IEA GEOTHERMAL

# Japan Country Report
# 2013

## IEA Geothermal
## Implementing Agreement

# National Activities

## Chapter 14 of Draft 2013 GIA Annual Report

# Japan

**Figure 1.** Drilling of an investigation well at the Toyako-Onsen field in Hokkaido, Japan, conducted by Toyako Spa Association.
(Photo courtesy of JOGMEC)

## 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 policy was made by the government that nuclear power plants older than 40 years old would be decommissioned. In order to supplement the electricity shortage, power plants using renewable energy as well as the conventional thermal power plants had to operate.

Many renewable energy power plants are powered by solar energy, which has more economical advantages in Japan's Feed-In-Tariff (FIT) initiated in July 2012. They have been constructed under the policy of the Japanese government. The policy, however, has been pointed out to have a lot of faults. One of the faults is that the number of solar power plants has rapidly increased and no power lines are available for other renewable energy power plants like geothermal. The installed capacity of solar power has also reached a level beyond the acceptable capacity of some electric power companies. Moreover, the government have also changed their plan for electricity supply. 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 organisation, as well as the local government agree on the commencement of operations. No nuclear power station will begin electricity generation before the end of 2014.

The environment around geothermal power generation has been changing but the promotion of the development of geothermal energy has continued. New geothermal R&D projects funded by the government were started by JOGMEC and NEDO in 2013. A plant with small binary power generation was designed to operate in a spa area in order to demonstrate the utility of hot water. JOGMEC subsidies and other financial support policies have been implemented since 2012. More than 20 applications were accepted for the subsidy, which could be applied for investigation of geothermal sites. Another topic of geothermal energy development is the construction of the renewable energy research centre of AIST, where R&D programs for renewable energy are conducted. Two R&D teams for geothermal energy were constructed in the institute. Although there were several schemes to encourage geothermal energy development, no new power plants were constructed or operated in 2013 because of their long lead time. A total installed capacity of 515.1 MW was announced in 2013. A new power plant with 42MW of installed capacity is expected to be operational in 2019.

| Electricity | |
|---|---|
| Total Installed Capacity ($MW_e$) | 515 |
| New Installed Capacity ($MW_e$) | 0 |
| Contribution to National Capacity (%) | 0.2 |
| Total Generation (GWh) | 2,620 |
| 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

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

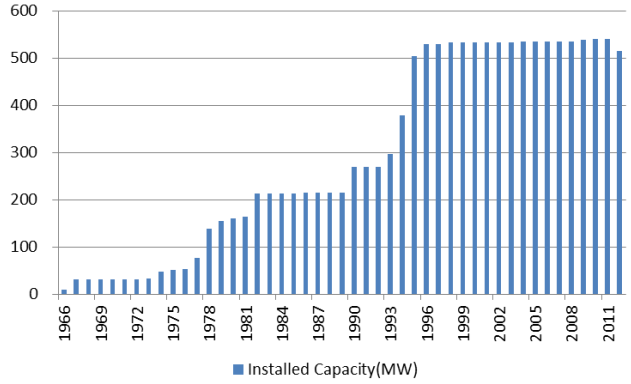


**Figure 2.** Total installed capacity of geothermal power plants in Japan.

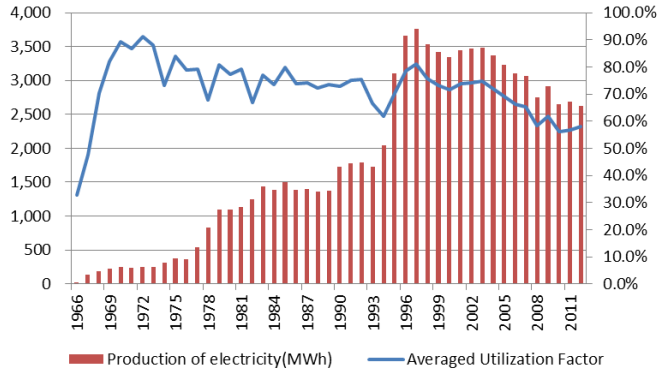


**Figure 3.** Total production of electricity and average utilization factor of geothermal power plants in Japan.

## 2. Highlights and Achievements

- 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, started their projects for geothermal energy development. JOGMEC (Japan Oil, Gas and Metals National Corporation) focuses on subsurface investigation and technology development. NEDO (New Energy and industrial technology Development Organization) mainly concerns electricity generation and technologies for above-ground equipment.

