RENEWABLES 2013 JAPAN STATUS REPORT EXECUTIVE SUMMARY

Institute for Sustainable Energy Policies (ISEP)
Address: 4-7-3, Nakano, Nakano-ku, Tokyo, 164-0001, Japan
http://www.isep.or.jp/en

Chapter 1 : Introduction

The severe nuclear disaster at Fukushima Daiichi nuclear power plant, caused by the huge earthquake and the massive tsunami in March 11th, 2011, brought about controversies over the safety of nuclear power plants. Uncertainty about the safety of nuclear power, as well as energy security issues have caused widespread reconsideration of demand-side management, energy efficiency, renewable energy, electrical liberalization and unbundling transmission from power production. Fig.1 shows trends of power generation in Japan from FY1990 to FY2012 (in FY2012, forecast by ISEP). The portfolio of power generation was drastically changed after the Fukushima Nuclear accidents. The Ministry of Economy, Trade and Industry has organized committees to discuss the current energy market system and the need for its reformation, especially when major electric utility companies are monopolizing the market. The decision to reform the current energy market is expected to take place around the spring of 2013, and if changes are made measures will be implemented by the end of 2013.

Renewables have been receiving widespread recognition as a promising future sustainable energy source, substituting fossil fuels and nuclear power. The rapid increase in the implementation of renewable energy is said to be “the fourth revolution” following industrial, agricultural, and IT revolutions. Renewables can be considered as a precious domestic sustainable energy source, especially for Japan with its current energy self-sufficiency rate of as little as 5%. With the rising price and unpredictability of imported fossil fuels, and the tremendous risks of operating nuclear power plants, which were unfortunately inevitably proven at Fukushima, it is an obvious decision for the nation to place renewables as the primary means of energy supply in the near future.

In addition, well-arranged renewable projects, particularly those of solar power generation, can be implemented within a relatively short time frame; therefore, introducing renewables will play an important role as a post-disaster recovery measure, as well as contribute to energy security and global warming prevention. One of the positive characteristics of renewable technologies is that the performance improves and price declines as they become more popularized. In other words, the next decade in comparison to the last decade will witness a much faster popularization and a dramatic price decrease of renewable technologies.

From now on, the respective regions of Japan are expected to adopt an energy policy that focuses on small scale and dispersive located renewables not only so as to make it a mainstay of post-disaster economic recovery but also to realize a potential society of 100% renewable energy. This will be achieved through a drastic and strategic energy shift aiming at supplying stable and self-sufficient energy, while at the same time mitigating global warming.

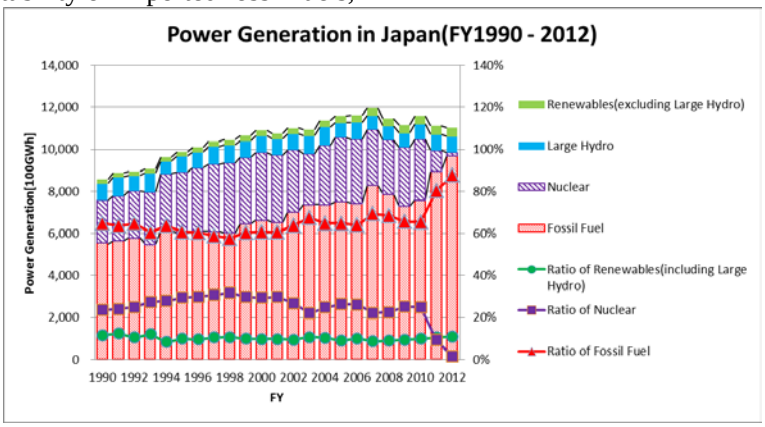

Fig.1 Trends of power generation in Japan (Source: ISEP)

Chapter 2 : Renewable Energy Policy in Japan

In 2011, global investment in renewable energy increased by 17%, to 257 billion dollars. This was a six-fold increase compared to the 2004 figure. As a part of global investment, Japan's renewable energy market only accounted for 3% of the total. However, in the comprehensive review of Japan's energy policy after the Fukushima disaster in 2011, the full-scale expansion of renewable energy has become a significant theme for Japan. In the "Energy and Environment Council" in June 2011, the ruling government (the Democratic Party of Japan) decided to reduce Japan's dependence on nuclear power and to shift to the distributed energy system, in an attempt to execute the "Innovative Strategy for Energy and Environment" released in September 2012.

Then, the FIT (Feed-in Tariffs) policy that enables the widespread use of renewable energy was enacted by the National Diet in August 2011, and was started from July 2012. In order for this FIT system to function effectively, however, appropriate purchase price and purchase period needed to be adequately set apart, so its introduction had to be delayed.

