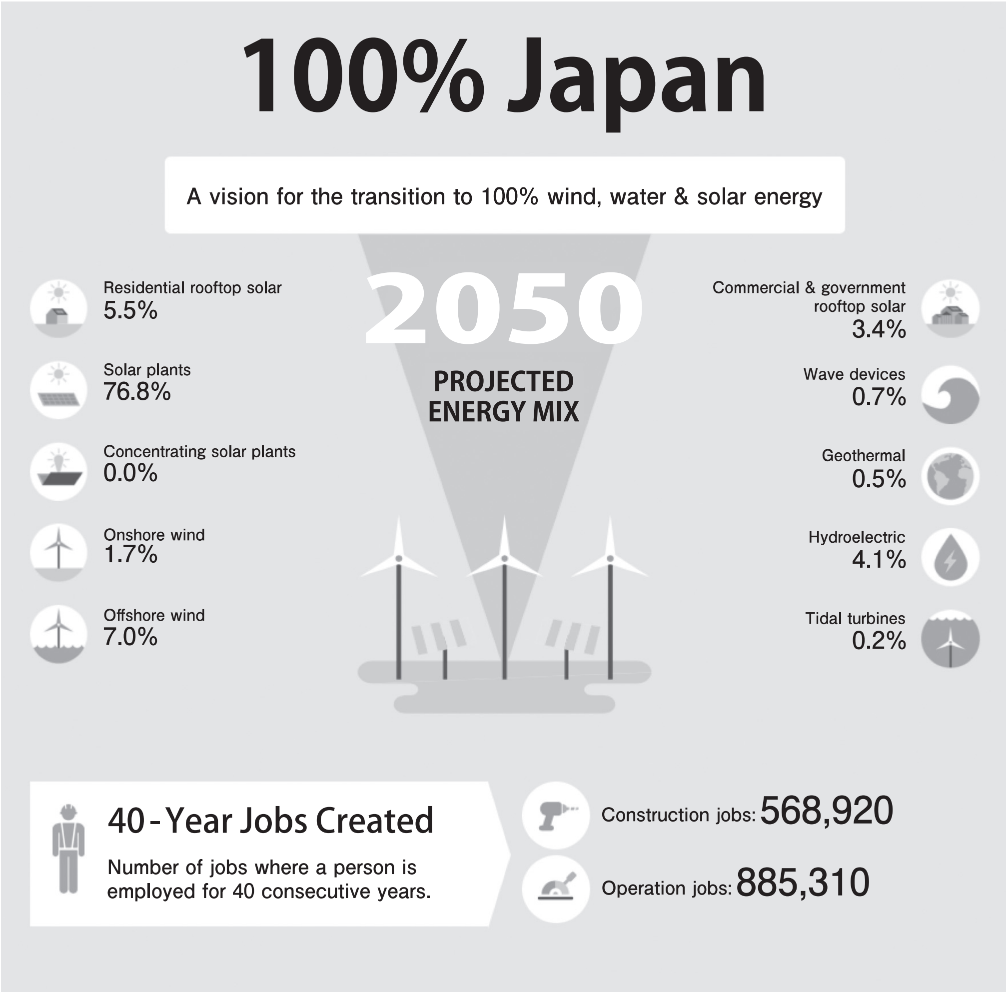
The next section examines the idealists' proposals for how to achieve an energy shift in Japan.

The 100% RE Proposals for Japan

The idealists want Japan to exit both nuclear and coal as soon as possible, and to eliminate all fossil fuels in a few decades. Some of their proposals are dated, such as Greenpeace's September 12, 2011 "Renewable Energy Revolution for Japan." This scenario addressed only the power sector, and allowed natural gas to remain part of the power mix in 2050 (Greenpeace 2011). But most of the idealists now offer ambitious scenarios in which Japan could achieve 100% reliance on renewable energy by 2050. And their proposals do not restrict themselves to electricity alone, which is roughly 40% of Japan's total energy. The scenarios we examine here address all energy, including heating/cooling, transport and such energy-intensive industrial processes as making steel and aluminum.

One example is "The Solutions Project" (2017), outlined in **figure 9**. The Project's main scientific advisors are Stanford University's Mark Jacobson and other experts (Hanley, 2018). Their scenarios are frequently cited in Japanese and interna-

9) The list of the Association for Resilience Japan's 16 working groups, their membership, and related information, is available (in Japanese) here: http://www.resilience-jp.org/wg/



Source: The Solutions Project, 2017

Figure 9 The Solutions Project 100% Renewable Proposal for Japan

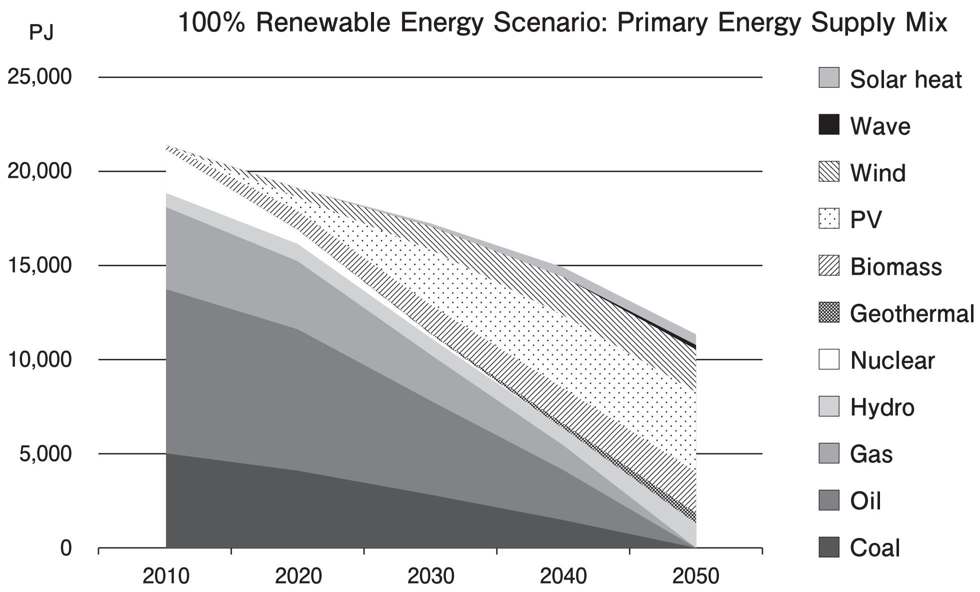
tional arguments that a 100% renewable energy economy is achievable in the medium term, with reduced costs (eg, EIC 2018; Tsuchiya 2017). Jacobson and his colleagues are perhaps the world's foremost exponents of a 100% RE transition. For example, American Senator Bernie Sanders (who co-authored an op-ed with Jacobson in the April 29, 2017 edition of *The Guardian*[10]), former US Vice-President Al Gore, and other have relied on their work. The Solutions Project has also informed energy

10) See Bernie Sanders and Mark Jacobson, "The American people — not Big Oil — must decide our climate future," *The Guardian*, April 29: https://www.theguardian.com/commentisfree/2017/apr/29/bernie-sanders-climate-change-big-oil

policymaking in such states as California and New York (Spector 2017).

As **figure 9** shows, this initiative's vision for Japan insists solar arrays could provide over 85% of all energy needs by 2050. That number is the sum of the various categories of solar, including residential rooftop, commercial and government rooftop, and solar plants. The Solutions Project further argues that supplementing this solar with some wind and hydro could allow Japan to displace all fossil fuels and nuclear while reducing energy costs by about 35%. It also calculates that the transition would create 568,920 construction jobs and 885,310 operational jobs (The Solutions Project 2017).

The Solutions Project is only one example of several 100% renewable proposals for Japan. Another 100% renewable proposal is offered by the World Wildlife Federation Japan (WWF Japan 2017a). On February 16 of 2017, the WWF Japan published a "Long-Term Scenario for a Decarbonized Society," together with a brief executive summary in English. As seen in **figure 10** and **table 3**, borrowed directly from the executive summary, this scenario also seeks to substitute all fossil fuels and nuclear energy with renewables.



Source: WWF Japan, 2017b

Figure 10　WWF Japan Long-Term Scenario for a Decarbonized Society

Table 3 WWF Japan Long-Term Scenario for a Decarbonized Society

	Primary energy supply (PJ)					Share	
	2010	2020	2030	2040	2050	2030	2050
Coal	4,981	4,076	2,814	1,443	0	16%	0%
Oil	8,819	7,474	5,009	2,657	0	29%	0%
Gas	4,243	3,682	2,380	1,278	0	14%	0%
Hydro	747	810	873	949	1,215	5%	11%
Nuclear	2,322	801	207	0	0	1%	0%
Geothermal	28	33	66	331	552	0%	5%
Biomass	153	938	1,500	1,778	2,200	9%	19%
PV	20	794	2,890	3,900	4,316	17%	38%
Wind	29	397	1,260	1,946	2,167	7%	19%
Wave	0	0	2	118	237	0%	2%
Solar heat	0	20	120	444	600	1%	5%
Total	22,157	19,025	17,122	14,844	11,287		
Total renewables	976	2,992	6,711	9,466	11,287	39%	100%

Source: WWF Japan, 2017b

Interestingly, the WWF's projected energy mix is considerably less reliant on solar than the Solutions Project. We saw that the Solutions Project foresaw Japan's energy being over 85% solar. By contrast, the WWF scenario projects solar's share of all primary energy to be only 38% by 2050. While less ambitious in this respect that the Solutions vision, the WWF scenario still involves some fairly bracing numbers. It foresees solar energy rising from providing 20 petajoules (PJ) of primary energy in 2010 to 4,316 PJ in 2050, an increase of 215.8 times. The next highest shares of primary energy are the 19% represented by wind and biomass respectively. Following that, hydro is estimated to be 11%, with geothermal contributing 5%, solar thermal 5%, and marine energy 2%. The projected costs of the deployment are JPY 191 trillion for efficiency and JPY 174 trillion for renewable capacity, with these expenses calculated to result in a net saving of JPY 84 trillion. The WWF scenario sees primary energy supply dropping by nearly 50%, from 22,157 PJ in 2010 to 11,287 in 2050 (WWF Japan 2017a, WWF Japan 2017b).