- As well as the development of conventional power generation, binary systems enabled small scale electrical generation. Some hot spring owners are interested in geothermal power generation with small installed capacity using their hot water. A demonstration plant started to operate to obtain data for small geothermal generation. Owners as well as local governments applied for subsidies for the investigation of small geothermal power plants and most of the plans supported by JOGMEC's subsidy were for power plants with installed capacity of less than 100kW.
- Fukushima Renewable Energy Institute, AIST (FREA) was established in 2013 and a geothermal energy team and a shallow geothermal and hydrogeology team were formed to develop innovative technologies. The first symposium of the JBBP (Japan Beyond Brittle Project) was also held in March 2013. The nuclear accident happened in March 2011. As the Japanese fiscal year starts in April and ends in March, the 2012 fiscal year was the year of planning and in 2013 the prepared budget was provided by the government.
- A total installed capacity of 515.1MW was announced in 2013. This was less than in 2012 because the installed capacity at the Mori Power Plant was changed to 25MW, half of the previous output, due to a decrease in steam. Geothermal energy usage in the form of direct use possibly increased but there was no statistical data available in 2013.

## 3. National Programme

Japan Oil, Gas and Metals National Corporation (JOGMEC), established in 2004, integrates the functions of the former Japan National Oil Corporation (JNOC) and the former Metal Mining Agency of Japan (MMAJ) These were in charge of securing a stable supply of oil and natural gas, and ensuring a stable supply of nonferrous metal and mineral resources respectively, 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 a fall in the temperature 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 a granting subsidy, investing of equity capital, and liability guarantee for geothermal development. In 2013, twenty projects applied to the granting subsidy, half of which were projects started in 2012 which were being continued.

Seven of the 20 projects were applied for by local companies or the local government, where 100% of the cost for the investigation is supported, while 75% of the cost is supported for other private sectors. The average subsidy was about 30 million USD. 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.

One of the most important implemented policies forJapanese energy is the Strategic Energy Plan pursuant to the law concerning "Basic Act of Energy Policy", which is based on a long-term, comprehensive and systematic perspective. The act was created in June 2002 and followed by the first Strategic Energy Plan which was drawn up in October 2003. The plan is scheduled to be revised every three years. The fourth revision was expected in 2013 but the circumstances surrounding energy changed drastically in the Great East Japan Earthquake and the following nuclear power plant accident. In the third plan announced in 2010, about 70% of electricity production in 2030 will be expected from the low carbon emission energies such as nuclear energy and renewable energies including geothermal. However, it is now not known how many nuclear power plants will be in operation due to the accident caused by the tsunami and the following objections against nuclear power. The revision of the plan was therefore postponed until April 2014.

## 4. Industry Status & Market Development

- A new institute in the AIST (National institute of Advanced Industrial Science and Technology, a governmental enterprise) was established in October 2013. The new institute is called Fukushima Renewable Energy Institute, AIST (FREA), and has two basic missions: the promotion of R&D into renewable energy, which is open to the world; and to make a contribution to industrial clusters and reconstruction. Two research teams for geothermal energy, the geothermal energy team and the shallow geothermal

and hydrogeology team, were formed to develop innovative technologies in collaboration with domestic and international partners. All the research work in AIST has to be conducted in FREA and any remaining projects have moved from Tsukuba.

- After the disaster happened on 11th March 2011, geothermal energy attracted attention as one of the renewable energies 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. There were several plans for a small power generation plant using hot spring fluid. At the Obama Hot Spring in Nagasaki Prefecture, Kyushu Island, a demonstration plant started to generate electricity with the installed capacity of 216kW over three units in April 2013. The demonstration generation would last for one year to clarify problems with small power generation.

