Services Undertaken by NTT Anode Energy

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Abstract

Major power outages due to large-scale natural disasters have been frequently occurring. As a countermeasure against them, NTT Anode Energy provides a backup-power-supply service that adopts a distributed energy system. In Europe, there is a trend toward integrating multiple distributed energy systems to build a single virtual power plant (VPP). In Japan, players such as electric-power companies are participating in the VPP Construction and Demonstration Project, which is a subsidy project of the Agency for Natural Resources and Energy of the Ministry of Economy, Trade and Industry. In this article, the energy services that NTT Anode Energy is working on to address the recent issues surrounding energy are introduced.

Keywords: distributed energy, backup power, virtual power plant

1. Introduction

Major power outages due to large-scale natural disasters, including the Hokkaido Eastern Iburi Earthquake in 2018, have been occurring frequently in Japan (**Fig. 1**). Typhoons Nos. 15 (Faxai) and 19 (Hagibis) that struck Japan in 2019 caused widespread damage in many places, and the power outages due to these typhoons lasted for a considerable amount of time and severely impacted daily life. One of the causes of those power outages was that the power-transmission and distribution equipment for the energy supply from the electric-power company was damaged and/or disconnected by fallen trees and flying debris caused by the strong winds brought by the typhoons. Since the conventional energy-supply system is centralized using large-scale power-generation facilities, the power-transmission and distribution equipment for delivering generated energy to customers is indispensable. However, if the power-transmission and distribution equipment becomes damaged, energy will not be available; it is thus necessary to build an environment in which customers can use energy without being affected by damage to such equipment. To address this issue, NTT Anode Energy will provide a backup-power-supply service that adopts a distributed energy system to supply energy to customers without dependence on the status of power-transmission and distribution equipment (**Fig. 2**). This distributed energy system is an energy-supply system that uses small-scale power-generation facilities that are deployed in a distributed manner. This backup-power-supply service will make it possible to improve regional power-supply resilience.

With the recent increase in environmental awareness, renewable energy is becoming more widespread. Even so, it is difficult for power-generation equipment based on renewable energy to adjust energy supply and demand because it is affected by natural phenomena. Consequently, renewable energy cannot easily be deemed the main power source for stably supplying energy such as existing thermal-power generation and hydroelectric-power generation.

Virtual power plants (VPPs) are expected to solve this problem. A VPP is a new energy-supply system that controls power-generation equipment, storage batteries, and demand-side equipment to function as if they were a single power plant (**Fig. 3**). A VPP is expected to make it not only possible to coordinate

[Earthquake]

June 2018	Northern Osaka Earthquake	Approximately 170,000 households in Osaka and Hyogo prefectures suffered power outages.
September 2018	Hokkaido Iburi Eastern Earthquake	Power outages affected approximately 2.95 million households throughout Hokkaido.

[Storm and flood damage]

September 2018	Typhoon No. 21 (Jebi)	Approximately 2.4 million households, mainly in the Kansai and Chubu (central Honshu) regions, suffered power outages (recovery time: approximately 120 hours).
September 2018	Typhoon No. 24 (Trami)	Approximately 1.8 million households, mainly in the Chubu region, suffered power outages (recovery time: about 70 hours).
September 2019	Typhoon No.15 (Faxai)	Approximately 900,000 households in Chiba prefecture suffered power outages (recovery time: about 280 hours).
October 2019	Typhoon No. 19 (Hagibis)	Approximately 500,000 households, mainly in the Kanto, Chubu, and Tohoku (northeast Honshu) regions, suffered power outages.

Source: Energy White Paper 2018

Fig. 1. Status of power-outage damage due to large-scale disasters.