Some Problems with the 100% Scenarios

Critiquing the Solutions Project is a risky endeavor, as its principal author, Mark Jacobson, took previous critics to court on September 29, 2017. These 21 critics, under lead author Christopher Clack (a PhD in solar physics and specialist in wind and solar forecasts), argued that 100% RE was likely not possible and that many aspects of the scenario were questionable. They are all strong advocates of renewables, and of aggressive decarbonization, so they were not denying that very high levels of renewable energy could be attained. But they also insisted that Jacobson's own modeling issues showed that nuclear or carbon-capture fossil energy (or some combination of the two) would be needed to fill the gap and, as it were, keep the lights with a very high level of certainty and at an acceptable cost.

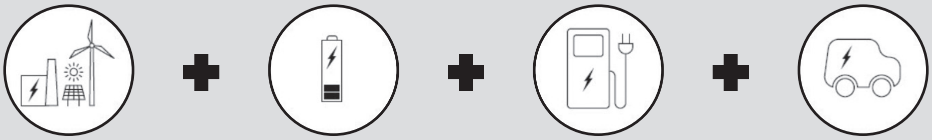
Quite germane to our purposes here, one of the most glaring problems that Clack et al highlighted was the Jacobson et al assumption (for the US case) that massive hydroelectric capacity, about 600 Hoover Dams worth (1,300 gigawatts) could be used as back-up (Porter 2017). They published their work (Clack et al 2016) in the Proceedings of the National Academy of Sciences (PNAS), and were targeted by Jacobson with a USD 10 million defamation suit. The suit was eventually dropped, on February 22, 2018, but cost the lead author about USD 75,000 and the NAS even more. In addition, the suit clearly had an inhibiting effect on the climate-energy debate. Climate scientists Ken Caldeira, one of the world's most respected experts and a co-author of the Clack paper, has publicly described how an article rebutting Jacobson was passed on to him anonymously "because the author worried about it being sued" (Caldeira 2018; Radio Ecoshock 2018). Quite rightly, the suit was derided as "ridiculous" by Pulitzer Prize-winning journalist Michael Hiltzik, who (like others) argues convincingly that Jacobson withdrew the suit because the judge in the case was about to dismiss it on the basis of a SLAPP ("Strategic Lawsuit Against Public Participation") charged levelled by Clack and the NAS (Hiltzik 2018).

Adding to the oddity of the Jacobson suit against Cohen, Jacobson employed the law firm Cohen Seglias Pallas Greenhall & Furman PC (Marshall 2017). Yet the same law firm is prominent in defending fossil fuel interests. Indeed, their "Energy and Utilities" website declares this explicitly, stating that the firm is a "proud member of the Marcellus Shale Coalition" (Cohen Seglias nd.).

More importantly, this paper argues that the Solutions Project, at least its application to Japan, suffers from serious inattention to infrastructure, governance and energy security. For example, it seems quite risky for Japan to secure nearly all its energy needs from solar. These risks relate to material supplies, infrastructure, governance and energy security.

First, Japan would have to deploy enormous amounts of silicon, steel, concrete, copper, cobalt and other materials in building out a vast solar capacity together with greatly expanded storage, transmission and distribution networks. Yet copper alone is a significant challenge for resource-poor Japan, not to mention the global economy in general. Copper requirements for renewables are generally 5 times that of conventional energy. Hence, there is already considerable concern that global supply can meet increasing demand for solar, wind, electric cars in the short and medium term, let alone the 100% RE energy transition scenarios (DBS 2018, Mining 2018). Similar problems confront cobalt, whose supply is constrained but which is crucial to batteries and renewable power systems (Sanderson, 2018). The other materials, such as steel and silicone are less constrained in terms of absolute supply. But the quantity required for a rapid build-out of solar, wind and other renewables would be prodigious. Even That would almost certainly require a coordinated, intensively planned approach that rationed scarce commodities. In other words, finite supplies of critical materials would have to be allocated by planners rather than left to decisions by firms and consumers. In concrete terms, individual consumers would be required to forego many common goods (such as electronic devices and automobiles) so as to permit a focused use of scarce materials.

Figure 11 offers one example of how much demand would increase for critical materials even under conservative assumptions. The figure represents the increased demand for copper (Cu), nickel (Ni) and cobalt (Co) between 2020 and 2030 for a scenario in which 30% of new vehicle sales are electric, non internal-combustion (ICE) vehicles. As the figure shows, there would be a considerable increase in copper demand for the generation and transmission infrastructure to cope with the electrification of transport. Indeed, copper demand in this sphere alone is calculated to increase from 40 kilotonnes (kt) in 2020 to 536 kt in 2030. Other areas include grid storage, charging infrastructure, and the vehicles themselves, where required volumes of copper, nickel and cobalt increase many times in the decade 2020-2030. The bottom section of the figure shows what this new demand represents as a fraction of 2017 global supply.



Generation and grid infrastructure (kt)

	2020	2025	2030
Cu	40	170	536

Grid storage (kt)

	2020	2025	2030
Cu	24	86	180
Ni	20	71	150
Co	7	26	55

Charging infrastructure (kt)

	2020	2025	2030
Cu	23	115	392

Non-ICE vehicles (kt)

	2020	2025	2030
Cu	304	1,068	2,972
Ni	66	299	985
Co	17	80	259

Leading to additional metal demand by 2030

Copper
4.1 Mtpa
18% of 2017 global supply

Nickel
c.1.1 Mtpa
55% of 2017 global supply

Cobalt
314ktpa
332% of 2017 global supply

Source: Glencore, 2018

Figure 11 Critical Material Demand for 30% Electric Vehicles by 2030

Copper demand for EVs in 2030 is seen to reach 18% of 2017 global supply. Without massive increases in copper production, that share would necessarily restrict the amount of copper available for other goods. The challenge is even more bracing for nickel and cobalt, whose respective demand in 2030 becomes, respectively, 55% and 332% of 2017 global supply.

These qualms are not critical metal-producing industry hype, in search of investment capital. In March 2018 Japan's JOGMEC grew concerned enough to release a detailed report (in Japanese) on "Changes in the Copper Business Since 2000." JOGMEC investigates the lessons learned from the material-intensity of China's development (about half of global copper consumption) and what it implies for other low and middle-income countries with large populations and massive latent infrastructure demand. It also examines the copper-intensiveness of projected urbanization, mobility and power generation, while outlining the supply problems due to declining ore grades, under-investment in new projects, political instability, environmental damage, and related factors. The JOGMEC report lists three kinds of growth regimes: 1) low per-capita GDP but high copper intensity, with China being the major example; 2) high per-capita GDP and low copper intensity, such as Japan, the US, France (although this calculation overlooks the copper intensity of their already built infrastructure networks, including massive electrical grids and the like); and 3) low per-capita GDP and low copper intensity (at present), characteristic of India, Brazil, and others. The core problem is that even were these other countries to grow in conventional ways, their aggregate demand would greatly challenge supply (JOGMEC 2018). As we have seen in the above, critical material-intensive green growth in these countries would make coordination and planning even more crucial.

Infrastructure is another problem area. Japan's current power grid, a network exceeding 4.22 million kilometers (ANRE nd), would have to drastically reconfigured. Like other power systems, its big transmission cables were built for centralized, large-scale generation (especially nuclear and fossil fuels), a clear hurdle in undertaking an energy transition towards distributed energy. Shifting from highly centralized generation to its polar opposite — solar on a multitude of roofs and open spaces — implies a massive, resource-intensive investment in cables, batteries, heat pipes and other infrastructure to generate, transmit, store and distribute the energy. The Solutions Project's vision would perhaps be more persuasive if it provided even a rough estimate of the scale and costs of this network.

Moreover, undertaking an energy transition — including new heat and power generation, transmission and distribution, and storage capacity — is an enormous task anywhere. But it is especially challenging in depopulating and aging Japan, when there is no clear idea of how many customers, and what kind of industry, will be in a given city or town a decade hence. That uncertainty is yet another reason it is imperative to craft energy policy in tandem with spatial planning, disaster planning and other policies. It is not enough to adopt very high feed-in tariffs and other subsidies and then rely on price signals to accomplish the transition.

At the same time, Japan's roughly JPY 700 trillion worth of roads, waterworks, and other infrastructures of the built environment generally exceed what it needs in the face of ageing and depopulation (OECD, 2016b). Lower population densities and per-capita incomes erode the fiscal capacity to afford the per-hectare costs of maintaining and replacing infrastructure networks. These kinds of variables have to be included in any analysis of the energy economy, because the structure of the built environment is a major determinant of per-capita energy demand. Moreover, the built environment's elements can be drawn on as new sources of energy generation and storage, something the technocrats are doing for example with water networks.

As to governance, the Solutions Project does not address the critical question of whether price incentives are sufficient to mobilize the required scale of investment. Though its scenario indicates that energy costs would decline by shifting to renewables, the direct pecuniary benefits come after quite large upfront investments.

