Decentralised energy production and community sustainability
How hydroelectricity shall contribute to local development

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Abstract

The Japanese energy market is currently experiencing a drastic market liberation. Electricity market reform, originally started during the 1990s-2000s when the nation facilitated retail competition for high-voltage customers, further proceeded in April 2016, when the market fully opened to allow about 85 million households and small businesses to choose electricity suppliers for the first time. The reorganization, partly in response to the Fukushima accidents, is to develop a stable supply of electricity, lower rates and more choices. The March 2011 earthquake and nuclear meltdown led to blackouts in the capital region of Japan, revealing the vulnerabilities of the nation’s power system. The meltdown led to the closure of the nuclear plants, forcing utilities to import fossil fuels and raise electricity rates.

Locally produced hydroelectricity (especially under the 1000kW capacity) is a decentralised renewable electricity source, and a number of local governments, groups and businesses have started to develop hydroelectricity using resources available to their community. Community based hydroelectricity development is expected to play an important role both in economic and social integration: as is widely known, Japan is facing rapid aging and community decline problems, and the locally produced electricity often functions to enhance community aspiration, as well as to gain financial income through the sales of the electricity.

There is, however, a question regarding the promotion of hydroelectricity: how can these local projects could have long-term business and community sustainability? Even though the electricity market was liberalized, there are some political uncertainties as to the business environment for the local renewable producers. In addition, though locally available, hydro energy could also be developed by big businesses and the financial benefits may be only experienced by those with large capital, hence there is a remaining argument as to whom the local resources belong to.

In order to answer the question as to whether the hydroelectricity project may contribute to the community sustainability and development, this presentation traces the history of local hydroelectricity development in Japan, then classifies recently developed local hydro projects into different categories, to identify how they demonstrate community sustainability. This presentation also describes the potential and uncertainty of decentralised renewable projects in the face of changing central political environment and consumer awareness.

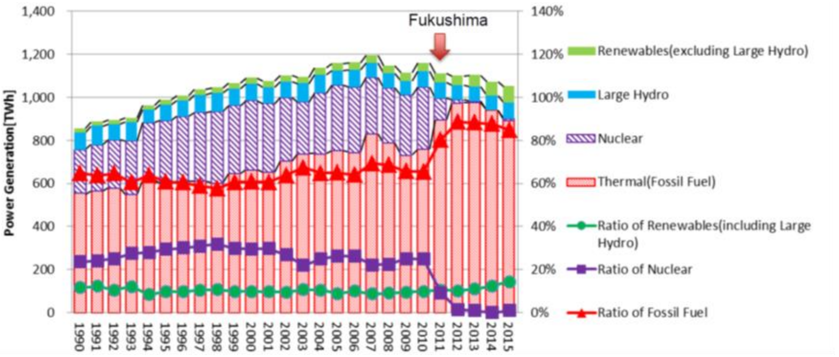
Key words: Community energy, small hydro power, renewable energy, Japan

1. Introduction: Japan Energy Overview

Japan is little endowed with indigenous fossil fuel reserves, which makes the country heavily reliant on imported energy sources. According to the International Energy Agency, the energy self-sufficiency rate of Japan was about 6% in 2014 (IEA, 2015). Historically, the Japanese government has encouraged utilities to take up energy efficiency and diversification strategies, shifting from oil to LNG, nuclear and, to some extent, renewable energy, especially after the oil crisis (Suwa, 2009a).

Yet, the country still uses fossil fuels in 2015, that accounts to over 70% of the total power generation. The Great East Japan Earthquake on 11 March 2011 became also the background to the high dependency on fossil fuel: after the catastrophic accidents in the Fukushima First Nuclear Plant, over 50 nuclear power plants, no matter which region they were locate, were ordered to suspend their operation. Nuclear share within the generation portfolio of utilities decreased, while LNG and coal power generation were taken to make up the electricity deficiency, forcing utilities to import fossil fuels

Figure 1: Trends of Power Generation in Japan



(Source: ISEP, 2016)

2. Japan electricity market: structure and reorganization

The March 2011 earthquake and nuclear meltdown thus revealed the vulnerabilities of the nation’s power system. The experienced power shortage after the nationwide nuclear suspension led to the experts and the government recognising the need to re-structure the power market, where the debate over the legitimacy of the *lasser-faire* electricity market structure was stimulated, including questioning the ownership of the power infrastructure for production, distribution and sales.