In March 2012, the Procurement Price Calculation Committee was launched to discuss feasible purchase prices and the purchase period, and was accomplished by collecting data of construction and operation costs of each renewable energy source, which includes solar, wind, geothermal, small hydro, and biomass, from industrial organizations.

Table.1 Purchase price and period of FIT in FY2012

	Solar PV		Wind		Geothermal	
Capacity [kW]	<10	>=10	<20	>=20	<15000	>=15000
PIRR(with Tax)	3.2%	6%	1.8%	8%	13%	13%
Tariffs [JPY]	42	40	55	22	40	26
Length [Years]	10	20	20	20	15	15

	Hydro			Biomass
Capacity [kW]	<200	>=200 <1000	>=1000 <30000	No limit (depend on Fuel)
PIRR(with Tax)	7%	7%	7%	1 – 8%
Tariffs [JPY]	34	29	24	13 – 39
Length [Years]	20	20	20	20

Taking the committee's report into account, The Ministry of Economy, Trade and Industry officially announced the details of the FIT system, such as the purchase period and purchase price in the form of ministerial ordinance in mid-June as shown in Table.1. While the system was managed to start from July 1, 2012, it proceeded through trial and error due to various difficulties, such as certification of facilities, in part because this new system of tariffs was operated for the first time in Japan. Under this policy, thorough attainment of so called priority connection, which is an obligation to connect to power grid, as well as development of the power grid system are strongly required. Furthermore, purchase price of FY2013 has been assessed since January 2013, and the revision of the purchase price only for solar power has been revised down 10% in March.

Importance of the roadmap and introduction targets of renewable energy has been also pointed out. The overall review of "Basic Energy Plan" has been under consideration in the Fundamental Issues Sub-committee of the Advisory Committee for Natural Resources and Energy since October 2011, and targets for the introduction of renewable energy by 2030 have also been discussed. Moreover, in the sub-committee of The Central Environmental Council, The Global Environmental Committee of Ministry of the Environment, and The Energy Supply Working Group, have specifically discussed the roadmap of energy supply in the medium to long term. As a result, the government provided plans for an energy strategy at the Energy and Environment Council in June 2012, and created the "Innovative Strategy for Energy and the Environment" in September 2012 after much discussion and a national public debate. In this strategy, realization of the green energy revolution, including the full-scale introduction of renewable energy, was indicated, and 30% of the total power generation as an introduction target by 2030 was set. Achieving this green energy revolution, the government showed the fundamental principles of "Green Policy Outline" in December 2012, but this strategy will now be reviewed from scratch due to the Prime Minister regime change which took place at the end of 2012. Since March 2013, in The Coordination Subcommittee, the Advisory Committee for Natural Resources and Energy has started to formulate once again the Basic Energy Plan.

In addition, as an essential reform which plays an important role in the spread of full-scale renewable energy, power system reform including electricity liberalization and unbundling of power generation and transmission has been examined in detail in the expert committee for Power System Reform since February 2012. Based on the Basic Energy Plan, a report that contains a specific work schedule was published in February 2013 aiming at creating legislation.

Moreover, the need to change a variety of regulations and systems on the current renewable energy sector has also been indicated. In The Energy and Environment Council and Government Revitalization Unit, innovative reform actions have been formulated in each ministry so as to accelerate power system reform and the spread of renewable energy. In 2011,

the main direction of the reform was announced and one aspect of it has been put into effect.

Municipalities that noticed the importance of renewable energy have set about expanding the introduction of renewable energy by establishing framework and strategy for it. Especially, in the Tohoku district, renewable energy utilization is highly expected to play a significant role as a post-disaster recovery measure.

As mentioned, Japan's situations surrounding renewable energy have dramatically changed after the 3.11 disasters. Thus, in order to catch up from the "lost decades" in the past, the year of 2012 can be positioned as the "the first year of renewable energy" for Japan.

Chapter 3 : Renewable energy trends in Japan

The percentage of renewable energy supply to the global final energy consumption was approximately 17% (estimated) in 2010. When limited to power generation capacity, at the end of 2011, renewable energy in service occupied more than 25% of global capacity of power generation, and supplied 20% of the world's electricity. Most of the electricity supply was generated by hydroelectric energy. In addition, renewable energy accounted for almost half of 208 GW estimated of worldwide power generation capacity installed in 2011.

In that estimate in 2011, Japan's cumulative installed capacity of facilities generating renewable energy was estimated to be approximately 15 GW as shown in Fig.2 (over 10MW large hydropower facilities are excluded.). The total installed capacity of both wind power and solar power accounted for more than half of the overall installed capacity, and this exceeds total installed capacity of geothermal, small hydro (less than 10MW), and biomass (including waste power generation) power generation capacity.

