Renewable Energy Use in Japan: National Policy, Critical Response and Alternative Paradigms

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Declaration

I declare that this study is my own account of my research.

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Abstract

Recent national renewable energy policy in Japan is informed by a very real, severe and continuing energy security crisis and by the perceived need for a national response to global warming. The recent history of this policy response is described, as are the socio-political and economic circumstances which have shaped and constrained it. The substance of the critiques from significant RE energy generator and advocacy groups in light of perceived policy failures is provided. These critiques are based on the research evidence these groups have produced which demonstrates how the full range of RE resources available in Japan have been under-emphasized or ignored. These same groups and sub-national organizations have undertaken alternative RE policy development and implementation strategies which underpin a larger concern for the long-term sustainability of Japanese society. Several of the more striking of these alternatives, the Tδkyδ-Regional Network, the Energy in My Yard concept, and Sustainability Zones, are described.

Table of Contents

Figures

Tables

Acronyms and Abbreviations

ANRE	Agency for Natural Resources and Energy
EIMY	Energy in My Yard
FIT	Feed-In-Tariff
ISEP	Institute for Sustainable Energy Policies
METI	Ministry of Economy, Trade and Industry
MITI	Ministry of International Trade and Industry (pre-dates METI)
NEDO	New Energy and Industrial Technology Development Organization
RE	Renewable energy
RJSR	The Renewables Japan Status Report
RPS	Renewable Portfolio Standard
SZ	Sustainability Zone
TMG	Tõkyõ Metropolitan Government

Note on Japanese Naming Conventions

Family Names

When the names of Japanese individuals are cited in this study, the name order will follow the Japanese convention of placing the family name first and the given name second. For example:

Iida Tetsunari

Where **Iida** is the family name and **Tetsunari** is the given name.

Place names

The Japanese language is made up of sounds of equal length. When two of the same sounds are placed next to each other, the sound is doubled in length. As place names cited in this study are written using the English alphabet, the doubling is captured using the following convention:

Without convention	With convention
to (single length)	to
to (double length)	tō

Examples:

Without convention	With convention
Tokyo	Tōkyō
Tohoku	Tōhoku

Japanese Yen/Australian Dollar Exchange Rate

Financial data in this study are shown in Japanese Yen (¥). At the time of submission the following rate of exchange was current:

1 $AUS = ¥80.7691

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Research Focus and Potential Contribution

Over recent years, the Japanese government has introduced several measures to encourage the integration of non-nuclear renewable energy technologies into the national electricity supply system. According to government policy statements, these measures have been driven by three imperatives: the need to increase Japan's energy security in the face of a volatile and increasingly constrained world fossil fuel market; a need to be seen to act to constrain carbon emissions in the face of global warming; and, a need to provide a renewable energy (RE) 'stopgap' given the long lead time necessary for bringing new nuclear power generating capacity online. In recent times, the main measures have included various subsidies, a Renewable Energy Portfolio Standard (RPS) and a renewable energy feed-in-tariff (FIT).

The introduction of these schemes in Japan, as one would expect, has not occurred in a politically neutral environment. Indeed, their introduction has been bitterly and consistently contested by the 10 major private electricity utilities who view the government mandated access of non-nuclear renewables to the grid as undermining their financial and technical control. They find a historically strong ally in the Ministry for Economy, Trade and Industry (METI), the ministry responsible for energy policy. The industry-METI nexus is claimed by RE generators and advocacy groups to be responsible for the dilution of most RE policy.

Research by RE advocacy groups shows quite clearly that Japan has an abundance of RE resources that, with adequate investment supported by long-term policy certainty from central government, could make a significant contribution to ensuring Japan's energy security and sustainability. The same research also shows how national policy and other issues have so far stunted this contribution. These same groups offer a range of RE policy and implementation alternatives that present real sustainability options, many of them associated with maintaining or re-building the

social, cultural as well as economic sustainability of many rural and remote communities in Japan that have undergone economic and social decline.

Four fundamental research questions control the focus of this study:

What have been the key strategic drivers in Japan for the incorporation of RE energy policies at the national level?

What are the political and socio-economic barriers that have prevented national RE policies from being anything other than intermittent, short term and thus only partially successful?

What are the findings and general conclusions emanating from the research of advocacy groups concerning the status and potential for RE in Japan in light of national policy inadequacy?

What sub-national and alternative RE energy policies have been proposed and implemented, particularly those that address the issue of regional and rural sustainability?

This study has a number of potential contributions to make:

- Firstly, it will hopefully add in a small way to the literature on RE in Japan. In particular, it will provide a survey of current national RE policy in that country, the socio-economic and political context in which that policy has developed, and the various barriers that have limited its effectiveness.

- Secondly, it will also provide a survey of some significant sub-national RE policy initiatives and implementations that may have escaped full international attention because they have only be described in Japanese. Revealing these activities in some degree will hopefully further dispel any conceptualizations of Japan as a homogeneous political and social entity.

- Finally, in the process of describing the sub-national RE ideas and activities, it is hoped that some of their ideas can find relevance to other settings, particularly to Australia. In particular, it is anticipated that the theory, research and practice associated with the Tδkyδ Metropolitan Government-Regional Network, Energy in My Yard (EIMY) and Sustainability Zones (SZs) in Japan will have something to contribute to further RE policy research and development in this country.

Description of the Research Design

The research associated with this study employed the following methods:

- A desk-top literature survey relying mainly on documents available through the internet. Many of these documents are in Japanese and their analysis involved translations by the author
- A synthesis of knowledge drawn from information found in this literature

Introduction

The Meiji Restoration of 1868 in Japan was a significant turning point in Japanese and global history (Borton 1970; Beasley 1973; Dower 1975). In a very short time, a small band of autocratic and powerful leaders transformed Japan from a feudal backwater to an imperial power built on the rapid industrialization of all sectors of the economy. The triggers for these momentous social, economic and political events were complex and dynamic but the change was particularly significant in national security and energy terms. From the perspective of those who led the Restoration movement , industrialization would make it possible to re-fit the country's defence systems using mechanical and organisational technologies imported from Britain, Germany, France and the US. But industrialization could only occur with adequate and secure access to fossil fuel energy sources (Mayo 1970).

The feudal energy system prior to the 1800s was predominantly biomass driven. But the basis and fundamental pre-requisite for the new economy would now need to be an ever-increasing dependence on fossil fuels (Õishi & Miyamoto 1975). At first, Japan's internal coal resources were able to meet this demand but as time went on, and as imperialistic ambitions grew, external sources of fossil fuels became more and more significant. At the same time, Japan's coal resources were depleting and increasingly difficult to obtain. Ultimately, overseas sources of coal and then oil, would become the main drivers of industrial society, even with the advent of nuclear power. And with this increased overseas dependence came an increasing sense of unease in Japan about energy and national security. Japan's wartime activity and its post-war diplomacy efforts were, and still are, framed within an integrated policy effort to secure fossil fuel resources (including nuclear fuels). It is also important to note that Japan's political and bureaucratic elites, as well as the very powerful industrial sector, are wedded to this policy cause, almost to the exclusion of all other

energy policy alternatives except energy efficiency (Iida 2007). It is in this context that national renewable energy (RE) policy in Japan must be evaluated and understood.

At the same time, there are many other (but less powerful) voices in Japan that have consistently called for a new approach to energy security that favours the maximum exploitation of all RE resources. Many of these views take into account Japan's history of, and capacity for, world-class technical innovation and the simple fact that Japan has a large range of RE resources readily available for exploitation. Taken together, this would indicate an as-yet mostly latent ability to build an advanced and integrated RE system which goes much further than current policy constraints allow. The integration of advanced technology, more adventurous policy frameworks and local implementation innovations (of which there are many) would have the effect of lessening Japan's dependence on external sources of fossil fuels and also prompt a revitalization of local communities, particularly those in rural areas.

This study has two major and consecutive themes. The first theme describes Japan's national policy history and current status in regard to RE. Apart from describing the general policy frameworks (such as the Renewable Portfolio Standard and the current feed-in tariff) that have developed and changed since the twin oil shocks of the 1970s, it will also provide an overview of those political and social forces that have tended to obstruct the full promotion and exploitation of RE resources (and the social systems that would make this possible). In addition, it will also provide an evaluation of Japan's extant RE resources by type, how they have individually been hampered by successive national policy regimes, and their potential, given full and coherent exploitation.

The second theme describes a range of policy and implementation alternatives which have emerged in Japan to further disseminate the use of RE in Japanese

society, particularly those designed for regional and remote areas. Those to be described are the Tδkyδ Metropolitan Government-Regional Network, the Energy in My Yard (EIMY) concept, and Sustainability Zones (SZs). These approaches deal in one way or another with the highly imbalanced relationship between the highly-leveraged energy systems of Japan's mega-cities such as Tδkyδ and Õsaka and the often impoverished societies in rural Japan, particular those in the north of the country.

Both themes concentrate on policies that one way or another are designed to encourage the greater uptake and use of RE in Japan. This focus will of necessity exclude a discussion of RE technological innovation and innovation policy, except in a limited and tangential way. It will also exclude a discussion of biofuels for transportation. RE technical innovation and RE for transportation are, of course, integral to a holistic understanding of RE policy systems, both in Japan and world-wide. However, and unfortunately, this study has only space for the RE usage part of the policy jigsaw.