As a result, electricity market reform, originally started during the 1990s-2000s when the nation facilitated retail competition for high-voltage customers, further proceeded in April 2016. The market was fully opened to allow about 85 million households and small businesses to choose electricity suppliers for the first time. The retail market liberalization will be followed by thorough market reform programmes. It is expected to separate electricity distribution functions from the utilities by 2020, by creating an independent transmission system operator that would oversees the nationwide power distribution (Takahashi, 2011). Electricity utilities, as a result, became concerned about their continuous dominance over the energy market, to the extent that they decided to diversify their business portfolio by, for example, entering into the gas market to compete with the existing big regional gas suppliers.

The reorganisation, in theory, should develop a stable supply of electricity, lower rates and more choices by creating spaces for diversified energy generation. It was expected to encourage non-utility entrance to the power production sector. At the moment of writing this report (June 2016), the liberalization process currently has a limited impact on the retail market, with less than 5% of customer having so far changed suppliers (OCCTO, 2017). This may be as a result of Japanese customers' conservatism over the choice of suppliers, lack of information as to energy and sustainability issues, as well as the marginal financial and other benefits to the customers upon changing the suppliers.

The liberalization of the energy retail market, nevertheless, certainly opened up a possibility for expanded parties to venture into power production. There are over 300 business entities who have started to supply electricity directly to customers. Many of them appeal to the customers with the electricity price discounts, e.g. packaged concessions with telephone and mobile packet subscription. In contrast, there are some new entrants who are mindful of cooperative energy development models, actively promoting decentralised renewable electricity.

Among these new entrants, there are a number of local governments, groups and businesses that have started to develop renewable electricity using resources available to their community. Community based renewable electricity development is envisaged to play an important role both in economic and social integration senses: as know widely, Japan is facing rapid aging and community decline problems, and there are increasing expectations that locally produced electricity will enhance community aspirations, as well as become a tool to gain financial income through the sales of the generated electricity via the national renewable support schemes. The next section therefore describes how the public renewable mechanisms have evolved in Japan, and how that has links with the community energy development.

3. Renewable policies: RPS to FIT and the community energy development

With scarce, local fossil fuel reserves, renewable energy deployment has been, at least, on the Japanese government energy policy agenda for decades. After the oil crisis, a significant amount of the government budget was allocated to renewables research and development. The Japanese government initiated a series of projects to support renewable technologies. Its primary focus, however, was mainly on technology research and development, while less attention was paid to public policy to support and deploy the renewables (Suwa and Jupesta, 2010).

It was only after 1992, when "net-metering" was launched as a voluntary scheme by the electricity utilities, that the rate of deployment of certain renewable electricity from PV and wind gained momentum (note that SHP was not covered by net metering then). Net-metering enables customers to use their own electric generation to offset their consumption over a billing period, where customers receive retail prices for the excess electricity they generate.

In 2003 the Japanese government enacted legislation based on the renewable portfolio standard (RPS) scheme, which requires electricity retailers to supply a certain amount of renewable electricity to grid consumers. The RPS legislation was to ensure market efficiency, as well as to increase renewable capacity. The RPS aimed to develop small hydro power (SHP) under 1 MW. The effect of RPS, however, remained minimum, to the extent that it was overtaken by the nationwide Feed-in-tariff (FIT), the new policy programmes which have been internationally proven to be effective to bring larger interests into renewable energy production *(ibid.)*.

After official legislation in 2011 by the Democrat cabinet let by the former Prime Minister Naoto Kan, FIT was placed into effect in July 2012, to require electric utility companies to purchase electricity produced from renewable energy sources with a higher price than that of conventional fossil-fuel -based energy. The extra costs of the purchase were added onto the electricity bill. Tariffs are set for each renewable energy category, and are revised each year based on the degree of circulation and market conditions of each category. Tariffs for hydropower are 20-27 yen/kWh (approximately US$0.21-29/kWh) for hydropower plants with 1-30MW, 29-34 yen /kWh for plants less than 1MW in 2017 (different tariffs applied if using the existing manmade water channels, as in Table 1) (METI, 2017).

