JAPAN ELECTRICITY MARKET AND THE ROLE OF RENEWABLES

ENERGY TRANSPARENCY 2013

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Bloomberg
NEW ENERGY FINANCE
JAPAN ELECTRICITY CONSUMPTION INTENSITY (MWh/PERSON)

Note: Japanese fiscal year runs from April to March

Source: The Federation of Electric Power Companies of Japan, IMF
JAPAN (MAXIMUM) PEAK DEMAND INTENSITY (kW/PERSON)

Source: The Federation of Electric Power Companies of Japan, IMF

Note: Japanese fiscal year runs from April to March
JAPAN MONTHLY ELECTRICITY CONSUMPTION (TWh)

March 2011 Tohoku earthquake/tsunami

Source: The Federation of Electric Power Companies of Japan
**FEED-IN TARIFFS**

- Provide predictable revenue stream for specified tenure
- Rates revised annually; the programme will be reviewed at least once in three years
- Financed by electricity consumers through a surcharge on their monthly bill

**INSTALLATION SUBSIDIES**

- Residential PV: up to JPY 35/W
- Residential/commercial PV: 3-5% of lease payments
- RE projects in Tohoku: 10% of CAPEX (up to JPY 500m/year for 4 years)

**TAX INCENTIVES**

- Choice of:
  - Superbonus depreciation (100% in year one) for FiT approved projects
  - Accelerated depreciation of up to 30% of original book value
  - Tax deduction of up to 7% of investment (SME)

**OTHERS**

- Ministries/local governments offer various other programmes that developers could enjoy on top of feed-in tariffs
FEED-IN TARIFF LEGISLATION

START DATE
1 July 2012

SECTOR
Biomass, geothermal, small hydro, solar and wind

TARIFF RATES
Set by Ministry of Economy Trade and Industry
Adjusted annually or mid year if the minister deems it necessary

COST COVERAGE
Surcharge (per kWh): charged on monthly electricity bill
<table>
<thead>
<tr>
<th>Sector</th>
<th>Capacity threshold</th>
<th>Rates (/kWh)</th>
<th>Term (year)</th>
<th>Capex assumption (/W)</th>
<th>Opex assumption (/W per yr)</th>
<th>Project IRR assumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geothermal</td>
<td>15MW+</td>
<td>JPY 26 ($0.27)</td>
<td>15</td>
<td>JPY 790 ($8.32)</td>
<td>JPY 33 ($0.35)</td>
<td>13.0%</td>
</tr>
<tr>
<td></td>
<td>&lt;15MW</td>
<td>JPY 40 ($0.42)</td>
<td>15</td>
<td>JPY 1,230 ($12.95)</td>
<td>JPY 48 ($0.50)</td>
<td>13.0%</td>
</tr>
<tr>
<td>Hydro</td>
<td>1 - 30MW</td>
<td>JPY 24 ($0.25)</td>
<td>20</td>
<td>JPY 850 ($8.95)</td>
<td>JPY 9.5 ($0.10)</td>
<td>7.0%</td>
</tr>
<tr>
<td></td>
<td>0.2 - 1MW</td>
<td>JPY 29 ($0.31)</td>
<td>20</td>
<td>JPY 800 ($8.42)</td>
<td>JPY 69 ($0.73)</td>
<td>7.0%</td>
</tr>
<tr>
<td></td>
<td>&lt;0.2MW</td>
<td>JPY 34 ($0.36)</td>
<td>20</td>
<td>JPY 1,000 ($10.53)</td>
<td>JPY 75 ($0.79)</td>
<td>7.0%</td>
</tr>
<tr>
<td>Solar</td>
<td>10kW+</td>
<td>JPY 36 ($0.38)</td>
<td>20</td>
<td>JPY 280 ($2.94)</td>
<td>JPY 10 ($0.11)</td>
<td>6.0%</td>
</tr>
<tr>
<td></td>
<td>(surplus buyback)</td>
<td>JPY 38 ($0.40)</td>
<td>10</td>
<td>JPY 427 ($4.49)</td>
<td>JPY 4.7 ($0.05)</td>
<td>3.2%</td>
</tr>
<tr>
<td></td>
<td>&lt;10kW</td>
<td>JPY 38 ($0.40)</td>
<td>10</td>
<td>JPY 427 ($4.49)</td>
<td>JPY 4.7 ($0.05)</td>
<td>3.2%</td>
</tr>
<tr>
<td>Wind</td>
<td>20kW+</td>
<td>JPY 22 ($0.23)</td>
<td>20</td>
<td>JPY 300 ($3.16)</td>
<td>JPY 6 ($0.06)</td>
<td>8.0%</td>
</tr>
<tr>
<td></td>
<td>&lt;20kW</td>
<td>JPY 55 ($0.58)</td>
<td>20</td>
<td>JPY 1,250 ($13.16)</td>
<td>-</td>
<td>1.8%</td>
</tr>
</tbody>
</table>