That fact requires the investors to possess relatively long time-horizons and a high degree of certainty that their investments would remain viable. But long time-horizons are not favoured by stock markets or by civil society, where short-term incentives and a myriad distractions overwhelm the capacity to plan. Only very close collaboration among the public and private sectors, together with civil society, seems likely to lead to the extensive planning, or industrial policy, required to shift the energy economy. That collaborative approach would be required in order to capture the non-monetizable health and other benefits (positive externalities) that accrue to society as a whole as opposed to individual firms, investors and other economic agents. Moreover, collaborative planning would seem essential to keep the energy transition's deployment of power and thermal energy systems consistent with Japan's rapidly changing demography.

Another problem is energy security. Nowhere in Solutions Project is there any concern expressed that relying so heavily on solar may present significant risks in an archipelago subject to increasingly severe weather extremes. For example, some of Japan's solar arrays have suffered damage by high winds and typhoons (KGS, 2017), and they have significant challenges generating power in snow-bound regions (Nikkei 2017). It is also perhaps unwise, as solar expert (and co-author of the Clack paper) Varun Sivaram argues, to overcommit to solar rather than integrate it with other energy sources and infrastructures. Ironically, Sivaram makes this argument on the basis of lessons learned from past decade's undue confidence in nuclear energy (Sivaram 2018).

Much the same could be said for the WWF vision, though it is far less reliant on solar than the Solutions Project. But like the Solutions Project, the WWF vision does not concern itself with transmission costs and other ancillary issues. In fact, it even ignores capital costs (Shiozu, 2017).

In the next section, we turn to examine the Technocratic Resilience outlined in **figure 8**. We shall see why its coordinated "National Resilience" planning appears to be especially important in Japan.

The Case for National Resilience and Planning

Japan's "Technocratic Resilience" narrative is expressed in literally hundreds of reports on energy, disaster, spatial and other planning. But it is most conveniently distilled in the writing of Kashiwagi Takao, including his edited volume on "The Super Smart Infrastructure Revolution" (Kashiwagi 2016). Kashiwagi is Director of the Advanced Energy Centre at the Tokyo Institute of Technology and a key policy entrepreneur in Japanese energy, spatial planning and other domains. Kashiwagi 2016 book includes contributions by LDP Secretary General Nikai Toshihiro, several central agencies, and the business sector. It describes an ambitious agenda on smart communities, distributed energy and the critical infrastructure for a low-carbon society addressing a wide range of initiatives that idealists have ignored or derided.

Kashiwagi is perhaps the most important figure in uniting adaptation and mitigation. He has been advocating smart communities and smart energy for years, advising the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) in 2010 that they needed to shift the focus of public works from roads and bridges to smart energy networks. Kashiwagi has chaired many of the committees and other initiatives that have designed Japan's energy networks and the subsidies that finance them. He has also compiled over a dozen volumes on this paradigm, including the 2012 "Smart Energy Revolution" book with Softbank CEO Son Masayoshi and Masuda Hiroya. The latter is former Governor of Iwate Prefecture and former minister of General Affairs. Like Kashiwagi, Masuda is a key policy entrepreneur on demography and compact spatial planning, and their intersection with smart energy.

Indeed, as Governor of Iwate, Masuda oversaw the installation of 43 wind turbines in Kamaishi City. Through this experience, Masuda learned of the need for large-scale system and policy integration in order to cope with intermittent renewables (Masuda 2011).

Japan's technocratic approach centres on new networks. Networks are critical to modern industrial policy. Smart networks are — as networks — comparable to the roads and conventional power grids that were core networks in the Fordist economy as well as the railroads that were fundamental to globalizing commodity trade during the steam-based economy. Nicholas Stern, the leading economist on climate change and energy, highlights the role of networks during past and present waves of innovation. He argues in his 2015 book *Why Are We Waiting? The Logic, Urgency, and Promise of Tackling Climate Change* 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).

Moreover, technocratic resilience does not ignore the need to mitigate. Kashiwagi and his collaborators routinely emphasize decarbonization. But the technocratic paradigm centres on adaptation to climate change as well as a range of other hazards. Its scientific assessment of climate risks, particularly hydrologic hazards, is more up to date than the IPCC's rather optimistic projections, just as most climate specialists are (Holthaus 2018). It asserts that building hard and soft resilience in the face of these hazards fosters public goods and positive externalities. These public goods include enhanced domestic disaster resilience, increased energy autonomy, revived local economies, and the potential to expand smart city infrastructure exports.

Interestingly, like the idealists, the proponents of the technocratic model of governance also look to Germany. But the technocrats see German local government and their public corporations, or *stadtwerke*, as the proper locus for bolstering local resilience (Kashiwagi 2018a). It also emphasizes a “whole of government” approach, one that builds on horizontal collaboration across ministries as well as with business, academe and civil society. It accepts the feed-in tariff and other policy supports, particularly as means to foster local revitalization via redistributing income from urban centres to rural areas. But the technocrats' smart community projects also include heat and power microgrids, renewable inputs, storage, and plenty of other disaster-resilient critical infrastructure that have been ignored by the populists. They also include municipal power projects and ambitious energy-environmental plans (Kashiwagi 2018a, 2018b).

In 2018, Japan is in its ５th year of implementing National Resilience against seismic events, climate change, cybersecurity risks and other hazards. In a dramatic increase over previous years (where the initial requests were roughly JPY 4.5 trillion)[11], the National Resilience programme's initial 2019 budget fiscal request is JPY

11) All of the National Resilience budgets are available (in Japanese) at: https://www.cas.go.jp/jp/seisaku/kokudo_kyoujinka/yosan.html

4.89 trillion (DECN 2018). The 2018 increase reportedly reflects the severity of heatwaves, floods and other climate-change phenomena that cost numerous lives and damage during the spring and summer of the same year. Moreover, this direct spending is backed up by tax incentives, regulatory measures and other mechanisms.

National Resilience spending is often dismissed as porkbarrel public works, including by idealists who privilege mitigation over adaptation and downplay the links between the two (DeWit, 2019, DeWit 2014b). But among other items, this budget is invested in advanced radar and supercomputing to forecast precipitation. There is also considerable evidence of an expanding commitment to public transit, compact cities, green infrastructure, cross-laminated timber (a substitute construction material for carbon-intensive concrete), and other decarbonizing investments (DeWit 2017a, 2017b).

National Resilience also has strong support outside of the central government and its agencies. This fact is hardly a surprise, as the direct impact of climate change and other hazards is experienced most keenly at the local level. As of August 1, 2018 the national government's National Resilience umbrella programme is also matched by local programmes in all the 47 prefectures and 135 cities and towns (Cabinet Secretariat 2018). These numbers are also growing, fostered by local collaboration and other means to diffuse the programme and facilitate its adoption by cash-strapped and people-poor local governments.

The evidence indicates that Japan's National Resilience programme has evolved into full-fledged industrial policy. The focus of National Resilience increasingly centres on information technology (ICT, IoT, AI) to smarten power, water, communications, transport and other critical infrastructure as well as network them together. Certainly it is a core element of Japan's Society 5.0 new innovation and growth policy (Kashiwagi 2018a). And like Society 5.0, National Resilience is aimed at: 1) increasing the productivity of extant assets, 2) coping with the crisis of scarce human resources, 3) raising energy self sufficiency (from a perilously low 8%), 4) dealing with accelerating disaster risks, 5) shrinking the spatial and carbon footprint of communities and other collective goals.

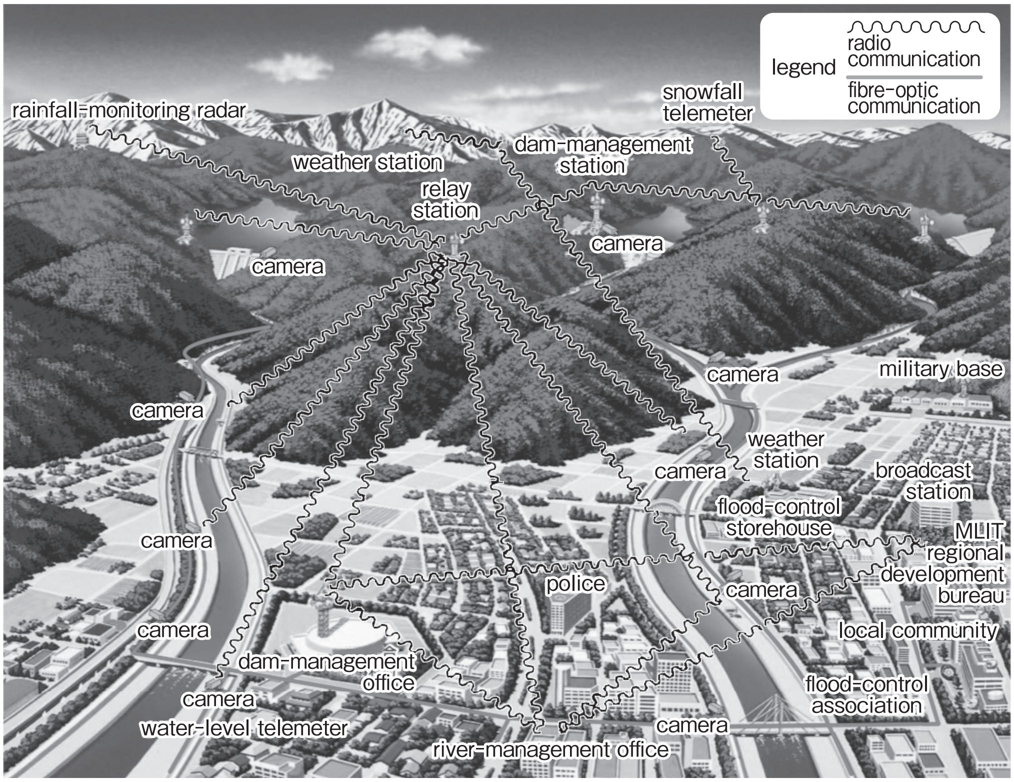
Most countries face, or will confront, Japan's sobering challenges on disaster risks, energy self-sufficiency, demographics, and scarce fiscal resources. So we argue that the Japanese case offers valuable lessons for how collaborative governance and smart technology can maximize the effective use of constrained fiscal, material, human and other resources as well as time.