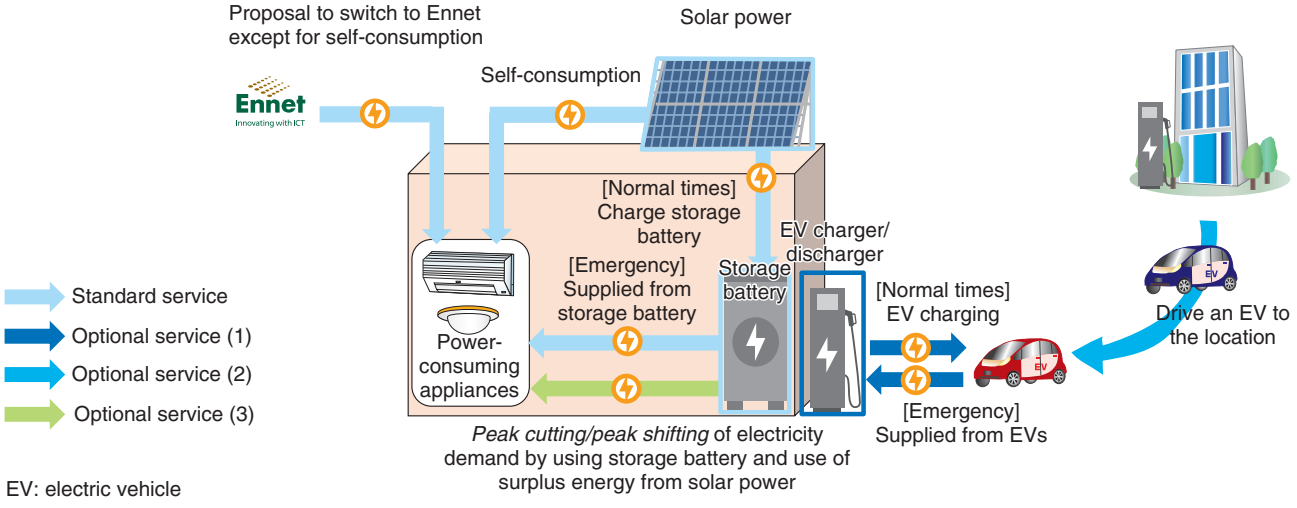
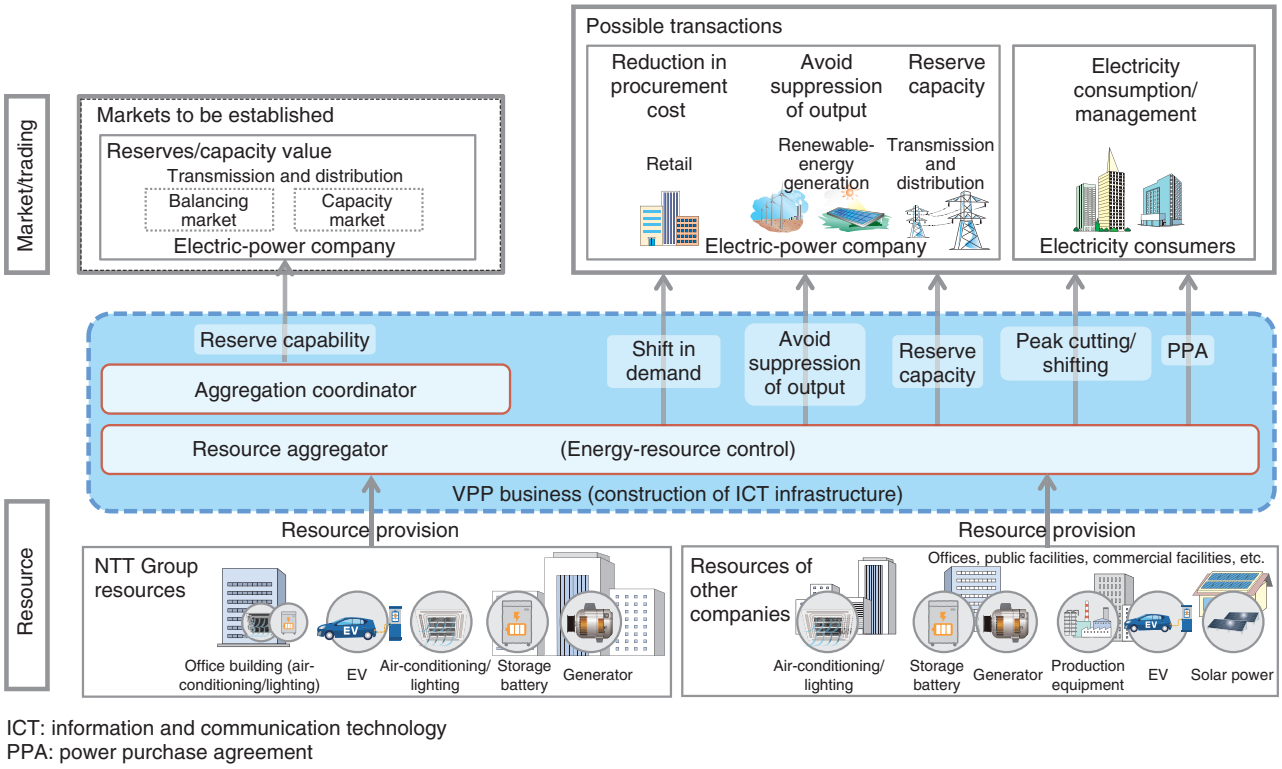


