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Key Points of IEEJ Outlook 2020

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On October 15, the Institute of Energy Economics, Japan (IEEJ), released the IEEJ Outlook 2020 that IEEJ positions as its flagship product. The annual long-term energy supply and demand outlook projects a future picture of energy in the world based on the following two scenarios: the Reference Scenario where current trends are assumed to continue and the Advanced Technologies Scenario where energy technologies for enhancing energy security and environmental measures are assumed to be introduced to the maximum. It also provides an analysis focusing for specific topics based on factors and challenges that are important for considering energy issues. The latest Outlook projects long-term energy supply and demand in selected countries and regions through 2050 and analyzes three topics – climate change, Asian LNG and renewable energy – under the subtitle "Coping with the Increasingly Challenging Energy Trilemma (3Es). The following summarizes key points of the latest Outlook.
(see https://eneken.ieej.or.jp/whatsnew_op/191015teireiken.html for details of the Outlook)

In the Reference Scenario, global primary energy consumption in 2050 will increase by 34% from 13.97 gigatons of oil equivalent (Gtoe) in 2017 to 18.76 Gtoe. Driving the increase will be developing countries including Asian emerging economies such as China, India and Southeast Asia. Asian primary energy consumption will grow from 5.67 Gtoe in 2017 to 8.59 Gtoe in 2050, accounting for 61% of the global increase. Asia's share of global energy consumption will expand from 41% to 46%, leading the gravity center of the international energy market to shift to Asia. In the scenario, global coal consumption will peak. However, oil and natural gas consumption will continue robust growth, allowing fossil fuels to dominantly account for total primary energy consumption. Among energy sources, natural gas will post the largest consumption growth, followed by renewable energy.

The conflict among the three energy-related challenges – energy security, environmental protection and economic growth or economic efficiency (the so-called 3Es) – will loom as an unprecedentedly important issue. The issue is called an "energy trilemma" as the three challenges frequently trade off with each other. It grows more complicated and serious as energy consumption expands. For the following reasons, the energy trilemma, while being a global issue, will grow more remarkable and serious in Asia that drives global energy consumption: Energy consumption expansion in Asia would raise its dependence on energy imports and the Middle East, making energy security more challenging. At the same time, air pollution and climate change would grow serious as Asia expands the consumption of coal as its main energy source. On the other hand, Asia would seek to sustain economic growth and reform its energy market in pursuit of greater economic efficiency.

In the Advanced Technologies Scenario, the Outlook assumes great structural changes in global energy supply and demand. In the scenario, substantial improvements in energy efficiency will limit global primary energy consumption to 15.92 Gtoe in 2050, 15% less than in the Reference Scenario. While a substantial increase in renewable energy consumption is combined with nuclear

consumption growth, coal consumption will decline steeply, with oil consumption peaking. Natural gas consumption will keep on expanding, though at a far slower pace than in the Reference Scenario. Non-fossil energy sources' share of primary energy consumption in 2050 will rise to 32% against 21% in the Reference Scenario. Zero-emission electricity sources' share in the power mix will increase to 79% against 41% in the Reference Scenario. Energy-related CO_2 emissions in 2050 will increase from 32.7 billion tons in 2017 to 40.9 billion tons in the Reference Scenario but will decrease to 25.3 billion tons in the Advanced Technologies Scenario. While emissions in the Advanced Technologies Scenario are 38% less than in the Reference Scenario, they will fall far short of being halved to limit the global temperature rise to less than 2℃. Additional efforts and costs will be required to further cut emissions.

Regarding climate change, the IEEJ, while fully understanding that greenhouse gas emission cuts (mitigation) are extremely important, has analyzed and proposed an approach of minimizing the total costs related to GHG emission reduction, namely, mitigation costs, adaptation costs and damage costs, taking into account the characterization of climate change as a super long-term issue and the importance of pragmatic global initiatives. It has also considered and pursued a path to minimize the total costs while limiting the global temperature rise to less than 2℃ over a super long term. Given that climate change is greatly uncertain, however, the total cost minimization approach faces some challenges such as how to secure accurate damage estimates or handle tipping elements (events that could bring about irreversible, extremely serious damage if progressing beyond critical points). The Outlook analyzes the adequacy of a path for the minimum costs for the 2℃ goal by estimating tipping elements such as the melting of Greenland's ice sheet, based on the latest analysis by Prof. William Nordhaus, a globally famous expert on climate change. The IEEJ plans to accumulate research to overcome challenges of this approach.

Various measures are under consideration to overcome the energy trilemma in Asia. Particularly great hopes are placed on natural gas/LNG expansion among them. This is because natural gas/LNG expansion is expected to contribute to diversifying energy sources, lowering Asia's dependence on the Middle East and cutting coal consumption to improve environmental problems. Particularly, LNG is expanding its market and expected to play a greater role in Asia. The Outlook analyzes high and low LNG prices' effects on demand, given that mainly low-income Asian emerging countries are expected to expand LNG demand. In the Low Price Case where LNG prices are assumed to stay as low as current spot LNG prices, Asian LNG demand in 2050 will reach 680 million tons, 56% more than 436 million tons in the Reference Scenario where LNG prices are assumed at $10 per million British thermal units (MMBtu). In the High Price Case where prices are assumed to exceed $17/MMBtu, demand will be limited to a far lower level of 221 million tons in 2050, indicating that the affordability and competitiveness of LNG prices would be the key to LNG demand expansion mainly in emerging countries. The problem is how to secure investment to increase supply meeting the demand expansion in the Low Price Case. LNG consumers and producers are required to promote initiatives to realize a win-win relationship in which both would benefit from a sound LNG market expansion, while investment costs being cut.

Renewable energy expansion is also expected to play a key role in overcoming the energy trilemma. This is because rapid falls in power generation costs of renewable energy that is produced domestically, distributed and free from CO_2 emission at generation stage have attracted global interests recently. Given the current conditions, solar photovoltaics, wind and other renewables will undoubtedly expand. However, the Outlook quantitatively analyzes the cost for integrating variable renewable energy (VRE) such as solar PV and wind into the grid network in Europe and the Association of Southeast Asian Nations (ASEAN) and indicates that the expansion of VRE's share

of the power mix would boost the integration cost to undermine the economics of renewable energy in total supply cost basis. It also points that it would be important to secure stable electricity supply by addressing windless periods as well as the so-called cannibalization effect where massive solar PV power generation would lead to a wholesale electricity price fall to undermine the value of such generation. As far as there is no perfect energy source, it is indispensable to pursue a best energy mix while trying to overcome each source's weak points.

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