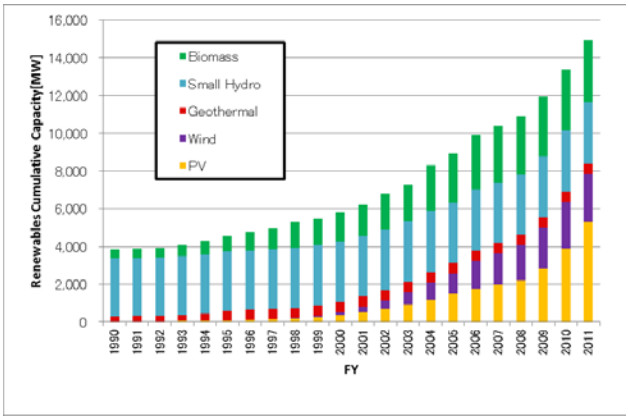

Fig.2 Renewables Cumulative Capacity in Japan
(Source: ISEP)

The accumulated installed capacity of solar power increased up to 5 GW by the end of FY2011. Since 2004, the growth rate of the installed capacity had slowed down due to the stagnation of dissemination policy, caused by discontinuation of subsidies.. However, thanks to new FIT policy enacted in 2009, annual installation capacity reached 1.4 GW (and that of previous year was approximately 1.0 GW).

While the total installed capacity of wind power was 2.56 GW at the end of FY2011, its annual installation capacity was still sluggish, which was about 80 MW. Although the number of installed wind power capacity had rapidly increased by the growth rate of 30 percent until around 2006, since 2007 the rate of its annual installation capacity has slowed down due to various constraints, including the matter of site conditions and of connection systems.

The situation of geothermal power has been facing the absence of newly installed facilities since 2000, although renovation has been carried out to some facilities. Its installed capacity remained 540 MW at the end of FY2011.

For small hydroelectric power (less than 10MW output), the number of new installed equipment has been low, and its growth has only increased by about 190 MW in 22 years, but in recent years installation of less than 1MW power output equipment has been developing.

Biomass power generation has been growing with the spread of power generation making use of general waste and industrial waste, but in recent years particularly installation of wood biomass power generation, has seen a fairly large increase.

While FIT policy, which started in July 2012, is expected to encourage installation capacity and increase considerably renewable energy, especially solar power, in 2012, this summary only focuses on the situation of renewable energy sector until the end of 2011. At the end of December 2012, the installed capacity of certified power equipment had exceeded 5.2 GW (4.7 GW is from solar energy) shown in Fig.3, and 1.17 GW (860 MW is subjected to the FIT system) has already started to operate.

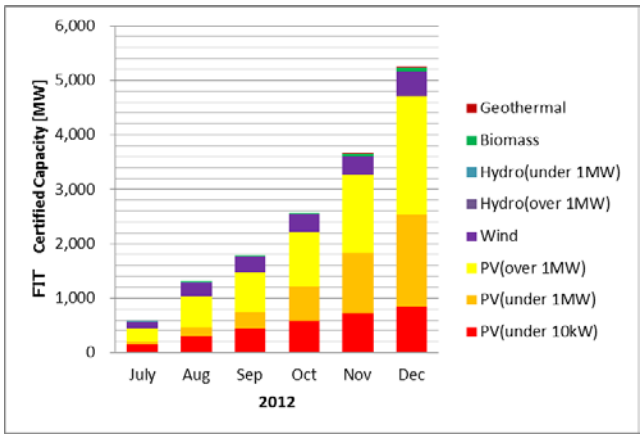

Fig.3 Certified Capacity of FIT scheme in Japan (Source: METI)

Fig.4 shows annual power generation by renewables of each year, which is estimated from cumulative installed capacity and capacity factor of each renewable energy source. Although the growth rate of geothermal, small hydro and biomass energy remains only less than 1%, their total annual energy production accounts for 70% of the total energy production by renewable energy. In terms of solar energy and wind energy that have rapid growth rates, it is estimated that they occupied 24% of total energy production by renewable energy worldwide in 2011, but in Japan each of them only accounts for 0.5% of the total energy production.