The Current Energy Position in Japan

It is significant that nearly all Japanese government documents relating to energy in particular and the Japanese economy in general are prefaced with some stark sentences about Japan's fundamental energy predicament. The following, from the (Japan) Basic Energy Plan, 2010 (METI, 2010) is representative:

> "Japan is a country almost totally dependent in external sources of energy and other resources. Japan's survival thus depends on the stable supply of these resources" (author's translation).

The statistics confirm this view. If the supply of uranium from overseas is artificially excluded, then Japan must satisfy 83% its current primary energy supplies from

overseas sources. As Figure 1 below indicates, domestic primary energy supply accounts for just under 17% of the total.

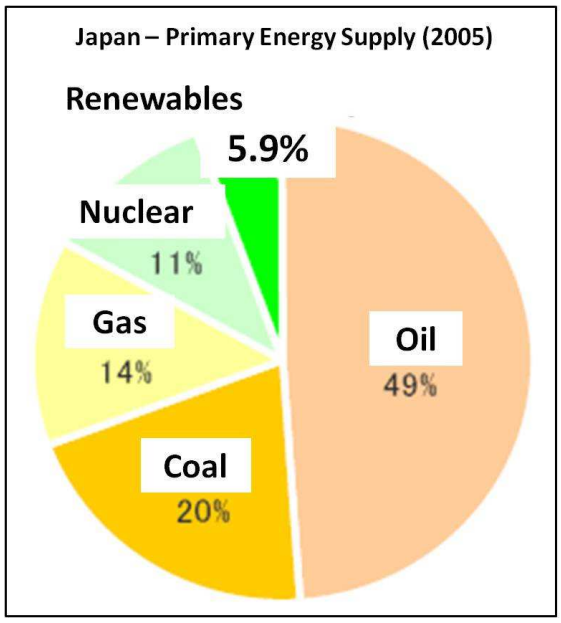

Figure 1: Primary energy sources in Japan
(Adapted from METI n.d.)

The renewable component of 5.9% is accounted for mainly by electricity generation from large hydro and waste incineration. If large hydro is discounted, then the resulting contribution from RE resources was just 3% by the end of financial year 2008 (JREPP 2010). This amounts to just a 1% increase in RE primary energy supply since 1990.

From these crude statistics two preliminary observations can be drawn. The first is that the Japanese socio-economic system is indeed deeply dependent on overseas supplies of primary energy. The second is that the true RE contribution appears to be relatively insignificant. And it is around these two observations that a subsequent description of RE policy developments in Japan can be drawn. However, it is acknowledged that energy policy developments do not take place in a socio-economic and political vacuum. It is therefore important to preface the main body of this study with a brief description of some of the more conspicuous elements of the

Japanese context that impact directly and indirectly on the course of RE policy in that country.

The Economic and Political Context

It is impossible to evaluate the progress and effectiveness of Japanese RE policy development without paying some attention to the political and economic difficulties that have beset Japan since the early 1990s. What follows is a simplification: given the focus of this study, it is impossible to investigate, evaluate and do justice to the Japanese economic and political context in anything more than a cursory way. Having said this, there are two major components of the Japanese system that are worthy of note: the continuing and deep debt crisis which stretches the capacity of the Japanese government to adequately fund public policy initiatives; and the instability and effeteness of successive and often short-lived governments plagued by internal divisions, corruption and weakness in the face of bureaucratic and interest group power.

The Japanese debt crisis is profound. De Wit (2009) states that Japanese debt is now almost twice the OECD average and is expected (at the time of De Wit's writing) to move to 250% of the OECD average. To put this in perspective, it is 113 per cent in Greece, 50 per cent in Spain, and 69 per cent in the United States (Globe and Mail 2010). Debt is not just a problem for the central government; smaller, local governments are in worse straits, particularly those in rural and remote areas where populations and economies have been in decline through migration of the young to urban centres and an advanced aging population. And it is the aging population that is the dynamic driving declines in tax revenue against increasing levels of welfare spending.

Tax revenue in 2010 is projected to be approximately ¥40 trillion against a general budget outlay of ¥90 trillion. But tax revenues are projected to decline further in the short- to mid-term with social security spending expected to increase by ¥1-trillion every year (Globe and Mail ibid). Adding-in the recent phenomenon of a high-value Japanese Yen which reduces Japan's capacity to export, then it becomes clear that the Japanese national ability to fund not just RE but any policy initiative is considerably hamstrung. This incapacity is exacerbated by a political system that is ineffective and effete in the face of powerful industry lobby groups and their allies in the pivotal bureaucracies of state.

The Japanese system of real government is characterised by a very strong collaboration between its leading bureaucracies and powerful industrial groupings (Johnson 1995). Japan's leading bureaucracies play a very significant part in developing polices that are consistent with a value-added, growth model of economic development worked in conjunction with industry and other powerful groupings in Japanese society. The power of the bureaucracies in regard to policy formation is held relative to the lack of power of politicians and political parties, in spite of political attempts to change that equation. The political parties themselves are very unstable, torn by internal factionalism and often tainted with accusations of corruption, real or not. The relatively new administration of the Democratic Party of Japan (DPJ), which came to power in 2009, is not immune from this behaviour and its early positive statements concerning action on climate change and RE in the process of implementing a new vision for Japanese society must be viewed as fundamentally rhetorical. Real power remains in the bureaucracy-industry nexus and substantive energy policy developments must be understood in that context.

National Renewable Energy Policy

Given this socio-economic and political backdrop, Iida Tetsunari, from the influential Institute for Sustainable Energy Policies (ISEP), states that national government RE policy has been, unsurprisingly, weak, inconsistent and intermittent (Iida 2009). He believes there is no concerted political will to promote RE in Japan because of the political strength of the regional utilities who, collectively, control a virtual oligopoly of economic and political power at the regional and national level. He contends that energy market liberalisation in Japan, beginning in the late 1990s, has achieved little except to consolidate this power which has a collective market share and grid monopoly of 97.6%. He believes the long-ruling Liberal Democratic Party (LDP) in Japan owed much of its power from its close alignment with this oligopoly, as did the influence of the very powerful Ministry of Economy, Trade and Industry (METI) in delivering policies and regulations consistent with oligopoly interest; a bureaucracy-industry partnership strengthened by so-called 'amakudari' or 'descent from heaven' arrangements whereby 'retiring' chief bureaucrats take up positions on utility and other leading industrial boards (Johnson 1995).

Iida (2007) also points out that the Democratic Party of Japan (DPJ), now in government, is also strongly influenced by these same organisations, but this time through the major utility unions that view policy efforts to promote RE as having the potential to dilute their employment security (although their rhetoric is more to do with safety and grid stability issues). This is not to suggest that the utilities have rejected RE as a contribution to Japan's energy needs outright: rather, their practices in relation to RE have been largely successful attempts to control policy via a close relationship with METI, the co-opting of political parties in power and paternalistic public relations. A brief historical overview of these practices makes the point.

Iida (ibid) states that the 10 regional utilities began flirting with RE between 1992-8 with the commencement of a voluntary net-metering program restricted to solar PV and wind power. Iida claims this was a paternalistic strategy motivated more by 'green washing' than a concern to transform the energy system in Japan to a more substantial sustainable footing. In any event, some local governments took their cue from this strategy and began to support local wind power projects, with a consequent boost to the wind power industry. These policy initiatives and growing RE market share went beyond what the utilities were willing to bear and, at the beginning of 1998, they began to raise issues of RE intermittency and resultant grid instabilities. The utilities scrapped their voluntary net-metering schemes and instead introduced a 15-year fixed price program for wind at very low purchase rates. Paradoxically, this didn't have the desired effect (of dampening the enthusiasm for wind energy and RE in general): although the prices offered were poor, the policy actually mitigated the greater concern of (wind power) project risk and the 'wind bubble' continued. Caught wrong-footed, the utilities changed strategy and turned grid instability into a major national issue through their close relationships with METI and the LDP. Iida believes that it was as a result of these efforts that the so-called Renewable Portfolio Standard (RPS) Law was introduced in 2003.

The Renewable Portfolio Standard (RPS) Law

The RPS Law (more specifically, the Special Measures Law Concerning the Use of New Energy by Electric Utilities) was promulgated on the 7th June, 2002 (ANRE 2003). The main electricity utilities were now obliged to acquire and retail a proportion of their supply from RE sources. The aim of the Law was, ostensibly, to enhance the stability of energy supply, contribute to environmental conservation and contribute to the development of the Japanese economy. The introduction of the RPS signaled an apparent willingness by government to expand its range of RE energy types of interest to include solar generation, wind generation, biomass

generation, medium- and small-sized hydro generation (generators up to 1MW capacity), and geothermal generation. In implementing the Law, METI established annual targets of utilization of electricity from this so-called 'New Energy' by electric retailers over an eight-year period (2003-2010). A target was set for 12TWh by 2010 which would be equivalent of 1.35% of the national energy supply. The target schedule is shown in Table 1 below.

