

Energy IoT to Realize Virtual Power Plants

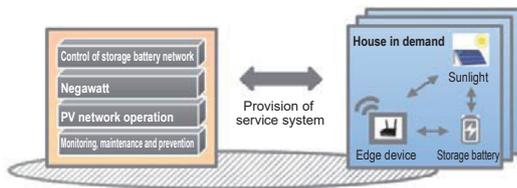
Features

- ◆ **Advanced Group Control System to Realize Virtual Power Plants**
 A virtual power plant is a network of multiple solar power generation units and storage batteries distributed in an area that is controlled as if they were a single power plant, thereby stabilizing supply and demand in the electric power market. To make a virtual power plant, it is necessary to monitor and optimally control the state of equipment that changes every hour of the day. Time-series data on the capacity and charging / discharging of storage batteries distributed in a specific area is collected through a cloud server to realize an environment that can be monitored and controlled in real time.
- ◆ **Completed the system development in a short period of time by applying the “IoT Standard Pack”**
 Our IoT Standard Pack is a solution that enables clients to connect devices, and collect, analyze and visualize data. With just an additional app for virtual power plants, we have tailored the package to work for this specific purpose, visualizing and remotely monitoring / controlling a network of storage batteries.

Basic Concept or Summary

Through collaboration with TEPCO Energy Partner (electricity retailer) and the City of Yokohama, we installed 10 kWh or 15 kWh distributed storage battery facilities at 36 elementary and junior high schools in Yokohama*. We have developed a control system for storage battery networks to perform charge and discharge operation in real time. We now provide operational services for the system. The storage batteries installed at school are normally used to help balance the supply and demand in electricity, but can be also used as BCP power supply in an emergency for better disaster preparedness.

* Full-scale introduction by bid was started in Yokohama. We have been operating storage batteries newly installed in 11 schools since January 2019.

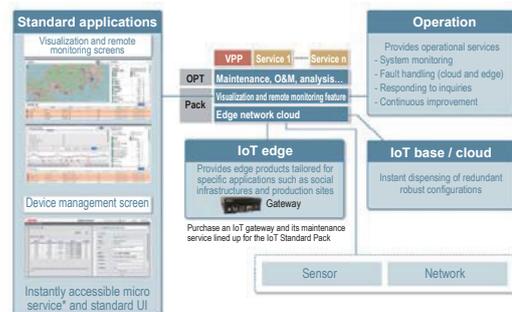


System Features

- Battery control based on prediction of chargeable / dischargeable amount, which changes depending on characteristics of installation environment, seasonal variations, weather, etc.
- Real-time charge and discharge operation according to the price fluctuation in the electric wholesale market
- Portfolio management and control taking into consideration different charging and discharging amounts for multiple storage batteries
- Flexible system expansion in line with the progress of the electric power system reform
- Uses the storage battery network control technology and operation know-hows nurtured in the Yokohama Smart City Project (YSCP)

Fast Development of the “Function for Visualization and Remote Monitoring” by Adopting the IoT Standard Pack

To expedite the development of the function that enables visualization and remote monitoring, we adopted the “IoT Standard Pack”, an all-in-one package that provides standard applications, IoT edge gateways, a cloud environment, as well as an operational solution, and added an app for virtual power plants to the upper layer. We will continue to work on adding more features such as predictive maintenance, O&M and big data analysis, which are provided by Toshiba IoT Architecture SPINEX™. (SPINEX is a trademark of Toshiba Digital Solutions)

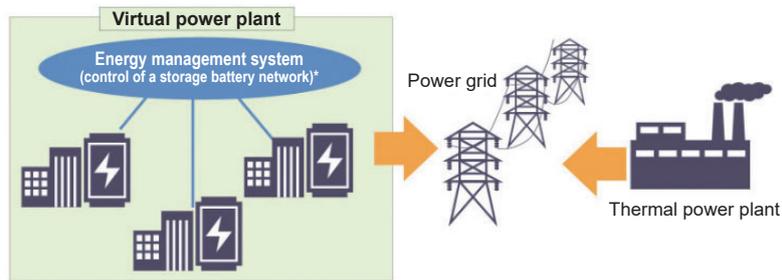


*Micro service is an architecture and its set of small services with different applications and purposes that together that serve as single software

VPP : Virtual Power Plant
 O&M : Operation and Maintenance
 IoT : Internet of Things

* Yokohama Smart City Project (YSCP): an initiative selected by the Ministry of Economy, Trade and Industry in Japan as "Next-Generation Energy and Social Systems Demonstration" area in 2010. To optimize the balance of supply and demand in electricity, the project was carried out introducing HEMS, solar power generation, electric vehicles to the city. (The project completed at the end of FY 2014)

- ◆ Controlling multiple storage batteries as a network has led to effective utilization of renewable energy such as sunlight, enabling us to regulate the electric power demand which had been dependent upon thermal power generation. As a result, we have successfully reduced CO₂ emissions.



*Regulate the peak electric power demand which used to be mostly met by thermal power generation

Installation in Practice or Schedule

Domestic Smart Resilience Virtual Power Plant Project (Yokohama City)