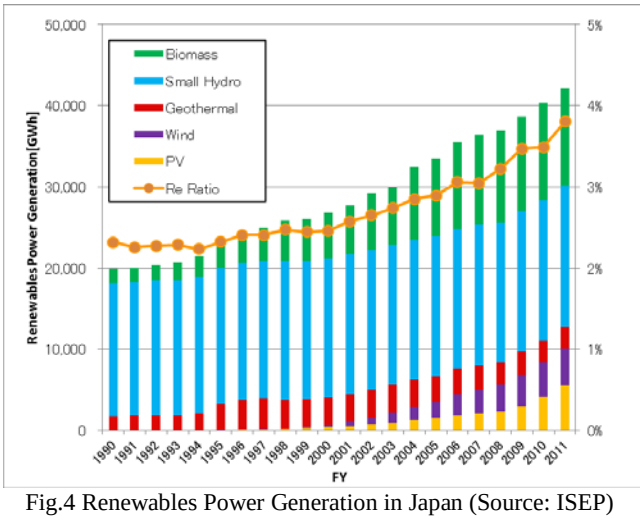

Fig.4 Renewables Power Generation in Japan (Source: ISEP)

In FY2011, the growth rate of cumulative capacity of solar power reached 36% of the total cumulative capacity of renewables, while wind power was only about 3%. In contrast, the growth rate of cumulative capacity of small hydro energy and biomass energy was only less than 1%. Despite public announcements about annual output of geothermal energy, its output has tended to decrease in recent years. In terms of the overall power generation in Japan, renewable energy(excluding large hydro) still remained at approximately 3.8%, which means a slow increase by 1.3% from about 2.5% in FY2000.

Table.2: Renewables Capacity and Power Generation in FY2011, Japan (Source: ISEP)

Japan (FY2011)	Installed Capacity in FY2011 [MW]	Cumulative Capacity [MW]	Power Gen. [GWh]	Power Gen. Ratio [%]
Solar	1,401	5,288	5,559	0.50%
Wind	85	2,557	4,419	0.40%
Geothermal	0	540	2,689	0.24%
Small Hydro	7	3,248	17,355	1.56%
Biomass	29	3,281	12,070	1.08%
Total	1,525	14,914	42,153	3.79%

Fig.5 shows comparison of PV installation trends in Germany and Japan. Cumulative capacity of PV has reached over 32GW in Germany by the end of 2012, meanwhile it was only 7GW in Japan. Annual installation capacity was over 7GW in Germany meanwhile only accounting for 2GW in Japan because of new FIT scheme only just starting in 2012.

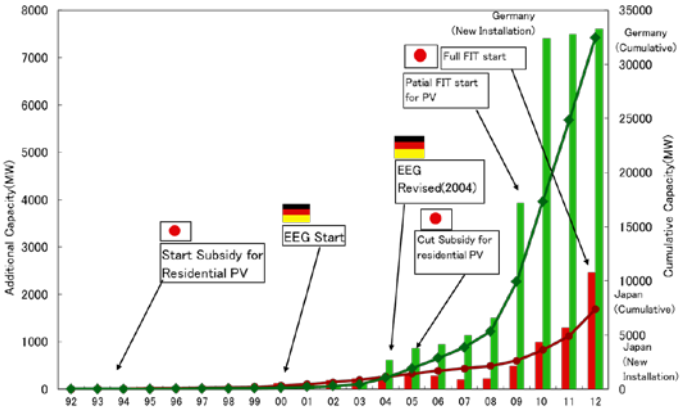

Fig.5 PV trends in Germany and Japan (Source: ISEP)

Worldwide, China and the US have seen rapid growth of wind power during recent years. Meanwhile Germany and Spain have made steady growth during the past twenty years. Fig.6 shows cumulative capacity trends of Wind power in Japan. In Japan, the new FIT scheme will not affect wind installation because of several regulations taking effect. Therefore, it will take time to boost installation of wind in Japan.

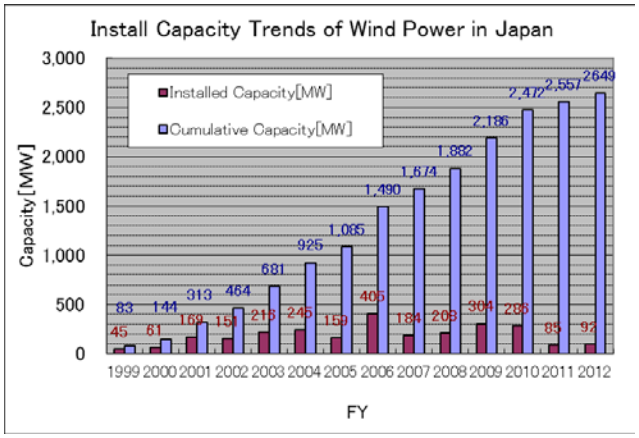

Fig.6 Install capacity trends of Wind in Japan (Source: JWPA)

Most of the hydropower plants in Japan were built

before 1990, and the cumulative capacity of those with a capacity of below 10 MW at the end of FY 2011 was 3.25 GW, which accounts for 6.7 % of the total capacity of all sized hydropower. 190 small hydropower plants with a capacity below 10 MW were erected after 1990, and the cumulative capacity of those plants is 188 MW. Renewable Portfolio Standard (RPS) applies to majority of those with a capacity of below 1 MW that were constructed after FY 2004.

