

“4D Challenges” in Electrified Society

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Energy stakeholders in the world are mostly interested in the ongoing global energy transition. This is because how energy market, supply and demand, and industry structure would change in the future is significant for government officials engaging with energy policy, energy industry people, energy experts and academicians, energy consumers and other energy stakeholders from their respective viewpoints or positions.

The 20th century is frequently called the “century of oil”. After coal had remained a main energy source since the industrial revolution, the “century of oil” was realized through factors such as market changes including automobiles’ rapid diffusion, the discovery and development of large oil resources in the Middle East and other regions, and growth in oil’s competitiveness through these changes. As of 2017, oil accounted for 34% of global primary energy supply, the largest share among energy sources, remaining the most important energy source.

Amid growing interests in global environmental problems, enhanced energy security initiatives and complicated energy geopolitics, however, oil’s energy mix share has declined gradually. Many energy stakeholders have recognized that the transportation sector’s fuel demand that has supported oil demand growth would greatly change due to the diffusion of electric and fuel cell vehicles, expectations of such diffusion, vehicle use mode changes through automatic driving and car sharing, and the overall enhancement of vehicle fuel efficiency standards. While oil is still the largest energy source, it is growingly recognized that the world is being reformed toward a new energy transition.

It is still difficult to forecast what would be a main energy source in the 21st century because of great uncertainties about future markets, policies and technologies. However, the following two directions are considered almost certain. First, global energy demand growth will be led by developing and emerging countries, particularly Asian emerging countries. Second, the world will go in the direction of electrification, with electricity accounting for the largest share of energy demand growth.

How to respond to great growth in electricity demand mainly in Asia would be a main energy issue or a central energy transition challenge for the world. Furthermore, how to satisfy substantially growing electricity demand affordably, sustainably and stably would be a key issue for energy policy planners, industry people, experts and consumers. This is not any simple issue that can be answered immediately. A right answer may not be found unless each energy stakeholder continues efforts for 10 to 20 years. In this report, I do not intend to find any right answer here in this paper. Instead, I would like to cite four keywords starting with “D” for exploring an answer to the issue and consider their significance.

The first keyword is Decarbonization. Tackling climate change is a very important challenge for pursuing global interests. The question is how to promote global decarbonization. How to decarbonize the power generation sector amid electrification and what the measures, energy sources, costs and speed should be for decarbonization are important issues. Appropriate policies should be planned and implemented, while innovative technologies should be developed and diffused to enable energy-related industrial measures. These elements are important for how affordably an electrified society is realized, exerting great influence on the affordability of electricity.

The second is Deregulation. Initiatives to introduce competition in electricity markets and utilize the market mechanism for promoting efficiency are being implemented in various regions of the world to different extents at different speeds. Generally, developed countries have taken leadership in implementing these initiatives, while developing and emerging countries are about to launch such initiatives. Although it is very important to increase market efficiency, experiences in developed countries have demonstrated that it is difficult for the market mechanism alone to respond to externalities such as decarbonization and energy security. The electricity market reform to secure investment in building an electrified society while responding adequately to the externalities will be implemented as a grand social experiment in the world. How to design markets will influence the behaviors and performance of relevant industries and companies, leading to the restructuring of markets and industries. We will have to keep close watch on future global developments regarding the second D.

The third is Digitalization. Today's information technology innovation and the subsequent industrial reform amount to digitalization. Supporting the great trend is stable, reliable electricity supply. Stable electricity supply will grow even more important for a society that is being digitalized and electrified. Although stable electricity supply has traditionally been a key challenge, how to secure stable electricity supply in the new situation featuring the above two Ds, the digitalization and the fourth D coming below is a key point. The cost for doing so is also important. In the new situation, new risks regarding stable electricity supply will emerge, including cybersecurity. As electricity grows more important, the value of electricity supply stability will increase.

The fourth is Decentralization. Traditional electricity systems have been centrally controlled, with large-scale investment made in connecting large-capacity power generation facilities with electricity transmission and distribution networks. Today, however, interests are growing in decentralized systems in various parts of the world, as indicated by the expansion of renewable energy. Although centralized systems are likely to continue playing a key role as infrastructure, the structure and business models for electricity-related industries and companies are expected to dramatically change depending on the diffusion and expansion of decentralized systems. Regarding how to efficiently realize an electrified society while responding to various national conditions (differences between developed and developing countries, between resources endowment conditions and between development stages for existing systems), I would like to pay attention to future changes or developments related to this D.

How global electrification would be realized under the four Ds will hold the key to the energy transition.

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