Fiscal year	2003	2004	2005	2006	2007	2008	2009	2010
TWh	7.32	7.66	8.00	8.34	8.67	9.27	10.33	12.20

Table 1: Target schedule for the RPS (ANRE, 2003)

Retail utilities could choose a possible mix of three strategies to meet their obligations. They were left to determine the most appropriate mix based on considerations unique to their region, infrastructure and economic position. The possibilities were as follows:

i. Self-generation of so-called 'New Energy'
ii. Purchasing New Energy from another party
iii. Purchasing an 'Applicable Amount of New Energy Electricity' entry from another party

The 'Applicable Amount of New Energy Electricity' (AANEE) was the term used to describe an amount of New Energy electricity recorded in an electronic current account as the amount having been generated and supplied by an METI-accredited New Energy facility. Applications for AANEEs took place on a quarterly basis with applications coming from either New Energy generators or electricity retailers with a submission to METI. On receipt of a valid submission, METI added a unique deposit record to the AANEE accounts. Deposits were recorded in units of 1MWh. AANEE units were valid for a period of two years (the year of deposit and a contentious 'banking' year). Once recorded, AANEE units could then be sold.

The critics of the RPS scheme pointed out that the 1.35% obligation and the short time scale would hinder the further investment and uptake of RE. In any event, the banking system made it virtually impossible for RE generators to gain access to the scheme in its later stages. For example, in 2008 the total potential RE energy supply amounted to 7,918GWh while the RPS obligation for the same year stood at 7,465GW. However, a surplus of 6,759GWh had been 'banked' the previous year by energy retailers. The relatively small amount left over to be provided by RE generators provided little certainty of a secure future or the incentive for others to invest in the RE industry generally (JREPP 2010). Having effectively achieved relatively little for RE generators, the RPS duly finished in 2010 and was replaced by an initial version of a feed-in tariff that has proved to be no less contentious and ineffective from the perspective of the RE industry and its promoters.

The initial renewable energy feed-in tariff (FIT)

The initial (and still extant) feed-in tariff came into effect in November, 2009. Under this scheme, the national government determines net premium rates to be paid by utilities to solar PV generators (which includes households, companies and public facilities) to help them recover the initial cost of installing solar power systems. The electrical utilities then have the authority to pass those costs along to consumers. The net tariff system was designed to run for 10 years with specific tariff rates to be reviewed annually. The starting year tariffs were established at ¥48/kWh (based an installed capacity of up to 10kW) for domestic suppliers and ¥24/kWh for other facilities (with a slight variation for annexed buildings). These prices are twice the existing domestic purchase rate for domestic users (METI n.d.)

Although the FIT has some positive features, such as the reduction in the net tariff rate year-on-year (known as 'degression') that ostensibly provides an incentive for industry and generators to deploy as quickly as possible, its most obvious failing is

its restriction to solar PV. As De Wit points out (2009), the economic arguments that were put up by the utilities that justified the exclusion of other RE technologies and resources do not take into account the external costs associated with climate change, national security, or the health care costs associated with greenhouse gas and other fossil fuel emissions. Nor do they take into account the subsidies and tax breaks regularly afforded the fossil fuel industry in Japan. As an example, the naphtha industry alone receives ¥3.6 trillion in subsidies (De Witt ibid). And finally, the scheme is again very short term (10 years) which provides no certainty to the RE industry. According to De Wit, the reasons for the very limited scope of the FIT are not difficult to find.

De Wit claims that the restriction of the FIT to solar PV can be accounted for by the consistent METI bureaucratic position of privileging the nuclear industry as the only really viable and economically sensible 'New Energy' option for Japan. He cites the head of the Agency for Natural Resources and Energy (ANRE), a sub-bureaucracy of METI, as saying that nuclear power is all that Japan needs in the way of renewables. The choice of solar PV as the only RE type to be eligible for the scheme is due to an historical close affinity with this technology by METI and its even more powerful predecessor, the Ministry for International Trade and Industry (MITI). On the other hand, the resistance of the utilities to a more inclusive and broad scheme is, as indicated previously, almost a given in the Japanese energy policy-setting context. They have made it consistently clear that any policy directly or indirectly associated with the expansion of RE in Japan is, in their view, not clearly thought out, that the 'numbers do not add up', is inefficient, will damage the Japanese economy irreparably (especially in the face of increased economic competition from China and India), and lead to a massive and unfair impost on their customers (FEPC 2010). Although providing a much needed boost to the solar PV

industry in Japan, the existing FIT scheme is clearly deficient from the point of view of encouraging a more complete and integrated adoption of all RE resources in Japan in the name of energy security. The newly-elected DPJ government (2009) has initiated a re-evaluation of the existing FIT as an integral part of its general approach to energy policy thinking and there are expectations from RE promoters that this will involve a more inclusive approach to RE resources.

The re-evaluation of the renewable energy feed-in tariff (FIT)

Government investigations into a revised feed-in tariff began on November 6, 2009, with the formation of Project Team made up of six academics under the leadership of the Agency for Natural Resources and Energy (ANRE), a sub-bureaucracy of METI (ANRE 2009). The investigation is still under way with a calendar of hearings to elicit views about the necessity for a revision as well as its possible design and impact. Input is being received from all stakeholders including the electric utilities, RE technology manufacturers, RE generators, utility trade unions, consumer groups and RE advocacy groups. Much of the evidence given so far has been predictable, with utilities saying it should be properly costed (FEPC 2010), unions saying it should not undermine safety and grid stability (METI 2009a), consumers saying that the burden on consumers should be minimal (METI 2009b) and the RE industry and its advocates saying that it's about time (METI 2009c). The general push from RE advocacy groups has been for a more inclusive system that incorporates all of the possible and potential generation types in Japan. Most are also calling for a gross rather than the existing net tariff. The outcome is not clear yet but it is essential to note that these deliberations are taking place against a national discussion about global warming which may impact on the final revamped FIT policy structure.

The global warming policy context

JREPP points out that DPJ policy statements continue recent concerns about global warming (JREPP 2010). Prior to the election of the DPJ, the then incumbent Liberal Democratic Party's (LDP) policy statements about Japan's response to global warming arising from the G8 Summit held in Japan in 2008 were integral to the first formulation of the FIT. The DPJ manifesto continued this trend, calling for a 25% reduction in greenhouse gas emissions by 2020 based on 1990 levels (subsequently incorporated into the Provisional Basic Law for Measures against Global Warming, 2010). The manifesto also called for a reformulated FIT to incorporate a broader range of RE resources and with an overall desire to bring the RE contribution to primary energy production to 10%. As encouraging as these calls may sound, they should be considered in relation to the sentiments expressed in the latest review of another major energy policy guiding document, the Basic Energy Plan.

Reviews of the Basic Energy Plan

In 2010 the DPJ launched the third review of the Basic Energy Plan (METI 2010). Basic Energy Plans are a requirement of the Basic Energy Law (promulgated June, 2002), with the first Basic Energy Plan being delivered in October, 2003. Basic Energy Plans are the base building block of all energy policy initiatives in Japan and, although often rhetorical in nature, do give some idea of the government's overall thinking on energy issues. The Basic Energy Law requires that Basic Energy Plans are reviewed at least every three years.

In the first review in 2007, the then LDP government first reiterated the traditional verity concerning Japan's profound energy security problems. In the name of continuity (and legal obligation) it also confirmed the three basic principles of energy policy established in the Basic Energy Law, namely: the maintenance of stable

energy supplies; the appropriateness of energy in relation to the environment; and, the activation of market principles in achieving its energy security goals. In addition to these basic principles, the second review (2008) also concentrated on three points relating to some significant issues of the day: that the international supplies of energy are under increased stress due to political instability in the Middle East, oil price speculation and price uncertainty, terrorism and oil nationalism; that Japan has an obligation to deal with global warming, including a commitment to reduce greenhouse gas emissions; and that in response to the energy and environmental issues identified above, economic growth based on new, 'green' technologies would provide the motive force for a Japanese economic resurgence. It was the recognition of these new realities and concerns, combined with a new social vision, that promoted a sense of expectation regarding innovative RE policies. However, the fine print was less than motivational for those concerned with long-term energy sustainability over-and-above business-as-usual market survival.

The second review noted that 90% of Japan's greenhouse gas emissions come from energy use and that a collaborative effort between governments, industry and citizens would be needed to achieve these reductions underpinned by a technological revolution. In this paradigm, the green technologies thought necessary to drive this revolution were conceived to be smart grids, nuclear power, energy reduction and energy efficiency technologies. Japan's current prowess in these technologies (with smart grids being debatable), would hold the key to future global market competitiveness. Laudable as these technologies are (admitting the contentiousness of nuclear power), the impression gained from reading this version of the Plan and related policy documents is that this whole approach has more to do with Japan regaining its lost standing as a leading industrial nation rather than any change of fundamental mind set concerning the relationship between finite fossil

fuels and social sustainability. This is confirmed by a Japanese cabinet determination of December, 2009, for a new growth strategy called the Fundamental Direction that would re-vision Japan as an, 'Environment and Energy Major Power' (Japan Government 2010, p.15). In spite of its almost vacuous rhetorical flourishes, the third review in 2010 only re-affirms this position. It provides no compelling reason to believe that the government is committed to a coherent, inclusive long-term support program for RE.

