Negawatt Aggregation Services in Japan

November 19, 2014

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Demand Response Market in Japan

- A Negawatt exchange market is scheduled to be launched in 2017.
- The demand response market scale is about $700M.

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>⋮</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity System Reform</td>
<td>🔄 Cabinet Decision</td>
<td>🔄 Organization for Nationwide Coordination of Transmission Operators</td>
<td>🔄 Full Liberalization</td>
<td>🔄 Separation of transmission/distribution</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negawatt Transaction Market</td>
<td></td>
<td></td>
<td>🔄 Negawatt Market Guideline</td>
<td></td>
<td>🔄 Negawatt Exchange Market Open</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Demand Response Market in Japan (year)

- 7.5〜15.0 GW
  (Peak of power demand: 157GW)
- $375〜750 M
  (DR price rate: $50000/MW/year)
Technical Standardization of DR

- METI and JSCA consider the OpenADR2.0 protocol to be the standard of demand response in Japan.
- Waseda university have evaluated this protocol based on Japanese use cases.

Negawatt Aggregation Service for business

- Electric power consumers get a financial incentive as a reward of "Negawatts".
- Negawatt aggregation service started in Japan from July, 2012.
Main Customers of Aggregator in Japan

☑ Many special high-voltage customers are already have a supply and demand adjustment contract with an electric power company.
☑ Main customers of aggregators is the high-voltage ones in Japan.

- Smart meter and BAS/BEMS is already installed in a building.
- There is a supply and demand adjustment contract.

- Smart meter and BAS/BEMS is not installed in a building.

<table>
<thead>
<tr>
<th>contract electricity (kW)</th>
<th>Special high-voltage customers (50,000)</th>
<th>High-voltage customers (770,000)</th>
<th>Low-voltage users (71 million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>500kW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50kW</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
We provide two types of demand response, “Best Effort” and “Auto”. The auto-demand response is able to maximize the amount of Negawatt while maintaining a comfortable environment.

**Flow Charts of Demand Response**

**<Best Effort Demand Response>**

- Power Company → Aggregator → Customer
- Demand and Supply Planning
- Demand of Power Saving
- Demand of Power Saving

**<Auto-Demand Response>**

- Power Company → Aggregator → Customer
- Demand and Supply Planning
- Demand of a certain amount of Power-Saving
- Negawatt Prediction
- Yes or No
- Commitment of Negawatt
- Scheduling
- Maintaining a comfortable environment
- Automatic Control
- The end of power saving

On the day

The day before

Voluntary Power Saving Action

The end of power saving

[Time]
## Aggregation Service Conditions

<table>
<thead>
<tr>
<th></th>
<th>Electric Power Company A</th>
<th>Electric Power Company B</th>
<th>Electric Power Company C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Customer</strong></td>
<td>High-voltage (more than 50kW)</td>
<td>High-voltage (more than 50kW and less than 2,000kW)</td>
<td>High-voltage (more than 50kW and less than 500kW)</td>
</tr>
<tr>
<td><strong>Power-Saving Time Slot</strong></td>
<td>Weekday, 13:00 to 16:00</td>
<td>Weekday, 13:00 to 16:00</td>
<td>Weekday, specified time slot</td>
</tr>
<tr>
<td><strong>A Unit of Measure</strong></td>
<td>Amount of electricity for 30 min.</td>
<td>Amount of electricity for 30 min.</td>
<td>Amount of electricity for 60 min.</td>
</tr>
<tr>
<td><strong>Baseline</strong></td>
<td>Maximum value in a month</td>
<td>Average value of top 4 days in last 5 days</td>
<td>Value in same time slot previous day</td>
</tr>
</tbody>
</table>
| **A Unit of Price**   | ¥15/kWh (Best effort)  
¥30/kWh (AutoDR)                                               | About ¥225/kWh (Floating)                                                                | About ¥240/kWh (Floating)                                                                |

There is no penalty and no basic payment independent on demand response dispatch.
### Number of Demand Response Dispatch

<table>
<thead>
<tr>
<th>Electric Power Company</th>
<th>2012 Summer</th>
<th>2012 Winter</th>
<th>2013 Summer</th>
<th>2013 Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company A</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Company B</td>
<td>1</td>
<td>-</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Company C</td>
<td>0</td>
<td>-</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Company D</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Company E</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Company F</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Demand responses have been dispatched only 17 times over two years from 3 electric power companies.
Issues of Negawatt Aggregation Services

These issues should be solved to vitalize the nagawatt aggregation markets in Japan

- Low negawatt price
- No standardized procedures
- Equipment cost burden
- Low dispatch numbers
We provide power supply service for condominium with smart meters. EnneVision® offers energy visualization, time-of-use pricing and demand response services.

Energy Visualization

Time-of-use Pricing

Demand Response
The time-of-use pricing is higher in daytime and lower in evening and night than the common pricing in the service.
The subscribers consumed more electricity in the morning and evening inversely proportional to the time-of-use pricing.

The peak shift of 6-9% in daytime was confirmed by comparing the electricity consumption of subscriber and non-subscriber.

The subscribers consume more electricity at morning and evening.
Condominium residents get a financial incentive as a reward of "Negawatts".

The baseline is the value in same time slot previous day.

**Best Effort Demand Response**

- **Power Company**
- **Aggregator**
- **Customer**

The end of power saving

On the day

Voluntary Power Saving Action

The day before

Demand of Power Saving

[Time]

Financial Incentive

Financial Incentive

Smartphone displaying a demand of power saving
Effects of Demand Response

- Only about 40% of residents reduced the energy consumption according to the demand response.
- The power reduction rate of the power-saving residents was about 35%, but no total power was reduced in this service.

No total power was reduced in the demand response

<table>
<thead>
<tr>
<th>Period</th>
<th>Ratio of the number of power-saving residents (x%)</th>
<th>Power reduction rate of power-saving residents (y%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>July to Sept. 2011</td>
<td>43%</td>
<td>25%</td>
</tr>
<tr>
<td>Dec. to Feb. 2011</td>
<td>40%</td>
<td>39%</td>
</tr>
<tr>
<td>July to Sept. 2012</td>
<td>35%</td>
<td>39%</td>
</tr>
</tbody>
</table>
✓ Energy management system (EMS) monitors the energy consumption of the disaster restoration houses and the generation of PV systems.
✓ Demand response, CHP and battery is utilized to optimize the energy use.
Diagram of Energy Management

Disaster Restoration Houses

Energy Management System

Energy Center

- Remote Control
- Demand Response
- Fee Collection

Power Conversion

- PV
- BATT
- CHP

Electricity

Waterworks Department

GAS Department

Terminal

HGW

Little warm water

Tap water

Gas

Meter

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Disaster Restoration Houses in Sendai City

Disaster Restoration Houses

Energy Center

Smart Meter BOX
The future of the negawatt aggregation

Key points to expand the demand response market in Japan

✓ The institutional design of a negawatt exchange
✓ The installation of smart meters
✓ Electricity deregulation.
✓ Bundling of the demand response service with other services
✓ Construction of a smart community.
Thank you for your attention.