There is insufficient space in this paper to describe how National Resilience emphasizes a “whole of government” approach and applies it across all critical infrastructures (power, water, transport, etc). It builds on extensive horizontal and vertical collaboration across ministries as well as with business, academe and civil society. There is also inadequate space to examine how all critical infrastructure networks are being bolstered and integrated, further bolstering resilience while reducing pecuniary, material, human resource and other costs. Here we want to focus on dams, because their role in resilience is significant for Japan’s continued resilient development as well as resilience in many other countries.

Dams are very important in Japan. They provide half of the country’s renewable energy, and at very low cost. Dams also afford resilience against floods, droughts and other hazards. Japanese policymakers aim to maximize these and other co-benefits by smartening existing dam assets. On June 27, 2017, the Ministry of Lands, Infrastructure, Transport and Tourism (MLIT) followed up with a “Dam Revival Vision.” The MLIT Vision forecast a doubling of hydro power from ９% of the power mix (MLIT 2017).

Figure 12 portrays the context of Japan’s dams. Roughly 70 percent of Japan is mountainous, with half the population and three-quarters of the assets concentrated into the 10 percent of land that is coastal flood plains. Japan thus has short and steep rivers, compared to the Seine, Rhine, Mekong and other major global rivers. Japanese rivers’ short length and steep pitch derive from the fact that the country is quite mountainous and narrow (no point in Japan is more than 150 kilometers from the sea). Moreover, Japan receives roughly twice the global annual average of rainfall. These factors make the flow variability of Japan’s rivers unusually great. As has been said for over a century, Japanese rivers are more like waterfalls during the country’s seasonal bouts of concentrated rainfall (ADRC 1998).

The figure is from 2007, when the MLIT was using cameras, sensors, radar, and other means to monitor and control dam assets to limit flood and other risks. As will be discussed below, a more recent figure (not currently available) would show that these monitoring and control plans have advanced considerably. This is in large part because of the subsequent evolution of information technology (ICT, IoT, AI); the cheapening of sensors for monitoring water height, flow and other parameters; and the ongoing integration of dam-asset planning with planning for other critical infrastructures.



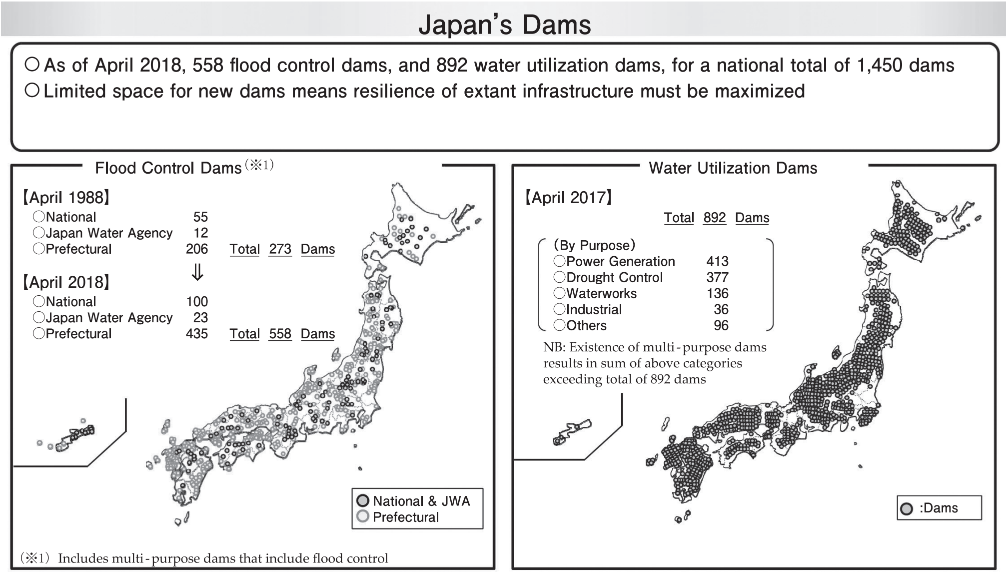
Source: MLIT, 2007

Figure 12 Reviving Japan's Dams

Figure 13 summarizes Japan's major dam assets. It shows that between 1988 and 2018 the MLIT ("National"), several prefectures and the Japan Water Agency have built a significant number of dams to deal with this flood threat, provide water for various uses, and generate power. It shows that as of April 2018, Japan is home to 1,450 dams, of which 413 generate power. The others are used for flood control, reservoirs for irrigation and industrial water, and other purposes.

These agencies also know that they need to upgrade those dam assets, due to ageing of the infrastructure as well as the acceleration of climate change. The June 27, 2017, "Dam Revival Vision" aims to bolster the existing dam network against floods and other climate extremes. Reflecting on the topography outlined in **figure 12** shows why advanced radar, drones, supercomputing, and raising the height of the dam walls are central to the Dam Revival paradigm.

This digitization of dams is not unrealistic. Dams are being digitized in other countries, including Switzerland (IHA 2018). And Tokyo Metropolitan Government's



Source: MOF, 2018

Figure 13 Japan's Dam Assets, by Type, Various Years

sewerage division has been doing similar things, with advanced radar and monitoring, to its 16 million meters of pipes that move 2.2 billion cubic metres of water per day (TMG 2017b).

Japan's "Dam Revitalization Vision" is important for a lot of reasons. First, it is crucial for adaptation to climate change. Second, it is also important for mitigation. As we alluded to earlier, big hydro remains the key decarbonizing energy source, and continues to grow (IHA 2018). In **figure 3**, we saw that the International Renewable Energy's (IRENA) March 31, 2018 summary of global renewable generation capacity reveals that hydro represented 53% of the 2,179 gigawatt (GW) total. Moreover, the International Energy Agency's (IEA) Technology Roadmap also advises that hydropower (both reservoir and pumped hydro storage, or PHS) is both flexible and helps balance variable wind and solar. At 172 GWs, PHS provided 95% of global power storage capacity in 2017 (IEA 2018a). IRENA's 2016 Roadmap for a Renewable Energy Future suggested that just doubling global renewables by 2030 would require more than doubling PHS to 325 GW (IRENA 2016).

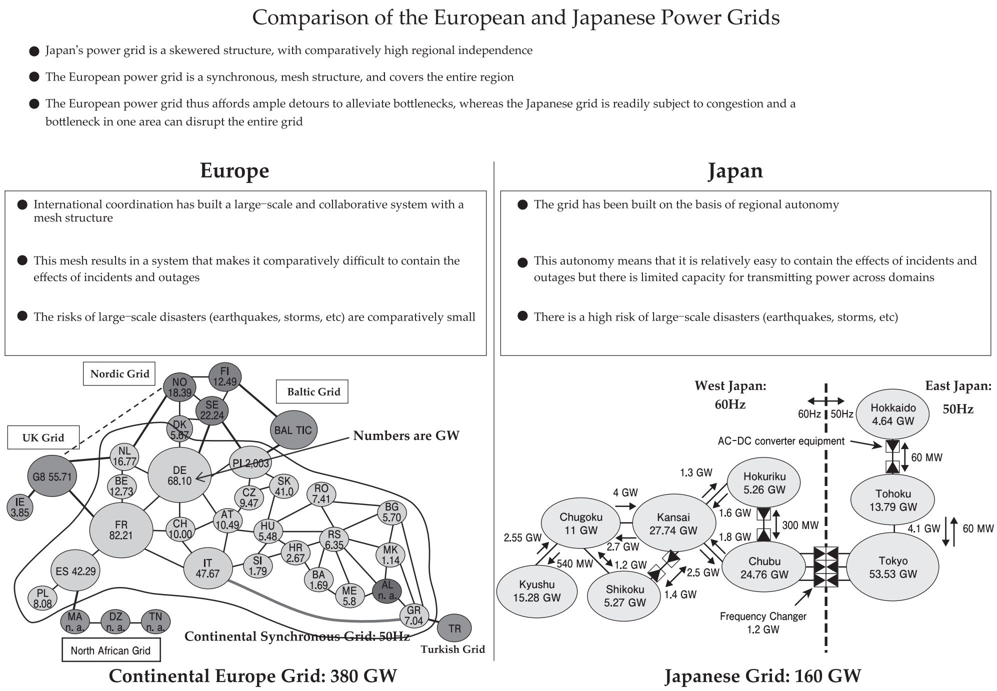
The importance of PHS in Japan is seen in Kyushu Electric Company's catchment area. Kyushu has Japan's highest penetration of variable solar in its power mix, at times reaching roughly 80% and relies heavily on PHS to cope with the intermittency (IEA 2018b). But intense rainfall early in 2018 raised dam levels so much that the PHS capacity was impaired (Kaneko 2018). As a result, the utility will have to curtail solar in an effort to limit power fluctuations.

Hydro's value compounds when dams are digitized and networked in a framework of resilience against worsening flood and drought threats (IHA 2018: 35-6). Thus Japan's 2017 "Dam Revival Vision" aims to double the country's hydro output while linking dams to advanced radar and IoT/AI. This Vision is already being implemented and will enhance Japan's prospects in emerging markets, where hydro is expected to grow most (IHA 2018: 4-5).

