Energy Market Reform of Japan and Building Smart Community

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Growing Interest in Resilient Energy Infrastructure

- Many thermal power plants, as well as nuclear power plants, were damaged by Tsunami, and severe electricity shortage occurred in 2011.
- Resilient Energy Infrastructure is one of the main concerns in energy policy discussion.
On April 11, 2014, the Cabinet decided to approve the new Strategic Energy Plan of Japan as the basis for the orientation of Japan’s new energy policy, considering the dramatic changes in energy environments inside and outside Japan.

There are three key points in the amendments:

- The first is to clearly define a position for each source of energy, including nuclear power.
- Of particular note for the power structure is the departure from the policy of the DPJ to "seek zero nuclear power."
- Safety is given priority above all else, and there is a clear statement that the Nuclear Regulation Authority will permit the restart of plants that pass the world's strictest standards.
• The second is the addition of international and economic growth perspectives to the basic perspectives of energy policy, and an emphasis on their importance.
• In the past, perspectives have been known as "3 E + S" (energy supply stability, economic efficiency, environmental friendliness, safety), but the addition of two new perspectives will have significant implications in the formulation of specific policies and programs.

• The third is Regulatory(Market) reform.
• The period from now until around 2018-2020 is positioned as the “period of intensive reform to establish a stable supply and demand structure for energy,” a position that is explicitly stated in the basic plan.

The ultimate goal is probably the creation of "general energy companies" who are able to take a comprehensive approach to energy-related services. Regulatory reform is crucial to economic growth. Indeed, the two are equivalent.
Japan’s Electricity Market Outline

- **10 Vertically Integrated Power Companies (EPCOs) and New Entrance (PPSs)**
  - Retail competition for over 50 kW customers (62% of the market in 2013)
    - Share of non-EPCOs: 4.2% (2013)
    - 1.3% of the total retail market sales is transacted at JEPX (2013)
  - Average household electricity price was 21.26 yen/kWh before 3.11 (2011); 24.33 yen/kWh (2013) (24.81 yen/kWh in 1994)

*EPCO: Electricity Power Company
*PPS: Power Producers and Suppliers
*JEPX: Japan Electric Power Exchange

- **Frequency**
  - West Japan: 60Hz
  - East Japan: 50Hz
    - Hokkaido (peak demand: about 5.7 GW) is connected by DC line.

Frequency in West: 60Hz
- DC – Direct Current,
- FC – Frequency Conversion

Frequency in East: 50Hz

Source: METI (ANRE)
Problem Revealed by 3.11

- Negative aspects of regional monopoly system with 10 big and vertically integrated EPCOs were revealed in the Great Earthquake 3 years ago:
  1. Lack of system to transmit electricity beyond regions
  2. Little competition and strong price control
  3. Limit in handling the change in energy mix including the increase in renewables

* DC – direct current, FC – frequency conversion

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

METI embarked series of reforms...

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<thead>
<tr>
<th>No.</th>
<th>Year enforced</th>
<th>Overview</th>
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| 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... |

Source: METI(ANRE)
Electricity System Reform  <Roadmap>

April 2, 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
Electricity System Reform

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

Source: METI(ANRE)

* DC – direct current, FC – frequency conversion, TDSO – Transmission and Distribution System Operator
Electricity System Reform  <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**

- Large factory
- Large building
- Building
- Medium factory
- Small Factory

Share of total power: 63%

**Regulated Sector**

- Small shop
- Residential Customer

Market Volume: ¥7.5 trillion (= $75bn, €54bn)
Number of contracts
- Residential Customers: 76.8m
- Small shops and offices: 7.4m

Share of total power: 37%

Source: METI(ANRE)
Electricity System Reform  
<3rd Step : Unbundle The T/D Sector >

- Unbundle the transmission/distribution sectors of big EPCOs by legal unbundling style at around 2018-2020

Holding company

Generation company  
(Power generation)

Transmission/Distribution company
(System operation)  
(Transmission/distribution facilities)

Retail company

Competitive  
(Competition)

Regulated

- Regional monopoly
- Network tariff
- Responsibility for maintaining frequency & providing LR service
- Code of conduct

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.

Source: METI(ANRE)
Smart Energy Network Concept

**Supply side**
- Next generation conversion
- Sector integrated energy supply

**Demand side**
- Demand side management
- Mutual use of infrastructure

### Smart City
- CEMS
- Wind, Mega solar
- Renewables
- Interconnection with overseas grid
  - Direct current transmission
  - Ultrahigh voltage transmission

### Compact City
- Residential Area
  - Smart meter
  - Smart HE
  - LED, HP
  - Fuel Cell, Solar Battery

### Commercial Area
- Smart House
- Smart meter
- EV, PHV, FCV

### Industrial Area
- Large CHP

### Thermal network
- Area-wide thermal use, Coproduction, biomass, Hydrogen infrastructure

### Electricity
- Wind, Mega solar
- CHP, Battery, Renewables

### Information
- Electricity
- Thermal network
- CHP, Battery, Renewables

### Area-wide use of energy
The 4th Strategic Energy Plan of Japan
Constitution of Electric Power Supply Corresponding to Demand

For reference:

- **Peaking Power Source**: High cost, easy to control generation.
- **Intermediate Power Source**: Middle cost, able to control generation.
- **Base-Load Power Source**: Low cost, constant generation.

**Outcomes**:
- **New Energies** (2012FY):
  - Solar, Wind: 1.6%
  - Oil: 18.3%
  - LNG: 42.5%
  - Coal: 27.6%
  - Nuclear: 1.7%
  - Hydro: 8.4%

**2010FY**:
- Oil: 25.0%
- LNG: 42.5%
- Coal: 27.6%
- Nuclear: 28.6%
- Hydro: 8.5%

**Base-load Power Source**: Low production cost that can be operated stably day and night regardless of the time.

**Intermediate Power Source**: Production cost is next lowest to base-load source. Generation can be adjusted in accordance with electricity demand.

**Peaking Power Source**: Easy to control generation in accordance with electricity demand while production cost is high.

Source: Jetro