Fig. 2. Illustration of backup-power-supply services.

energy supply and demand but also replace existing thermal-power plants by increasing the capacity of energy handled. Among thermal-power plants, coal-fired power plants in Japan were mostly constructed in the 1960s and will come up for renewal sometime within the next ten years. Since coal-fired power plants are exposed to international criticism, it is expected to be difficult to upgrade them. Toward *decarbonization*, which was set as a goal of the Paris Agreement (the international framework for global-warming countermeasures), Japan's Ministry of Economy, Trade and Industry (METI) has set a goal of increasing the ratio of renewable energy from 16% in 2017 to 22–24% by 2030. Accordingly, NTT Anode Energy is creating a new system for supplying energy in a different manner from the existing energy-supply system by constructing a VPP, which is crucial for making renewable energy into the main power source. NTT Anode Energy will facilitate the spread of renewable energy and help create an environmentally friendly society.



ICT: information and communication technology
PPA: power purchase agreement

Fig. 3. VPP business.

2. Backup-power-supply service

NTT Anode Energy will provide backup-power-supply services to customers, such as local governments, having needs concerning business continuity planning to improve regional power-supply resilience. The backup-power-supply service provided by NTT Anode Energy is based on the following two approaches.

The first approach is to introduce a distributed energy system to buildings that require enhanced power-supply resilience. Establishing a distributed energy system makes it possible to avoid power outages by supplying energy from the system even if the power-transmission and distribution equipment owned by the electric-power company is damaged due to disasters, etc. Specifically, NTT Anode Energy will install solar panels on the roofs of customer buildings, and the energy generated by the solar panels will be used by the customer. By installing storage batteries to store excess energy, the customer will also be able to use energy even when electricity cannot be generated. Since the number of solar panels installed depends on the size of a building's roof, it may not be possible to cover the full amount of electricity required by customers. Therefore, NTT Anode Energy will secure against insufficient amount of electricity by supplying electricity from the electric-power company. This backup-power-supply service adopts a mechanism called a power purchase agreement (PPA) model. With the PPA model, a third party installs power-generation equipment, such as solar panels, while the customer signs a contract to purchase the electricity. Therefore, customers do not have to pay the initial cost of installing the power-generation equipment or its maintenance costs. The cost of the power-generation equipment will be collected as part of the cost of the long-term electricity purchased by the customer. From the customer viewpoint, it is possible to build an environment that secures two sources, namely, the energy supply from the electric-power company and the distributed energy system installed in the customer's building. With the distributed energy system acting as a backup, it will therefore be possible to improve power-supply resilience.

However, the issue is the cost of supplying energy via a distributed energy system. This is because if that