## 5. Research, Development & Demonstration

JOGMEC supports high-risk initial-stage surveys for promising geothermal resources, including geological surveys, geophysical surveys, and drilling surveys, in order to promote the development of geothermal resources. An airborne geophysical survey 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 are presently in natural parks in Japan. An airborne geophysical survey is, therefore, an effective method to acquire data over a wide area without modification of the land surface.

NEDO (New Energy and industrial technology Development Organization) launched a new R&D project in 2013 concerned with the improvement of geothermal power generation. The project included hybrid generation systems, extraction of scaling in brine, simulation techniques for environmental assessment, etc. Eight proposals were funded and will be continued up until2017.

## 6. Future Outlook

Hydrothermal and EGS reservoirs are developed in the brittle region from a lithological point of view, where pre-existing faults are dominant and the water recovery from an EGS reservoir is expected to be less than 50% in Japan as it is located on a fracture-rich tectonic belt. A new concept for EGS development was proposed where reservoirs are created in ductile basement. The proposal is called JBBP (Japan Beyond Brittle Project). There are several advantages to creating an EGS reservoir in the ductile region. For example, very high enthalpy fluid is expected in the high temperature ductile region, where fluid originates from subducted slab water. Moreover, it is simpler to design and control the reservoir because homogeneous rock properties and stress states are expected within the ductile region. A 100% recovery of injection water would be expected due to the hydraulically closed reservoir. One of the most advantageous characteristics is that induced earthquakes with damaging magnitudes would not occur in these reservoirs. An international symposium for JBBP was held in March 2013.

Japan Geothermal Developers' Council was dissolved in June 2013. The council was composed of the major geothermal developers and exchanged information among the members, carried out R&D for geothermal energy, and proposed suggestions and recommendation to policymakers. The Japan Geothermal Association, a successor of the council, was established in December 2012. Not only the geothermal developers but plant makers, turbine and generator makers, consultants, financiers, and others signed up as members of the new association.

A new geothermal power plant was planned in Akita Prefecture with an install capacity of 42MW in 2010, and the environmental assessment began in 2011, lasting for several years. The results of the assessment will be announced in 2014.

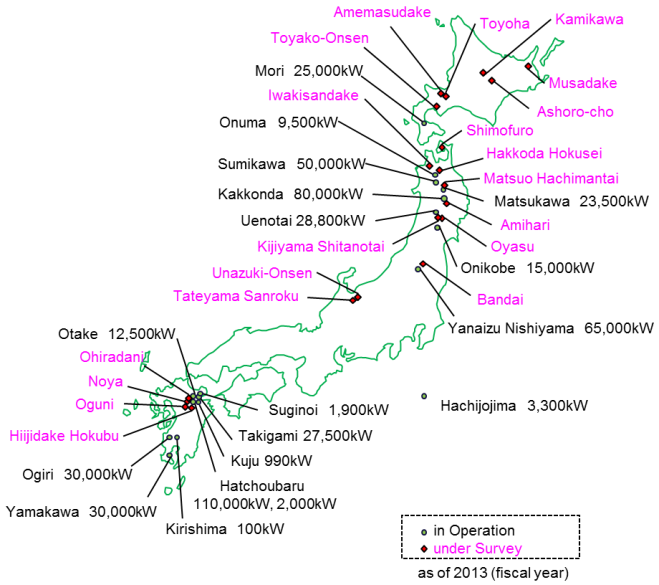


**Figure 4.** Geothermal projects in Japan as of 2013.

## 7. Publications and Websites

Thermal and Nuclear Power Engineering Society (2013): The Present State and Trend of Geothermal Power Generation of Japan in the Fiscal Year 2012. (in Japanese).

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# *To Find Out More*

**If you are interested in learning more about the IEA Geothermal Programme, or you wish to join the GIA:**


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**Cover Photo:** Courtesy of JOGMEC