IRED Side event
iiESI Asian Workshop

JAPAN’s Energy Situation

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The University of Tokyo
Contents

1. Energy
2. Electricity
3. Electricity industry reform
4. Renewable energy
5. For the outlook of energy mix

Many of the pages uses materials prepared by the courtesy of METI.
1. Energy
Japan’s Energy Supply Structure

Source: Prepared based on “Comprehensive Energy Statistics (Preliminary Report for 2012)” issued by the Agency for Natural Resources and Energy.”

* “Renewables etc.” consists of solar power (0.1%), wind power (0.2%), geothermal heat (0.1%), and biomass (3.3%).
Final Energy Consumption in Japan

Japan has improved energy efficiency by approx. 40% after the oil crises in the 1970s as a result of positive actions by both public and private industrial sectors.

Japan intensively introduced "Energy Management System based on Energy Conservation Law", then achieved the lowest level of energy consumption per GDP in the world.

Energy Consumption: Japan’s Conservation Efforts

Primary energy use per real GDP of Japan

(Oil converted Mt /1 trillion yen)

Primary energy supply per GDP (2011)

(Index : Japan=1.0)

- Japan
- Germany
- France
- EU27
- Australia
- U.S.A.
- Canada
- Korea
- Middle East
- Indonesia
- India
- Thailand
- China
- Russia
- World

Source: Total Energy Statistics by ANRE/METI

Calculated according to IEA statistics
“Energy Conservation Law” was introduced in 1979.

The Law covers energy consumption in industry, commercial & residential and transportation sectors.

The Law specifies:
1) the framework which requires the business operators to annually measure and report their energy consumption to the Government,
2) energy efficiency standards for buildings and houses, and
3) the “Top Runner program” which is applied to household appliances, equipment and automobiles.

<table>
<thead>
<tr>
<th>Regulatory measures</th>
<th>Industry sector</th>
<th>Consumer sector</th>
<th>Transportation sector</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Commercial sector</td>
<td>Residential sector</td>
</tr>
<tr>
<td>✓ Annual reports to the Government by business operators with 1,500 or more kl/yr energy consumption</td>
<td>✓ 15,000 manufacturing plants &amp; offices</td>
<td>✓ Energy efficiency standards for buildings and houses (300m2 or more)</td>
<td>✓ Periodic reports by freight carriers and consigners</td>
</tr>
<tr>
<td>✓ 15,000 manufacturing plants &amp; offices</td>
<td>✓ Reduction efforts of 1% per year</td>
<td>✓ Top runner standards for household appliances, equipment, automobiles etc., 28 items in total (Account for about 70% of household energy consumption)</td>
<td>✓ Reduction efforts of 1% per year</td>
</tr>
<tr>
<td>✓ Reduction efforts of 1% per year</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Acceleration of Use of Energy Management System

- Energy Management Business, such as ESCO, Energy Service Company, is becoming more common.
- In addition, the energy management business including the multi-base package management for two or more consumers and demand watch and control, is also expanding.
- Registration system for energy management service provider is established and program in which they achieve more efficient and effective energy-saving by introduction of Energy Management System (EMS), is added to object program in Subsidies for Supporting Business Operators Strive to Rationalize Their Energy Use in FY 2014 budget.

Main Service Contents

- **Visualization service**: Give electricity consumption in real time (at 30 minutes interval)
- **Demand Response service**: Reduce the load on power grids
- **Diagnostic service**: Provide continuous energy-saving advice and make a proposal about renewal of facilities and systems.
- **Energy-saving service**: Provide Energy-saving service such as energy-saving advice, tuning and ESCO
Energy Management at Demand Side

- Handle electricity supply-demand problem with promotion of introduction of HEMS / BEMS, high efficient air conditioners, lighting and hot-water supply.
- Pursue energy efficiency of entire systems by managing entire houses and buildings.
- In addition, more efficient energy management can be realized by cross-management of houses and buildings, or regional management.

Installation of energy management equipment ➔ Optimize houses and buildings ➔ Regional or cross-regional optimization

Cooperate by buying equipment such as efficient air conditioners and lighting, and controlling them with HEMS or BEMS.