Cumulative capacity of geothermal power grew to 530 MW between when the first power plant was built in 1966 and 1990. The oil crisis in 1970's empowered movement in the private sector to develop geothermal energy power. However, added capacity was only 1 MW between 1990 and 1999 when the latest geothermal plant was built, and the 10 year period of no added power capacity was called 'the lost decade'. Annual generation has been declining since its peak in 2003 and exhibited 3 % average reduction for 8 years. Issues involving locating appropriate sites and the costs relating to development, construction and maintenance have led to an exemption from RPS.

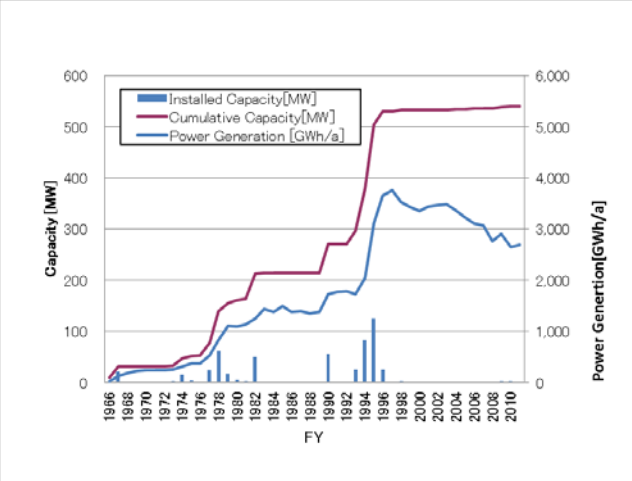

Fig.7 Trends of geothermal power in Japan (Source: The Geothermal Research Society of Japan)

The tradition of the Japanese hot spa is regarded as exploiting geothermal heat. Although there is little data available to assess trends in the use of hot springs for bathing purposes, it is estimated that available heat energy has increased since the amount of flow has doubled in the last 40 years. It was estimated by the government in 2006 that utilizing hot springs for bath can save 36.5 PJ of heat energy. Growth in geothermal heat pumps was marginal when it was first introduced at the beginning of 1980's and it slowly became more noticeable around 2004. At the year 2011, it was estimated that the annual installation number of geothermal heat pumps was around 200 and cumulative installation reached around 800.

Sources for fuel in biomass power generation vary, from wood fuel, food, and livestock, to waste such as industrial and municipal waste. Biomass power is generated through direct combustion, gasification or methane fermentation of these fuel resources. Cumulative capacity at the end of FY 2011 was 3.28 GW, which was 6.7 times larger than that in 1990. General and industrial waste accounts for 90 % (55 % and 35 %, respectively) of the total capacity under the incentive of RPS regulatory policy. On the other hand, power generation from wood fuel accounts for only 8%, so the wood biomass is expected to be encouraged while promoting forestry and the usage of domestic timber. It is difficult to assess sustainability and the effect of reducing CO2 for each different type of biomass fuel, even though the credibility of reviewing such data is important in emission trading schemes and feed-in-tariffs.

In contrast to a tradition to include firewood as a biomass resource when estimating the trend in the biomass heating, this report focuses on combusting appliances that use wood pellets and wood chips. The number of the boilers for woody fuels is about 654 by end of FY2011 in Japan. It is difficult to estimate the total amount of domestic biomass energy supply, especially the amount generated via large boilers and 'combined heat and power (CHP)' in paper manufacturing, since most of it is consumed for the manufacturing process.

Solar heating market grew after the oil crisis and peaked in 1980s when the cumulative capacity reached 1.7 GWth. As shown in Fig.9, total capacity of solar heating, while incorporating depreciation in stock into the estimation, has been declining since FY 1994 due to a fossil fuel supply at low prices. This has impeded technological development and innovation of the systems. Deterioration in product reliability stemming from quality issues of these solar heating systems caused a decline in sales down to the current sales of 40 to 60 thousand per year.

