Activities of JOGMEC
Geothermal Resources Development Department

Japan Oil, Gas and Metals National Corporation
• JOGMEC Overview
• JOGMEC Missions
  - Financial assistance
  - Potential Survey
  - Research and Development
Japan Oil, Gas and Metals National Corporation

Established 29 February, 2004
Capital JPYen 921 Billion (Approx. US $8.1B) (As of September, 2018)
Chairman&CEO Tetsuhiro Hosono
Employees 609 (As of 1 July, 2018)

Domestic Network (25) Tokyo Head Office, Technology & Research Center (Chiba), Kyushu Office
  Mine Pollution Control Project and Geothermal development Support Offices (4)
  Mine Pollution Control Project Support Office(1)
  Site Management Offices (15) –Oil & Gas Stockpile
  Metal Technology Center / Test Field Office

Overseas Offices (13) Beijing, Jakarta, Sydney, Washington D.C., Huston, Vancouver,
  Mexico, Lima, Santiago, Moscow, London, Abu Dhabi, Botswana

Head Office (Tokyo)  Technology & Research Center (Chiba)  Metals Technology Center (Akita)
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

4 Divisions (July 2018~)
Ministry of Economy, Trade and Industry, METI, announced “Long-term Energy Supply and Demand Outlook” pursuant to the policies of the Strategic Energy Plan, which mentioned Geothermal energy would be increased to 1.0-1.1% of the power supply by FY 2030.
Main geothermal power plants in Japan

Total Installed Capacity: 521MW

Installed Capacity & Electricity Generated
Decreasing gradually for the past dozen years

Total Installed Capacity: 521MW
• Geothermal Development in Japan

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**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
CONTENTS

- Geothermal Development in Japan
- JOGMEC Missions
  - Financial assistance
  - Potential Survey
  - Research and Development
Financial Assistance provided by JOGMEC

Subsidy
- Up to 50%~100%* of necessary funds (* depends on terms and conditions)

Equity Capital
- Up to 50% of equity capital (JOGMEC is not allowed to be the largest shareholder.)

Liability Guarantees
- Up to 80% of loan provided by financial institutions

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

Development / Maintenance Cost

Hatchobaru (Oita Pref.)
Adopted Projects from FY2012 to FY2017

As of end of Mar, 2018
• Geothermal Development in Japan

• JOGMEC Missions
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JOGMEC conducts air-borne geophysical survey which aims to acquire basic data for the evaluation of geothermal resources. From 2017, in order to accelerate the geothermal development furthermore, JOGMEC has started the heat flow drilling survey based on the outcome of air-borne geophysical survey. The structure and the temperature of underground is acquired through the heat flow drilling survey.

- Air-borne geophysical survey: 18
- Heat flow drilling survey: 4
• Geothermal Development in Japan
• JOGMEC Missions
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Reduction of Exploration Risks

Exploration Techniques for Geothermal Reservoirs

Uncertainty of Reservoir Prediction
- Missed geothermal Reservoirs
- Inappropriate geological model

➢ Improvement of Subsurface Imaging
➢ Proper Understanding of Reservoir Architecture

Evaluation & Management of Geothermal Reservoirs

Inappropriate Management of Reservoirs
- Vaporization
- Cooling
- Acidification

➢ Proper Understanding of Reservoir Conditions
➢ Optimizing Reservoir Utilization

(http://www.chikaikyo.com/chinetsu/)
Technology for Exploration of Geothermal Reservoirs

- 3D seismic, SQUITEM※, Borehole exploration techniques

Improvement of exploration accuracy will be expected by applying those methods to image the geothermal reservoir structure.

※SQUID: Superconducting Quantum Interface Device

TEM: Time domain transient electromagnetic
Research & Development

- **Drilling Technology**
  - **PDC bit development**
    Development of the PDC* bit cutter and body for geothermal well drilling and conduct verification test in order to reduce a drilling cost.

- **Lost Circulation Techniques**

- **Small sized High Power Rig Development**

- **Evaluation & Management of Geothermal Reservoir**
  - **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)

  - **Permeability Improvement Technology (Fracturing..)**
  - **Equipment Utilization Improvement Technology**
  - **Acid Reservoir Utilization Technology**

*PDC : Polycrystalline Diamond Compact

Yanaizu-nishiyama power plant
## Projects schedule

<table>
<thead>
<tr>
<th>R&amp;D Theme</th>
<th>Goals</th>
<th>Fiscal Year</th>
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<tbody>
<tr>
<td><strong>Exploration</strong></td>
<td><strong>Seismic exploration Technology</strong></td>
<td>2017-2022</td>
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<tr>
<td></td>
<td>30% improvement in the drilling success rate</td>
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<tr>
<td><strong>Drilling</strong></td>
<td><strong>Drilling Equipment Technology</strong></td>
<td>2017-2022</td>
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<tr>
<td></td>
<td>20% shortening of drilling term</td>
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<tr>
<td><strong>Evaluation &amp; Management of Geothermal Reservoir</strong></td>
<td><strong>EGS</strong></td>
<td>2017-2022</td>
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<tr>
<td></td>
<td>Prevention of production decline by long term EGS (Joint study with EPRI)</td>
<td></td>
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<tr>
<td></td>
<td><strong>Permeability Improvement Technology</strong></td>
<td></td>
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<tr>
<td></td>
<td>Establishment of methods to improve permeability of production/injection wells</td>
<td></td>
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<tr>
<td></td>
<td><strong>Equipment Utilization Improvement Technology</strong></td>
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<tr>
<td></td>
<td>60% improvement in the declination of production</td>
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<tr>
<td></td>
<td><strong>Acid Reservoir Utilization Technology</strong></td>
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<td></td>
<td>Geothermal development in the high temperature and acid geothermal field</td>
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- Shortening the development term
- Publication of the technical manual
- Improvement of the equipment utilization
- Publication of the guideline
International relation / Promote public acceptance

MOU with GNS Science (NZ)  JOGMEC-GNS 2nd Workshop  Information Exchange at the Geysers, USA

Promotion poster  Promotional conference  Special class for schools

Source: JOGMEC
## Conclusion

Japanese Government has been trying to expand the developable areas, reduce investment risk and raise public awareness towards geothermal development.

<table>
<thead>
<tr>
<th>Problem to be solved</th>
<th>Solution</th>
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<tbody>
<tr>
<td><strong>1. Exploration &amp; Production Businesses</strong></td>
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</tr>
<tr>
<td>(1) High risks in subsurface</td>
<td>(1) Feed-in Tariff</td>
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<tr>
<td>(2) Long lead-time from initial survey to operation</td>
<td>(2) Subsidy(★)</td>
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<tr>
<td>(3) Continuous investment for geothermal resource development</td>
<td>(3) Equity Capital Finance(★)</td>
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<tr>
<td>(4) Power lines to transmit Electricity</td>
<td>(4) Liability Guarantees(★)</td>
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<tr>
<td>(5) Technology &amp; Research Development(★)</td>
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<tr>
<td><strong>2. Volcanic Region Location</strong></td>
<td>(6) Deregulation, permission for the construction in the National Parks</td>
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<tr>
<td>(1) In the National Parks</td>
<td>(7) Raising public awareness and acceptance of geothermal resource development(★)</td>
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<tr>
<td>(2) Near the Hot Spring Resorts</td>
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<tr>
<td>⋯ Harmonizing with local communities and the environment</td>
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(★) JOGMEC’s support program
Thank you for your attention!