IEA GEOTHERMAL

IEA Geothermal
Implementing Agreement

Japan
Country Report
2014

Japan

Figure 1 Sugawara geothermal power plant (5MW) is under construction

1.1 Introduction & Overview

The strategy for electricity supply in Japan was greatly changed due to the accident at the nuclear power plant in Fukushima. All of the nuclear power plants had to be suspended and the government reviewed from scratch the energy strategy that it mapped out before the accident. In April 2014, the government issued the 4th Strategic Energy Plan and it said the dependency on nuclear power generation would be lowered to the maximum possible extent, by saving energy and introducing renewable energy as well as improving the efficiency of thermal power generation.

After the accident, new regulatory standards were made. A nuclear power plant is allowed to operate after an assessment has been completed for prevention against natural disasters like Tsunamis, and after the nuclear power committee (a governmental organization) and the local government, agrees on the commencement of operations. All nuclear power plants were stopped one after another due to the implementation of the periodical inspection, and no nuclear power station had been allowed to re-start by the end of 2014.

The Japanese government initiated Japan's Feed-In-Tariff (FIT) in July 2012 to accelerate the introduction of renewable energy. Under this tariff, solar energy projects have dominated because solar projects are faster to build compared to larger projects such as wind power or geothermal projects, which require quite a long time to plan and build. Some electric companies announced that they would place limitations on solar projects due to a lack of grid capacity in their regions. It is hard for developers to make a decision to invest in new energy resources.

As of 2013, renewable energy, including geothermal, accounted for about 10% of total energy generation. However, 8.5% was hydro power generation while geothermal was only 0.3%. The circumstances around geothermal power generation have been changing but only one small geothermal power plant started to operate in 2013. The total geothermal installed capacity was 515 MW in 2013.

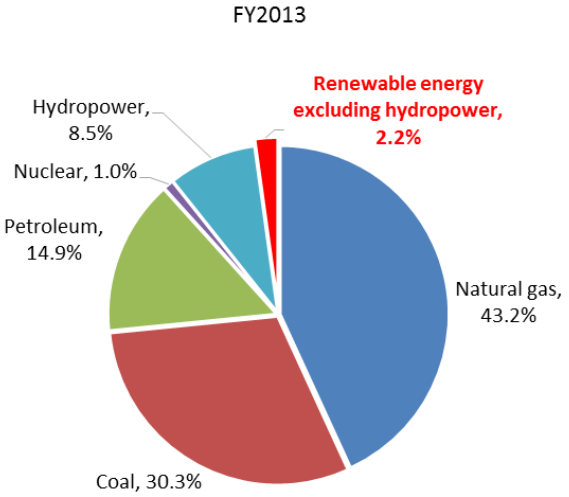

Figure 2 Composition of annual electricity generated in Japan

Table 1 Status of geothermal energy use in Japan for 2013.

Electricity	
Total Installed Capacity (MW_e)	515
New Installed Capacity (MW_e)	0.1
Total Running Capacity (MW_e)	515
Contribution to National Capacity (%)	0.2
Total Generation (GWh)	2,605
Contribution to National Generation (%)	0.3
Direct Use	
Total Installed Capacity (MW_{th})	2,094
New Installed Capacity (MW_{th})	na
Total Heat Used (PJ/yr or GWh/yr)	26.1 [7,250]
Total Installed Capacity Heat Pumps (MW_{th})	na
Total Net Heat Pump Use [GWh/yr]	na

na = data not available

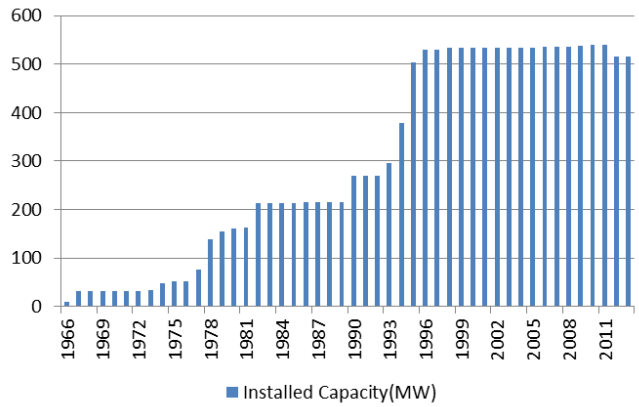

Figure 3 Total installed capacity of geothermal power plants in Japan.

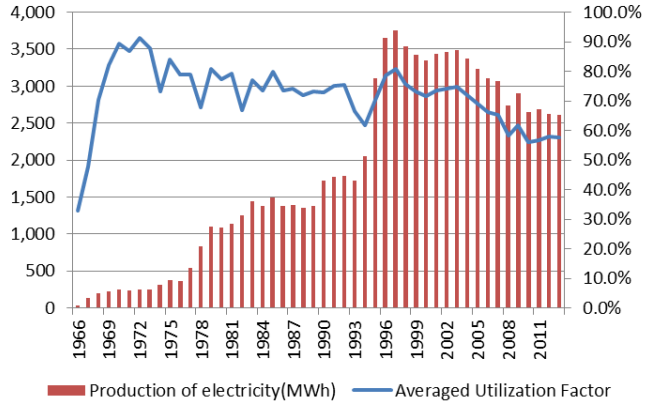

Figure 4 Total production of electricity and average utilization factor of geothermal power plants in Japan.