Net zero energy means that net annual primary energy consumption is approximately zero.
Demonstrations of Smart Community in Japan

Starting in FY2011, large-scale smart community demonstration projects have been proceeding in 4 regions across Japan that constitute representative examples of different concepts, with the participation of many residents, local governments, and corporations.

**Kitakyushu City**

**Designated supply area (Kitakyushu City)**

In an area where power is supplied by Nippon Steel Corporation, a pricing system is being implemented where the energy price fluctuates for 2 hours afterwards in accordance with the state of supply and demand of energy for the day, applicable to 50 business establishments and 230 households.

**Wide-area metropolis (Yokohama City)**

Introduction of an energy management system for an existing wide-area metropolis. As the sample number is high (4,000 households), demonstration using a variety of strategies is possible.

**Keihanna Science City**

**Housing development (Keihanna Science City)**

Demand response demonstration based on a point system is being implemented for general households (approximately 700 households) where PV or HEMS automatic control has not been introduced.

**Toyota City**

**Separated housing (Toyota City)**

Automatic control of home appliances in 67 homes. Secondary cells equipped in vehicles are used to supply energy to households. Approaches to drivers for reducing a traffic jam.
2. Electricity
LNG increase compensates for the decline of nuclear power.
There are 48 nuclear power plant units in Japan.
- All units (in red) are in a state of temporary shutdown as of February 24 2014.
- 20 units (in blue squares) are under review for restart by the Nuclear Regulation Authority in accordance with its new safety regulations.
Schedule of The New Nuclear Safety Regulation

Discussion with academics at the Commission of NRA

Review by experts
* Listening to other academics and electric utilities

Compile an outline of New Nuclear Safety Regulation (February 6)

Public Comment (until February 28)

Hearings from Experts, Electric utilities
(severe accident countermeasures only)

Draft texts of Nuclear Safety Regulation (April 10, 2013)

Public Comment (until May 10)

Publication • Enforcement (July, 2013)

Applications for restart were made in 19 reactors in 12 power-stations (as of Today)
Power Generation Share after the Quake

- The nuclear share in domestic electricity production has dramatically decreased due to the shut-down for periodical inspection after the quake. (Oh-I No. 3 and 4 resumed in July, 2012.)
- The thermal power share has increased up to 90%. The share of LNG thermal is about 50%.
- The replacement fuel costs of thermal generation is estimated to increase from FY2010 3.1 trillion Yen in FY2012 and 3.6 trillion Yen, respectively.

### Trend of Generation Share after 2010 (10 utilities and wholesale electricity utility)

![Graph showing the trend of generation share after the quake]

#### Fuel Cost Increase

| Power Category | Fuel Cost (FY2012) (Yen/kWh) | Cost Impact | Trillion Yen
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimation in FY2012</td>
<td>Estimation in FY2013 (※)</td>
<td></td>
</tr>
<tr>
<td>Nuclear</td>
<td>1</td>
<td>-0.3</td>
<td>-0.3</td>
</tr>
<tr>
<td>Coal</td>
<td>4</td>
<td>+0.1</td>
<td>+0.1</td>
</tr>
<tr>
<td>LNG</td>
<td>11</td>
<td>+1.4</td>
<td>+1.7</td>
</tr>
<tr>
<td>Oil</td>
<td>16</td>
<td>+1.9</td>
<td>+2.1</td>
</tr>
<tr>
<td>Total</td>
<td>-</td>
<td>+3.1</td>
<td>+3.6</td>
</tr>
</tbody>
</table>
In 2011, due to the increase in fuel import costs, Japan recorded a trade deficit for the first time in 31 years. The trade deficit is **11.5 trillion yen** in 2013.

Lowering fuel import costs is an urgent task for the Japanese government.
The Japan’s electricity rate (model rate for a typical household) is higher by 20% on average compared to that before the earthquake, due to the rate revisions due to the increased fossil fuel consumption as a result of suspended NPPs, and the rising prices of fuel.

