Current Situation of Geothermal Power Generation in Japan

Japan Oil, Gas and Metals National Corporation
JOGMEC’s Mission and Activities

Mission
Secure constant and stable supplies of oil, natural gas and mineral resources to support industries and citizens in Japan through various activities relating these resources. In 2012 Geothermal function was added to the role of JOGMEC.

Activities

- Oil & Gas Upstream Investment and Research & Development
- Metals Strategy & Exploration, and Technology Development
- Stockpiling
- Mine Pollution Control
- Coal Strategy & Exploration, and Technological Support
- Geothermal Resources Development
Geothermal Power Plants in Japan

**Main geothermal power plants in Japan**

- **Matsukawa**: 23,500kW
- **Mori**: 25,000kW
- **Ohnuma**: 9,500kW
- **Sumikawa**: 50,000kW
- **Uenotai**: 28,800kW
- **Kakkonda**: 80,000kW
- **Onikoube**: 15,000kW
- **Yanaizu Nishiyama**: 65,000kW
- **Ohtake**: 12,500kW
- **Sugawara**: 5,000kW
- **Ohgiri**: 30,000kW
- **Yamakawa**: 30,000kW
- **Suginoi**: 1,900kW
- **Takigami**: 27,500kW
- **Kuju**: 990kW
- **Hacchouraru**: 110,000kW, 2,000kW
- **Kirishima**: 100kW

**Installed Capacity**

Total Installed Capacity: 525MW

**Electricity Generated**

Decreasing gradually for the past dozen years or so

Source: TENPES, JOGMEC
Japan has the world’s third largest reserve of geothermal resources (23,400 MW), however has only 520 MW (2.2%) to have been developed.
Geothermal Potential Area in Japan

- Approximately 80% of energy potential of geothermal is located within the areas of Natural Parks stipulated by Natural Parks Act.
- Consequently, Geothermal Power Plants have been developed mainly outside of these natural parks.
- However, after the accident at nuclear power plants in Fukushima, Ministry of Environment issued the guideline which lifted restrictions on drilling at national parks.

<table>
<thead>
<tr>
<th>Category of Natural Parks</th>
<th>Potential (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special Protection Zone</td>
<td>7,000MW</td>
</tr>
<tr>
<td>Special Zone I</td>
<td>2,600MW</td>
</tr>
<tr>
<td>Special Zone (II &amp; III)</td>
<td>7,700MW</td>
</tr>
<tr>
<td>Ordinary Zone</td>
<td>1,100MW</td>
</tr>
<tr>
<td>Outside of Natural Parks</td>
<td>5,000MW</td>
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<tr>
<td>Total</td>
<td>23,400MW</td>
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Japanese government initiated Japan’s Feed-In-Tariff (FIT) in 2012 to accelerate the introduction of renewable energy.

<table>
<thead>
<tr>
<th>Energy source</th>
<th>Solar PV</th>
<th>Wind power</th>
<th>Geothermal power</th>
<th>Small- and medium-scale hydraulic power</th>
</tr>
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<tbody>
<tr>
<td>Procurement category</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 kW or more</td>
<td>Less than 10 kW (purchase of excess electricity)</td>
<td>20 kW or more</td>
<td>Less than 20 kW</td>
<td>15,000 kW or more</td>
</tr>
<tr>
<td></td>
<td>280,000 yen/kW</td>
<td>300,000 yen/kW</td>
<td>1,250,000 yen/kW</td>
<td>790,000 yen/kW</td>
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<td>427,000 yen/kW</td>
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<tr>
<td>Installation cost</td>
<td>280,000 yen/kW</td>
<td>300,000 yen/kW</td>
<td>1,250,000 yen/kW</td>
<td>790,000 yen/kW</td>
</tr>
<tr>
<td>Operating and maintenance costs (per year)</td>
<td>300,000 yen/kW</td>
<td>1,250,000 yen/kW</td>
<td>790,000 yen/kW</td>
<td>1,230,000 yen/kW</td>
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<tr>
<td>Pre-tax IRR</td>
<td>6%</td>
<td>3.2%(*1)</td>
<td>8%</td>
<td>1.8%</td>
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<tr>
<td></td>
<td>7%</td>
<td>7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Procurement period</td>
<td>20 years</td>
<td>10 years</td>
<td>20 years</td>
<td>15 years</td>
</tr>
<tr>
<td>Tax inclusive</td>
<td>38.88 yen</td>
<td>41.04 yen</td>
<td>23.76 yen</td>
<td>28.08 yen</td>
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<tr>
<td>Tax exclusive</td>
<td>36 yen</td>
<td>38 yen</td>
<td>22 yen</td>
<td>26 yen</td>
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<tr>
<td>Procurement price per kWh</td>
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Japanese government initiated Japan’s Feed-In-Tariff (FIT) in 2012 to accelerate the introduction of renewable energy.
Ministry of Economy, Trade and Industry, METI, announced “Long-term Energy Supply and Demand Outlook” pursuant to the policies of the Strategic Energy Plan, what mentioned Geothermal energy would be increased to 1.0-1.1% of Primary energy by FY 2030.
Our Big Goal
Promote the activation of domestic geothermal development.