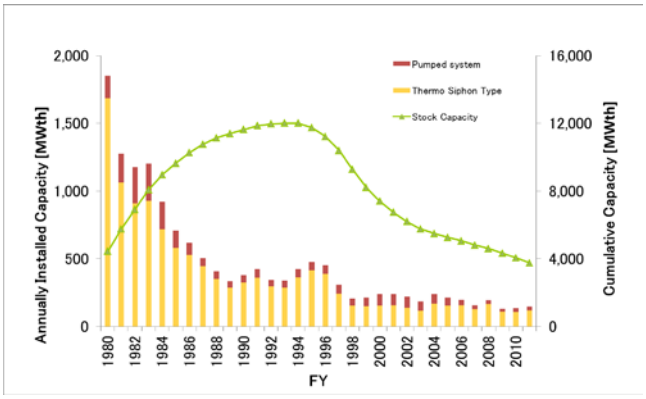

Fig.8 Trends of solar heating system in Japan (Source: ISEP)

Chapter 4 : Toward Renewables 100% - Medium and long-term Scenarios

Japan needs to make a shift toward a decentralized energy policy focusing on small scale and dispersive located renewables by means of increasing efficiency on energy consumption and introducing renewables. The goals are not only making it a mainstay of post-disaster rehabilitation or economic recovery after "the lost two decades", but realizing the society of 100% renewable energy through a drastic and strategic energy shift for the purposes of supplying stable and self-sufficient energy, while at the same time mitigating global warming.

In opposition to the medium and long term scenario under consideration by the government, multiple domestic environmental NGOs such as Institute for Sustainable Energy Policies (ISEP), Kiko Network , and WWF Japan, have proposed revised medium and long term scenarios after the Tohoku earthquake and tsunami on March 11, 2011.

"Energy Policy Paper after 3.11" released by Institute for Sustainable Energy Policies (ISEP) immediately after the disaster played a significant role in leading public opinion regarding energy policy in Japan. This paper introduces a positive prospect on securing short-term power supply without operating nuclear power plants and as shown in Fig.9, which proposes a medium to long term feasible energy strategy to allow renewables to supply more than 30% of total power consumption in 2020 and 100% in 2050[1].

Kiko Network also announced a scenario stressing the high possibility of achieving "Three 25s" by 2020"; reducing electricity consumption by 25%, reducing greenhouse gas emission by 25%, and supplying 25% of electricity from renewables. In response to the WWF international's "The Energy Report – 100% Renewable Energy by 2050" published in February 2011, in which they introduce research demonstrating that it is both economically and technologically feasible to achieve 100% renewables worldwide by 2050, WWF Japan also announced "The proposal for energy scenario toward low-carbon society – 100% renewables" in November 2011. This scenario is based on the assumption that the domestic energy demand will be halved by 2050. In the proposal, they discuss the possibility of satisfying all the energy demand with domestic renewable energy by means of heat and fuel as well as electricity.

To provide a long term global energy prospect, The International Energy Agency (IEA) publishes "World Energy Outlook (WEO)" every year, which continuously-revises type of scenarios towards 2030. In a report published in November 2011, IEA made special remarks on issues regarding nuclear power, energy security measures to address issues associated with fossil fuels such as peak oil, and greater possibilities of rapidly growing renewable energy beyond their previous expectation. The report also questions the on-going but unsatisfactory measures against global climate change reflecting an unfavorable evaluation on climate change prevention.

A summary of these long term scenarios and future predictions was published in January 2013 as the "Renewables Global Futures Report"[2]. As shown in Fig.10, this report analyzes and compares a total of fifty long-term scenarios by interviewing more than 170 experts on the outlook of renewable energy fields. The Renewable Energy Policy Network for the 21st Century (REN21) also issues a "Renewables Global Status Report" every year that introduces initiatives and presents the states of renewable energy in respective nations. The latest version "Renewables Global Status Report 2012" was released in June 2012[3].

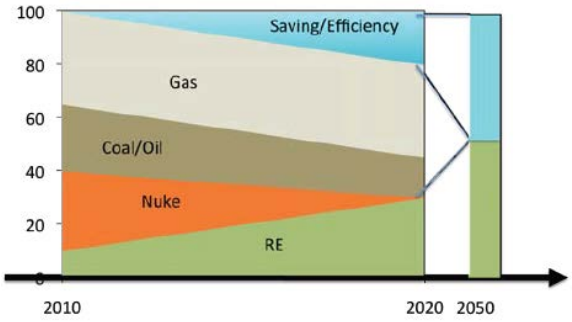

Fig.9 Images of energy shift of power generation for mid and long terms in Japan (ISEP, 2011)[1]

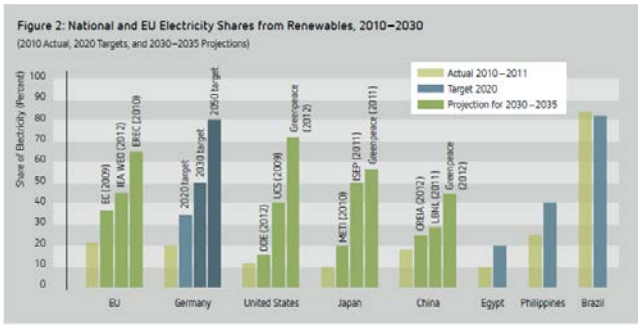

Fig.10 National and EU Electricity Shares form Renewables, 2010-2030 (REN21/ISEP, 2013)[2]