Networking dams can bolster mitigation and adaptation to climate change. It can also afford low-cost energy for development. But doing it right requires good governance, based on extensive collaboration. Japan offers a model of how to do this, in order to maximize the potential benefits and minimize costs. Thus Japan's work on building resilience potentially offers important lessons on how to benefit from developing sustainably.

The above points are made more strongly in **figure 14**, which portrays the European and Japanese power grids. It shows that the Japanese archipelago has no international power networks through which to balance intermittent wind and solar. METI calculations, based on EU data, indicate that Denmark, Germany and the UK benefit greatly from these international grid connections. The network allows the Danes to balance 80% of their intermittency via power exports and imports, while the Germans figure is 40% and that for the UK 35%. Moreover, the EU's plan to raise its overall renewable energy target from 20% in 2020 to 27% in 2030 may depend on using Norwegian dams (the country's power mix is 96% hydro) as a "green battery" for the region (METI 2018). The most recent evidence suggests that plans to decarbonize Europe's continental grid will rely at least in part on the "green battery" afforded by Norwegian hydro (CEDREN 2018).

Japan is not only handicapped by not having international power trading. Japan also has no truly national power grid structure, as shown in **figure 14**. The figure shows that the EU system has twice the power flows of the Japanese (Germany and France together equal Japan), but Japan is both isolated as well as still quite balkanized internally. Japan's grid is in fact separated in spatial and in frequency terms. The figure shows that West Japan runs on 60 Hz and East Japan is 50 Hz, in contrast to the European synchronous grid, which operates at the same 50 Hz frequency over an entire continental region.

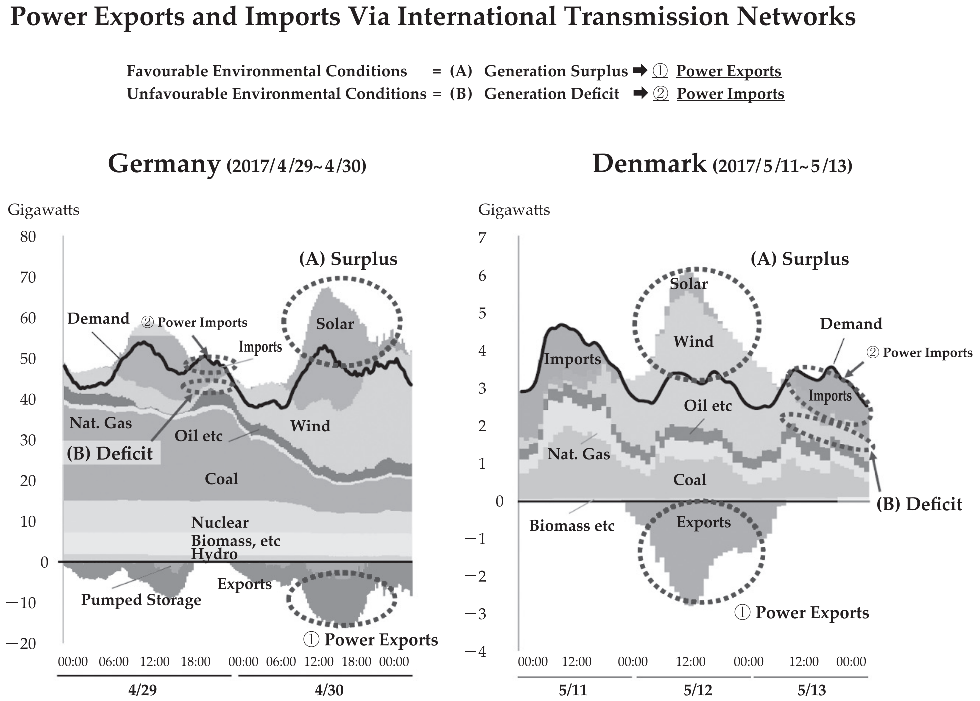


Source: METI, 2018

Figure 14 Europe and Japan's Power Grids

Japan's handicaps of differing frequencies and balkanized transmission likely cannot be solved by simply building more transformers and transmission links. Such assets are quite expensive, require several years of planning and construction, and routinely confront NIMBY opposition. Indeed, even Germany's deployment of "trans mission super highways" to bring offshore wind power to areas of heavy power demand ran into NIMBY in Bavaria and other areas. As a result, the transmission links have to be built underground, at three times the cost (Radowitz 2018). And related Japanese constructions costs are notoriously higher than its counterparts. Added to these factors, Japan's demographic, disaster and other risks undermine the economics of building a large, networked synchronous grid as in Europe or even the less integrated North American network.

In contrast to China as well as the EU countries and North America, Japan has limited prospects for large investment in macro grids. A declining and aging population, coupled with several other factors (such as Japan's comparative isolation), means that ordinary market incentives are weakened. As we have seen, future energy demand is difficult to assess. Nor can excess intermittent power be shipped, for



Source: METI, 2018

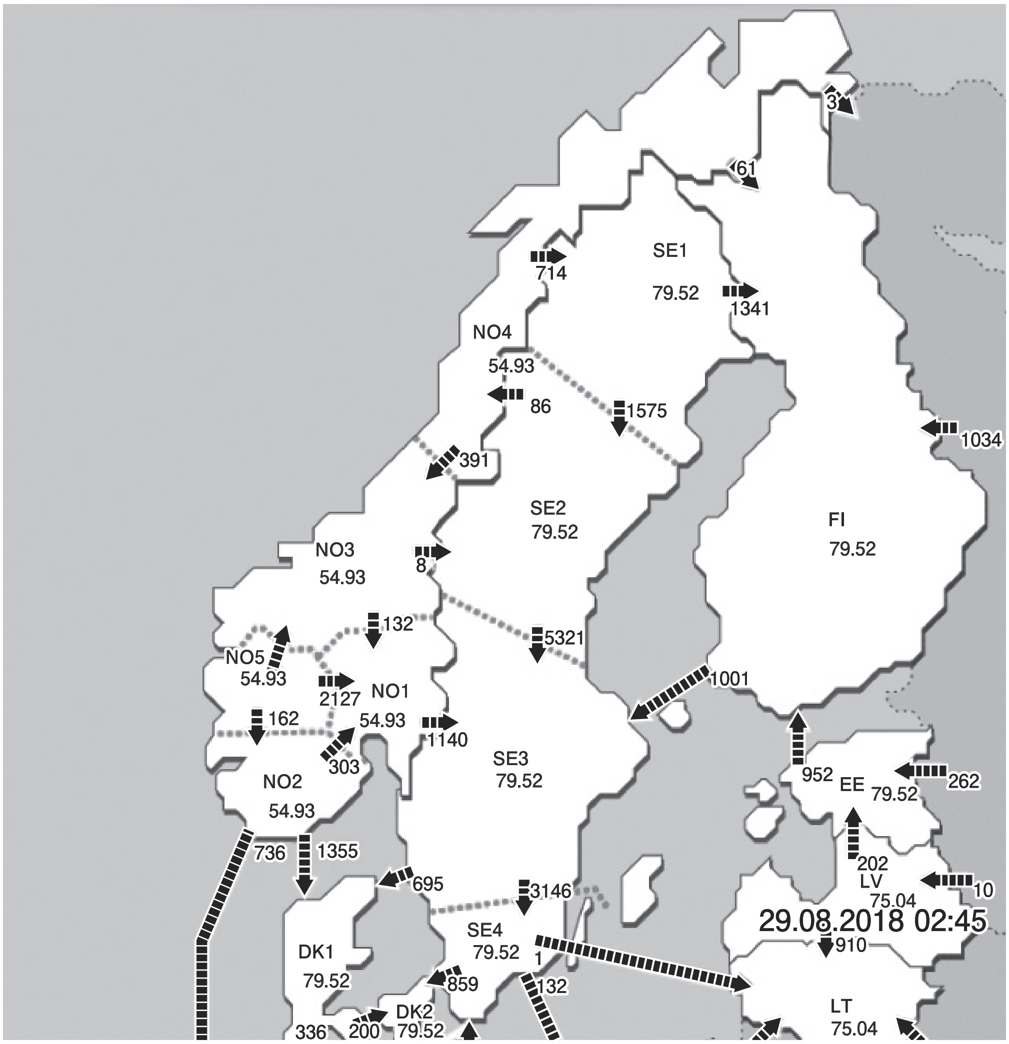
Figure 15 Power Exports in Germany and Denmark

example, to Scandinavian dams for temporary storage.

Figure 15 indicates the utility of the European grid for power trading. The figure displays power output and exports in Germany and Denmark for 2-day periods in the spring of 2017. The figure's x-axis is time and the y-axis is gigawatts of power generation and exports (or pumped storage). One especially salient aspect of the figure is power exports. These exports clearly allow both countries to help manage their intermittent and surplus solar and wind energy inputs. These surplus production and export volumes are clearly indicated in the figure. The two countries are advantaged by international electricity grids as well as significant dam assets (for pumped storage). Even so, the German system often faces negative prices in its wholesale markets due to surges of intermittent power that cannot be readily stored or exported (Wilkes et al 2018).

The important enabling role of international power trading and baseload power is perhaps even more evident in the Nordic power system. This system is mapped in **figure 16**. The figure shows that the Nordic system integrates Denmark (DK), Estonia (EE), Finland (FI), Latvia (LT), Lithuania (LV), Norway (NO), and Sweden (SE).