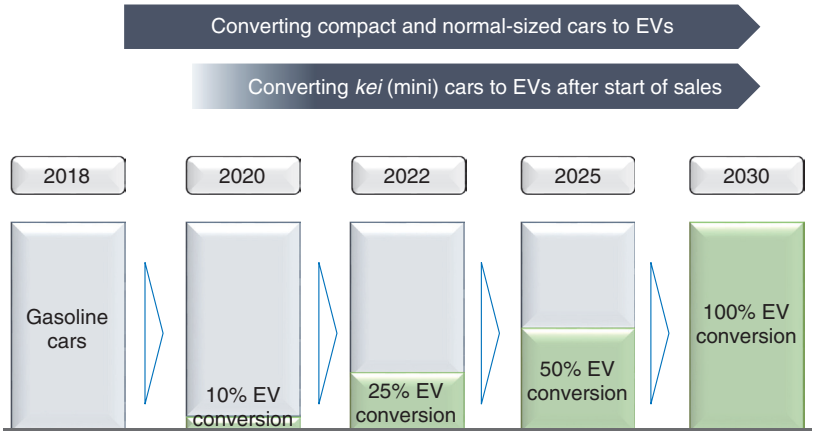


Fig. 4. Plan for converting company-owned cars to EVs.

energy-supply cost is high, customers are likely to continue to use only the energy supplied from the electric-power company as usual. Currently, *grid parity*, namely, the cost of power generation from solar panels is equal to or lower than the cost of energy supply from electric-power companies, has been achieved. However, the power-generation cost of the combination of solar panels and storage batteries has not reached the level of *storage parity*, that is, equal to or lower than the cost of energy supply from electric-power companies. Grid parity was achieved as a result of the expansion of the solar-panel market, which brought about economies of scale due to cheaper, mainly overseas-made, products. As with grid parity, expanding the market is essential for achieving storage parity. Therefore, it is necessary to further reduce the cost of storage batteries and peripheral equipment such as power-conditioning systems (PCSs).

The second approach is to deliver energy to important bases that have lost power due to disasters. Specifically, an electric vehicle (EV) rushes to an important base where a power outage has occurred. Then, by supplying energy from the storage battery installed in the EV, it is possible for customers to use energy in the event of a disaster. However, even if an EV rushes to the important base with the power outage, it cannot directly supply energy to the buildings at that base as is. A PCS is required to supply energy from EVs to these buildings.

With that problem in mind and for the time being, NTT Anode Energy will provide a service that receives the energy supplied from EVs via a portable PCS (carried by the EV) and directly connects customer devices that require power supply to the PCS. In the future, we will install vehicle-to-everything (V2X)-compatible EV stations at important base buildings so that the energy stored in EVs can be directly supplied to those buildings. The popularization of EVs is indispensable to provide backup-power-supply services that use them. Accordingly, the NTT Group has announced a plan to join the EV100 initiative and replace all 10,000 company cars it owns with EVs by 2030 and plans to introduce them at a rate of about 1000 vehicles a year nationwide (**Fig. 4**). NTT Anode Energy will continue establishing EV stations to charge EVs in line with the initiative. By developing EV stations not only for company cars but also for important customer bases, NTT Anode Energy hopes to contribute to the further expansion of EVs.

3. VPPs

With the widespread use of storage batteries and EVs capable of storing electricity, there is a trend in Europe towards building VPPs that connect renewable energy and storage batteries via a network and treating it like a single power plant. With a VPP, the equipment on the power-generation side and that on the demand side can be bundled (aggregated) and remotely controlled in an integrated manner that allows the power supply-and-demand balance to be adjusted. We introduce three initiatives by NTT Anode Energy for building a VPP focusing on demand-side controls.

3.1 Participation in VPP Construction and Demonstration Project

NTT Anode Energy provided business support to the VPP Construction and Demonstration Project, which is a subsidy project of the Agency for Natural Resources and Energy of METI, in which NTT FACILITIES is participating. The demonstration project NTT Anode Energy worked on is aimed at examining the implementation of a VPP and *demand response*[*1] in electricity markets. Specifically, in collaboration with an aggregation coordinator[*2], the NTT Group acted as a resource aggregator[*3] by controlling air-conditioners and storage batteries and suppressing demand on the demand side to provide the amount of electricity (reserve capability (ΔkW)) specified by the directive (from Waseda University). The challenge is to increase the amount of equipment on the demand side that can be controlled remotely, shorten the time from receiving an order to responding to it, and improve the control accuracy of demand-side equipment so that the ordered reserve capability can be appropriately provided. The more equipment that can be controlled, the more it is possible to increase the reserve capability. If response time can be shortened and control accuracy can be improved, reserve capability can be provided as a reserve power source that can respond to supply and demand more efficiently. In 2021, a "balancing market" will be opened as one of the markets for trading electricity. NTT Anode Energy will work to solve the issues it is currently facing through this demonstration project toward the opening of this market.