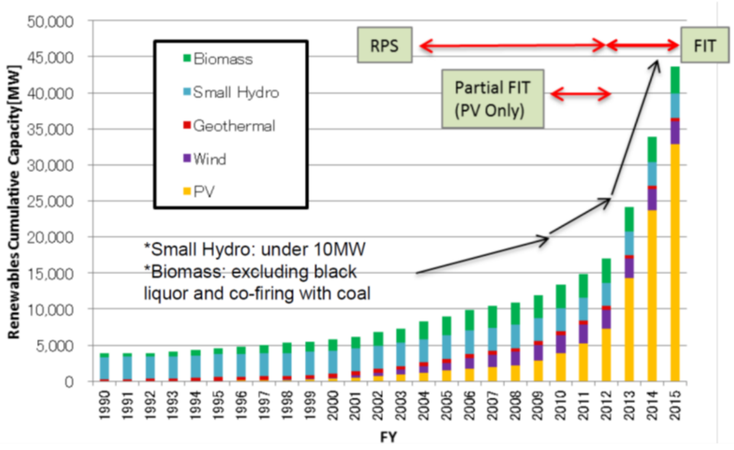
Table 1: Hydropower FIT (JPY)

Category	Capacity	2016	2017
Hydropower	5-30MW	24	20
	1-5MW		37
	200kW-1MW	29	29
	Less than 200kW	34	34
Hydropower using existing manmade water channels	5-30MW	14	12
	1-5MW		15
	200kW-1MW	21	21
	Less than 200kW	25	25

(Source: METI, 2017)

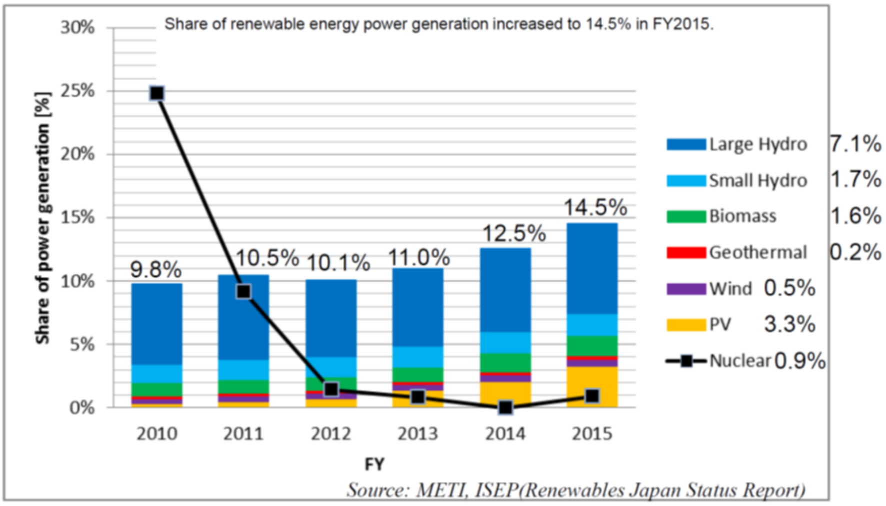
Indeed, the Japanese FIT accelerated renewable deployment in Japan, with PV, wind, SHP and geothermal electricity, and increased their capacities. The capacity increase is significant for solar and wind, whereas the hydropower increase remains relatively modest (Figure 2 and 3). Compared to the last few decades, however, the pace of the SHP has steadily increased.

Figure 2: Trends of Renewable Energy Capacity in Japan



(Source: ISEP, 2016)

Figure3: Trends of renewables and nuclear power generation in Japan



(Source: ISEP, 2016)

The increase of the renewable feed-in to the electric grid was enough to provoke discussion over ancillary control. Ancillary services are what maintain the proper flow and direction of electricity, address imbalances between supply and demand, and help the system recover after a power system event. The electric utilities claim that reliable operations of the grid may be disturbed by the intermittent power inputs from renewables. The utilities are keen to control the amount of renewable-generated electricity so as to keep it within their preferred range.