The Current Status of RE in Japan

Although the utilities have voiced some (but not total) opposition to the RPS and FIT schemes, METI appears to hold the more dominant hand in policy development and application. Iida, quoted in Engler (2008), suggests that METI has been able to do this because of a culture of 'energy conservatism', 'command-and-control' energy policy leadership, the promotion and maintenance of the nuclear 'myth' and simple pork-barrelling. More tellingly, Iida suggests that the RPS and similar minimalist RE energy policies were and are mechanisms to mitigate political risk rather than exploit imaginative and sustainable energy opportunities. In spite of some advances in the promotion of RE use, the overall resistance from utilities and the overarching policy constraint and intermittency on RE has been profound, as indicated in the first comprehensive non-government attempt to evaluate the status of RE in Japan.

The Renewables Japan Status Report (RJSR) was published in 2010 by the Japan Renewable Energy Policy Platform (JREPP 2010). JREPP is a voluntary association comprised of RE related organisations including the Japanese Association for Water Energy Recovery, the Japanese Wind Power Association (JWPA), the Wind Power Developer Association (WPDA), the Solar System Development Association, the Japan Geothermal Developers' Council, the Geothermal Research Society of Japan, the Research Committee on Climate Change Measures (Architectural Institute of

Japan), the Japan Wood Pellet Association and the Institute for Sustainable Energy Policies (ISEP). JREPP was established in 2008 and aims to encourage sustainable renewable energy policies for the development of a low carbon society by providing policy analysis and advice on RE.

The structure of the RJSR follows that of the world RE white paper, the initial Global Status Report which was first published in 2005 at the Beijing International Conference on Renewable Energy (REN21 2005). The RJSR provides data on the current status of a range of RE resources and technologies in Japan but it is also a vehicle for a major critique of national government policies, past and present. In particular, it targets the RPS and the first formulation of the FIT as major policy failures due to their restrictiveness and consequent ineffectiveness. Against these national policy developments, the RJSR scans activities and initiatives occurring in the non-government sector (private industry, local governments, non-profit organisations and communities). These include investigations into the use of smart grids (stunted and stalled by regulation and retail utility opposition), the so-called 'mega-solar' installations promoted by the major energy companies (which, though contributing to overall RE capacity, reduce the need for these same companies under current policy arrangements to purchase RE power from outside organisations), the creation of large wind farms (which also meet resistance from all sectors of society as well as being caught-up in a tangled web of various and non-integrated regulatory frameworks), the expansion of the Green Power Certification system and various carbon trading schemes (which currently lack harmonisation and the backing of national legislation). The RJSR is quite clear: interesting and creative as many of these initiatives are, they cannot be fully realised unless adequate systems of financial support and socio-economic systems encouraging the full participation of communities and citizens are created.

Electricity from renewable energy

As of May 2008, the RJSR estimated the RE electricity generation capacity in Japan to be just over 10,000MW. Of this, 60% was accounted from small hydro (under 10,000kW) and biomass (which includes a significant proportion from contentious waste power generation). 37% was due to solar PV and wind power. Figure 2 below shows the cumulative RE power capacity in Japan in 2008 while Figure 3 shows estimated generation (again for 2008).

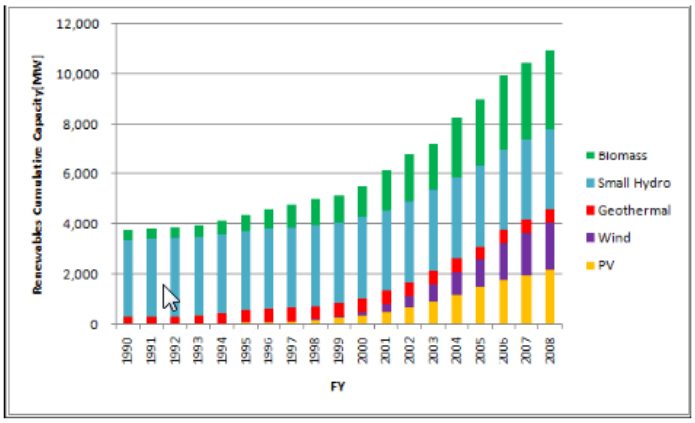

Figure 2: Cumulative RE power capacity in Japan, 2008
(From JREPP 2010, p.3)

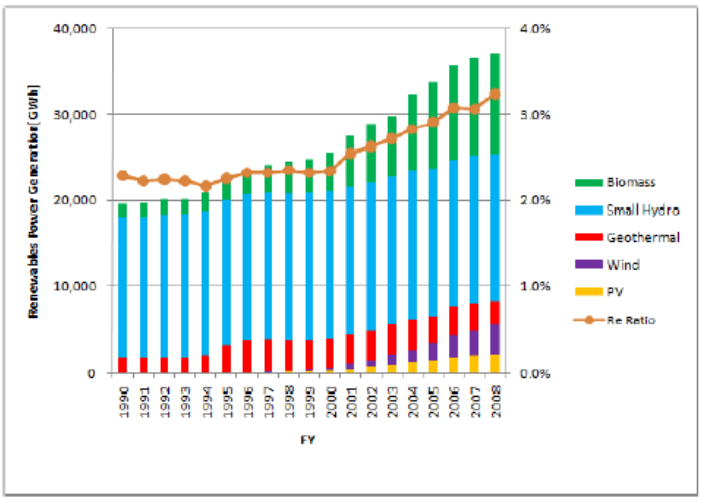

Figure 3: Estimated power generation from RE (GWh)
(From JREPP 2010, p.3)

Electricity generation from solar PV

According to the RJSR, the overall growth rate in the uptake and use of solar PV continues in spite of the on again-off again intermittent policy support from successive national governments. Solar PV is the RE technology favoured most by METI and the utilities and it was a flagship industry until subsidies were terminated in 2005. Japan subsequently lost its position as the premier international solar PV manufacturing nation. The reintroduction of subsidies in 2009 (Tsukimori 2008) and the favourable treatment given to solar PV in the initial feed-in tariff scheme has, according to JREPP (2010), reintroduced some confidence into this RE sector.

Electricity generation from wind power

Although wind power generation started in 1980, it did not gain major momentum until the introduction of larger turbines (1000kW) after 1998. As of 2008, a total of 1,517 wind turbines have been installed with a combined capacity of 1,854MW. Most installations are in rural regions to the north of Japan (Hokkaidð and Tðhoku) with some in the far south. These regions are marked by reasonable quality wind regimes. In spite of these resources, considerable limits have been placed on wind generators in gaining access to the regional grids.

These limitations are considerable. The limited obligation placed on utilities through the RPS resulted in a very constrained bidding system. This compelled applicants to either bid or draw lots for the privilege of supplying electricity to a regional utility (JREPP 2010). Other problems include METI and industry favouring nuclear and solar PV as the preferred technology options (with the nuclear industry enjoying very high subsidies and producing 30-40% of Japan's electric power), high global turbine demand (many Japanese turbines are sourced overseas), the insistence of utilities for wind generators to install battery backup (in the name of grid stability, which adds to costs and reduces competiveness), amendments to the national building

code in 2008 which severely constrains the selection of turbine and wind farm sites, and problems associated with the development of off-shore wind farms due to geological issues and the resistance of a powerful fishing lobby (Engler 2008). JREPP also notes that perennial problems such as controversy over bird strikes, noise and aesthetics will also need to be resolved (JREPP 2010). Against these odds, it is perhaps not surprising that newly installed wind power was just 139 megawatts in 2007 (Engler 2008). Figure 4 shows the existing and added wind power generation capacity in Japan up to and including 2008.

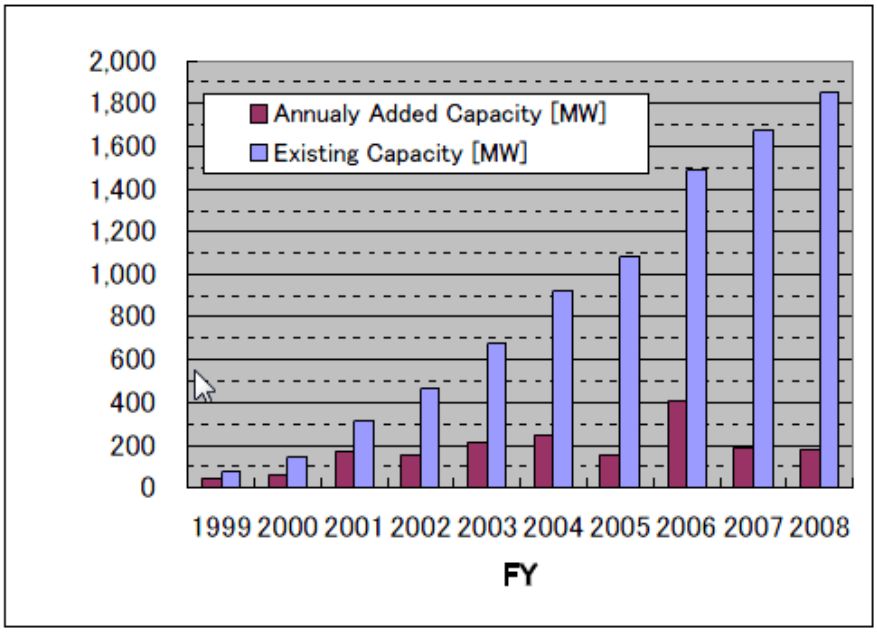

Figure 4: Wind power capacity, added and existing (MW)
(From JREPP 2010, p.4)

Electricity generation from small hydro power

Japan is a predominantly mountainous country with many short but fast-flowing rivers and streams. This resource is perhaps ideal for small hydropower installations. Small hydro capacity in Japan is defined as 10,000kW or less. At the end of the fiscal year 2008 in Japan, small hydropower capacity accounted for 6.6% of total hydropower capacity, made up of 1198 installations with a combined capacity of 3,225MW. In spite of the potential, small scale hydro has been

fundamentally neglected in national policy: most of the existing capacity was installed prior to 1990 with minimal installation since (only 127 installations with a total capacity of 166MW).

