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Digitized/Electrified Society and Energy Security

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On October 26, a symposium titled “AI/IoT-realized Super Smart Society and Energy Network” took place at the Tokyo Institute of Technology. Sponsored by the International Research Center of Advanced Energy Systems for Sustainability (AES Center), Institute of Innovative Research, Tokyo Institute of Technology, the symposium dealt with how artificial intelligence, the Internet of Things and other advanced information technologies would transform society and the energy world and what business chances and challenges would emerge, as indicated by the title.

The symposium consisted of three parts – Part 1 “National Strategy and Outlook on Super Smart Society,” Part 2 “Super Smart Society and Energy Technologies Seen from Academia,” and Part 3 “Panel Discussion – Social Implementation Led by the Private Sector.” In Part 1, Kazuo Kyuma, a member of the Council for Science, Technology and Innovation, Jun Takashina, director-general of the Energy Conservation and Renewable Energy Department at the Agency for Natural Resources and Energy, and Katsuya Watanabe, director-general of the Telecommunications Bureau at the Ministry for Internal Affairs and Communications, made reports on government initiatives for the super smart society, based on their expertise. In Part 2, AES Center Professors Takao Kashiwagi (director of the AES Center), Hiroshi Asano and Ken Koyama (author, named AES Center professor in April 2017) presented reports. In the Part 3 panel discussion, panelists from NTT Facilities Engineering, Inc., JXTG Nippon Oil & Energy Corp., Tokyo Gas Co., Toshiba Corp., Hitachi, Ltd. and Mitsubishi Corp. discussed relevant initiatives at their respective companies and future challenges.

What is the “super smart society?” This is an interesting question. In Part 1, it was argued that human society historically transitioned from a hunter society to a farmer society, an industrial society and an information society, or from Society 1.0 to Societies 2.0, 3.0 and 4.0, before a new economic society comes as Society 5.0 or super smart society. The new society was explained as a society in which AI, big data, IoT and other advanced technologies would be fully used to achieve both economic development and the resolution of social challenges facing the world. The super smart society was also described as a society in which AI, big data and dramatically advanced information technologies (electronics, communications and data processing) would be fully used to integrate cyberspace with physical space to produce new values.

An important challenge in energy and environment areas would be to build a low-carbon society and very efficient energy supply systems using renewable energy, storage batteries, hydrogen, advanced next-generation vehicles, distributed energy systems, demand response systems, virtual power plants and other technologies. AI, big data, IoT and other advanced technologies would be fully used to digitize and expand the energy world in the new economic society. The symposium

gave me an opportunity to find a new concept of the energy world. It was an interesting, stimulating opportunity. As a matter of course, the super smart society and energy's expected roles in such society represent long-term strategic challenges, with any specific path to such society remaining uncertain. There may be numerous problems to be resolved for realizing the new society. Nevertheless, initiatives to overview social transition and transformation from a broader perspective and depict and pursue the future society we should build are very significant and valuable. We will have to closely watch future initiatives to realize the super smart society and energy's roles in such society.

Based on matters of interest to me and my expertise, I presented a report from a viewpoint that was different from those of other presenters. While other presenters focused on the image of the super smart society and on expectations and visions on energy's roles in such society, I argued that as the super smart society would be digitized and electrified, energy security (particularly, power supply security) would be the key to realizing and managing the super smart society. Then, I made the following three points on new risks that we would have to consider in regard to energy and power supply security while digitization and electrification would make irreversible progress.

The first point is the impact that the substantial expansion of renewable energy including intermittent solar photovoltaics and wind power generation would exert on power supply systems. Storage batteries, grid enhancement measures, auxiliary fossil power generation and other measures are required to cover the intermittency of solar PV and wind power generation. This means additional costs. While solar PV and wind power generation costs are remarkably declining, the additional costs are required for integrating such intermittent renewable energy into power supply systems and may not necessarily be negligible. As intermittent power sources' share of the power mix expands further, the costs for integrating these sources into power supply systems will grow. Power supply security and the integration costs could be challenges.

The second point is related to cybersecurity. As social and economic systems grow more dependent on stable power supply due to further digitization and electrification, they are likelt to become more vulnerable to cyberattacks. As cybersecurity problems are growing more complex, diverse and serious, cybersecurity measures must be updated in response to the fast-changing situation. So far, cyber problems have not become as serious as the oil crises that globally shook energy and power supply. As stable power supply becomes the most important challenge in the digitized society, however, we should recognize cybersecurity problems as a major potential risk.

The third point is a stable power supply problem related to investment in deregulated markets. In Japan, power and gas system reform will be implemented to deregulate markets more and more through the beginning of the 2020s. In globally known cases, there are many cases where investment costs in power sources has failed to be recovered in deregulated power markets, leading to the so-called "missing money problem". The classic "missing money problem" has transitioned to a more complex problem as wholesale power market prices have declined due to the large scale inflow of renewable energy power generation promoted by policy support and cost reduction. In response, the introduction of the capacity mechanism is being considered or implemented. In the digitized and electrified society, how to secure investment and stable power supply in liberalized markets witj renewable energy expansion trends may be a key challenge.

While great expectations are placed on the realization of the super smart society, or Society 5.0, there are many challenges to tackle in the energy world. In the new economic society in which advanced technologies are fully used, energy is likely to take an even more important position instead of staying at its present level of importance. Energy security will thus remain an old and new issue.

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