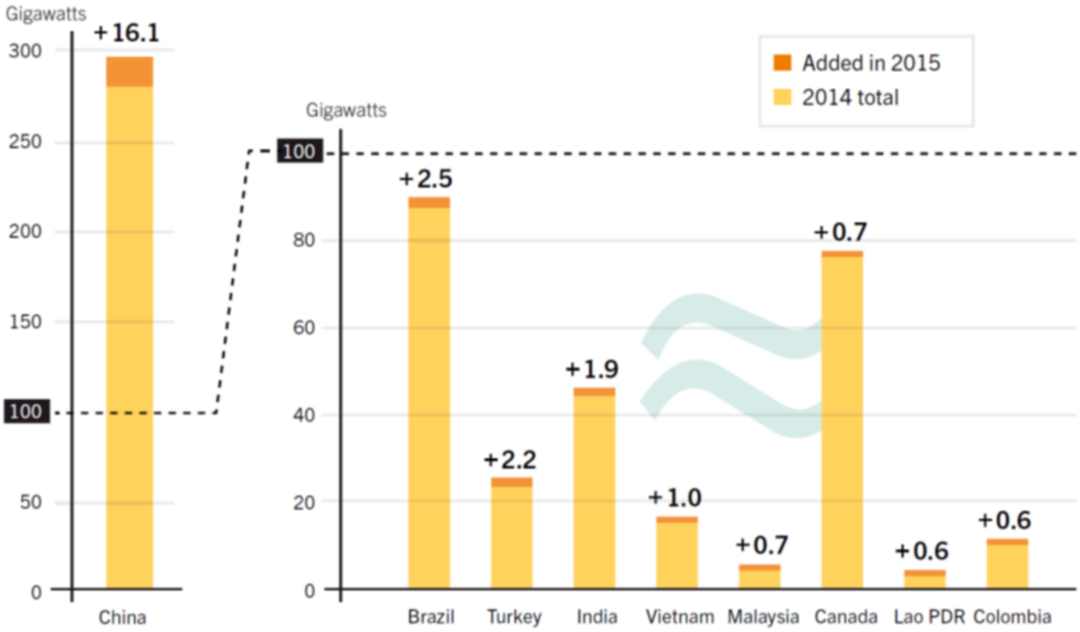
This argument has created uncertainty regarding investments in renewables, with the market cautiously observing whether and how the FIT tariffs will change, especially PV. Nevertheless, FIT, as the main renewable policy mechanism, continues to have large influences over the renewable development, as it has direct links with their profitability.

4. Small hydropower sector overview and potential

Looking at the international context, hydroelectricity is one of the world’s most important renewable energy sources. It is fifth in installed capacity to date, followed by wind and solar power (UNIDO, 2016). On the other hand, small hydropower (SHP) represents approximately 1.9 per cent of the world’s total power capacity, 7 per cent of the total renewable energy capacity and 6.5 per cent (less than 10 MW) of the total hydropower capacity (including pumped storage)(*ibid.*). As in Figure 4, China, Brazil, Turkey and

India, among others, are showing steady increases on SHP capacity (REN21, 2016).

Figure 4: Worldwide increases on SHP capacity



(Source: REN21, 2016)

In Japan, large hydroelectricity is the most widely used RES, accounting for nearly 7.1% of the total electricity production, whereas SHP accounts for 1.7% (Figure 3). Further developments of large-scale hydropower are limited, with the lack of appropriate sites for the large hydro power installation, and their associated environmental and community impacts. In contrast, SHP (including micro hydro) power production became the focal for further development on the available stream resources.

The mechanical features of SHP, though vary, are simple by using energy of falling or running water, to drive turbine to generate electricity. Different countries and institutions have a number of definitions, but they are usually classified into separate categories depending on the power production capacity. EU, for example, sorts small hydro into: Large small hydro as 500kW-10MW, small-small hydro as 100kW-500kW, and micro-hydro 1kW-100kW (SPLASH, 2005). The definition of SHP generally used by Japan is up to 10 MW, but FIT applies to the different categories.

In 2015 the installed capacity of SHP in Japan was at 3,545 MW. A further 49 plants with a combined capacity of 54 MW are under construction and 2,456 potential sites with a combined capacity of 6,725 MW have been identified (UNIDO, 2016). Separate research conducted by the Ministry of the Environment estimated further potentials in using man-made irrigation canals *(ibid.)*.

5. Community SHP and barriers

Compared with photovoltaic (PV) and wind power that have been rapidly disseminated in Japan especially in the last few decades, hydroelectric power generation has more than 100 years of history of development. PV and Wind, as a result, exhibit relative “exoticism” to the rural Japanese scenery, whereas hydropower, both in large and smaller scales, has been an important source of electricity for localities.

In 1891, Kyoto Keage Hydropower Plant was developed, as the first commercially developed Japanese hydropower facility, supplying electricity to the Kyoto city households and the public transport (e.g. trams). There was a steady increase of hydropower at the beginning of 20th century, when the number of power plants in Japan increased by over 1,000 facilities. With the rapid increase of hydro installation, the nexus of technological guilds also grew. These experts, developed during the pre-World War II (WWII) period, were effective in overcoming multiple barriers, including technical, legal, social and human obstacles to local hydroelectricity development *(ibid.)*.

In the post-war period of 1945, and during economic recovery, the government focus was changed from hydropower to fossil fuels and nuclear energy. This was partly reflecting the US policy changes over Japan, with the US demanding Japan to be the market for fossil fuels that would be supplied by the major international oil industries. A number of coastal areas, especially with refineries disused after the WWII, were re-opened to accommodate petrochemical complexes. The age of petroleum for power production and industry began, while hydroelectricity gradually subsided, with a large number of hydroelectric power plants being decommissioned during the 1960s and the 1970s *(ibid.)*.