Electricity cost fluctuation

The model rate for a typical household
(TEPCO, Yen/month)

[Note] The average model price
The calculation is based on the following settings: Meter Rate Lighting B, Demand charge of 30 A, monthly energy consumption of 290 kWh.
Solar energy promotion surcharge is inclusive since April 2011.
Renewable power energy promotion surcharge is inclusive since August 2012.
Comparison of Electricity Rate

- After the Earthquake, the electricity rate of Japan keeps rising due to the rate revisions owing to the increase of fossil fuel costs, and the rising renewable power energy promotion surcharge.
  (※0.29JPY/kwh (2012) → 0.4JPY/kwh (2013) → 0.75JPY/kwh (2014))

※Electricity rate for industry of Korea use the 2009 data for 2010 and 2013, and that of U.K. use the 2012 data for 2013
Source: IEA Energy Prices and Taxes (using the exchange rate of OECD)
CO2 emission before and after the Earthquake

- CO2 emission in FY2012 increased by 84 million tons compared with FY2010.
- Although the emission except for electricity (*) decreases slightly, that of electric utilities increased by 112 million tons in due to the increased use of thermal power generation to make up for the lack of nuclear.

<table>
<thead>
<tr>
<th>(Million t-CO2)</th>
<th>BY (FY1990)</th>
<th>FY2008</th>
<th>FY2009</th>
<th>FY2010</th>
<th>FY2011</th>
<th>FY2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greenhouse gas emission</td>
<td>1,261 (+1.6% from BY)</td>
<td>1,281</td>
<td>1,206 (+4.4% from BY)</td>
<td>1,256 (+0.4% from BY)</td>
<td>1,307 (+3.6% from BY)</td>
<td>1,343 (+6.5% from BY)</td>
</tr>
<tr>
<td>CO2 emission for energy</td>
<td>1,059</td>
<td>1,138</td>
<td>1,075</td>
<td>1,123</td>
<td>1,173</td>
<td>1,208</td>
</tr>
<tr>
<td>Of which, for electricity</td>
<td>–</td>
<td>395</td>
<td>353</td>
<td>374</td>
<td>439</td>
<td>480 (+71% from BY)</td>
</tr>
<tr>
<td>Of which, for non-electricity</td>
<td>–</td>
<td>743</td>
<td>722</td>
<td>749</td>
<td>734</td>
<td>722</td>
</tr>
</tbody>
</table>

1: Removals by forest and other carbon sinks (forest carbon sink measures and urban revegetation etc) that can be used toward achieving the target. The removals by forest carbon sink measures exceeded the upper limit (238.3 Mt-CO2 for the five years) set for Japan for use toward achieving the target, therefore the value is the upper limit per year.

2: Acquired by the government: Total credits that were acquired as of FY2013 year-end through the Kyoto Mechanisms Credit Acquisition Program (97.493 Mt) Acquired by the private sector: The amount of credits that were acquired by the Federation of Electric Power Companies of Japan (According to the Environmental Action Plan by the Japanese Electric Utility Industry [FY2013])

3: Total emission and removals for the Kyoto Protocol target will be finalized after the technical review process under the Kyoto Protocol and the Convention to be conducted in FY2014. Also, the Kyoto mechanisms credits will be finalized after the true-up period for the first commitment period (expected to be completed in the second half of 2015 or later).

If the forest and other carbon sinks and Kyoto mechanisms credits are taken into account, Japan will have achieved its target for the CP1 of the Kyoto Protocol (-6% below base year level).
History of Japan’s Energy Policy

1970s  
[(1) Responding to the oil crises (1970s-80s)]
   - Energy security

1973: First oil shock
1979: Second oil shock

1980s  
[(2) Promoting regulatory reform (since 1990s)]

1990s  
[(3) Coping with global warming issues (since 1990s)]
   - Energy security + Economic efficiency + Environment = 3Es

1997: Kyoto Protocol adopted
2005: Kyoto Protocol came into effect

2000s  
[(4) Enhancing resource security (2000s)]

2002: Basic Act on Energy Policy enacted

[(5) Strategic Energy Plan]

[(6) New Strategic Energy Plan (April 2014)]
   - Safety + Energy security + Economic efficiency + Environment + Global viewpoint + Economic Growth
3. Electricity Industry Reform
## History of Reforms in Japan

No competition in the electricity market before 1995: 10 vertically-integrated General Electricity Utilities (GEUs) dominated and controlled the market.

