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Utilization of Digital Technology in the Energy Sector

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The growing trend of digitalization in the energy sector

Greening and digitalization are being promoted as the driving forces to stimulate growth in the post-COVID era. Taking response to climate change as an opportunity for growth, widespread efforts are ongoing to promote greening for achieving carbon neutrality, as well as to promote digitalization initiatives that harness information and communications technology (ICT), artificial intelligence (AI), and other technologies.

Digitalization, which advanced rapidly from the 2010s, brought about major transformations to economies and societies. According to the “World Development Report 2016: Digital Dividends” published by the World Bank in 2016, the direct changes caused by digitalization include improvement in access to information, spread and popularization of automation technology, and the rise of platform enterprises.

The wave of change is also exerting its influence on existing systems and business models that are under pressure to make the transition toward a decarbonized society. This article, which comes at the end of this series on carbon neutrality, focuses on initiatives that harness digital technology in the energy sector, which accounts for more than 80% of all greenhouse gas emissions, and requires urgent effort to reduce its carbon footprint.

One of the specific initiatives is the Virtual Power Plant (VPP). A VPP is a system that adjusts the demand and supply balance of electricity by functioning as a single power generation plant, using Internet of Things (IoT) technology to remotely integrate and control decentralized energy resources such as renewable energy power generation facilities, storage batteries, and electric vehicles (EV). To expand the adoption of renewable energy, which varies its power output depending on the weather conditions and time of the day, it is vital to secure adjustment capability to maintain the demand and supply balance of electricity stably. To provide this adjustment capability, it is necessary to have a grasp on the power generation and charging status of the decentralized energy resources, predict the potential for utilization, and based on that, aggregate and control the target energy resources. Hence, digital technology, such as AI technology for making advanced predictions and IoT technology for carrying out remote control of the decentralized resources, play an important role in the implementation of this series of processes quickly and accurately.

VPP is increasingly becoming one of the new business models for the electric power sector in Europe and the United States. For example, Next Kraftwerke GmbH and Energy2market GmbH (e2m) are representative VPP companies in Germany. In addition, there are about 100 other such businesses in Germany that are engaged in the trading and

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operation of energy resources on platforms based on digital technology.

In Japan, demonstration projects, which are primarily subsidized by the Ministry of Economy, Trade, and Industry, are being implemented, while diverse stakeholders, including electric companies, manufacturers, and local governments, are putting effort into developing a VPP market.

Blockchain and power trading

Power trading initiatives that make use of blockchain technology are also coming into the spotlight. A blockchain is a form of technology that allows participants on a network spread across dispersed terminals to save data and carry out transactions directly without going through a centrally managed server. The greatest characteristic of blockchain is its ability to reduce the risk of the data being tampered with to zero as far as possible. This is achieved through the multi-layered sharing of chained data among participants of the network. Furthermore, when compared to large-scale centrally managed systems, blockchain technology offers cost benefits by minimizing the cost of investing in system development, commissions to intermediaries, and management costs.

Prosumers (electric power producers and consumers) who own renewable power generation facilities are increasingly harnessing such technology to engage in power trading with electricity consumers. In the state of New York in the United States, for example, households (prosumers) that own solar power generation facilities are advancing efforts to sell their surplus electricity to electricity consumers on platforms that are based on blockchain technology. When prosumers generate surplus electricity, smart meters that are installed at the consumers' end detect that and automatically engage in trading if trading conditions, which are based on smart contracts, are met. Such a system is gradually being developed.

In addition to enabling direct power trading, blockchain technology also makes it possible for consumers to easily obtain information on purchasing power, which had previously been hard to get hold of. Individuals who wish to use electricity generated from renewable energy sources that are rooted in the local region, as well as companies that seek to procure energy only from renewable sources, have high expectations for the application of blockchain technology that is characterized by high data precision and traceability.

Making greening and digitalization work closely together

As described above, digital technology is actively being utilized to promote the adoption of renewable energy, which holds the key to decarbonization. As a result of digitalization, a wide range of information can now be handled by a diverse range of stakeholders, and platforms for managing information and trading are also emerging.

This series introduced the trends in and outside of Japan, with a focus on technology that contributes to decarbonization. This includes areas where innovation is advancing, such as next-generation solar power generation and storage battery technology, and areas where

further development is expected in the future, such as offshore wind power generation, ocean energy power generation, biofuels, as well as hydrogen, carbon capture and storage (CCS) technology, and the electrification of vehicles. Despite the earnest and ongoing efforts to advance many initiatives, including research and demonstration projects, to develop such technology, there is still a long way to go toward achieving carbon neutrality in 2050.

To achieve the goal of carbon neutrality, on top of such technological innovation, there is also a need to promote digitalization for societies and economies as a whole. The “Green Growth Strategy through Achieving Carbon Neutrality in 2050” announced by the Government of Japan in June this year places emphasis on the importance of strengthening digital infrastructure. For example, it sets out the policy of introducing digital technology for the management of smart grids for the advanced operation of systems as well as the maintenance and inspection operations of infrastructure in the power sector, and of improving energy use efficiency by promoting the automatic driving of cars, drones, aircraft, and trains in the transportation sector. Further examples include the realization of a smart city in which all services are optimized through the use of digital technology.

Digitalization can optimize the cross-sectoral movement of people and things, as well as contribute to the efficient use of energy. As digitalization and decarbonization concurrently progress, and social transformation is urgently needed, it is important to take an extensive view of technologies and policies that are related to decarbonization and to effectively utilize digital technology for a better future. However, while the advancement of digitalization creates opportunities to enhance efficiency, improve information access, and develop new business models, it also throws up challenges at the same time, such as the monopolization of information and markets, and cybersecurity. While paying attention to such aspects and putting in place cautious measures, we can look forward to growth propelled by a tight link between greening and digitalization.

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