It is only during the past few decades that the interest in energy from renewable sources have gradually paved the way for SHP resurgence. There are a number of “communities” that venture into the development of those locally accessible energy sources, given the nature of renewable energy, of being relatively small and available nearby the sites of energy demand.

Community energy development could suggest the kind of projects that incorporate community-led, -controlled and -owned renewable energy installation development (Walker, et al, 2007). Though having significant implications both from local development and carbon reduction contexts, community energy projects face various barriers, ranging from technical and economic to legal for the early and operational phases of their development.

As mentioned, during the post WWII industrialisation period the electricity sector in Japan was centralised and heavily focused on large-scale power generation. This brought the decline of hydropower, and of the associated sectoral knowledge and expertise for both large and small hydropower development. In addition to the loss of expertise, the permit procedure has been a big obstacle intrinsic to river development. Japanese River Act, a regulatory framework on river and water resources management, came into effect in 1986 (fully revised in 1994, revised partially in 1997). In principle, most of the surface flow became under the jurisdiction of the River Act overseen by the national government. In contrast, the right to use agricultural water is usually awarded to the farming associations, who function as farmers unions, and heavily use irrigation water for growing rice crops (UNIDO, 2016).

Upon the new development of SHP, it is necessary to obtain the water rights, by establishing consensus with existing water right holders. It is also required to obtain permission from the responsible authorities. Preparation of a bulk of document has created the hurdles for new development, where the application should include considerable technical details, e.g. calculation of 10 years prospective water intake, and policies on ecosystem conservation. Though these data is useful in its nature for anticipating possible impacts on the natural environment, significant scientific and engineering knowledge and expertise are thus required upon SHP planning.

Above all these technical and legal complications, social and political disputes are increasingly observed in the scene of renewable development, to be potential barriers for the renewables. There are debates over community benefits for wind power, and even solar electricity, with various contestations from communities experienced in the international context, objecting to the proposed development on wind, based on the issues over landscape (Walker, et al, 2007). In the Japanese context also, the issues of landtitle, noise, vibrations and birdstrikes have been the key perceived complications to the diffusion of wind power generation (Maruyama, 2016).

In addition to the wind development, there are increasing numbers of arguments over Photovoltaic (PV) development, that is related to the potential shading of solar collectors due to obstruction from another owner’s property (buildings, foliage or other impediments) (Suwa, 2016) As more people adopt residential solar energy systems, there could potentially be many more disagreements about shadows, reflections and access to sunlight. Currently this means that the people who have installed or will install PVs are assuming high risks, and there is increasing concern among property developers as to how much solar access should be given around their construction projects. Further, there is an increasing need to identify the tolerable degree of reflectivity and to estimate financial losses that may result due to reflections (*ibid.*).

In the wind and PV cases, the feed-in-tariff, by its design, made a clear connection between wind/sunlight and income. In other words, winds, sunlight (or other renewable resources) are no longer just a source for warmth and amenity, but also a source for property and economic return: Renewables now can generate financial benefits, as a form of energy and electricity, which are materialised through financial rebate system, such as FIT, or other forms of supporting policies.

The energy-related benefits are strongly connected to social and economic systems, where equity on the production, distribution and benefit sharing are fundamentally required. Armstrong and Bulkeley (2014) argues for a focus on the socio-materiality of renewables, calling for a different viewpoint over the renewable resources to understand the shifting discourses, coalitions and interests at stake.

6. Socio-material resource: Who owns the river flow and the associated power produced?

For the cases for SHP development, river flow became material-resource potentially to contribute to community benefits. There have traditionally been a various interests over the river flow; the sources of SHP. Fishing, leisure and ecology, not mention the physical ownership of the potentially suitable sites for energy production, all address the typical rights and interests intrinsic to river usage. As the number of SHP increases in Japan, however, poor public consultation process by the developers, selection of the most economically viable location and the lack of direct paybacks to local community became appealing issues for opposition to SHP development. The production of energy, especially electricity, often produces conflicts with these existing rights and ownership, where the right to produce electricity tends not to be established within the existing legal and political framework for river management.

In addition, though locally available, hydro energy could also be developed by big businesses and the financial benefits may be only experienced by those with large capital, hence there is a remaining argument as to whom the local resources belong to. This means there is a question regarding promoting hydroelectricity about how these local projects could have long-term business and community sustainability.