Note: Changes from inaugural assumptions are highlighted in orange. Rates exclude consumption tax (5%). Consumption tax is not applicable for residential. Residential sector enjoys installation subsidy. JPY 95/$; capex, capital expenditure; opex, operational expenditure (fuel cost excluded), IRR=internal rate of return. Source: METI
PROJECTS APPROVED UNDER FEED-IN TARIFF (MW)

<table>
<thead>
<tr>
<th>Month</th>
<th>Solar</th>
<th>Other renewables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jul 12</td>
<td>567</td>
<td>445</td>
</tr>
<tr>
<td>Aug 12</td>
<td>732</td>
<td>586</td>
</tr>
<tr>
<td>Sep 12</td>
<td>480</td>
<td>449</td>
</tr>
<tr>
<td>Oct 12</td>
<td>778</td>
<td>733</td>
</tr>
<tr>
<td>Nov 12</td>
<td>1,091</td>
<td>1,049</td>
</tr>
<tr>
<td>Dec 12</td>
<td>1,586</td>
<td>1,441</td>
</tr>
<tr>
<td>Jan 13</td>
<td>2,135</td>
<td>2,004</td>
</tr>
<tr>
<td>Feb 13</td>
<td>5,551</td>
<td>5,690</td>
</tr>
<tr>
<td>Mar 13</td>
<td>8,649</td>
<td>8,306</td>
</tr>
</tbody>
</table>

Source: Ministry of Economy Trade and Industry
# TOP 15 COUNTRIES FOR NEW INVESTMENT IN CLEAN ENERGY IN 2012 AND % CHANGE ON 2011 ($BN)

<table>
<thead>
<tr>
<th>Country</th>
<th>2012 Investment ($BN)</th>
<th>% Change on 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>65.13</td>
<td>20%</td>
</tr>
<tr>
<td>United States</td>
<td>35.58</td>
<td>-37%</td>
</tr>
<tr>
<td>Germany</td>
<td>22.80</td>
<td>-27%</td>
</tr>
<tr>
<td>Japan</td>
<td>16.28</td>
<td>75%</td>
</tr>
<tr>
<td>Italy</td>
<td>14.71</td>
<td>-51%</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>8.34</td>
<td>-17%</td>
</tr>
<tr>
<td>India</td>
<td>6.85</td>
<td>-45%</td>
</tr>
<tr>
<td>Australia</td>
<td>6.19</td>
<td>40%</td>
</tr>
<tr>
<td>South Africa</td>
<td>5.46</td>
<td>20563%</td>
</tr>
<tr>
<td>Brazil</td>
<td>5.34</td>
<td>-32%</td>
</tr>
<tr>
<td>Canada</td>
<td>4.41</td>
<td>-23%</td>
</tr>
<tr>
<td>France</td>
<td>4.31</td>
<td>-34%</td>
</tr>
<tr>
<td>Belgium</td>
<td>4.05</td>
<td>11%</td>
</tr>
<tr>
<td>Greece</td>
<td>3.42</td>
<td>179%</td>
</tr>
<tr>
<td>Spain</td>
<td>2.95</td>
<td>-68%</td>
</tr>
</tbody>
</table>

Note: Excludes corporate and government R&D

Source: Bloomberg New Energy Finance
CAPACITY CONVERTED FROM RPS SCHEME TO FEED-IN TARIFF (MW)

<table>
<thead>
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<th>Source: NEDO</th>
</tr>
</thead>
</table>