State of the Nordic Power System Map

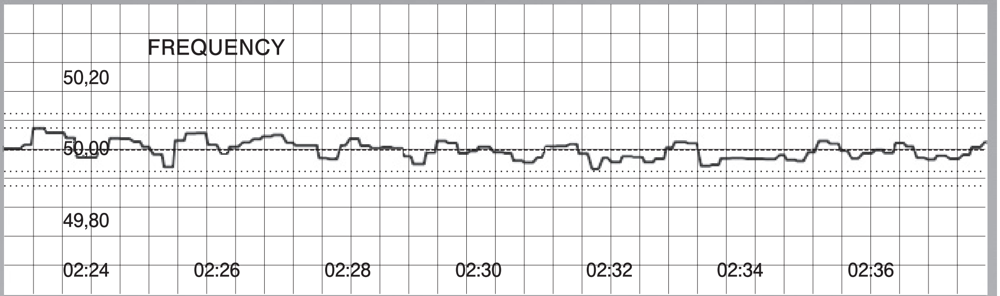


Source: Statnett 2018a

Figure 16 The Nordic power system

Figure 17 shows the power balance among these countries for August 29, 2018. The left-hand side of the figure details the various kinds of power generation (eg, nuclear and hydro), by type and symbol. The right-hand side of the figure (far right: "Total") portrays overall power production and then provides the breakdown by type. The total production of over 43 GW is supplied by a regional power mix that is more than half hydro (28 GW) with nuclear (６ GW) not far behind coal and other

Nordic power balance (table)



	SE	DK	NO	FI	EE	LT	LV	Total
PRODUCTION	14,470	1,392	16,542	6,807	1,447	937	1,565	43,159
Nuclear	4,005	—	—	2,243	—	—	—	6,248
Hydro	9,144	—	16,216	1,733	—	444	560	28,097
Thermal	388	1,273	277	2,390	1,439	401	877	7,045
Wind	438	119	49	112	8	9	0	735
Not specified	495	—	—	329	—	83	128	1,034
CONSUMPTION	14,500	3,900	12,515	9,185	929	1,456	857	43,341
NET EXCHANGE	30	2,508	−4,027	2,378	−518	519	−708	182

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Source: Statnett 2018b

Figure 17 The Nordic power balance, August 29, 2018

thermal energy (7 GW). In the time period portrayed, the amount of solar and wind in the regional mix is quite low, far below a total of 2 GW even if we define all of the “Not specified” category as intermittent renewable (though much is likely to be non-intermittent biomass). The contribution of Denmark’s wind varies considerable, depending on the ambient weather and wind speeds. The point is that this regional network, with its significant baseload (esp. hydro) assets, is clearly valuable. It may in fact be indispensable for allowing Denmark to achieve the high penetration of wind shown in **figure 15**.

Enlarging the perspective, as provided in **figure 14**, it is clear why Norwegian dams (the country’s power is almost entirely hydro) allow it to be a candidate for the "green battery" of Europe and not just the Nordic pool. At present, attempting to substitute for this massive storage capacity with batteries and other options would seem quite costly. And as we have already seen, the material requirements (for copper, cobalt and other metals) might be quite challenging.

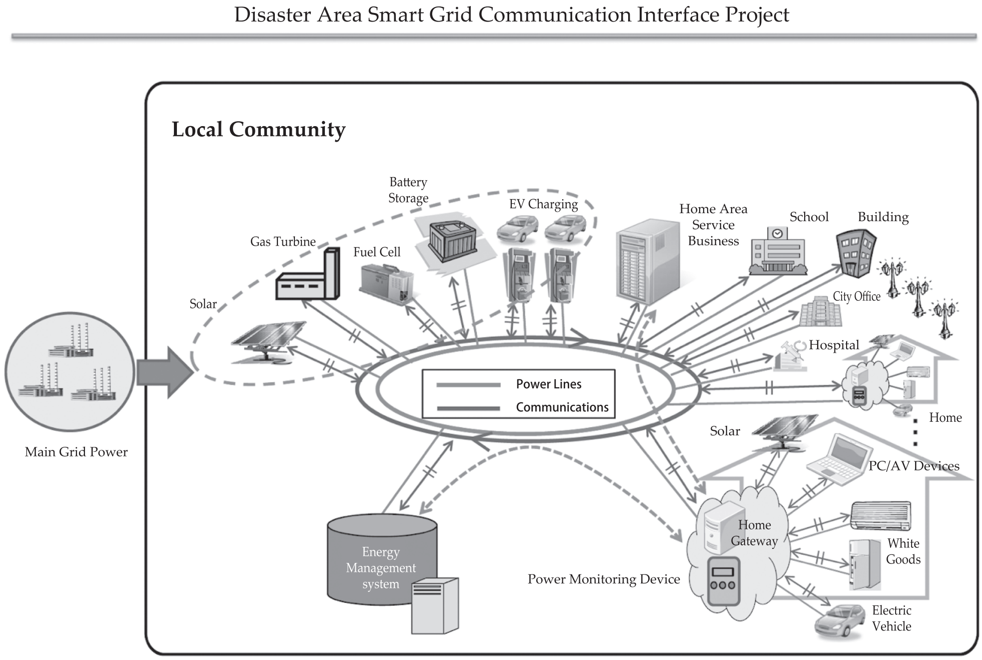
The point here is not to deny that a large percentage of energy can be supplied by renewables. The evidence already shows that RE is achieving significant levels of penetration in power mixes, and that the costs are cheapening. It is also clearly desirable to have high levels of RE in the energy economy. The reasons include a cleaner environment, reduced health impacts from noxious emissions, enhanced economic competitiveness, reduced geopolitical risks from relying on fossil fuels, and etc.

But we have seen that there are a host of geographical, material and other challenges that need to be considered. The evidence suggests that the idealists' model of emphasizing solar and wind, while dismissing hydro and nuclear, may not be the best approach politically and technologically. While this assertion is heresy in some camps, and has led to legal challenges, open debate is crucial in collectively analyzing how to mitigate and adapt to climate change. Even an all-out and expensive programme of mitigation by solar and wind would not stop climate change, as the stock of emitted greenhouse gases is driving change that will continue for decades if not centuries (Revkin and Hayes 2018). And we have already seen that Germany's paradigm has fallen short of its objectives, in spite of the country's geographical and other advantages compared to Japan. So at the very least it would appear useful to examine Japan's adaptation-led National Resilience approach more pragmatically.

In the next section, we turn to consider how Japan's paradigm has been applied in specific circumstances.

Collaborative Disaster Resilience

We have argued that Japan's adaptation-led paradigm is coordinated and collaborative. It does not aim at 100% RE. But ironically its integrated, pragmatic approach may be more effective at maximizing Japan's deployment of RE.



Source: MIC 2018b

Figure 18 MIC's Tohoku Smart Grid Interface Projects

We see some evidence of this in **figure 18**. The figure shows that the Ministry of Internal Affairs and Communications (MIC) used the 3-11 disaster as an opportunity to deploy smart grid communications interface networks. The MIC undertook 15 of these projects in the Tohoku region between 2011-14, in local communities as geographically and demographically diverse as Fukushima Prefecture's Minamisoma City (pop. 55,364) and Aizuwakamatsu City (pop. 121,925), Miyagi Prefecture's Higashimatsushima City and Sendai City (pop. 1,087,182), and Iwate Prefecture's Kuji City (pop. 34,544), Hirono Town (pop. 15,989), Noda Town (pop. 4,009) and Tonahata Village (pop. 3,378). The smart grid projects were undertaken in collaboration with METI and other agencies. They focused on assisting the local community to maximize the benefit of existing assets, such as schools and other facilities, through deploying the communications infrastructure to facilitate remote operation and monitoring of energy management systems. As the figure shows, these systems link power generation, storage and charging assets together with social infrastructure (schools, hospitals, offices, etc) and also reach into the private home. As indicated in the lower right-hand corner of the figure, the home has become a nexus for power generation (via such means as rooftop solar), demand-response efficiencies (in white goods and other devices), and enhanced storage via the electric vehicle.

MIC's collaborative deployment of energy-related ICT communications networks was part of a larger 290-project initiative of rebuilding the 3-11 disaster area's communications networks, with an emphasis on disaster resilience, community bonds and risk communication. This overall initiative started in 2011 and reached 290 projects by 2017. In 2017, it aided 67 local communities (including cross-community collaborative projects) in the 11 prefecture (comprising 227 cities, towns and villages) designated disaster recovery area (MIC 2018b).

MIC's projects are not the only energy-related initiatives deployed or underway in the Tohoku region, or for that matter throughout the country. They are important for our purposes because they highlight several important facts overlooked by the idealistic narrative. One point is that MIC is explicitly collaborating with METI and other agencies on energy-related initiatives. This collaboration is simply not part of the idealistic discourse, which emphasizes METI's siloed dominance of energy and conflictual relationship with the MoE. In point of fact, Japan features 12 separate inter-agency initiatives to maximize the deployment of renewable energy, 6 of which feature cooperation between the METI and MoE. One of these initiatives is distributed energy systems centred on renewable energy, where the MIC works with other government agencies. In this category, 39 master plans for community energy projects had been completed by 2016 (Kashiwagi 2018b).

