

## **Carbon Neutral and Decarbonization of Fossil Fuels (1)**

Ken Koyama, PhD  
Chief Economist, Managing Director  
The Institute of Energy Economics, Japan

Carbon neutral initiatives to pursue net-zero greenhouse gas emissions over the long term are being promoted globally. The European Union known for its aggressive climate change countermeasures has advocated net-zero GHG emissions in 2050. In late September, China, the world's largest GHG emitter, vowed to pursue net-zero emissions in 2060. On October 26, Japanese Prime Minister Yoshihide Suga in his first keynote policy address at the National Diet declared that Japan would seek to achieve net-zero GHG emissions in 2050. On October 28, South Korean President Moon Jae-in as well announced a policy of pursuing net-zero emissions in 2050. In this way, major countries in the world have announced net-zero GHG emission or carbon neutral initiatives one after another. If Democratic candidate Joe Biden wins in the attention-attracting U.S. presidential election, Washington may specify a policy of enhancing climate change countermeasures and go in the direction of decarbonization.

Various factors are conceivable behind the series of carbon neutral initiatives announced by major countries. They include international and domestic political strategies to lead the world in addressing climate change and maintain or enhance leadership in protecting global interests, strategies to address severe geopolitical environments by building strategic relations with major countries and regions in the world regarding climate change policy, policies to leverage clean energy investment as part of climate change countermeasures for recovering from huge economic damage caused by the COVID-19 pandemic, economic and industrial strategies to win supremacy in advanced or innovative technologies for achieving net-zero GHG emissions, and industrial policies to secure long-term economic development growth by nurturing technologies and industries to support the transition to carbon neutral status. Essential or fundamental purposes for preventing climate change and protecting the global environment might have been combined with the abovementioned strategies, policies, or motivations to lead governments to pursue carbon neutral initiatives.

Given that all countries, including those pursuing net-zero GHG emissions, in the world still depend heavily on fossil fuels at present, however, it will not be easy for any country to realize net-zero GHG emissions even in the next 30 or 40 years. Net-zero emissions in 2050 or 2060 would be an extremely challenging or ambitious target. In fact, none of those vowing to achieve carbon neutral status has specified paths or energy mixes to accomplish the target. Investment or costs to realize the status have not been specified. They seem to be embarking on uncharted voyages to achieving carbon neutral status.

The first step for realizing carbon neutral status would be to eliminate emissions in the power sector after electrifying energy systems as much as possible. This is because the elimination of emissions is relatively easier for the power sector than for others. After a zero-emission power sector is realized, emissions will have to be eliminated in all other sectors such as those in the

industry, buildings, and transport sectors. Under this carbon neutral concept, interest has grown in CO<sub>2</sub>-free hydrogen. This means a growing recognition that net-zero emissions or the decarbonization of all energy systems would be difficult to realize without CO<sub>2</sub>-free hydrogen and other innovative technologies. Therefore, the Hydrogen Ministerial Conference launched by Japan in 2018 attracted global attention. Then, the European Union, Germany, the Netherlands, and others announced hydrogen strategies one after another. Hydrogen promotion policies have been implemented while the business sector has been enhancing hydrogen initiatives.

As is well known, CO<sub>2</sub>-free hydrogen includes green hydrogen produced with renewable energy electricity and blue hydrogen made from fossil fuels with CO<sub>2</sub> captured and stored. CO<sub>2</sub>-free hydrogen produced with nuclear power generation is also considered. Although what type of CO<sub>2</sub>-free hydrogen would be a future leader is still uncertain, it may be important to accept any type that could contribute to achieving net-zero GHG emissions. This is because options vary depending on resource endowment, technological capabilities, infrastructure development, and industrial arrangements for specific countries or hydrogen developers.

Among the types of hydrogen, however, blue hydrogen produced from fossil fuels with CO<sub>2</sub> emissions captured and stored is attracting growing interest. The thorough enhancement of energy efficiency and the spread of non-fossil energy such as renewables and nuclear would be indispensable for realizing carbon neutral status. Given that fossil fuels account for most of global energy supply and are abundant sources of energy and available through existing infrastructure, however, the decarbonization and utilization of fossil fuels is basically important. This is the reason Saudi Arabia, a leading oil producer that hosts an annual summit of the Group of 20 major countries this year, has advocated the concept of a circular carbon economy for promoting comprehensive decarbonization initiatives and pointed out that it would be important to eliminate CO<sub>2</sub> emissions from fossil fuel consumption with the so-called 4R technologies to reduce, reuse, recycle, and remove CO<sub>2</sub>. The decarbonization of fossil fuels is expected to make great contributions to global carbon neutral initiatives.

As a matter of course, many of those categorized as the 4R technologies are still under development and have yet to be commercialized. Their innovative development must be secured along with their improved economic efficiency, relevant infrastructure development, and their social acceptability. Their development path would be difficult and long. Subject to growing interest in blue hydrogen produced through fossil fuel decarbonization is the whole supply chain covering upstream development and production, midstream transportation, and downstream consumption. The key is the improvement of economic efficiency to cut blue hydrogen supply costs. The utilization of CO<sub>2</sub>-free ammonia (blue ammonia) is attracting attention as the phase before blue hydrogen development. This is because there is potential to use some of the existing supply chain to cut costs. A joint press release by the Institute of Energy Economics, Japan, Saudi Aramco, and SABIC on the world's first blue ammonia shipment has attracted global interest.

The path to carbon neutral status is not easy. Initiatives to decarbonize fossil fuels and utilize blue hydrogen and blue ammonia are entering crucial stages. I would like to pay attention to their promotion through future policies and market players' specific initiatives.

Contact: [report@tky.ieej.or.jp](mailto:report@tky.ieej.or.jp)

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