METI embarked series of reforms...

<table>
<thead>
<tr>
<th>No.</th>
<th>Year enforced</th>
<th>Overview</th>
</tr>
</thead>
</table>
| 1   | 1995          | • Open the IPP (Independent Power Producer) market  
• Allow specified-scaled and vertically integrated power generators |
| 2   | 2000          | • Introduce partial retail competition  
• Accounting separation of transmission/distribution sector |
| 3   | 2005          | • Expand retail competition  
• Establish the wholesale power exchange (JEPX) and its supporting body for transmission in wider areas |
| 4   | 2008          | • Modify the rule of wheeling rates |
Problem revealed by 3.11

• The Great Earthquake in 2011 revealed negative aspects of regional monopoly system with 10 big and vertically integrated EPCOs:
  1. Lack of interconnections with enough capacity among regions
  2. Little competition and strong price control
  3. Limit in handling the change in energy mix including the increase in renewables

Frequency in West: 60Hz

Frequency in East: 50Hz

- DC – direct current,
- BTB – Back-to-back frequency conversion

- Hokkaido 5.52 GW
- Tohoku 13.72 GW
- Chugoku 10.85 GW
- Kansai 26.82 GW
- Hokuriku 5.26 GW
- Chubu 24.78 GW
- Tokyo 50.78 GW
- Kyushu 15.21 GW
- Shikoku 5.26 GW

DC Tie line 0.6GW
DC Tie line 1.2GW
DC Tie line 2.4GW
DC Tie line 1.4GW
DC Tie line 5.57GW
DC Tie line 5.57GW
DC Tie line 2.4GW
DC Tie line 1.4GW
DC Tie line 5.57GW
DC Tie line 5.57GW
DC Tie line 2.4GW
DC Tie line 1.4GW
DC Tie line 5.57GW
DC Tie line 5.57GW
DC Tie line 2.4GW
DC Tie line 1.4GW
DC Tie line 5.57GW
DC Tie line 5.57GW
DC Tie line 2.4GW
DC Tie line 1.4GW
DC Tie line 5.57GW
DC Tie line 5.57GW
Roadmap for Electricity Market Reform in Japan

- 2 April 2013, Cabinet decided the “Policy on Electricity System Reform” to realize three objectives in Japan’s market with a three-step approach.

- 3 objectives:
  1. Securing a stable supply of electricity
  2. Suppressing electricity rates to the maximum extent possible
  3. Expanding choices for consumers and business opportunities

(1) Securing a stable supply of electricity
(2) Suppressing electricity rates to the maximum extent possible
(3) Expanding choices for consumers and business opportunities

- Full retail competition
- Period of transitional arrangement for retail tariff
- Abolishment of retail tariff
- Legal unbundling of transmission/distribution sector

- Establishment of the Organization for Cross-regional Coordination of Transmission Operators (OCCTO)

- Roadmap:
  - 1st Step: 2015
  - 2nd Step: 2016
  - 3rd Step: 2018-2020

- At around 2015: Transition to new regulatory organizations.
1st step: Establish the OCCTO

- Establish the Organization for Cross-regional Coordination of Transmission Operators (OCCTO) in 2015

  - Main functions of OCCTO
    1. Aggregate and analyze the EPCO’s supply-demand plans and grid plans, and order to change EPCO’s plans such as tie lines construction
    2. Order EPCOs to reinforce generations and power interchanges under a tight supply-demand situation
2nd step: Full Retail Competition

- Expand retail competition to the residential sector in 2016, opening a new market
- Maintain regulated tariffs to 10 big EPCOs at around 2018-2020