Electricity generation from geothermal power

Given the very large potential for geothermal power generation, it is initially surprising that Japan's abundant geothermal resources have not been positioned as a major component in national RE policy strategy. Be that as it may, the history of geothermal energy policy is bleak. Although experiments with geothermal power for electricity generation have a significant history in Japan (the first plant was established in 1966), current capacity remains stuck at about 550MW. The oil shocks in the 1970s stimulated some activity, as did the various subsidies available to the industry after 1990. However, there has been no further investment since 1999 when the last plant was built on Hachijð island (part of Tðkyð). Geothermal power was dropped from consideration with the passing of the Law concerning Promotion of the Use of New Energy in 1997. The Energy Supply and Demand Outlook of 2001 assumed the growth of geothermal energy to be zero. The final coup de grace for geothermal energy at that time was delivered by METI which cut the entire budget for geothermal research apart from an allocation toward a promotional survey which was deemed a purely political move and so without major policy merit (Niitsuma 2002b, p.1).

Although electricity generation from geothermal emerged again in the RPS, the current policy has been extremely biased toward the development of 50,000 kW class power plants to be connected to the national grid. Not surprisingly, the period 1999-2009 is known as the "lost decade" as far as geothermal power is concerned (JREPP 2010). Apart from the continuing total lack of government policy and financial support, the industry also suffers from a regulatory framework shambles

and opposition from the culturally-significant and powerful ‘hot springs’ industry in Japan which sees any growth in geothermal energy installations (for electricity generation and heating) as bleeding their resource (Japan Times 2006).

Electricity generation from biomass

Biomass power generation capacity stood at 3,138MW at the end of 2008 (fiscal). This represented an increase of 750% over 1990 levels. The overwhelming majority of this capacity is based on the incineration of general and industrial wastes (55% and 40% respectively) with waste accounting for a total of 95% of biomass energy generation feedstock. Energy production from waste incineration is a contentious issue worldwide with doubts about its environmental value and its sustainability (for example, see Japan Times 2007). Nevertheless, biomass energy from waste incineration was counted under the RPS. Apart from its dubious credentials, JREPP states that the major issue associated with biomass seems to be in finding an effective methodology for measuring and comparing biomass energy resources.

Heat energy

Although solar heating is the most widespread of the RE heating technologies in Japan (followed by geothermal heat and biomass heat from forest resources), JREPP claims there is little statistical data available to evaluate just how these systems have been installed and are being used (JREPP ibid).

Heat from solar

Solar heating installations are in effective decline in Japan with the market reaching a peak in the 1980s. Following shortly after the twin oil shocks, over 800,0000 solar hot water systems (a capacity of 1680MWth) and over 26,000 solar heating systems (a capacity of 17.5MWth) were installed. By 2008 this market had contracted to 10% of its 1980s value, with only 60,000 solar hot water and 4,700 solar heating systems installed. This decline was put down to public perceptions of poor system quality

rather than obstructive government policy and, with system quality improvements, there is an anticipation of a resurgence in the solar heating market in both the domestic and business sector.

Heat from geothermal energy

As mentioned above, hot springs in Japan have been used historically for their purported therapeutic and cultural value. Beyond this, and given the relative ubiquity of the resource, there appears to be a lot scope for extending the use of geothermal heat for pre-heating water and for efficiency gains in building heating and cooling systems, although this is not a current reality.

Heat from biomass

As with all societies that have a significant pre-industrial past, the use of firewood and charcoal in Japan has a long history and cultural associations. However, the RJSR is concerned mostly with the use of biomass in technologically advanced heating systems such as combined heat and power (CHP), large-scale boilers used by paper manufacturers and domestic pellet stoves. Because of the diffuseness and variety of these devices (and because they are mostly employed internally in manufacturing processes), the RJSR finds it difficult to provide any general metrics regarding the total amount of heat energy generated or consumed. Having said this, the increasing promotion and use of pellet stoves, integrated with local forestry initiatives, is an indication that woody biomass may prove to be a significant component of Japan's RE system. As with heat from geothermal, the RJSR's discussion of this resource is to do with future potential use rather than current uptake.

The JREPP 2050 Vision

Against what may be described as relatively weak uptake of all possible RE resources available in Japan, JREPP has also published a RE vision for the year

2050 (JREPP 2008) which puts forward the goal of achieving a 75% reduction in CO_2 emissions by 2050 (on 2000 levels). It clearly believes this is feasible given their assessment of the current availability of RE resources and latent potential for growth. JREPP claims that there is a potential for RE to meet 67% of domestic electricity demand and over 50% of primary energy supply by 2050 given the setting of high targets, long-term political commitment and policy implementation, and the inclusion of all external costs in evaluating all current and future energy supply types. The significant features of this vision are the complete absence of oil and a dramatic reduction in the contribution of nuclear in the final primary energy equation. Figure 5 below shows what proportion of each of the RE resources described above would contribute to this target.

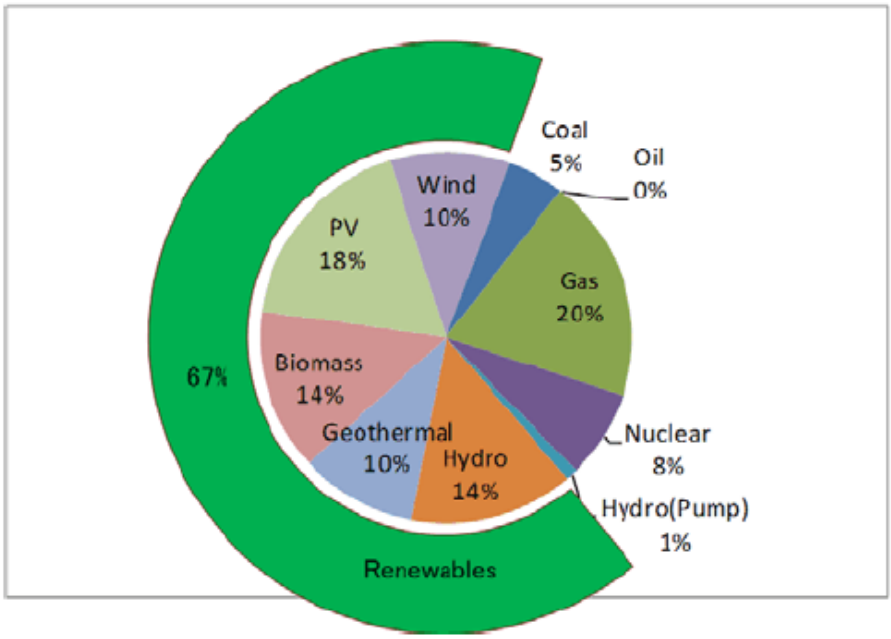

Figure 5: Share of power generation by technologies, 2050
(From JREPP 2010, p.6)

Alternative Paradigms

The discussion so far has described Japan's energy as being in part a failing of the national government in Japan to seriously address long-term social sustainability through the optimal use of available RE resources. As might be expected, these

resources are to be found in mostly rural and regional settings and it was noted that it is in these regions that one aspect of Japan's demographic difficulties lie. As with many countries, including Australia, rural and regional communities are (and have been for some time) in social, cultural and economic decline. This is particularly so in the north of Japan which, as it turns out, has an abundance of RE resources, predominantly wind, biomass and to some extent geothermal. Social migration is to Japan's mega-cities, which conversely are highly dependent on external sources of fossil fuel and nuclear energy, with minimal contributions from RE. Cities are also the main contributors to greenhouse gas emissions, compounding their environmental impact.

The stark dichotomy between rural and city existence has not gone unnoticed by RE advocates in Japan. Some academics, RE non-profit organizations (NPOs) and elements of the RE industry are all informed by larger concepts of sustainability and perhaps a more realistic understanding of Japan's energy and demographic predicament. The result has been a number of sub-national policy proposals and paradigms for the more-effective use of RE within a sustainability framework. Many of these have been translated into action, albeit within the constraints imposed by the limitations of national policy. It has to be said that some of them have also been implemented in conjunction with regional utilities, often conceived as the RE advocates' nemesis, although these arrangements are often born of necessity rather than desire. They include RE cooperatives, Green Power Certificates, remote island systems and the construction of comprehensive municipality RE plans (often with the assistance of government funding). All these are worthy of note and further study, but what follows is a description of three policy paradigms which directly address the issues of energy security (through the expanded use of RE) and the demographic plight afflicting rural and remote communities. Each of the three see

merit in relating synergistically the needs of the countryside with the needs of the city. The three policy paradigms are the Tδkyδ-Regional Network, Energy in My Yard (EIMY) and Sustainability Zones (SZs).