3.2 Verification of measures to reduce rate of electricity by using NTT buildings

NTT Anode Energy is implementing initiatives to control facilities on the demand side remotely to reduce rates of electricity used in NTT buildings. The company is aiming to reduce electricity charges through the following measures: (i) *peak cutting*, i.e., reducing electricity consumption when electricity is used the most (peak time) and (ii) *energy saving*, i.e., suppressing reducible power consumption. As a concrete approach, a gateway (GW) is installed on the demand side to control equipment and monitor electricity-usage status remotely. Then, if the usage exceeds a threshold, the equipment is controlled in a manner that suppresses electricity usage. The challenge is to reduce the installation cost of the GW and increase the amount of controllable equipment. A limited amount of equipment that can be controlled means that the cost effectiveness of these measures is also limited. Therefore, *peak-shifting* measures, i.e., storing electricity with storage batteries (expected to become more popular) during off-peak demand time and using the stored electricity during peak demand time to increase cost effectiveness will be undertaken. NTT Anode Energy also aims to use energy resources that it can control in the market.

3.3 Efforts to provide *power source I'* reserve capability for severe weather

NTT Anode Energy is making efforts to provide *power source I'*[*4] severe-weather-response reserve capability to general electricity transmission and distribution companies[*5]. These companies need to secure additional adjustable power sources (reserve capability) to balance electricity supply and demand in the rare cases of tight supply and demand (such as during extremely hot or cold weather). From the perspectives of offering fair participation opportunities for providers of many power sources, etc. and ensuring transparency and appropriateness of procurement costs, general electricity transmission and distribution companies procure reserve capability through public bidding. NTT Anode Energy is working on providing power source I' by suppressing demand by using permanent generator facilities owned by the NTT Group when a general electricity transmission and distribution company issues an order. Power source I' is a mechanism that is beneficial for both the electricity transmission and distribution company and the demand side: it is rarely issued and is issued for activation three hours in advance, so the demand side can generate profit by suppressing demand (providing negative power) through adjustment of the operational plan of its facilities.

*1 Demand response: A mechanism of balancing electricity supply and demand as a whole by controlling electricity consumption at the demand side.

*2 Aggregation coordinator: A company that aggregates electricity that is controlled by a resource aggregator and trades that electricity with general electricity transmission and distribution companies and electricity retailers.

*3 Resource aggregator: A company that enters into a VPP service contract with electricity customers and controls the electricity consumption of the customer.

*4 Power source I': Electricity procured by a general electricity transmission and distribution company to adjust the electricity demand and supply during extreme hot and cold weather by complementing *power source I*, i.e., a dedicated power source that is constantly secured.

*5 General electricity transmission and distribution company: A company that provides a wheeling service or electricity quantity adjustment service in its service area by using facilities for the transmission and distribution of electricity that it independently maintains and operates.

In addition to making the above-mentioned efforts to control the facilities on the demand side, NTT Anode Energy also plans to target renewable energy to be used for adjusting energy supply and demand in the future. As well as possessing many central offices and storage batteries throughout Japan, the NTT Group owns the information and communication technology required for supply-and-demand adjustment. NTT Anode Energy intends to build the platform required for VPPs by leveraging the resources and strengths of the NTT Group.

4. Future developments

With the demand for improved regional power-supply resilience, a new energy system is needed to supplement the vulnerabilities of existing energy systems, and a distributed energy system is one of the solutions to meet this need. The backup-power-supply service being developed by NTT Anode Energy adopts a distributed energy system; accordingly, NTT Anode Energy believes that it can contribute to improving regional power-supply resilience through its introduction nationwide. To expand the use of renewable energy, a mechanism for stable renewable-energy supply is necessary and constructing VPPs is one solution to meet that need. Accordingly, NTT Anode Energy will contribute to the expansion of renewable energy by building a VPP platform.

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