### Liberalized Sector (50kW~)
- Large factory
- Large building

### Regulated Sector (~50kW)
- Medium factory
- Small Factory

**Market Share:**
- Liberalized Sector: 63%
- Regulated Sector: 37%

**Market Volume:** ¥7.5 trillion (= $75bn, €54bn)
- Residential Customers: 76.8m
- Small shops and offices: 7.4m
3rd step: Unbundle the T/D sector

- Unbundle the transmission/distribution sectors of big EPCOs by ITO-style (“legal unbundling”) in around 2018-2020

<Note>
- Big EPCOs will be required to unbundle transmission and distribution companies from generation ones or retail ones, in “legal unbundling.”
- Both the holding company style and the affiliated company style, in which a generation and retail company has a transmission and distribution company as a subsidiary company, are allowed.

- Regional monopoly
- Network tariff
- Responsibility for maintaining frequency & providing LR service
- Code of conduct
4. Renewable Energy
History of Japan's Policy of Renewable Energy

Japan’s measures to increase the use of renewable energy shifted from (1) financial support through subsidies, (2) aid through placing an obligation on electric power companies to source part of their electricity from renewable sources (the RPS scheme), to (3) the feed-in tariff (FIT) scheme that requires electric power companies to purchase electricity at fixed prices.

Japan

(1) Support through subsidies (1997–)
- Enactment of the Act on the Promotion of New Energy Usage (New Energy Act)
  - Provides partial financial aid to private companies implementing new-energy projects and guarantee on loans taken from financial institutions.
  - Provides financial aid to local governments implementing new-energy projects.

(2) Support through placing an obligation (the RPS scheme) (2003–2012)
- Launch of the RPS Scheme in 2003
  - Requires electric power companies to source a specified proportion of their electricity from renewable sources (without fixed prices).

(3) Support through buyback at fixed prices (to give prospects for recovering investment) (2009–)
- Launch of the Residential Surplus Electricity Purchasing Scheme in 2009
  - Requires electric power companies to purchase home-generated solar power of less than 500 kW at the procurement price and for the procurement period set by the government.
- Launch of the Feed-in Tariff (FIT) Scheme in 2012
  - Requires electric power companies to purchase electricity produced from renewable sources, including solar, wind, hydro, geothermal and biomass at the procurement price and for the procurement period set by the government.
Under the feed-in tariff scheme, if a renewable energy producer requests an electric utility to sign a contract to purchase electricity at a fixed price and for a long-term period guaranteed by the government, the electric utility is obligated to accept this request.
## Tariffs and Durations (PV, Wind, Geothermal and Hydro)

<table>
<thead>
<tr>
<th>Energy source</th>
<th>Solar PV</th>
<th>Wind power</th>
<th>Offshore Wind</th>
<th>Geothermal power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procurement category</td>
<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>
</tr>
<tr>
<td>Tariff (per kWh)</td>
<td>32 yen (+ tax)</td>
<td>22 yen (+ tax)</td>
<td>36 yen (+ tax)</td>
<td>26 yen (+ tax)</td>
</tr>
<tr>
<td>Procurement period</td>
<td>20 years</td>
<td>10 years</td>
<td>20 years</td>
<td>20 years</td>
</tr>
</tbody>
</table>

- Act on Purchase of Renewable Energy Sourced Electricity by Electric Utilities (Feed-in Tariff Scheme for Renewable Energy)
  - Approved at the 177th session of the Diet 2011 and started on July 1st, 2012.

<table>
<thead>
<tr>
<th>Energy source</th>
<th>Small- and medium-scale hydraulic power</th>
<th>Small- and medium-scale hydraulic power (Utilization of existing headrace)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procurement category</td>
<td>1,000 kW or more but less than 30,000 kW</td>
<td>200 kW or more but less than 1,000 kW</td>
</tr>
<tr>
<td>Tariff (per kWh)</td>
<td>24 yen (+ tax)</td>
<td>29 yen (+ tax)</td>
</tr>
<tr>
<td>Procurement period</td>
<td>20 years</td>
<td>20 years</td>
</tr>
</tbody>
</table>
The main driver shifted to RPS in 2003, and then, to Feed-in Tariff in 2009.
As business environment from the financial point of view was improved, investment in RE has been stimulated. Then, extension and upgrading of the grid and regulatory reform become more important than ever.
Among the total electricity generated in fiscal 2012, renewable energy, etc. accounted for approximately 10%; 8.4% of which is hydraulic power generation.