- Wind: 3,160
  - Switched from RPS to FiT: 2,520
  - Unchanged: 640
- Biomass: 2,353
  - Switched from RPS to FiT: 1,124
  - Unchanged: 1,229
- Hydro: 221
  - Switched from RPS to FiT: 185
  - Unchanged: 36
- Solar: 109
- Other: 18

Source: NEDO
JAPAN CUMULATIVE WIND INSTALLATIONS (MW) AND AVERAGE CAPACITY FACTOR (%)
WIND FARMS IN JAPAN

BY NUMBER OF PROJECT

- 1-10MW: 65%
- 10-20MW: 27%
- 20-30MW: 18%
- 30-40MW: 15%
- 40-50MW: 8%
- 50-60MW: 5%
- 60MW and larger: 1%

261 projects

BY CAPACITY

- 1-10MW: 18%
- 10-20MW: 27%
- 20-30MW: 21%
- 30-40MW: 15%
- 40-50MW: 8%
- 50-60MW: 5%
- 60MW and larger: 6%

2.5GW

Note: Projects less than 1MW are excluded

Source: Bloomberg New Energy Finance
ESTIMATED TIME REQUIRED BY FOR 10MW AND LARGER PROJECTS (YEARS)

Step 1: Project planning and design
Step 2-3: FiT process
Step 4-6: Contracting, EIA and construction

Solar
Wind
Geothermal

1.7-2.7 yrs
5.5-9.0 yrs
9.0-13.0 yrs

Note: EIA stands for Environmental Impact Assessment

Source: Bloomberg New Energy Finance
INTER-REGIONAL GRID ENHANCEMENT PLAN

60MWh battery @ substation

Kansai 30,950MW

Hokuriku 5,732MW

Chubu 27,093MW

Hokkaido 5,788MW

Tohoku 15,572MW

Tokyo 58,879MW

5,570MW

300MW

6,310MW

300MW

600MW → 900MW

FC 1,035MW → 2,100MW

60Hz ← 50Hz

Source: METI
US LNG COST BUILD-UP (TO JAPAN) ($/MMBTU)

Note: Short-run costs do not include the fixed charge, which must be paid on full contract volumes regardless of whether the buyer actually takes them. Regas & blending accounts for LPG reinjection to get US lean LNG (~1,020Btu/scf) to a HHV of closer to 1,090Btu/scf.

Source: Bloomberg New Energy Finance
Note: Data represents global ranges except for Japan CCGT scenario. Central scenario is representative of a typical developed market such as Western Europe and the US.

Source: Bloomberg New Energy Finance, IEA, Japan National Policy Unit
AVERAGE LEVELISED COST OF ONSHORE WIND, 1984-2012 (€/MWH)

WIND TURBINE PRICES HAVE FALLEN 29% SINCE 2008

Note: Learning curve (blue line) is least square regression: $R^2 = 0.88$ and 14% learning rate.

Source: Bloomberg New Energy Finance, ExTool
GRID-COMPETITIVE CLEAN ENERGY

New coal = Best Wind = Natural Gas at $6/MMBtu

Source: Bloomberg New Energy Finance
SCHEDULE OF KEY EVENTS FOR ELECTRICITY MARKET REFORM

2013  2014  2015  2016  2017  2018-

Retail market

Grid unbundling

Utilities’ voluntary measures to use the market

Wholesale market

Establishment of national operator

Supply assurance

Establishment of regulation body

Full liberalisation (lift entry regulation)

Capacity market launch

Real-time market launch

Social unbleasing

Liberalisation (lift regulations on wholesalers)

Hour-ahead market launch

Source: METI, Bloomberg New Energy Finance

Note: Schedules are soft targets and could turn to be hard targets after relevant bills pass the Diet.
Japan’s FiT has been successful in spurring investment in renewables: 21.7GW worth of applications approved by April 2013, however 90% of approvals are for solar PV (only 798MW of wind).

There is substantial uncertainty in how much electricity generation contribution the FiT-approved projects will make due to grid connection and curtailment rules for utility-scale projects.

For renewable resources to make a significant contribution to Japan’s electricity mix, significant restructuring of both the electricity market rules and the physical grid structure is needed.
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Carbon Markets
Energy Smart Technologies
Renewable Energy Certificates
Carbon Capture & Storage
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Nuclear

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