1 ISEP,"A Report on Japan's Energy Shift since March 11th" http://www.isep.or.jp/images/press/ISEP_Strategy%20No1%20Revised.pdf

2 REN21/ISEP, "Renewables Global Futures Report" http://www.isep.or.jp/en/gfr

3 REN21, "Renewables Global Status Report" http://www.ren21.net/REN21Activities/GlobalStatusReport.aspx

Chapter 5 : Transition to Renewable Energy based on community

The rural parts of Japan, such as agricultural or beachfront areas, have a larger potential for renewable energy. Therefore, the benefits of promoting renewable energy are not only limited to addressing global climate change and securing domestic energy sources, but can also lead to revitalization of regional economies and support regional energy independence.

Introducing renewable energy will also create a number of job opportunities. According to the latest statistics, approximately 5 million people are engaged in renewable energy industry both directly and indirectly worldwide.

Since the Tohoku earthquake and the nuclear accident in 2011, various regions of Japan have recognized the importance of renewable energy and have started taking initiatives in introducing and spreading it as "Community Power". There are accelerated moves in promoting renewable energy in various regions in the world as well. There have been a number of cases of setting targets and regulations, utilizing infrastructures, and founding public electric companies, mainly in EU countries such as Denmark, Germany, and Spain. These initiatives will serve as good models for Japanese communities.

It has long been known that each region of Japan has a significantly large potential to introduce renewable energy. The Japanese Ministry of Environment released the "Study of Potential for the Introduction of Renewable Energy" in April 2011, in which the potentials of solar (non-residential), wind, and medium and small-scale hydroelectric power generation were estimated. Solar power generation can utilize various unused spaces such us idle lands in addition to roofs of factories and buildings. The introduction potential of medium and small-scale hydro power generation has been estimated to be 14 GW, mainly in mountainous areas where water resources are abundant.

On the other hand, on-shore wind farming is promising particularly in Tohoku and Hokkaido region, where as much as 144 GW can be introduced. Offshore wind technology has currently been developed around the world, and it has a particularly large introduction potential in regions such as Hokkaido, where a total of 378 GW can be introduced. As shown in Fig.11, the combined potential of on-share and off-share wind power generation is estimated to be over 500 GW, which is far more than all the installed capacity of currently existing power generation facilities in Japan .

Geothermal energy potential for power generation is estimated as large as about 23GW in Japan as shown in Fig.12. This potential is very large as compared with current capacity 0.5GW of geothermal power generation in Japan.

Renewable energy accounts for only 4% of the total domestic energy supply in Japan. It is important that the nation will continuously increase the number of regions where sustainable development by renewable energy is possible. The first step is to evaluate each region at both a municipal and prefectural level in order to discover regions of a larger renewable energy potential.

A joint research "Sustainable Zone" with Chiba University has revealed the trends and current status of renewable energy supply by region in Japan every year since 2007. The proportion of renewable energy in the region is an effective indicator of the sustainability of the region. By evaluating past records of utilizing a variety of renewable energy including solar, wind, small-scale hydro, geothermal, and biomass as an indicator, it will become possible to evaluate and further develop the sustainability of the region, which could not have been grasped well solely by economic indicators. Fig.13 shows municipal map of self-sufficiency of energy in Japan by the research of sustainable zone. In the regions of about 50 municipalities, 100% or more renewable energy is supplied by comparison with their municipal energy demand (both power and heat, excluding industrial energy).