Renewable energy other than hydro is still cost prohibitive.

Note: “Etc.” of “Renewable energy, etc.” includes the recovery of energy derived from waste, refuse derived fuel (RDF) products, heat supply utilizing waste heat, industrial steam recovery, and industrial electricity recovery.

Source: Prepared based on the Agency for Natural Resources and Energy’s “Outline of Electric Power Development in FY 2010”
Status after the start of the Feed-in Tariff

- Since FIT started (July 2012), the capacity of RE increased by 8.95 GWW (45%) as of the end of March 2014, during 21 month.
- Among the Res, PV is the super-highest in the share of deployment and that FIT application

### Deployment of renewable energy (as of the end of March 2014)

<table>
<thead>
<tr>
<th>Renewable Energy</th>
<th>Accumulated capacity before FIT started</th>
<th>Deployed capacity after FIT started (July 2012)</th>
<th>Certified capacity in FIT As of March, 2014</th>
<th>Target as of 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar power (residential)</td>
<td>4.7 GW</td>
<td>2.28 GW</td>
<td>2.69 GW</td>
<td>53.00 GW</td>
</tr>
<tr>
<td>Solar power (non-residential)</td>
<td>0.9 GW</td>
<td>6.44 GW</td>
<td>63.04 GW</td>
<td></td>
</tr>
<tr>
<td>Wind</td>
<td>2.6 GW</td>
<td>0.11 GW</td>
<td>1.04 GW</td>
<td>10.00 GW</td>
</tr>
<tr>
<td>Mid- to small-sized hydraulic (Less than 30MW)</td>
<td>9.6 GW</td>
<td>0.01 GW</td>
<td>0.30 GW</td>
<td>5.56 GW</td>
</tr>
<tr>
<td>Biomass</td>
<td>2.3 GW</td>
<td>0.12 GW</td>
<td>1.57 GW</td>
<td></td>
</tr>
<tr>
<td>Geothermal</td>
<td>0.5 GW</td>
<td>0.00 GW</td>
<td>0.01 GW</td>
<td>1.65 GW</td>
</tr>
<tr>
<td>Total</td>
<td>20.6 GW</td>
<td>8.95 GW</td>
<td>68.6 GW</td>
<td></td>
</tr>
</tbody>
</table>
Before the launch of the FIT scheme, residential use accounted for the majority of the market. The commercial market grew over time following the launch of the scheme, as seen in the increasing construction of mega solar power facilities (with capacity of 1000 kW or more), which were scarce before the launch.
Acceleration of RE deployment

- Steps toward problem solution – Technology development & corroboration, transmission & distribution network construction, rationalization of procedure for environmental assessment

**Technology development & corroboration**

Floating wind power generation station off Fukushima aiming at first actual operation in world

(Two 7MW stations will be installed from 2014 and onward: ¥28 billion)

**Construction of transmission and distribution networks**

GOJ paying for half the cost of constructing and testing transmission and distribution networks in appropriate places for wind power in Hokkaido and Tohoku

(2013: ¥25 billion, 2014: ¥15.05 billion)

**Rationalization of procedure for environmental assessment**

To shorten period of procedure for environment assessment of wind and thermal power generation, which usually takes 3 or 4 years

(2014: ¥2 billion)
Wind power generation costs are favorable even compared to thermal and hydro sources. As wind power is cost effective relative to other renewable sources, it is seen as a key to increasing the use of renewable energy. However, it should be noted that it has economies of scale.

66% of areas that have wind speed of over 6.5 meters per second—the level considered necessary to ensure business profitability—are concentrated in Hokkaido (45%) and Tohoku (21%).