1.2 Highlights and Achievements

Japan Oil, Gas and Metals National Corporation (JOGMEC), established in 2004, integrated the functions of the former Japan National Oil Corporation (JNOC) and the former Metal Mining Agency of Japan (MMAJ). They are in charge of securing a stable supply of oil and natural gas, and ensuring a stable supply of nonferrous metal and mineral resources, the latter including implementing mine pollution control measures. JOGMEC has a lot of experience to develop subsurface resources. In 2012 a new function was added to the role of JOGMEC, and it started to play an important role in the development of geothermal energy including financial support and subsurface technology development.

As the development of geothermal resources is a time-consuming activity, it takes a long time before the generation of electricity begins. In addition, there are risks specific to the development of geothermal resources, for example the temperature decrease of a geothermal reservoir, which are different from the risks involved in the development of other subsurface resources like oil and natural gas. In order to deal with these risks, JOGMEC supports the development of geothermal resources. Three financial support plans commenced in 2012 such as grant subsidies, investing equity capital, and liability guarantee for geothermal development.

In 2014, 23 projects applied to the grant subsidy body. 8 of the 23 projects were applied for by local industries and/or the local government, where 100% of the cost for the investigation is supported. 50-100% of the cost is supported for other private sectors. The total subsidy was about 28 million USD.

After the initial survey is completed, developers have to estimate the ability of the production. At this stage, JOGMEC can invest up to 50% of the equity capital of the company. No equity capital was invested in 2014.

At the construction stage of a power plant, a huge amount of money is required to drill sufficient numbers of wells. Therefore, JOGMEC guarantees the loans which private companies borrow from private financial institutions when they attempt to construct a geothermal power plant if they need to be financed from institutions such as development funds. Under this program, JOGMEC provides a liability guarantee for up to 80% of the total loan. 3 projects were applied for at the end of 2014.

METI (Ministry of Economy, Trade and Industry) also started a plan to increase the understanding of local residents in regards to geothermal power generation in 2013 and 52 bodies adopted this in 2014.

1.3 National Programme

One of the most important implemented policies for Japanese energy is the Strategic Energy Plan pursuant to the law concerning the “Basic Act of Energy Policy”, which is based on a long-term, comprehensive and systematic perspective. The act was created in June 2002 and the fourth revision was issued in 2014, where saving energy and introducing renewable energy as well as improving the efficiency of thermal power generation were suggested to cause lower dependency on nuclear power generation. However, it did not provide a concrete percentage of each power source for 2030 because the circumstances surrounding energy changed drastically since the Great East Japan Earthquake on 11th March 2011 and the following nuclear power plant accident.

For the development of geothermal energy, one of the barriers for the construction of a geothermal power plant is that higher potential sites are located in national parks where development is prohibited. However, after the accident, there is much greater interest in clean, renewable forms of energy because they are much safer. The Ministry of the Environment issued a guideline which lifted restrictions on drilling at national parks in 2012 and the new relaxation guideline will be issued in the near future.

1.4 Industry Status & Market Development

After the disaster happened, geothermal energy attracted attention as one of the renewable energy sources for the reduction of CO_2 emission into the atmosphere and for increasing the amount of resources for energy security. However, a large geothermal power plant needs 10 or more years to be constructed.

Although no large scale geothermal power plant has been constructed for over a decade, recently some areas slated for construction or operation of geothermal