The Tδkyδ-Regional Network

There are many cities and localities in Japan that have adopted RE plans and policies, mostly in the name of global warming mitigation and not necessarily or directly as a response to energy security issues (see particularly Iida City 2004 & Hachinohe City 2007). Tδkyδ stands out among these, firstly because of its absolute size: it is an Asian mega-city and the largest city in Japan. It follows that Tδkyδ is Japan's largest consumer of fossil fuels and the largest emitter of greenhouse gases. Tδkyδ also has a controversial governor who appears to have lost faith in central government inaction (Harden, 2008). (The Tδkyδ Metropolitan Government (TMG) has consistently criticised the national government for its poor record on RE and climate change policy, echoing ISEP, JREPP and other RE advocacy groups in labelling these policies inadequate.) And it is Tδkyδ that has developed a comprehensive RE strategy which incorporates a novel framework for connecting the city and rural economies through the procurement of RE to the future economic and social benefit of both parties.

As a major plank in its policy framework, the TMG launched its Renewable Energy Strategy, 2020, in April 2006 (ENS, 2006; TMG 2006a, 2006b). The Strategy aims to increase the city's RE usage to 20% of all energy supplies by 2020. The TMG is aware that, as a city accounting for 10% of the national population, its carbon footprint extends beyond the city's boundaries to industrial and agricultural systems in regional Japan and internationally. There is therefore a perceived moral imperative to reduce emissions. The TMG views its RE Strategy as the logical extension of its Environmental Basic Plan and its Basic Strategy for the Preventing

Global Warming, both launched in 2002. In 2005 the TMG reformed its Environmental Preservation Ordinances and its Global Warming Response Plan Certification System and also strengthened a range of related systems.

In spite of this activity, the TMG has started from an exceptionally low base as far as RE systems and use are concerned. In 2003, Tδkyδ's annual energy consumption was approximately 830,000 TJ, with the proportion contributed by RE standing at about 0.7%. This could be raised to 2.7% if the supply of hydro-electric power to Tδkyδ by the Tδkyδ Electric Power Company (TEPCO) is included. The following table shows the percentage contribution of each RE source in 2003:

RE Source	**%**
Electricity from waste	55.6%
Solar heating	14.0%
Hydro electric	13.1%
Heat from waste	7.8%
Heat difference	4.0%
Electricity from biomass	2.4%
Solar PV	1.8%
Geothermal	0.9%
Wind power	0.5%
Heat from biomass	0.0%
Total	**100%**

Table 2: Proportion of individual RE sources to Tδkyδ's total RE supply (Adapted from TMG 2006b, p.15)

Given this low starting point, TMG's projects for the expanded use of RE are quite comprehensive and extensive and incorporate a full range of behavioural, technical and system-change approaches. Among these is a plan for the expanded use of RE through city-regional network partnerships involving government agencies, industry and NPOs.

The TMG frames the rationale for the establishment of city-regional networks in terms of the city's goal of achieving a 25% reduction in greenhouse emissions by

2020 (2000 as the base year) (TMG 2009). It reasons that to achieve this it must not only dramatically increase its energy consumption from energy efficient sources but also move to ensure greater supplies RE. In order to attain the second goal, and in light of minimal opportunities for the further development of RE resources within the city boundaries, it has established a network agreement with Aomori Prefecture (in the northern Tōhoku region of Japan and with abundant wind and other RE resources). The TMG reasoned that this would not only satisfy TMG's policy goals of greater RE use but also contribute to the economic development of Aomori, one of several prefectures and regions in the north of Japan that has relatively high unemployment and low levels of investment. The agreement with Aomori is for that prefecture to supply Chiyoda-ku (the main business district in Tōkyō) with RE power.

The initial agreement with Aomori has led to further invitations from the TMG to expand the network. The invitations identify the forms in which network participation can be fulfilled. These are:

1. Direct generation of RE (electrical) energy
2. Direct supply of RE
3. Direct use of RE
4. Activities that provide finance for the promotion of the RE Network
5. Activities that promote and integrate all of the above

In 2010, the TMG announced that it had concluded agreements with a further four entities, the prefectures of Iwate, Akita and Yamagata as well as Hokkaidō (TMG 2010). The new framework has the following aims:

1. To establish a greater demand for green energy in city offices, etc. (Tōkyō)
2. To establish a direct grid supply of RE to Tōkyō by parties to the agreement (Hokkaidō, Aomori, Iwate, Akita and Yamagata)

3. To encourage industry, financing bodies and local governments to participate in the network
4. To encourage central government-related agencies and national industry groups to provide finance and RE technical and sales support to network initiatives

Given the recency of this initiative, there is as yet not much in the way of substantive activity with which to judge the effectivenes of this scheme. However, a private relationship established between a new office facilty in central Tδkyδ and wind farms across Japan, including those in Tδhoku, will most likely prove to be the first major success under the TMG's strategy.

Although not as yet officially related to the TMG's City-Regional Network scheme, the potential viability of the arrangement was given significant credence with the development of the New Marunouchi building in central Tδkyδ. The New Marunouchi building (Shin Maru) is owned by the Mitsubishi Estate Co and is located in central Tδkyδ above Tδkyδ station. Nagano (2009) reports that Mistubishi Estate has entered an agreement with the Idemitsu Kδsan Co. to purchase electricity from RE generators in regional Japan and supply the Shin Maru building directly with electric power. The connection will be made by leasing existing grid lines under an arrangement known as a wheeling service which became a possibility under the partial relaxation of grid access and management regulation (Õhashi 2008). The first RE generator to contribute to this arrangement is the Futamata Wind Development Co. in Rokkashδ, Aomori Prefecture (a signatory partner to the TMG-Regional Network). The electricity needs of the Shin Maru building will be fully met through this system and the building owners claim that this will reduce the Shin Maru building's (theoretical) emissions by 20,000 tonnes of CO_2 per annum. Figure 6 below shows a photo montage of the Shin Maru – Rokkashδ Wind Farm concept.

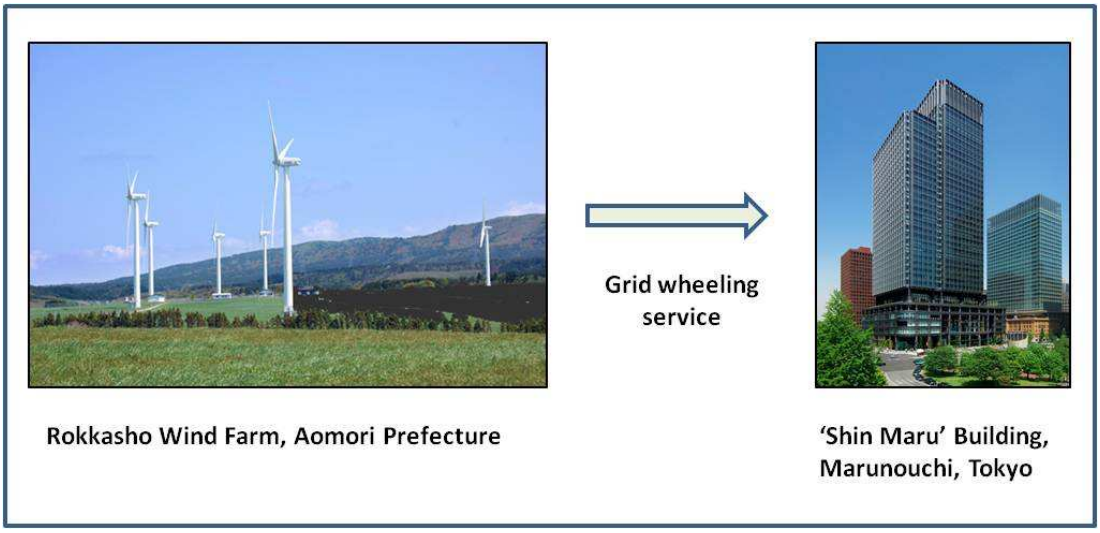

Figure 6: Rokkashδ - Shin Maru wheeling service
(Photo montage adapted from http://greenz.jp/2009/12/19/tokyo_shinmarunouchi_building_renewable_energy/**)**

Bearing in mind Tδkyδ's dependence on a prepondurance of its limited RE supply from controversial waste incinerators, it is significant to mention here that Mitsubishi Estate chose not to purchase the increasingly popular Green Energy Certificates to satisfy its need for 'green energy'. The reasoning was that there was no guarantee that sourcing power through Certificates would ensure truly sustainable and 'clean' power generation. Green Energy Certificates are growing in popularity in Japan (and the TMG is promoting their expanded use in its RE strategy). But Mitsubishi have clearly set an important precedent in opting for a direct connection to what it views a truly 'clean' RE source. Mitsubishi Estate has now approached the TMG to investigate how their specific scheme can form a template for future TMG-Regional Network initiatives (Nagano 2009).

Energy in My Yard (EIMY)

The first framework that has the potential to configure the rural-regional component of an effective city-regional network is Energy in My Yard (EIMY). EIMY is a concept developed by Niitsuma Hiroaki, leader of the Niitsuma Laboratory in the School of Solar and Terrestrial Systems and Energy Sciences at Tδhoku University,

Sendai (Niitsuma 2002a; 2002b; 2003; 2005; 2006). The acronym was conceived as a positive inversion of the negative NIMBY (Not in My Backyard). Although not related initially or directly with the network framework, it nevertheless establishes a set of ideas and practices that fit well with network construction and starts from the same premises.