Challenges to increase installations of wind power include improving the power grid in sites suitable for wind power generation (part of Hokkaido and Tohoku) and streamlining regulations.

Estimated wind power generation costs by capacity (by NEDO)

Sites suitable for wind power generation (part of Hokkaido and Tohoku)
Current Status of Japan’s Geothermal & Industry

- Geothermal power, which has a higher operating rate (70%) compared to other renewable generation, is expected to serve as a long-term stable energy source.
- Japan has the world's third largest reserve of geothermal resources (23,400 MW) but has only 520 MW of installed capacity, due to environmental and land-use constraints of people.
- The government eased regulations on development in designated national parks and monuments that have abundant geothermal reserves and are concentrated with sites that allow for power generation at low cost (March 2012). Projects are underway in Hokkaido, Tohoku, and Kyushu.
- Three Japanese manufacturers, Mitsubishi Heavy Industries, Toshiba, and Fuji Electric, account for 70% of the global market of geothermal turbines.

<table>
<thead>
<tr>
<th>Country</th>
<th>Geothermal resources (10,000 kW)</th>
<th>Installed capacity of geothermal power (10,000 kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>3,000</td>
<td>309.3</td>
</tr>
<tr>
<td>Indonesia</td>
<td>2,779</td>
<td>119.7</td>
</tr>
<tr>
<td>Japan</td>
<td>2,347</td>
<td>52.0</td>
</tr>
<tr>
<td>Philippines</td>
<td>600</td>
<td>190.4</td>
</tr>
<tr>
<td>Mexico</td>
<td>600</td>
<td>95.8</td>
</tr>
<tr>
<td>Iceland</td>
<td>580</td>
<td>57.5</td>
</tr>
<tr>
<td>New Zealand</td>
<td>365</td>
<td>62.8</td>
</tr>
<tr>
<td>Italy</td>
<td>327</td>
<td>84.3</td>
</tr>
</tbody>
</table>

World geothermal resources

Geothermal reserves in Japan (Inside or Outside of National Park)

Outside 21%
Inside 79%
Total 23,400 MW

Global geothermal turbine market share

Japan (70%)

Source: National Institute of Advanced Industrial Science and Technology, 2011

Source: Materials provided by the National Institute of Advanced Industrial Science and Technology, 2007

Source: Bloomberg

Current Status of Japan’s Geothermal & Industry

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- Japan has the world's third largest reserve of geothermal resources (23,400 MW) but has only 520 MW of installed capacity, due to environmental and land-use constraints of people.
- The government eased regulations on development in designated national parks and monuments that have abundant geothermal reserves and are concentrated with sites that allow for power generation at low cost (March 2012). Projects are underway in Hokkaido, Tohoku, and Kyushu.
- Three Japanese manufacturers, Mitsubishi Heavy Industries, Toshiba, and Fuji Electric, account for 70% of the global market of geothermal turbines.

World geothermal resources

<table>
<thead>
<tr>
<th>Country</th>
<th>Geothermal resources (10,000 kW)</th>
<th>Installed capacity of geothermal power (10,000 kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>3,000</td>
<td>309.3</td>
</tr>
<tr>
<td>Indonesia</td>
<td>2,779</td>
<td>119.7</td>
</tr>
<tr>
<td>Japan</td>
<td>2,347</td>
<td>52.0</td>
</tr>
<tr>
<td>Philippines</td>
<td>600</td>
<td>190.4</td>
</tr>
<tr>
<td>Mexico</td>
<td>600</td>
<td>95.8</td>
</tr>
<tr>
<td>Iceland</td>
<td>580</td>
<td>57.5</td>
</tr>
<tr>
<td>New Zealand</td>
<td>365</td>
<td>62.8</td>
</tr>
<tr>
<td>Italy</td>
<td>327</td>
<td>84.3</td>
</tr>
</tbody>
</table>

Geothermal reserves in Japan (Inside or Outside of National Park)

Outside 21%
Inside 79%
Total 23,400 MW

Global geothermal turbine market share

Japan (70%)

Source: National Institute of Advanced Industrial Science and Technology, 2011

Source: Materials provided by the National Institute of Advanced Industrial Science and Technology, 2007

Source: Bloomberg
The Ministry of Economy, Trade and Industry (METI) decided to newly establish a Working Group on Grid Connection of Renewable Energy under the New and Renewable Energy Subcommittee, the Committee on Energy Efficiency and Renewable Energy of the Advisory Committee for Natural Resources and Energy, in order to verify the utility companies' capacity of power grid connection for renewable energy, as well as to deliberate measures for increasing such capacity.