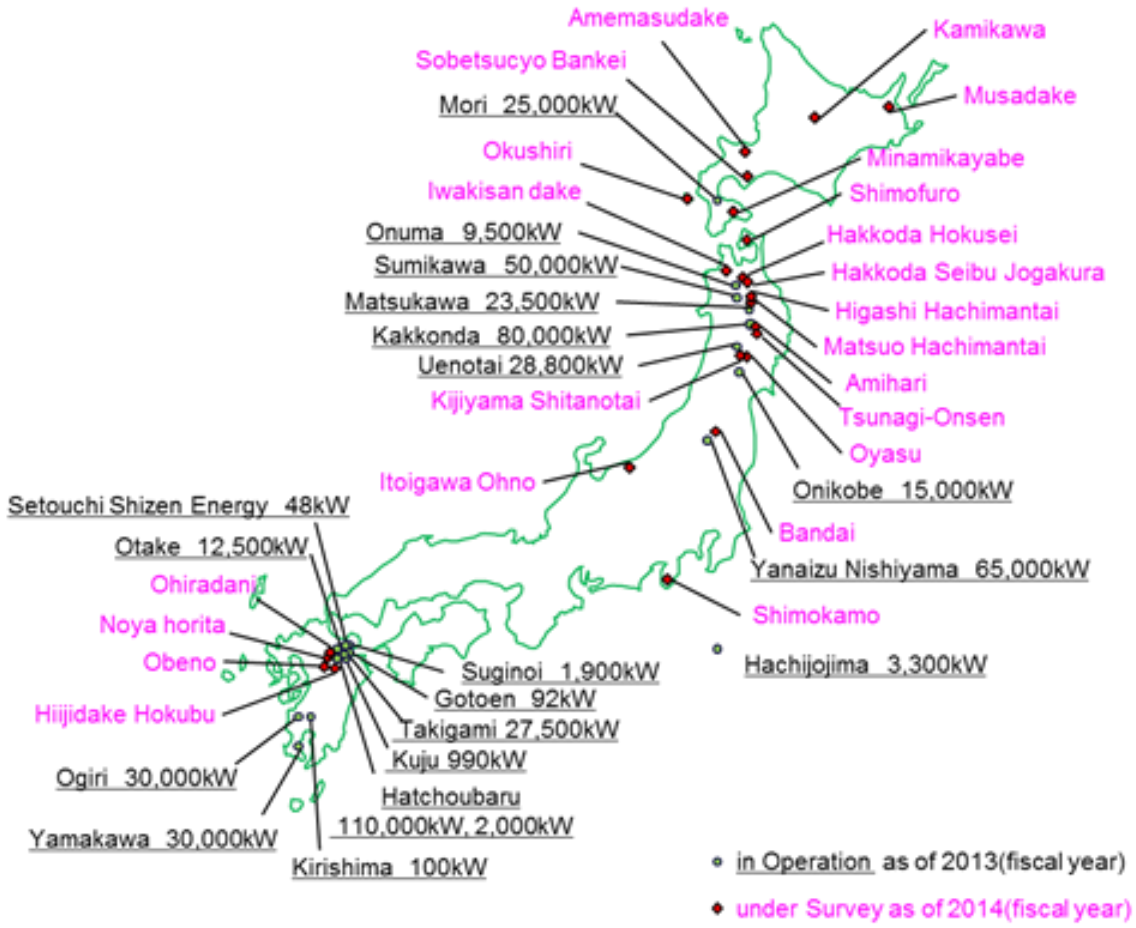

Figure 5 Geothermal projects in Japan as of 2014

power plants have appeared . Wasabizawa geothermal power plant, one of new geothermal power plants, is under the EIA (Environmental Impact Assessment) process and will be commenced to operate with a capacity of 42MW in 2019.

There are several small geothermal power plants which started to operate in 2014.

1.5 Research, Development & Demonstration

In 2013, budgets for research and technology development using geothermal energy were created after a more than 10 year suspension of financial support by the Japanese government. Two governmental enterprises, JOGMEC and NEDO (New Energy and industrial technology Development Organization), started their projects for geothermal energy development. JOGMEC focuses on subsurface investigation and technology development while NEDO is mainly concerned with electricity generation and technologies for above-ground equipment.

An airborne geophysical survey by a helicopter began to be conducted in 2013 aiming to acquire basic data for the evaluation of geothermal resources in order to promote geothermal development. Most geothermal resources are located within national parks or in mountainous areas where access is difficult. In fact, about 80% of geothermal resources exist in natural parks in Japan. An airborne geophysical survey is, therefore, an effective method to acquire data over a wide area without any modification of the land surface.

JOGMEC launched the Geothermal Reservoir Evaluation and Management Project in 2013 at Yanaizu-Nishiyama geothermal power plant area. For this project, JOGMEC has tried to stabilize the production of subsurface geothermal steam and hot water

by not only improving accuracy in evaluation of behavior of the fluid, but also recharging water to the geothermal reservoir. Drilling of the recharge well was completed in 2014 and recharge will commence from 2015.

NEDO launched a new R&D program in 2013 concerned with the improvement of geothermal power generation. The program consists of many projects, including hybrid generation systems, extraction of scaling in brine, simulation techniques for environmental assessment, etc. The program has been funded and will continue until 2017.

Figure 6 Airborne Electro-Magnetic Survey

1.6 Future Outlook

For Japan, which depends largely on fossil fuel from abroad, energy security is always a significant issue. Japan's energy supply would be easily affected by external factors due to its high dependency on overseas fossil fuel. Due to an increase of fossil fuel imports, Japan faces further dependency on the Middle-East, a rise in electricity prices and a rapid increase of greenhouse gas emissions.

Geothermal power, which has a higher operating rate compared to other renewable sources of energy, is expected to serve as a long-term stable energy source. Japan has the world's third largest reserve of geothermal resources (23,400MW) but to date only 515MW has been developed.

The Japanese government has been trying to expand the developable area, reduce investment risk, and promote the understanding of local people. These measures have brought new interest in geothermal development, and 23 locations across the country are being surveyed for potential geothermal power generation by electric power companies, oil companies, construction companies, local governments, and other entities. This is hopefully the start of booming geothermal development in the near future.

1.7 Publications and Websites

Thermal and Nuclear Power Engineering Society (2014): The Present State and Trend of Geothermal Power Generation of Japan in the Fiscal Year 2013 (in Japanese).

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