A concrete example of these collaborative successes is the smart city in Fukushima Prefecture's Aizuwakamatsu City. As noted earlier, Aizuwakamatsu is one of the 15 smart grid projects MIC undertook in Tohoku. Aizuwakamatsu's smart city project is underpinned by MIC-METI collaboration that began right in the wake of 3-11. In 2011, Aizuwakamatsu City was awarded a MIC grant for HEMS, as its smart grid communications interface. The next year it received a 4-year METI grant for developing a disaster-resilient smart community, centred on CEMS, biomass cogeneration, solar power and battery storage. That crucial investment in smart-energy network infrastructure has since blossomed into a world-class smart city, paired with Amsterdam. Aizuwakamatsu's smart city project transcends energy, reaching across multiple administrative areas (health, etc) and linking up not just MIC and METI but also MHW, MLIT and other ministries. Moreover, in more recent years, Aizuwakamatsu has received MIC and other agency funding to deploy IoT projects, making the city one of the model projects for Japan's rollout of the Society 5.0 industrial policy.

As a result of these collaborative investment, Japan's competitiveness has increased. MIC's comparative surveys of Japanese competitiveness in smart energy and smart communities indicates that the Japanese have managed to hold a significant share in a rapidly expanding global race. The most recent MIC (2018a) data rank Japan second (with a comprehensive score of 57.1 in 2016) overall in the Internet of Things (IoT) and Information and Communications (ICT) markets globally, behind the front-rank US (67.7) and ahead of the Chinese (55.8). The Germans, meanwhile are ranked fifth (47.9).

These projects are bearing significant fruit in other respects, in Tohoku and nationwide. One example of a Japanese smart community initiative is seen in Minamisoma City (population 63,000). The city is very close to Fukushima, so emphasizes renewable energy and efficiency (along with electric vehicles and other smart-energy projects). The city started from 4% renewable in its power mix in 2011. It aims for 65% by 2020, with a longer-term goal of 140% by 2050. We chose Minamisoma because it is in the disaster-stricken Tohoku region. The point is to show that the region is not at all being overlooked in what is a collaborative nationwide rollout of smart communities. One might as readily have chosen other examples from Tohoku, including the very advanced smart community/smart city projects underway in Higashimatsushima City, Aizuwakamatsu City, Kamaishi City and many others (DeWit 2017a).

Smart communities and National Resilience are also powerfully supported outside the realm of technocratic planners. All levels of government and the general public appear more supportive of adaptation than mitigation. 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 (Oguro 2014). Moreover, Japan's most recent annual and authoritative "Environmental Consciousness Survey," 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 (NIES 2016: 20).

Another example of this support for resilience is seen in **Table 4**. The table reproduces the most recent results of Tokyo Metropolitan Government's (TMG) annual

Table 4 Tokyo Metro Resident Survey of Priorities, 2012–2017

Rank	2012	2013	2014	2015	2016	2017
1st	DRR (54.9)	DRR (52.7)	DRR (49.4)	Aging (49.8)	Aging (53.5)	DRR (48.7)
2nd	Pub. Saf. (47.5)	Pub. Saf. (48.1)	Pub. Saf. (47.7)	Pub. Saf. (48.7)	DRR (48.6)	Pub. Saf. (48.2)
3rd	Aging (43.6)	Aging (44.2)	Aging (46.5)	Med. (41.9)	Pub. Saf. (48.1)	Aging (46.7)
4th	Med. (41.5)	Med. (38.0)	Med. (43.1)	DRR (41.6)	Med. (41.7)	Med. (41.5)
5th	Enviro. (25.8)	Enviro. (27.3)	CA (26.5)	Trans. (23.1)	Admin. (27.1)	Admin. (31.2)

Legend: DRR＝Disaster Risk Reduction; Pub. Saf.＝Public Safety; Med.＝Medical Services and Sanitation; Enviro.＝Environment; Admin.＝Administration and Finance; CA＝Consumer Affairs; Trans.＝Transportation

Source: TMG 2017a

survey of 3000 residents concerning the priorities they wish TMG to pursue. The results indicate that disaster risk reduction (DRR) was ranked #1 from 2012 to 2014, then dipped to #4 in 2015, but rose again to 2nd place in 2016. In 2017, it returned to the top, just above public safety (i. e., policing etc). Environmental measures (Enviro) routinely score far lower, being 7th in 2017 (chosen by 23.2% of respondents as a priority).

This survey indicates that TMG residents strongly support spending on resilience, much more than explicitly environmental measures. That kind of evidence is one reason to look for how Japanese policymakers link their energy projects to the "resilience" theme. In TMG, the approach is evident in the use of the sewerage network as an anti-flood system (integrated with advanced radar and supercomputing) as well as a means for boosting TMG energy and cutting its GHG emissions (sewer operations result in 35% of TMG greenhouse gas emissions)[12]. TMG's FY 2018 budget projects spending JPY 88.7 billion on the smart city, an increase of JPY 16 billion over the previous year. Given the above, it is no surprise that mitigation measures (including

12) TMG's use of its sewerages to adapt and mitigate is described in its excellent series of short videos (in Japanese), "Tokyo JOBs," released in May of 2017. The system integration with advanced radar and computing is described in "Real-time rainfall information" (https://www.youtube.com/watch?v=SPaf3SDBrX4) and the use of sewerages to increase renewables and reduce demand is outlined in "Effective use of energy" (https://www.youtube.com/watch?v=tqmbz8zDV9g)

EVs, solar, Hydrogen Stations) are budgeted at JPY 12.7 billion while adaptation measures (bolstering river levees) are budgeted at JPY 76 billion (TMG 2018).

In short, the evidence suggests that Japanese local governments and the public are quite amenable to changing the built environment as an adaptation response. Pragmatic policymakers appear to have skillfully linked resilience against hazards to mitigation in the face of climate change. Their approach threads multiple hazards together through common solutions, such as the coordinated diffusion of AI/IoT, maximizing the number of stakeholders and thus support for the projects.

Why Does the Narrative Duel Continue?

Thrown out of policymaking by the 2012 return of the Liberal Democratic Party (LDP), under PM Abe Shinzo, Japan's idealists insist that renewable energy is being sidelined. As we have seen, they represent Japan's current energy policy as being focused on nuclear restarts rather than renewables. Their claim is routinely disseminated internationally by such organizations as the international environmental NGO German Watch. In its Climate Change Performance Index 2017, German Watch ranked Japan's climate performance as 60th, just above Saudi Arabia (German Watch 2016).

After 3-11, the 100% RE community-power advocates soon became stymied by inconvenient truths. The abrupt shut-down of all nuclear plant coupled with the world's most generous subsidies for renewable power (especially solar panels) led to an expensive boom in solar but minimal investment in wind, hydro and other renewables. And in place of nuclear, fossil-fuel generation (coal, natural gas and oil) surged. The idealist emphasis on the German model also overlooked important geographical and other differences. Japan is clearly not Germany, differing greatly in geography, resource endowments, and disaster hazards. These differences have a profound impact on what kind of networks and energy systems it is feasible to build.

Yet rather than rethink their analyses, the idealists doubled down. Hence, they continue to offer an unrelenting critique of the current Japanese central government's energy and environmental policies, usually comparing them to those of Denmark and Germany and finding them wanting. Further, the idealists maintain that Japan's alleged backwardness is due to central-government reluctance to expand renewables rather than restart nuclear reactors and build more coal-fired generation. They also claim that this lack of policy support compels Japanese firms to deploy their advanced technology overseas. The idealist narrative has also been internationalized through the ３-11 Fukushima disaster, which reinforced the image of captured agencies, craven politicians, and policy immobilism. The idealists also enjoy extensive connections in German Watch, Greenpeace, IRENA, REN21, and other global networks that (largely because of language barriers) rely on the idealists' interpretation of Japan.

The idealists continue to argue that refinement of the feed-in tariff, which pays a premium price for solar, wind and other renewables, will generate an energy revolution premised on the sharp reduction of coal, oil and gas and the elimination of nuclear power. They highlight German, Danish and other successes, and imply that this price mechanism (along with carbon pricing) could and should be the main driver in displacing nuclear as well as coal and other fossil fuels from the power mix. They declare that rolling out renewable energy, especially through community-led initiative, will both mitigate climate change and bolster civil society. Their narrative's focus is thus the mitigation of climate change and enhancing the energy autonomy of local communities. They believe distributed, renewable energy can help resolve climate change, overcome dangers associated with nuclear power, and re-invigorate local community.

In general, the idealist model of governance centres on a particular vision of the German experience, with attention also paid to community power in Austria, Denmark, Switzerland. Their literature is replete with case studies of local communities in these countries (eg, Matoba 2018; Oshima and Takahashi, 2016). In Germany, they see a country with ambitious plans for renewables, denuclearization, and emissions reductions, all fostered by such policies as the feed-in tariff and ambitious renewable and carbon-reduction targets. Their rhetoric clearly indicates that they want Japan to be more like this idealization of Germany, in mitigation policy as well as a "bottom up" activist civil society. They also distrust Japan's central state, which they see as top-down and sectionalist. They view the central government's fiscal initiatives as inherently wasteful and its regulatory reforms as largely biased towards the status quo. They therefore look to local governments and NGOs as the ideal locus of governance. The domestic case studies they privilege include Iida City's *Ohisama* (on this, see in English Furuya 2017, Hamanaka 2016) mechanism for fostering community renewables. They display little interest in critical infrastructure and smart communities.

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 Paper.” Their document's 128 pages completely ignore the role that policy integration plays in fostering such technology as microgrids, energy management systems, and smart communities. Instead, it depicts a top-down (*tatewari gyousei*) sectionalist state that favors big business (Green Watch 2016: 63-64) at the expense of the citizens, the latter allegedly being excluded from policymaking (Green Watch 2016: 63-67).