**Background:** The introduction of the Feed-in Tariff Scheme has rapidly expanded the dissemination of photovoltaic power generation facilities, utility companies are now facing issues of the limited capacity of power grid systems and that of adjusting the supply-demand balance across their service areas, making it difficult for them to accept additional connection requests. For example 18 GW FIT certification by the Government in Kyushu Island with 15 GW peak load.

**Objectives:** These issues may be an obstacle to introducing renewable energy sources to the maximum extent possible. Japan should closely verify the adequacy of utility companies' current measures for accepting such connection requests and should quickly discuss possible measures to address such issues.

For this purpose, METI decided to newly establish the Working Group on Grid Connection of Renewable Energy of experts from a neutral stance, so as to verify the grid capacity, within which utilities are able to accept CONNECTION REQUESTS, and to discuss possible measures for increasing such capacity.

Regarding the members of the WG, METI decided to invite experts who are familiar with the technology in the field, considering the technical and highly-professional subjects to be discussed. In addition, METI has asked the related industries to attend the meeting as observers. For details of the members, see the Japanese language press release.

The WG meetings, the first second ones being held on October 16th and 30th, will have more meetings in December to draw some conclusions by the end of this year.
History of Japan’s Energy Policy

1970s

1973: First oil shock
1979: Second oil shock

[(1) Responding to the oil crises (1970s-80s)]

1980s

[(2) Promoting regulatory reform (since 1990s)]

1990s

[(3) Coping with global warming issues (since 1990s)]

1997: Kyoto Protocol adopted
2005: Kyoto Protocol came into effect

[(4) Enhancing resource security (2000s)]

2002: Basic Act on Energy Policy enacted

[(5) Strategic Energy Plan]

[(6) New Strategic Energy Plan (April 2014)]

3Es = Enhanced resource security + Economic efficiency + Environment

Safety + Energy security + Economic efficiency + Environment + Global viewpoint + Economic Growth
Decision for the new energy mix

Based on the Strategic Energy Plan, the energy mix for the future will be decided in the near future.
The official discussions have been paralleled subcommittees of Energy Efficiency, RE, Nuclear, and Thermal Generation and Fuel.
The Energy mix will be decided based on the schedule of the restart of nuclear, RE integration, and the latest discussions on Global Environment including COP.

<table>
<thead>
<tr>
<th>Schedule</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Efficiency</td>
<td>Global Warming Summit</td>
<td>COP 20 Submit of CO2 target where possible (The First Q)</td>
</tr>
<tr>
<td>RE</td>
<td>Subcommittee</td>
<td>✓ Indicators of each sector ✓ Verification of potential, impact, limitation</td>
</tr>
<tr>
<td>Nuclear</td>
<td>Subcommittee</td>
<td>✓ Nuclear under deregulation ✓ Maintenance and development of technology and human resources ✓ Decommissioning</td>
</tr>
<tr>
<td>Thermal and Fuel</td>
<td>Committee</td>
<td></td>
</tr>
</tbody>
</table>

Decision of Energy Mix

- Outlook for the Japan’s Energy consumption including enhancement of energy efficiency
- Primary energy share and electricity cost
- R&D of energy technology (high-efficiency thermal, low cost fuel procurement)
Questions?

Special Exhibition
Masterpieces of Kōsan-ji Temple
Commemorating the Restoration of the National Treasure Scrolls of Frolicking Animals and Humans
October 7 to November 24, 2014

http://www.kyohaku.go.jp/eng/index.html