The EIMY concept is captured in the phrase, 'local energy systems for locals' (Niitsuma, 2003, p.3), and suggests that the most appropriate *local* renewable energy resources should be utilized to the highest degree possible using technical and economic means to promote sustainable *local* social systems (author's italics). What is critical in this concept is that it doesn't reject the need for a national policy approach to RE nor the need for national and regional grids. Rather, it suggests that the current direction of thinking associated with national policy is back-to-front. Instead of top-down RE dissemination policies, Niitsuma argues that policy thinking should start from the resource configuration and the socio-economic needs of specific localities.

Given that a local community will contain a range of renewable energy resources, and these will vary in proportion from one region to another, the concept calls for the best integration of RE resources in each locality. Any surplus in local energy (electric power) requirements can be injected into the national grid. Likewise, any under-fulfillment of local electricity demand can be met with national grid withdrawals. If this integrated and maximized use of locality-specific RE resources is put in place, this will necessarily drive the lifestyle changes deemed imperative (by Niitsuma and his collaborators) for a truly sustainable society. EIMY is therefore not just a narrow, economic and purely technological concept. It is rather one that promotes local control, the maintenance of local cultural identity and social capital construction. It is also one that in the long term will contribute to the development of

a distributed network systems but at the same time does not envisage a decline in large-scale, centralized energy distribution grids; both have their place. Indeed, if city-regional networks are to be realized, then a national grid system is imperative.

The starting point for an EIMY analysis of a particular locality is its energy demand profile (incorporating future demand projections). The local RE resources are then fully identified and the best, and most economical, strategy for using these resources is determined through computer modeling. The modeling results in a local RE integrated 'solution' that is thought to overcome the problems of low energy content and the diurnal and seasonal intermittency inherent in many single RE sources. The solution is supported by carefully constructed and integrated regional and national policy mechanisms as well as academic and business group participation under local direction. A framework for EIMY is shown in Figure 7 below.

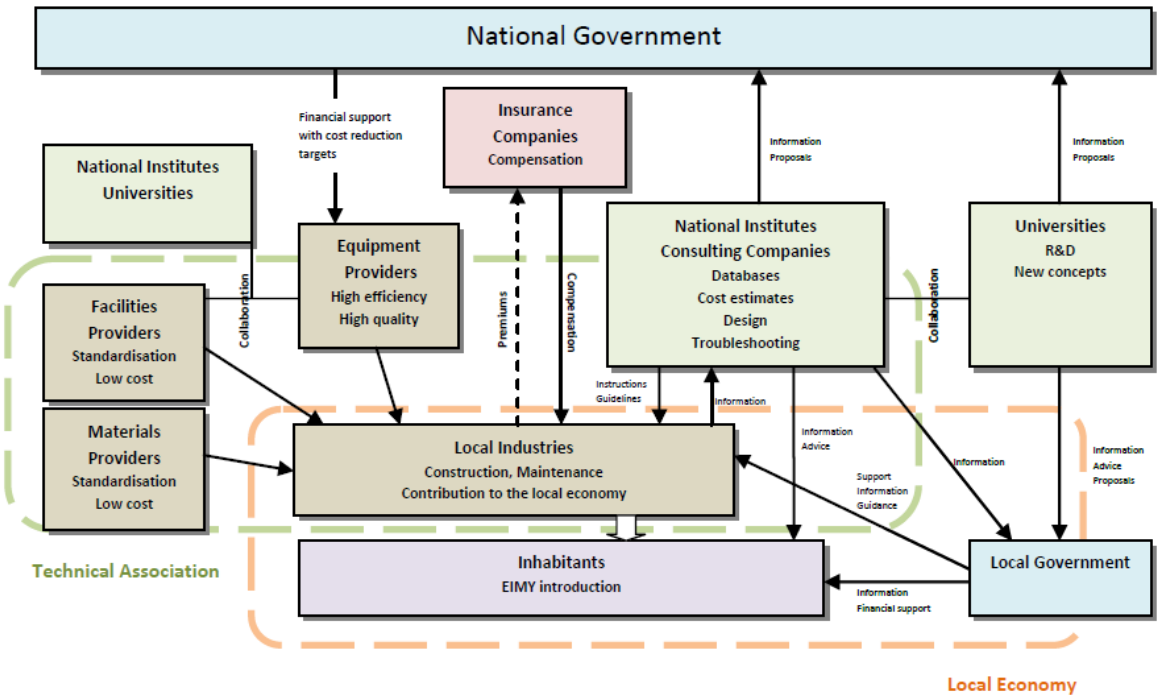

Figure 7: Schematic of the EIMY concept
(The integration of local communities, governments, industrial groups and academia in the realization of the EIMY concept. Adapted from Niitsuma & Nakata 2003, p.7)

The EIMY model is just not theoretical. For example, Mie Prefecture has created two model regions that employ the EIMY concept to promote the identification and integration of local RE resources in the aim for a locally sustainable society (Mie, n.d.). The Prefecture has worked in conjunction with Tδhoku University which (under the direction of Niitsuma and his team) produced a plan entitled, 'Business Master Plan for the Promotion of Locally Produced-Locally Consumed New Energy', originally for Miyagi Prefecture (Niitsuma, 2007).

A smaller scale implementation of parts of the EIMY concept has been carried out in the small northern hamlet of Teneimura in the south of Fukushima Prefecture (Niitsuma 2006). The Teneimura project demonstrated a collaborative, and sometimes experimental, approach to developing the best RE framework for the requirements of the hamlet. The full engagement of the community was viewed as a prerequisite for success. An initial action plan was developed through a collaborative effort between the community and outside consultants from academia. The spirit of the collaboration was captured in the phrase, 'By the Strength of the Wind (the outside consultants), By the Strength of the Earth (the community)'. Eventually, the plan identified the potential for the introduction of wind turbines, solar PV and heating, geothermal power, and the use of ground heat and biomass, with wind power chosen as the starting point because of its relative simplicity, given the specific Teneimura context.

To support the introduction of wind power to supply electricity to a local ski lodge, a (successful) wind power field test was carried out with funding support from the national government. Environmental impact assessments were also successful, in spite of the proposed wind farm site being located within a Prefectural nature park. In 1998, four 750kW wind turbines were erected with power production starting in 2000 supplying power to the Tδhoku power system via a 66kV power line (the

regulatory framework prohibited the direct use of the electricity generated.) Although the wind turbines were at an altitude of 1000m and subject to extremes of weather, their combined output continued to grow, from 4,830,000kWh in 2001 to 5,770,000kWh in 2007. With this success, the community was eager to incorporate the other RE resources into the action plan. This required a more systemic approach to RE usage and the community found it necessary to develop an integrated 'New Energy Vision' for Teneimura.

This New Energy Vision was given added impetus with the (external) establishment of a (Tδhoku) Regional Revitalisation Plan. The first impact of this Plan on Teneimura was the creation of a blueprint for a local micro-hydro generation scheme resulting in the installation of a 60kW system. Next came a New Energy and Industrial Technology Development Organization (NEDO)-funded geothermal development and promotion survey which was later incorporated into a geothermal binary generation feasibility study. The 1500m test drilling found that the +100℃ necessary to meet the criteria established by NEDO for binary generation was not available. The well was temporarily abandoned until the EIMY team found that the well, if exploited under an integrated RE concept, could be of significant value to the community. NEDO allowed Tδhoku University access to the well to establish a water preheating system for a health centre using a heat exchanger and a supply of water from a mountain stream. The value of the EIMY concept is quite clear from this: RE resources hitherto thought sub-optimal from a standalone perspective become extremely valuable if positioned within an integrated system.

Further drillings by Tδhoku University identified a ground heat gradient of nearly twice the national average. This heat source is now used to heat a local nursery school, obviating the need to use a noisy and polluting oil heater, and at the same time reducing its energy costs by 45% and its CO_2 emissions by 60%. In 2009, the

University also installed a solar PV unit in the grounds of the school, further developing the EIMY approach. In a more recent initiative, the University is promoting the idea of so-called ‘pellet stoves’ in the community, linking this idea with the national imperative of developing sustainable forest regimes across Japan (Japan Government 2010).

The Teneimura project has not been without tribulation and occasional setbacks but the collaborative approach, built on a strong and close relationship between the university team, the community, relevant government agencies, regional planners and equipment suppliers has been, according to Niitsuma, the absolute prerequisite driving the EIMY concept forward. Although not at a stage yet where Teneimura can contribute a surplus of energy to a network arrangement, it has encouraged local self-reliance in energy and has played an important part in sustaining the social capital of the community. It has also established a framework for constructing regional and rural RE hubs that, with further collaboration and integration, has the real potential of satisfying the ‘back end’ infrastructure to support the network system.

Sustainability Zones (SZs)

Another approach that considers the ‘back end’ rural and regional RE infrastructure is that of Sustainability Zones (SZs). However, in a radical departure, the SZs concept inverts what may be viewed as the mainstream consensus concerning the future of Japanese society and the place of RE within it. Although still having the capacity to support a network concept, the SZ idea challenges the assumptions of business-as-usual which implicitly takes for granted the long-term existence of the mega-city.