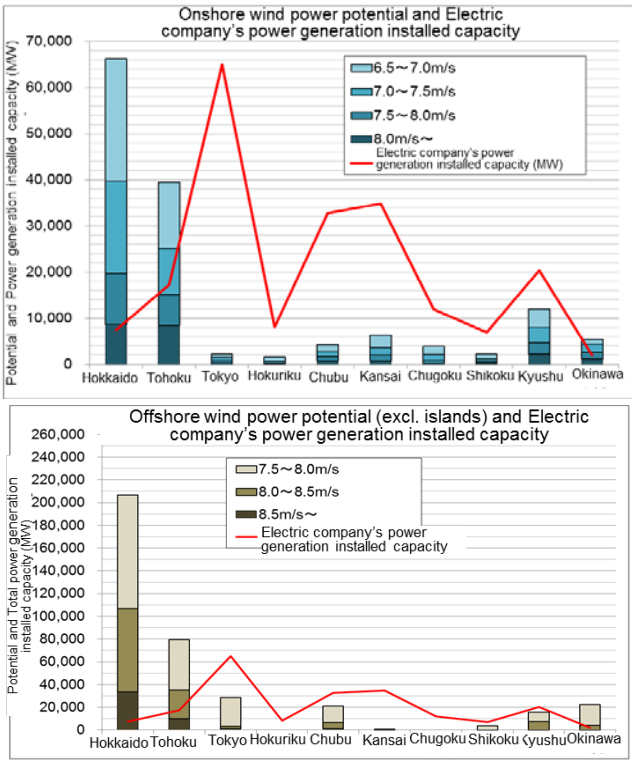

Fig.11 Potential of onshore and offshore wind power in each utility area of Japan (Source: JWPA)

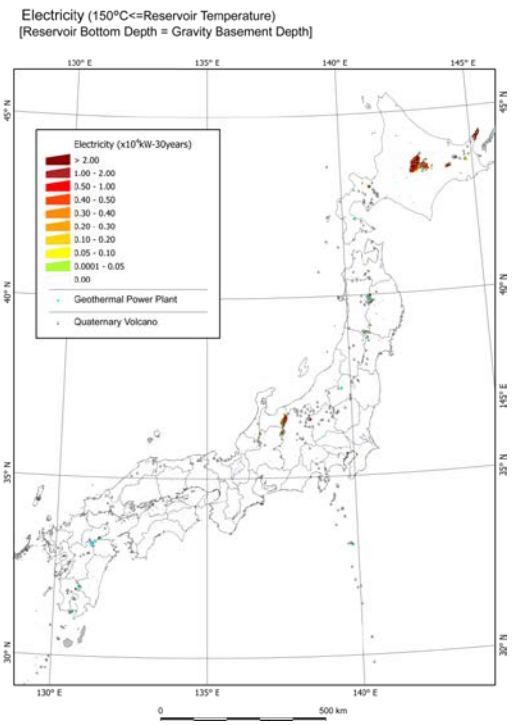

Fig.12 Potential map of geothermal power generation by over 150 C Reservoir Temperature in Japan (Source: AIST)

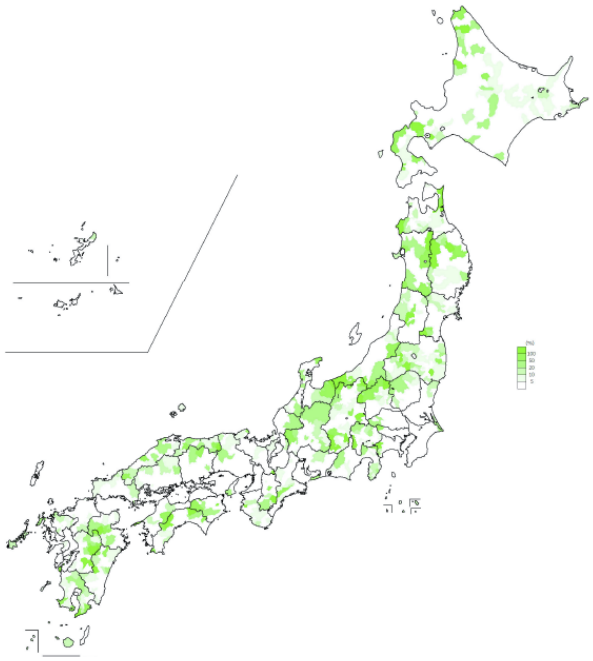

Fig.13 Municipal map of self-sufficiency rate for energy by renewables in Japan, FY2010 (Source: Research group of Sustainable Zone)

"Renewables 2013 Japan Status Report", Executive Summary

Producer : Independent, Non-Profit Research Organization,
Institute for Sustainable Energy Policies (ISEP) http://www.isep.or.jp/en
Tel: +81-3-5942-8937 Fax: +81-3-5942-8938
Address: 4-7-3, Nakano, Nakano-ku, Tokyo, 164-0001, Japan
Editor in chief : Hironao Matsubara (ISEP)
Editorial Supervisor: Tetsunari Iida (ISEP)
Translators of this summary : Koki Inomata, Naoki Wada, et al.
Publisher (Main report): Nanatsumori Shokan, Tokyo, Japan
Published : March, 2013(Main Report), Executive Summary in English: May, 2013
Cooperation : JREPP(Japan Renewable Energy Policy Platform) http://www.re-policy.jp
Research group of Sustainable Zone http://www.sustainable-zone.org/
JST Research Group of Community Energy Finance http://www.isep.or.jp/jst-project.html

※Main report of this summary was made possible with the financial support of Environmental Restoration and Conservation Agency Department of The Japan Fund for Global Environment.