Action assignments
✓ Financial supports for cost issue
✓ Reduce exploration risk (Geological aspect)

JOGMEC implements three approaches
✓ Financial supports
  (Subsidy, Equity Capital, Finance, Liability Guarantees)
✓ Technology development
✓ Regional air-borne geophysical survey
Outlines of Financial Assistance

**Potential Survey**
- Geological Survey
- Geophysical Exploration
- Structural Boring

**Exploration**
- Drilling of Investigation Well
- Discharge Test

**EIA**
- Environmental Impact Assessment

**Development**
- Drilling of Production Well & Reinjection Well
- Construction, Start-up & Commissioning of Power Plant

**Operation**
- Commercial Operation

**Resource Risk**
- Up to 50%~100%* of necessary funds
- Up to 50% of equity capital (JOGMEC is not allowed to be the largest shareholder.)
- Up to 80% of loan provided by financial institutions

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Financial Assistance provided by JOGMEC

- **Subsidy**
- **Equity Capital**
- **Liability Guarantees**

Air-Borne Geophysics By JOGMEC
Currently, more than 40 exploration projects are on the road by electric companies, oil companies, mining companies, local government and other entities.

- **Subsidized projects (47)**
- **Equity Capital projects (1)**
- **Liability Guarantee projects (3)**
Wasabizawa Geothermal Power Plant

- Wasabizawa geothermal power plant (in Yuzawa city, Akita prefecture) under construction and will be commenced to operate with a capacity of 42MW in 2019.
- This is the first large-scale project in about twenty years for constructing such a plant with a capacity of 10,000 kW or more.
- JOGMEC provide a liability guarantee for 80% (about 21 billion yen) of the total loan.
JOGMEC conducts heli-borne geophysical survey that aims to acquire basic data for the evaluation of geothermal resources in order to promote geothermal development start-up.

Time Domain Electromagnetic Survey (HTEM)

Air-borne Gravity Gradiometer (AGG)

No limitation in national parks!
➢ Artificial recharge by river water (EGS technology)

The research and development to stabilize the geothermal production by improving evaluation accuracy of fluid flow, and optimizing artificial recharge technique

This project is carried out under a collaborative research with EPRI (Electric Power Research Institute in USA)

➢ Technology for Exploration of Geothermal Reservoirs

Improvement of exploration accuracy will be expected by applying the seismic method to image the geothermal reservoir structure by solving these issues.

➢ Drilling Technology

Develop the PDC* bit cutter and body for geothermal well drilling and conduct verification test in order to reduce a drilling cost.

*PDC : Polycrystalline Diamond Compact
Japanese Government has been trying to expand the developable area, reduce investment risk and promote understanding of local people.

JOGMEC has a important role to achieve above mission.

These measures is expected to bring new interest and new investment in geothermal development in the future.
Thank you for your attention!