The concept of SZs began with the work of Professor Kurasaka Hidefumi and his team at Chiba University. In his various publications (Kurasaka 2001; 2002; n.d. a),

Kurasaka adopts a historical, limits-to-growth perspective in identifying global population growth, an impending collapse in the availability of fossil fuels (including uranium) and the advent of global warming as unmistakable signs that must compel a need for a complete re-orientation of existing socio-economic systems to one of true sustainability. Unlike the majority of government policy papers, Kurasaka has no difficulty in treating peak oil as a real and imminent threat to Japan where neo-classical economics and ideas of infinite growth are still, to borrow a phrase from Daly and Farley (Daly and Farley 2004, pp.23-4), incorporated into the mainstream dominant 'pre-analytic vision' of socio-economic organisation.

Kurasaka discusses Japan's renewable energy resources in detail and points out that Japan would be more than able to meet its energy needs from these sources. He is careful to point out, though, that with a fossil fuel dependency rate of 90% a (necessary) transition to a sustainable energy future will not occur overnight in Japan. He therefore sketches a scenario for a staged approach in RE introduction which he deems inevitable. His first task is to discuss whether this transition should be policy-led or community led.

By policy-led he means a government interventionist approach which employs taxation, regulation, etc, to induce the introduction of RE. Community-led refers to local communities and private industry working for economic advantage in developing RE technology. For Kurasaka, central government's role should be restricted to support agent only, through information dissemination and funding provision for basic research. He believes that policy development is very important, but his views about where this leadership should be located is of critical importance. The choice is between central-government bureaucrats and a devolved model of policy creation and implementation. Throughout his writing, Kurasaka clearly has little faith in the former.

Kurasaka's lack of faith in central government stems from his belief that, for one reason or another, central government is unable or unwilling to differentiate between truly sustainable RE sources and those that just provide a mechanism for full or partial domestic generation, whatever the source. His scepticism is illustrated by two examples. The first refers to the activities of ANRE which was charged with designing and promoting taxation policies that would reduce Japan's energy dependence on oil through the promotion of energy alternatives, including RE. In the event, about 80% the tax revenues gained from these policies were allocated to the promotion of nuclear energy (something Kurasaka is clearly against). His second example is in regard to the problems inherent in the centrally created and enforced RPS Law. The regulations associated with this law allowed, for example, the use of general incinerators for the generation of electricity. As already noted, incinerators have generally been discredited because of their deleterious environmental impacts, including dioxin emissions, and because they are predicated on a make-use-waste model of material throughput.

Kurasaka relates the linear flow make-use-waste model to our historical experience of centralized policy systems and resource allocation. Centralized resource allocation seems to have led to increased productivity and profits associated with the centralized extraction, distribution and consumption of energy resources through economies of scale but with linear approaches to production, consumption and waste disposal. The energy resources are also of typically high quality (oil, coal, etc). On the other hand, distributed energy resources are of typically low quality but are produced and consumed locally. Furthermore, as these energy resources are invariably renewable, their use makes for a more sustainable socio-economic system in harmony with (and less intrusive on) the environment in each policy-making locality. This encourages a circular, more sustainable, flow redolent of that

articulated by McDonough and Braungart in their seminal work, *Cradle-to-Cradle* (McDonough & Braungart 2009). Kurasaka turns next to the local administration of RE policy.

As previously noted, in terms of administration, Kurasaka asserts that local administration is best but he is aware that perhaps not everything can be achieved at the local level. To deal with this he proposes a 'reverse-flow' process of policy administration. Policy development and administration clearly begin at local level with full community participation. However, if these policy directions are not fully achievable at the local level, the unachievable portion should be passed to the next level of government (for example, to the prefecture). Only in the last resort should the national government should be involved. Clearly, Kurasaka's approach does not fully undermine the governmental structure in Japan with its fundamental three levels. What he is suggesting, though, is that local, community-led initiatives should be dominant, and in fact will be crucial, for Japan's survival. And this is where Kurasaka's thesis becomes quite dramatic.

Kurasaka paints a scenario for Japanese society to the middle of the 21st century which is characterized by a sense of growing unease among those living in Japan's mega-cities (Tδkyδ, Õsaka, etc) driven by the rising costs of centralized fossil-fuel systems. This unease will eventually lead to increasingly large flows of people to the countryside. Local, sustainable communities, including those using local RE resources, are now seen as a key to Japan's long-term survivability. The local community must clearly have the capacity to deal with this influx else panic and confusion will ensue. As the maximum use of local RE resources is seen as imperative, a coherent policy strategy for their use is indispensable. At an early stage of this strategy the identification of the degree to which a specific community is self-sufficient in food and energy must be undertaken and it is toward this end that

Kurasaka and his colleagues have undertaken surveys of every region in Japan to determine just this (Chiba 2009). In Kurasaka's nomenclature, a Sustainability Zone is one in which, in the best case, both food and energy demand are met from local, distributed resources. There are degrees to which each locality has achieved sustainability on these dual criteria and these have been carefully mapped and recorded in the most recent and previous Energy Sustainable Zone reports. The most recent data are interesting but must be read with some caution.

The Energy Sustainable Zone report for 2008 shows that 11 prefectures supplied more than 10% of their energy demand from renewable sources. However, this is for households, offices and the agricultural sector only and does not include the industry or transportation sectors. For regional municipalities, it seems that approximately 76 are able to meet their power and heat demand in the domestic and agricultural sectors from locally-sourced RE. In every case, the RE supply is over-and-above the local requirement. In other words, these sectors are more than self-sufficient in RE terms. The report reiterates the point that big cities (Tõkyõ, Õsaka, etc) have an average energy self-sufficiency rate of less than 1%. The case is then made for a deeper collaboration between RE-rich rural and regional areas in Japan and the RE-poor big cities so that a synergistic arrangement can be forged to the benefit of both parties. This is not a serendipitous conclusion: the authors of the Energy Sustainability Zone reports work closely with the Institute for Sustainable Energy Policies (ISEP) referred to above. The director of ISEP, Iida Tetsunari, sits on a special board of advisors to the Tõkyõ Metropolitan Government (TMG) in regard to RE policy and has been instrumental in developing the TMG-Regional Network strategy (Engler 2008).

In stressing his vision for the future of Japanese society in light of declines in fossil fuel availability, Kurasaka suggests that a SZ will need to perform the following social functions:

- It is a bridgehead to another type of social formation which is seen to be attractive and a catalyst for further sustainability initiatives in other communities.
- In a society that is danger of dissolution, a sustainability zone becomes a locus for the preservation of a society's traditions and technological capacity, culture and language.
- It is a site for absorbing populations fleeing unsustainable cities.

To reiterate, Kurasaka believes it is imperative that local government be viewed as the most appropriate means for furthering the development of distributed RE resources. Financial resources should be moved from central government to the local level to achieve this. In order to become a Sustainability Zone it's important that the means of existence exist and that the internal demand for energy and food is low. Paradoxically, it is those regions that have suffered the greatest population loss (with people moving to the city, etc) that are in fact the leading sites for SZ development. In particular, policies for the development of mountain, island and peninsula communities in Japan will need to be constructed so that investment flows can be used to develop their full potential (Kurasaka n.d. b).

The SZs concept is clearly a departure from more conventional thinking and policy making concerning the place of RE in Japanese society. One can only think that Kurasaka's notion of collaborative network arrangements connecting RE-rich rural and regional communities to Japan's mega-cities is either just a transitional

arrangement or a logical inconsistency. From a close reading of his work, one suspects the former.

Conclusion

The TMG-Regional Network, EIMY and SZs are all interesting developments for those seeking ideas and strategies to develop more sustainable societies and localities built on truly renewable sources of energy. However, it should be remembered that these are not yet in the mainstream of RE policy development and implementation in Japan. Mainstream RE policy in Japan is still characterized by its minimalism, inconsistency, intermittency and uncertainty. The causes of this relative policy failure are to be found mostly in the brake applied by the near oligopoly powers of the electricity retailers, the conservatism of METI, the political effeteness of successive Japanese governments and the Japanese political system in general. Added to this is a prolonged and deep budget crisis exacerbated by increasingly significant outlays on social welfare brought about by Japan's advanced aging demographic.

The full exploitation of RE resources and associated technologies in Japan is clearly hamstrung by these socio-political realities. But this dominant reality seems to be viewed through a mindset that does not address Japan's long-term energy dilemma. Since major industrialization following the Meiji Restoration, Japanese governments have exerted a large proportion of their diplomatic (and sometimes extra-diplomatic) efforts in securing stable external supplies of primary energy resources. Current indications are that this will be very difficult to sustain. Fossil fuels, which still account for a dominant component of Japan's energy supplies, are finite. In addition, the scramble for remaining and diminishing fossil fuels has brought into play some very powerful international forces, China being the most conspicuous as far as Japan is concerned. The search for alternative pathways to sustainability may be

more than just one policy option. However, until the Japanese mainstream gives local RE resources the attention they deserve via coherent RE policy development and funding, Japan's future as a sustainable society must be cast in considerable doubt.

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