VPP demonstration project of Tohoku EPCO with Next Kraftwerke

24th, October 2019
Overview of Tohoku Electric Power

Established in 1951, Tohoku EPCO is one of 10 major electric power utilities in Japan

- Overview of company
  - Capital: 251.4 billion yen
  - Main service area: Tohoku and Niigata (79,531 km²) 1st in Japan
  - Electricity sales: 68,876 GWh (Lighting and power)
  - Employees: 12,189

<table>
<thead>
<tr>
<th>Power Station Sites</th>
<th>Type</th>
<th>No.</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal</td>
<td>12</td>
<td>11,430 MW</td>
<td></td>
</tr>
<tr>
<td>Nuclear</td>
<td>2</td>
<td>2,750 MW</td>
<td></td>
</tr>
<tr>
<td>Hydroelectric</td>
<td>209</td>
<td>2,446 MW</td>
<td></td>
</tr>
<tr>
<td>Geothermal</td>
<td>4</td>
<td>189 MW</td>
<td></td>
</tr>
<tr>
<td>Solar</td>
<td>4</td>
<td>5 MW</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>231</td>
<td>16,820 MW</td>
<td></td>
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<table>
<thead>
<tr>
<th>Network facilities</th>
<th>Type</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission Lines</td>
<td>15,330 km</td>
<td></td>
</tr>
<tr>
<td>Distribution Lines</td>
<td>147,934 km</td>
<td></td>
</tr>
</tbody>
</table>

※ Figures as of March, 2019
PotentialAction of renewable energy in Tohoku and Niigata region

Tohoku has high development potential for solar and wind power due to climate and geographical conditions.

- Development potential of solar is widely distributed around the Pacific side.
- Wind power development potential is unevenly distributed in Hokkaido and Tohoku.
- Requests of connection to our grid are concentrated in the Pacific area.
- Requests of connection to our grid are concentrated in the Northern area.

Development potential of wind power distribution by power companies:

- In the application process of power supply projects in the northern Tohoku area, majority of priority connection is wind.
- Our area has the highest wind potential in Honshu (Main island of Japan), and it is expected that requests of connection of renewable energy will continue to expand.

Source: “Renewable energy white paper 2017” (Institute for Sustainable Energy Policies)
Since the start of FIT in July 2012, renewable energy connection in our area has expanded rapidly. Total amount of connection and application to our grid is 9.65GW for solar and 3.27GW for wind. Connection with a capacity equivalent to maximum summer power in 2018 (approximately 14GW) is expected. As the amount of renewable energy connection increases, balancing is required accordingly.

Transition of renewable energy connection in Tohoku and Niigata regions

- Solar: 4.75GW
- Wind: 1.26GW

※ Figures are actual as of Mar. 2019
What is Virtual Power Plant?

VPP uses a new information technology such as IoT to remotely control and aggregate energy resources distributed in the region such as power generation facilities, storage batteries, and electric vehicles owned by customers such as local governments, companies, and general households, to make them function as if it were a single power plant.

Local communities (public institution)  
Office, factory  
General households

Power generating facilities  
Renewables  
Storage battery  
Electric vehicle  
Air-conditioner  
Heat pump, boiler  

Controlling remotely with IoT  
Providing resources (electricity)  
Paying the consideration

Aggregator  
(Operators who aggregate and remotely control power sources)

Utilizing state-of-the-art technology

IoT  
AI  
Big Data

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Overview of Tohoku’s VPP Project

- In order to commercialize VPP, we are promoting multiple demonstration projects to verify the possibility of using VPP in resources with different attributes.
- In addition, a strategic cooperation agreement was signed with Next Kraftwerke in Germany, the world’s largest VPP operator, in order to expand future business areas.

Strategic alliance for the future

- Expansion of future business such as commercialization of VPP and new service development
- Capture large scale resources for companies (generator, battery, heat pump etc.)
- Capture home resources considering end of FIT (PV, heat pump, air-conditioner, battery etc.)
- Capture local government resources (PV of public facility, battery etc.)
- Acquire V2G technology, Validate utilization of EV for the energy market

Secure and capture resources

- Project for Companies (Office, factory)
- Project for Homes
- Battery project for local governments
- Vehicle to Grid (V2G) Project

Revenue expansion

- Tohoku Epcos
- Energy market (ancillary, balancing, capacity etc.)
- Re-energy company

Strengthen existing business

- Secure VPP resources
- Consideration

Consideration
Technical structure of VPP server/functions

- We are now verifying the availability of energy resources such as industrial or household storage batteries, PV, generators, heat pump and EV (storage battery) etc.
- AI technology is required for advanced and optimal control of these devices

Image of server function

Aggregation server

- Weather forecast
- Historical data of demand
- PV Power generation information
- Battery SOC

→ Demand forecast
→ Heat pump forecast
→ Battery SOC forecast

Planning for resource control and Control

AI technology

- Control
- response

PV
EV
Battery
Heat pump
air conditioner
generator
Strategic Partnership with Next Kraftwerke in a Virtual Power Plant (VPP) Demonstration Project

Press Released on May 23, 2019

May, 23, 2019
Tohoku Electric Power Co., Inc.
Purpose of concluding basic agreement with Next Kraftwerke

- Next Kraftwerke is one of the largest VPP operators in the world developing its large-scale VPP from Germany to most of central Europe. The company possesses extensive expertise and experience in the field of VPP, including technology for accurately controlling various energy resources.
- Tohoku EPCO aims to **accelerate the commercialization of VPP and development of new services in the future** by leveraging Next Kraftwerke’s knowledge and technology.
- Next Kraftwerke aims to **develop service solutions for the Japanese electricity system/market**.

### NEMOCs

- VPP system that collectively manages multiple energy resources, and measures and predicts power levels in each device
- Automatically control energy resources via Next Box

### NEXT BOX

- A transmission and control device that controls VPP resources installed in customer equipment such as generators and batteries.

Conclusion of basic agreement
Demonstration schedule based on basic agreement

- **Step 1** (from around August 2019): To **verify the basic functions** of VPP system through remotely monitoring and controlling energy storage devices in Tohoku EPCO’s Research and Development Center, utilizing “NEMOCS” and “NEXT BOX”.

- **Step 2** (from around February 2020): To verify and evaluate the system functions to remotely monitor and control multiple devices by **gradually expanding the number of energy resources**.

- **Step 3** (from around August 2020): To **verify the feasibility of commercializing VPP and developing new services** leveraging Next Kraftwerke’s systems. At the same time, we will **seek for the possibility of a further strategic alliances**, including power trading and ancillary services.

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**Verification period will last for approximately 2 years**

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<tr>
<th>Schedule</th>
<th>Details</th>
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| **Step 1** | From around August 2019 | Verify basic functions  
- Utilize systems including “NEMOCS” to control energy storage devices (2 to 3 devices) in Tohoku EPCO’s Research and Development Center  
- Establish technical methods to control resources |
| **Step 2** | From around February 2020 | Expand energy resources  
- Expand applicable energy and verify/evaluate functions to control multiple energy resources |
| **Step 3** | From around August 2020 | Consider business opportunities  
- Verify response in Japan’s ancillary/balancing market  
- Consider potential business opportunities to increase revenue |

May 23, 2019

March 31, 2021
より、そう、ちから。
東北電力
Tohoku Electric Power Co., Inc.