Special Bulletin

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# Carbon Neutral and Decarbonization of Fossil Fuels (2)

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My previous “A Japanese Perspective on the International Energy Landscape” report described a global trend in which major economies such as the European Union, China, and Japan have announced basic policy targets of achieving net-zero greenhouse gas emissions, or carbon neutral status, over the long term. In Japan, Prime Minister Yoshihide Suga in his keynote policy address declared a target of realizing net-zero GHG emissions in 2050. The carbon neutral target requires a fundamental transition from the present energy supply and demand system in which fossil fuels account for most of energy consumption, exerting great impacts on future energy and environmental policy discussions in Japan and other countries pursuing the carbon neutral target.

In the previous report, I also pointed out that any country seeking to achieve an energy supply and demand system for net-zero GHG emissions would have to improve energy efficiency and use renewable energy, nuclear, and other non-fossil energy sources as much as possible, to electrify energy consumption as much as possible and eliminate GHG emissions from the power generation sector, to decarbonize non-power sectors. To these ends, hopes are placed on $CO_2$-free hydrogen and other innovative energy technologies. As the use of $CO_2$-free ammonia has attracted global interest in the first step to the development of $CO_2$-free hydrogen technologies, initiatives to use fossil fuels for producing ammonia have been promoted.

In this report, I would like to analyze a path to carbon neutral status from a different viewpoint. That is how to minimize total costs for the transition to carbon neutral status. As noted above, the current energy supply and demand system depending heavily on traditional fossil fuel consumption would have to be fundamentally and innovatively transformed to realize carbon neutral status. The transition to carbon neutral status would require huge investment costs for transforming the whole of the energy system and developing relevant social infrastructure. It is difficult to accurately estimate or predict how far the investment costs would grow.

The IEEJ Outlook 2021, the latest long-term global energy supply and demand outlook of the Institute of Energy Economics, Japan, estimates cumulative energy sector investment between 2018 and 2050 at $84.3 trillion for the Advanced Technologies Scenario in which advanced energy technologies will be adopted to the maximum extent. In this scenario, energy-related $CO_2$ emissions will peak out before 2030 and drop by 8.1 billion tons or 24% from 33.3 billion tons in 2018 to 25.2 billion tons in 2050. Nevertheless, the emission decline will fall far short of the 50% emission cut to keep the maximum global temperature rise at 2℃. If the world were to promote decarbonization and realize net-zero emissions, the energy sector would have to invest far more than estimated for the abovementioned Advanced Technologies Scenario. Additional investment would be required for developing relevant social infrastructure. Such huge investment would provide new business chances in some sense. However, someone would have to bear the huge investment costs that would push up overall energy costs. This is the reason initiatives are required to minimize overall costs for the

transition to carbon neutral status.

What should be done then? In an orthodox approach, efforts must be made to minimize costs for various elemental technologies required for decarbonization. In the next step, elemental technologies that are the cheapest or likely to become the cheapest may be put at the center of the energy mix. In this respect, cost cuts are important not only for commercialized technologies but also for technologies just before commercialization and those before innovative development stages. The problem is that prospects are uncertain for the latter technologies. If high hopes are placed on innovations or carbon neutral status is difficult without contributions from innovative technologies, however, their development and relevant cost cuts would be an important challenge to be resolved. To resolve such challenge, industrial policies would have to be employed to provide large-scale, intensified policy support for nurturing those technologies.

In addition to the orthodox initiative, the effective utilization of existing equipment, infrastructure, and technologies would be indispensable for minimizing total costs. Initiatives based on national or regional conditions, features, and realities would be significant for the world to achieve decarbonization by 2050 or later. In Asian emerging market and developing economies that will drive future GHG emissions growth, the promotion of energy efficiency improvements and non-fossil energy sources is as important as more efficient fossil fuel consumption and the expansion of natural gas and LNG featuring less environmental load than other fossil fuels. These measures represent the first step to effectively utilize existing equipment, infrastructure, and technologies.

In Japan and other Asian countries, existing fossil-fired power plants may switch from traditional coal and gas to $CO_2$-free hydrogen/ammonia, taking such steps as firstly introducing co-firing of traditional fossil fuels (like gas) and CO2-free ammonia/hydrogen with gradually increasing share of the latter fuels and then using CO2-free fuels only. In this way, existing equipment may be effectively utilized to minimize total costs during a transition to zero emissions. As $CO_2$-free hydrogen/ammonia is attracting attention, the utilization of fossil-fired power generation infrastructure and supply chains for zero emissions may be an interesting initiative to simultaneously accomplish the minimization of total costs and decarbonization.

Blue ammonia produced from fossil fuels with $CO_2$ emissions captured and stored is attracting great interest, indicating how important the utilization of existing infrastructure, equipment, and supply chains is for holding down costs. For Saudi Arabia and other oil-producing countries, the transformation of their fossil fuel resources into blue hydrogen for global use has grown more important as a future survival strategy for them. In a run-up to the use of blue hydrogen, beginning with utilizing existing infrastructure for blue ammonia may be a pragmatic approach for minimizing total costs, maturing relevant technologies, and accumulating business experiences.

The effective utilization of existing technologies, infrastructure, and supply chains is important for all fields. The abovementioned effective utilization of fossil fuels for decarbonization is undoubtedly important, but the effective utilization of existing decarbonization technologies such as nuclear power generation is also significant for efficient decarbonization. Innovative technology development may have to be well combined with existing technologies to minimize total costs for the transition to carbon neutral status.

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