The classic divisions between community and big capital have been often observed by advocates of “community energy development” and seen in wind development cases (Pasqualetti, 2011, Aitken, 2010). Devine-Wright (2009) addressed the ethos of local contestations, which have roots in place-protective action and arise when new developments disrupt pre-existing emotional attachments and threaten place-related identity processes. Place-protective behaviors are generally shaped by a variety of psychological and contextual factors, where the politics of energy production strongly correlates with behavioral resistance. In case of SHP, even referred to as micro-or mini-micro generation, a growing role is expected to be played by communities in the production of renewable energy, instead of by utilities and investors seen external to the communities.

It is often the case that large-scale energy projects, such as nuclear, thermal and large-scale hydropower have addressed political and economic influences over their development, but they became as critical to the “similar” forms of energy, including SHP. When supported by environmental and social validity, SHP can be an important renewable energy technology, contributing to inclusive local sustainable development.

In the next section, this paper classifies recently developed local hydro projects into different categories, to identify how they demonstrate socio-material dimensions of water-energy resource, in order to allow for more interaction with wider community and stakeholder engagement.

7. Case studies

In undertaking classification with key categories involved in the SHP, it has become clear that there are multiple factors contributing to the typology of benefit sharing among the different cases. These factors are mostly represented by the government, utility and community initiatives, purposes for power generation (power sales or power consumption, and whether the financial benefit is obtained though power sales though FIT, or on-site electricity consumption). By looking at three cases indicative, we can identify how the typology of the projects is associated with the community benefits.

- Local government-utility cooperation model

The Gifu prefecture Government, in the middle region of Japan, has been working to promote renewables in its domain. In Gifu, there is a local river called the Atagi River, up stream of the Nagara River. The Atagi Dam was constructed in 1988, to control river flow to prevent flooding. Unlike other dams constructed for the similar purpose, which store river water and let it be discharged only in emergency, Atagi Dam maintains a regular flow, in order to protect the ecosystem down the stream.

In the late 2010s, Chubu Electric Company was approached by the Gifu Prefectural Government, to jointly develop SHP using the maintained stream. It was sufficient to install a 190kW capacity generator, enough to produce 1.3TWh electricity to support 3.6 million households electricity.

Figure 5: Atagi SHP using the existing dam facility

(Source: SUIRYOKU.COM)

Additional water pipes, in addition to power generators, were constructed nearby to the existing dam (Figure 5). Chubu Electric Company obtains financial payback though FIT over its investment into the project, while paying charges to Gifu Prefectural Government over the usage of the stream, generating the additional income for prefectural budget.

The Atagi Dam power scheme is thus designed to promote local energy resources, which would be wasted without local government intervention. The Gifu prefectural Government agreed with the Chubu Electric Company to further investigate the similar hydro potentials in other sites, by means of the similar joint cooperative partnership.

The project did not explicitly intend to include local community involvement, but the profitability to the local government, if marginal but constant, could indirectly benefit the residents of the Gifu prefecture. The local authority had a distinctive role in this case, negotiating with the large-scale player (the Chubu Eclectic Company) to invest in the projects as its business. Gifu prefecture has the right to use the water, but the collaboration with the Chubu Electric Company, with the expertise and capacity for hydro power development, eased the technical obstacles, and helped the process of connecting the power flow to the nearby grid, shortening the development procedure.

- Local government-community NGO cooperation model

The Ikoma City Government, a local government in Nara prefecture in the middle-west part of Japan, is going to establish an independent power producer in July 2017, in collaboration with a local NGO, named the Citizen Energy Ikoma (CEI). The new company will get investment from CEI, Osaka Gas Co., Ltd., as well as the Ikoma City Government that has 51% of its share. It is the first case in Japan where a local NGO invested into the community energy company.

The new company is going to supply electricity to the City Government buildings and facilities, including over 70 municipal schools. By 2019, it is planned to generate and deliver electricity to 5000 households, accounting for 10% of the total within the Ikoma City area.

SHP is an important component of the new company’s portfolio. The Ikoma City Government provides electricity generated at its water purification facility (Ikoma Yamazaki Purification Facility) that has the height differences of 63m between the water intake and the mechanical location. As a result the water purification facility, with 40kW production capacity, is sufficient to supply 350GWh electricity per year (ITMEDIA, 2013).

The new company will also secure renewable electricity from CEI, which has been actively developing local renewable electricity, through mainly rooftop PVs, since 2013. The renewables account for about 10% of the total company portfolio, with the rest of the electricity to be covered by the Osaka Gas Co., Ltd., a big private gas utility which entered into the electricity market in 2016.