Yet Japan's idealists insist that Japan's geography is not a significant problem for the diffusion of renewables. One line of argument is to recognize that Germany is part of a continental grid, and then deny that Germany is reliant on French nuclear power to back up its renewables (Takahashi 2017: 205). That response appears to stem from Japan's nuclear village's hoary assertion that Germany was able to pursue RE at the expense of nuclear because it imports French nuclear power. Yet even pro-nuclear observers are aware that this is not the case. Several point out that the Germans a net power exporter and that troubles at French reactors forced the latter to import power during the winter of 2016-2017. In other words, the specialist debate has moved on, recognizing that key to RE penetration in the European power system is the hydro and pumped storage of Scandinavia, and especially of Norway. But within Japan, the idealists continue to quibble with outdated assertions.

Moreover, in response to rebuttals that Japan is not Germany, idealists declare that other archipelagos (New Zealand), islands (Iceland), and relatively isolated energy economies (such as the Iberian Peninsula and Ireland) have achieved high levels of renewables (Yamaka 2017: 350). But this summary dismissal fails to analyze the character of renewable portfolios in these areas. For example, in 2015 fully 56 percent of New Zealand's power was generated by large hydro projects (IEA 2017c: 21). And while Iceland certainly does secure a staggering 85 percent of its primary energy from baseload renewable sources, these are mostly large geothermal and hydro projects (OECD 2016a). Moreover, Spain (the heart of the Iberian Peninsula) certainly does have impressive renewable penetration, at just over 35% in 2015. But it also has roughly 20% nuclear in its power mix along with 10% hydro. And its rich endowment of intermittent onshore wind resources (just under 18% of its power mix in 2015) is scheduled to be further balanced by the EU's largest ever grid investment. The EU will build a EURO 578 million, 370 kilometre subsea power cable across the Bay of

Biscay to link Spain and France, roughly doubling the Iberian Peninsula's current 5000 MW power exchange capacity (de Carbonnel 2018). In short, it is not enough to insist that high levels of RE penetration have been achieved elsewhere, even in archipelagoes. The precise details matter.

It would appear that the idealists draw too much on foreign, especially German models. Their work, moreover, lacks a serious analysis of Japan's powerful "Not in My Backyard" (NIMBY) problem, which blocks onshore wind, geothermal, hydro, and even some local solar projects. Relying on an idealized concept of individual rationality, they assert that local ownership of renewable projects is the solution to NIMBY. As we have seen, large hydro provides concentrated and comparatively constant power. But hydro elicits strong opposition from Japan's energy idealists and local environmentalists (Aldrich 2008: 96–99). And in Japan, geothermal development continues to be opposed by hotspring owners and environmental interests. Another inconvenient example of Japanese NIMBY concerns wind power. When the FIT was introduced in 2011–12, Japan's "Wild Bird Society" and other interests mobilized to block it. They succeeded in convincing the Ministry of the Environment to adopt even more stringent environmental assessments for wind power than for coal (Looop Way 2017). Yet onshore wind has been assessed as the most effective and efficient of renewable energy options (Hawken 2017).

The idealists' reliance on community power also seems to have been inadequate. The total capacity of Japan's people-power projects has been enumerated in a survey undertaken by Japanese environmental NGO Kikonet (Kikonet 2017). Kikonet is a core actor in the populist network, resolutely anti-nuclear and anti-coal. So it is all the more instructive that Kikonet's own survey reveals how limited has been the impact of community groups. If one includes projects undertaken before 3–11, community power has conducted over 1,000 projects nationwide. But its annual increase in initiatives peaked in 2014 at 214 projects, falling back to 52 in 2016. Most of the projects are solar or wind, meaning that the total capacity was just under 90,000 kW (less than 1/10th of a single nuclear reactor). Moreover, the power actually generated by these intermittent projects is only 12% (solar) or 20% (wind) of their total capacity[13].

13) The IEA undertakes comparative studies on average generation capacity factors (meaning the percentage of energy output versus rated capacity). Its survey of output between 2008–2012 indicates that Japan's aggregate figure for both solar and wind is 15 percent, far less

It is very unlikely that people-power will engender a green revolution in Japan, given the scale of the challenge in changing a modern industrial economy's energy system. An energy transition certainly requires a lot more than the solar panels and windmills that civil-society (even together with business) can put in place. At least in Japan, civil society lacks organizational coherence, energy literacy and financial resources to lead an energy revolution. It is not even able to establish a Green Party. That should be obvious, but a lot of Japanese activists and academics combine a powerful commitment to community-based energy with deep suspicion of state energy policies.

Conclusions

The evidence indicates that, at least in Japan, the technocratic narrative is credible and that its approach produces robust results. Japan is not a laggard, and recent evidence indicates an impressive, and expanding, energy-environmental policy regime. That said, the populist narrative is certainly correct that Japan could and should have more ambitious targets for renewable energy and reductions in greenhouse gas emissions. But the idealists downplay the crucial role of collaborative agency and critical infrastructure, even though a rapid shift to renewables would surely rely on both. That is, they do not ask whether civil society-centred governance has the organizational discipline and financial resources to lead a cost-effective and competitive energy-environmental revolution in a country beset with an unparalleled array of demographic, fiscal, climate and other challenges. Their literature instead emphasizes reforms to the feed-in tariff, enhanced grid access, and other regulatory measures that they believe would increase community-power projects. But they shy away from discussing how one actually incentivizes the massive and rapid rollout of the critical infrastructures, such as smart networks, that allow the local political economy to maximize its exploitation of renewable endowments while minimizing energy consumption. And their interest in hazards generally focuses on seismic risks to nuclear facilities. Preoccupied with the risks associated with nuclear power, they rarely, if ever, discuss the full slate of hazards and the urgent imperative of adaptation to climate change.

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than the 27 percent recorded for the United States, the 26 percent seen in Canada, and the 18 percent figure for China (IEA 2015).

Indeed, the Japanese idealists appear to perceive adaptation as coming at the expense of mitigation. Yet the global specialist debate now recognizes the urgency of doing both and the fact that they often overlap[14]. Abundant evidence indicates the potentially decarbonizing impact of resilient adaptation, especially when coordinated at the national level to maximize public goods and positive externalities. For example, compact cities and green infrastructure are inherently mitigating as well as robust in the face of mounting risks of flood, fire and other disasters (Bay and Lehmann 2017). So too are the smart distributed energy networks that are growing from within vulnerable, carbon-intensive conventional power and heating systems (MIT 2016). Japanese technocrats and their adaptation-led smart communities thus deserve more attention. They appear to offer valuable lessons in linking institutions, infrastructures, and actors towards resilient and equitable decarbonization.

It is important to pay close and unbiased attention to what Japan is doing to mitigate and adapt to climate change, and what incentives underpin its own particular approach. One reason to scrutinize Japan is that no country or institution has all the right answers on what to do in the face of what is possibly humanity's most dire threat. It is quite likely that Japan holds important lessons overlooked by critics. Japan remains one of the largest economies on earth and possesses very competitive energy, environmental and disaster-resilience intellectual and institutional assets. Second, the country confronts energy challenges and climate change threats that are as much or even more dire than its peers (DeWit 2019). Third, the Japanese are well aware that scientific evidence strongly indicates the global climate system has transitioned from the relatively placid Holocene era to an increasingly uncertain Anthropocene (JANET-DR 2016; Hamilton 2017, Yokoi 2018). Japan's national and subnational governments, together with their scientific advisory organs, understand that climate change poses rapidly worsening hazards for human communities, their critical infrastructure, agriculture, and other crucial elements of the built and natural environments. Indeed, on February 16, 2018, the Ministry of the Environment (MOE), the Ministry of Education, Culture, Sports, Science and Technology (MEXT), the Ministry of Agriculture, Forestry and Fisheries (MAFF), the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), and the Japan Meteorological Agency

14) On this point, see the critical comments of IPCC Working Group II on the "presumed tradeoff between mitigation and adaptation": http://www.ipcc.ch/ipccreports/tar/wg2/index.php?idp=62

published a new comprehensive report on monitoring, forecasting and assessing the impacts of climate change on Japan (MoE 2018). Since 2013, Japan has built a "National Resilience" paradigm centred on countering such disaster threats by bolstering energy, water, communications, transport and other critical infrastructure (DeWit 2019; Kashiwagi 2018b). And many of the challenges posed by the Anthropocene are recognized in the Sendai Framework for Disaster Risk Reduction 2015-2030. The framework's concerns about climate change and how to adapt were strongly informed by Japanese expertise.

Japanese pragmatists appear compelled to frame their arguments within an "all of the above" strategy in order not to abandon any technological possibility (and perhaps not to alienate any particular energy interest). After all, no state — least of all resource-poor Japan — can afford to exclude any area in the midst of unprecedented upheaval in energy and climate-related technologies.

The pragmatists represent Japan as a renewable and efficiency leader, but also recognize that the country must accelerate its mitigation and adaptation in the face of stiff competition. The pragmatists are also committed to decarbonization, perhaps more aggressively than the official Japanese government goal of reducing CO_2 emissions by 26% by 2030 and 80% by 2050. Unlike idealists, who lack even a Green Party, Japan's pragmatists enjoy the privilege of directly shaping ongoing policy, through leadership of major advisory committees. They drive this policy forward, towards ever smarter and integrated solutions. The energy technocrats' "smart energy" paradigm is thus very different from what the idealists envision, particularly concerning how to maximize renewables and efficiency. At the same time, the technocratic narrative explicitly recognizes the gravity of the energy-environmental crisis. It interprets the crisis as a multiplicity of threats as well as opportunities. But rather than idealistic critique, it emphasizes creating solutions through collaborative governance, system-integration and diversity in energy inputs. After examining the evidence, this paper finds Japan not to be a laggard and concludes that Japan's technocratic narrative is worth a closer inspection.

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