Special Bulletin

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Key Points of IEEJ Outlook 2022

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On October 15, the Institute of Energy Economics, Japan, published the IEEJ Outlook 2022 at its 439th meeting on research reports in the form of a teleconference. The outlook projects global energy supply and demand through 2050, being positioned as the IEEJ's flagship publication. The IEEJ releases the annual outlook every October, providing a long-term energy supply and demand analysis in the form of annual "regular exercise" and special analyses on up-to-date topics. In addition to a long-term analysis based on the Reference Scenario and the Advanced Technologies Scenario for "regular exercise", the latest Outlook gives (1) an updated analysis on the Circular Carbon Economy/4Rs Scenario focusing on the decarbonization of fossil fuels, and (2) an analysis titled "Challenges and Issues toward Carbon Neutrality" dealing with key issues that could be induced by economic activities, energy security, and upstream oil and gas investment shortages in the world going in the direction of carbon neutrality. The following summarizes key points of the latest Outlook.

In the Reference Scenario in which current trends will be sustained, global primary energy demand will steadily increase under sustained economic growth, posting a rise of about 1.2-fold from 2019 in 2050. The increase will be driven by Emerging Market and Developing Economies, including India, the Association of Southeast Asian Nations (ASEAN) and the Middle East & North Africa that will account for three quarters of the global increase. Of fossil fuel demand, coal will decline through 2050. However, natural gas and oil will steadily increase. Fossil fuels as a whole will continue to account for most of global primary energy demand. In 2050, they will command 77% of global primary energy demand. In the Advanced Technologies Scenario in which advanced energy technologies will penetrate as much as possible to enhance climate change prevention and energy security measures, primary energy demand in 2050 will be 17% less than in the Reference Scenario due to powerful progress in energy efficiency improvement. Demand will sharply grow for non-fossil energy sources such as renewable energy and nuclear, while slackening for fossil fuels. Coal demand will decrease substantially. Oil demand will peak in the 2030s and natural gas demand in the 2040s. As a result, global energy-related CO_2 emissions in 2050 will be 15.8 billion tons or 42% less than in the Reference Scenario. Nevertheless, fossil fuels will still account for 63% of primary energy demand in 2050, keeping their position as an important energy source.

The IEEJ Outlook forecasts future global energy supply and demand under various assumptions while being based on changes to date. The outlook of the forecast type contrasts with the backcasting analysis adopted by the International Energy Agency (IEA) to indicate how global energy supply and demand would have to change to reach a specific goal. The two types are commonly useful for analyzing future conditions but differently significant. The Net Zero Emission Scenario in the IEA's World Energy Outlook 2021 is a representative backcasting analysis, assuming net zero greenhouse gas emissions for the world in 2050. It indicates how the world would have to change to reach the net zero emission goal in 2050. The Advanced Technologies Scenario in the

IEEJ Outlook indicates how energy markets would change if advanced technologies that have been commercialized penetrate the markets to the maximum extent (based on the assessment by IEEJ experts). In this sense, it is a bottom-up outlook against the IEA's backcasting, or top-down, outlook. It is indispensable for any long-term energy supply and demand analysis to use the two types while understanding their differences.

The first special analysis in the IEEJ Outlook covers the Circular Carbon Economy/4Rs Scenario. As the world grows interested in decarbonization, comprehensive decarbonization initiatives are becoming more important. The promotion of non-fossil energy sources such as renewables and nuclear is important as a matter of course. Also important as part of comprehensive initiatives is the decarbonization of fossil fuels that will remain significant as energy sources in the future. Then, a circular carbon economy that will use 4Rs technologies to reduce, reuse, recycle and remove CO_2 emissions from fossil fuel consumption is attracting interest in the world. Last year's IEEJ Outlook took up the special analysis for the first time. This year, the IEEJ attempts to update and refine the analysis.

In this scenario analysis, we estimate the effects of the maximum penetration of 4Rs technologies. Fossil fuel consumption in 2050 in the scenario will be almost the same as about 9.1 billion tons oil equivalent in the Advanced Technologies Scenario. Thanks to the expanded use of blue hydrogen (clean hydrogen produced from fossil fuels with CO_2 emissions subjected to carbon capture and storage technology), blue ammonia, and synthetic methane and other fuels made from blue hydrogen and ammonia, however, global CO_2 emissions will be as much as 6 billion tons or 28% less than in the Advanced Technologies Scenario. In this scenario in which natural gas is assumed to play a central role in producing blue hydrogen and ammonia, natural gas demand will expand, with the Middle East and North America becoming significant blue hydrogen and ammonia exporters. In the scenario, fossil fuel trade will shift to hydrogen and ammonia trade. As hydrogen and ammonia trade expands, the Middle East and Asia will remain dependent on each other regarding energy trade. There are many challenges regarding the 4Rs technologies, including how to thoroughly improve economic efficiency regarding global supply chains for these new fuels and how to secure their social acceptability. However, this scenario indicates a world in which fossil fuels will be effectively used, with great contributions being made to initiatives for substantial global CO_2 emission cuts and decarbonization. Nevertheless, the world will fail to reach carbon neutrality in 2050. In realizing carbon neutrality, the further expansion of hydrogen use, as well as DAC (direct air capture of CO_2), CCUS (carbon capture, utilization and storage) and other innovative technologies will have to play a key role.

The second special analysis focuses on challenges and issues toward carbon neutrality, dealing with various issues that could arise in the world going in the direction of carbon neutrality. It considers whether green growth will be realized and whether costs to address climate change as an economic externality will exert any negative impact on economy, indicating that a net impact could become positive or negative depending on individual conditions of countries. Through analysis on carbon neutrality's economic burdens on ASEAN, it also points out that the implementation of tough policies to realize carbon neutrality could widen various gaps including those between Advanced and Developing Economies. A key challenge toward carbon neutrality is how to prevent gaps from widening and maintain international cooperation. The analysis also indicates that energy security will be further complicated by new issues including new energy security problems emerging through the expansion of blue hydrogen and ammonia trade, how to secure stable supply of electricity growing more important, new risks such as the impacts of cyberattacks and the expansion of variable

renewable energy on electricity supply, and how to secure stable supply of critical minerals playing key roles in promoting renewable energy and electrification. The analysis warns that if upstream oil and gas investment becomes insufficient due to uncertainties amid decarbonization initiatives, the supply-demand balance would tighten to destabilize crude oil and liquefied natural gas markets in the not-so-distant future. Toward the tough goal of realizing carbon neutrality, inclusive initiatives that respect the diversity of countries and actors will be significant

Long-term global energy supply and demand outlooks entail great uncertainties. No one knows how the world would be in the far future. However, it is important for all energy stakeholders to develop future pictures of the world based on various assumptions and premises. The IEEJ is determined to continuously contribute to solving energy problems in the world through analyses in the IEEJ Outlook.

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