Figure 7: Ikoma Yamazaki Water Purification Facility

(Source: ITMEDIA, 2013)

The challenge for the new company is to ensure further renewable supply. The company is anticipating to procure electricity from more rooftop PVs within the city, with the observation that the rooftop PV has shown a steady increase over recent years. The City Government sees the local government subsidies for PVs, in addition to the national FIT, are part of attributes to its increase, implicitly claiming the PVs are a community asset, seeded and grown by the local taxpayers' contributions.

There are increasing numbers of community funds, which raise financial contributions from wider investors to develop renewable energies. Through these funds, institutions and individuals are able to participate in renewable energies. The fund organisors are often local non-governmental organisations (NGOs), keen to contribute to the locality through establishing networking between projects and actors within or outside of the concerned areas. The Ikoma case can be seen as an example of the collaboration between local government and NGOs/funds.

- Agricultural association model

An agricultural cooperative in Japan’s Tochigi Prefecture has been benefiting from electricity produced by hydropower stations installed in their rice irrigation water since 2006. The Nasunogahara Land-use Improvement Union’s (NLIU) Momura No. 1 and Momura No. 2 devices generate 30kW and 90kW, respectively.

Figure 6: Momura Daiichi SHP

(Source: J-Water portal)

Land-use Improvement Unions in Japan were created under the Land Improvement Act in 1949 to promote the “modernisation” of rice field arrangements. The unions have exclusive rights to use irrigation water for growing crops. Though it is not uncommon for agricultural cooperatives to develop or own hydropower facilities, most hydropower facilities were developed a few decades ago on relatively big river streams.

However, in the context of increasingly unstable oil prices, some of the Unions are now starting to expand their water rights to generate electricity from irrigation channels. In Tochigi, NLIU took up the initiative to develop community hydroelectricity. According to the international practice of dividing hydropower into different categories, based on the amount of energy generated, the devices are “micro hydro” since their output is less than 100 kW.

In the Nasunogahara case, the kinetic energy is generated by height gaps in the human-made channels where the gravity is sufficient to supply power for the NLIU’s irrigation facilities, which would have otherwise used electricity from the grid.

In addition, long-term financial benefits can be expected. In the NLIU case, the four generators cost approximately ¥100 million (US $12 million) in total, including equipment and installation. The exact cost-effectiveness is yet to be calculated, but the NLIU expects a long-term return on investment in about 10 years. This will be had through savings gained by offsetting electricity purchased from the grid with self-power generation (Suwa, 2009b).

The Momura micro hydropower is an early example of generating electricity by using irrigation water, which has most often been for growing rice. Growing rice is a water-intensive business. For most of Japan’s rice fields, water is brought in through human-made irrigation systems that source water from local lakes and rivers. Irrigation water has huge potential for hydropower applications, especially given its availability in most regions of Japan. It is estimated that it can supply more than 1.2 terawatts of electricity a year if its potential is fully tapped.

Tokyo Hatsuden, a consultancy under the umbrella of the Tokyo Electricity Power Company, is working closely with NLIU to develop more micro hydropower stations. This signals a new trend where cooperative relationships are developing between giant utilities and small-scale electricity generators. As a result, the Nasu case has drawn a lot of attention from other communities that are looking into new forms of electricity provision.

8. Discussion and conclusion

The above three cases demonstrate the local energy projects, especially on SHP, which have been carried out at localities within Japan. These suggest to us that the implications of community-based energy development should be recognized, along with the models, whose benefits could be shared among the developers and the community.

There has been increasing understanding that small-scale energy initiatives require stakeholder engagement and actor analysis and need encouragement to produce sustainable electricity generation. SHP, as part of these small power typologies, demonstrates an example where original material implications expand into the social domain. Traditionally, water flows have long have long represented fishery and agricultural values, while now it has begun to be placed within the energy context.

The cases in Japan demonstrate the interventions by the actors that hold legible ownership of the water rights (Nasu agricultural example) and the associated facilities for SHP (as in the Gifu retrofit dam development, and show how the Ikoma water purification SHP) contributed practical backgrounds to the local community energy development. Mobilisation and engagement of local actors (again in the Ikoma case) often drives the sharing process.

The three cases are only indicative to illustrate the recent successful examples among over 500 SHP cases in Japan. The local governments' direct and indirect intervention seem to be the key for these initiatives The resources and the relevant facilities themselves are often owned by the local governments in Japan, indicating that the legal and social requirements may be better handled there. Also, their commitment may give credibility and authority to these projects, to the Japanese localities where the nexus of community human factors are intricate and often involve cohesive personal relationships and contestation.

