Distributed energy systems japan

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Former Prime Minister Yoshihide Suga"s announcement in October 2020 that Japan would achieve carbon neutrality (CN) by 2050 meant that Japan would join the framework of international cooperation and competition to achieve CN as a climate change mitigation measure, which has had a significant impact on Japanese industry.

The government has already taken measures such as the massive introduction of renewable energy, and solar power generation is now being introduced on the third largest scale in the world after the US and China, which have vast land areas. On the other hand, concerns about the stability of electricity supply have continued to arise in recent years, with a nationwide electricity shortage in January 2021 due to a shortage of LNG imports, and the government issuing its first electricity supply and demand crunch warning in March 2022.

The global energy crisis has been triggered by geopolitical risks such as Russia"s invasion of Ukraine, while not only Japan but also other countries are working on CN, and there is a growing global recognition that the energy transition towards the realization of CN is irreversible. At the same time, it has already become clear that it will not be easy to achieve.

This article first describes the recent electricity supply and demand situation in Japan, and then explains what is needed for CN and a stable energy supply. It also adds the perspective of ensuring the resilience of local communities and explains the challenges for the electricity system to achieve this, the need for early societal implementation of the new framework for industrial collaboration and fusion proposed by the authors as "Utility 3.0"[1]. The TEPCO group"s efforts to achieve this are discussed.

Figure 1 shows the power supply and demand situation in the TEPCO area on March 22, 2022. Supply-capacity measures were implemented, including requests to increase the generation output of in-house power plants, full use of pumped-storage hydroelectric power plants that had pumped up water for power generation the day before, and power supply from western Japan, but as it was expected that the pumped-storage plants would fail and blackouts would occur on their own, the Minister of Economy, Trade and Industry twice called for power conservation.

As a result, the TSO was able to maintain stable supply and demand without blackouts, but it showed the importance of consumer cooperation, including energy storage such as pumped storage, and demand response in power systems where solar power has been massively deployed, as is currently the case. It also highlighted the lack of firm supply capacity, such as nuclear and thermal generation, to avoid the need for painful conservation.

On the other hand, the problem was that the dissemination of information on supply and demand shortages by power companies and the government was too slow, so since then, measures have been considered in cooperation with the Meteorological Agency, such as issuing supply and demand shortage information two days in advance and posting supply and demand assumptions on the website with daily updates for the next three days, and careful information dissemination by the government has been implemented since the summer of 2022.

On the other hand, during Golden Week, special holidays from April 29 to May 5, when there is little demand for heating and cooling and electricity consumption is low, there is a surplus of electricity in the area due to solar PV, which has already been installed about 17 GW, and it may be necessary to operate PV output control from 2023.

As renewable energy continues to be introduced in the CN and thermal power generation is reduced, electricity supply and demand will face the structural challenge of a surplus in spring and fall and a recurring shortage in summer and winter when demand for heating and cooling is high. There are high hopes for energy storage such as batteries, but as Figure 2 shows, it is unfortunately not realistic to continue to store surplus electricity in the spring for several months and use it in the summer and winter. The way forward is discussed in Section 4 below.

The study of measures to achieve CN with net-zero CO2 emissions related to energy use requires an overview of the entire energy flow from primary energy to final energy consumption. The energy flow for achieving CN is shown in Figure 3.

The electricity or hydrogen used in the final energy consumption phase must then be generated from decarbonized primary energy sources. Candidates include renewable energy sources, including biomass fuels, nuclear power, and thermal power with CO2 capture and storage (CCS) technology.

The CO2 that is not generated in this energy stream must be sequestered using technologies such as Direct Air Carbon Capture and Storage (DACCS), which captures CO2 directly from the atmosphere.

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