The energy-related benefits are strongly connected to social and economic systems, where equity on the production, distribution and benefit sharing are fundamentally required. These the cases in Japan, also, prove the necessity of understanding and discussing the essence and implications of changing roles of local renewables.

References:

Aitken, M., (2010), Wind power and community benefits: challenge and opportunities, Energy Policy, 38(10), pp.6066-6075

Armstrong, A., Bulkeley, H., (2014), Micro-hydro politics: Producing and contesting community energy in the North of England, Geoforum. 56(2014), pp.66-76, ISSN 0016-7185

Devine-Wright, P., (2009), Rethinking NIMBYism: the role of place attachment and place identity in explaining place protective action, Journal of Community & Applied Social Psychology, 19, pp.426–441, DOI: 10.1002/casp.1004

International Energy Agency (IEA), (2015), Energy Balances of OECD Countries 2015 Edition, DOI: 10.1787/energy_bal_oecd-2015-en

Institute for Sustainable Energy Policy (ISEP), (2016), Renewables 2016, Japan Status Report, <http://www.isep.or.jp/wp/wp-content/uploads/2017/03/JSR2016_all.pdf>

ITMedia, (2013), Yamazaki Water Purification Facility expects profits in 20 years, <http://www.itmedia.co.jp/smartjapan/articles/1303/19/news007.html>

J-WatER, Tochigi Nasunogahara case, <http://j-water.org/result/case05.html>

Motosu, M., Maruyama, Y., (2016), Local acceptance by people with unvoiced opinions living close to a wind farm: A case study from Japan Energy Policy Volume 91, pp. 362–370

Ministry of Economy, Trade and Industry (METI), (2017), Tariffs for 2017, <http://www.meti.go.jp/press/2016/03/20170314005/20170314005.html>

Organization for Cross-regional Coordinator of Transmission Operators Japan (OCCTO), (2017), The status of changing suppliers, as of April 30, 2017, <https://www.occto.or.jp/system/riyoujoukyou/170512_swsys_riyou.html>

Pasqualetti, M. J., (2011), Opposing wind energy landscapes: A search for common cause, Annals of the Association of American Geographers, 101(4), pp.907–917

REN21, (2016), Global Status Report 2016, <http://www.ren21.net/wp-content/uploads/2016/10/REN21_GSR2016_FullReport_en_11.pdf>

Renewable Energy World, (2015), Japan passes FIT peak now <http://www.renewableenergyworld.com/articles/2015/11/japan-passes-fit-peak-now-what-for-87-gw-re-queue-2030-energy-mix.html>

SPLASH, (2005), Best practices guide for small hydro, project report funded in part by the European Commission ALTERMER programme (1998-2002), <http://www.energie-cites.eu/IMG/pdf/splash_best_practice_guide_en.pdf>

SUIRYOKU.COM, SHP Gallery, <http://www.suiryoku.com/gallery/gallery.html>

Suwa, A., (2009a), Soft energy paths in Japan: a backcasting approach to energy planning, Climate Policy, 9 (2009) 185–206 doi: 10.3763/cpol.2007.0322

Suwa, A., (2009b), How Things Work: Micro Hydroelectricity in Japan, OurWorld, United Nations University portal: <https://ourworld.unu.edu/en/rice-water-power-micro-hydroelectricity-in-japan?mid=5213044>

Suwa, A., Jupesta, J., (2012), Policy Innovation for Technology Diffusion: through a case with Japanese Renewable Energy Public Support Programs, Sustainability Science 7(2), DOI: 10.1007/s11625-012-0175-3

Suwa, A., (2016), Renewable Energy Policy within the Climate Context: Learning from the US Solar Access and Right (in Japanese), Review of environmental Economics and Policy Studies, Vol. 9, No. 1

Takahashi, H., (2011), Market Liberalization of Electric Utilities: Why do we need unbundling of power grid after 3.11?, Nihon Keizai Shinbunsha, Tokyo

UNIDO (2016), World Small Hydropower Development Report 2016 <http://www.smallhydroworld.org/fileadmin/user_upload/pdf/2016/WSHPDR_2016_full_report.pdf>

Walker, G., Hunter, S., Devine-Wright, P., Evans, B., Fay, H., (2007), Harnessing community energies: explaining and evaluating community-based localism in renewable energy policy in the UK, Global Environment Politics.7(2), pp 64-82, ISSN 1626-3800