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Exploring the Energy Future

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Our Institute released the latest IEEJ Outlook 2027 on October 23. The report presents visions of the global energy supply and demand outlook through 2050 under two scenarios: Reference Scenario (REF) and Advanced Technology Scenario (ATS). The REF assumes the continuation of current policy directions and technology trends. In contrast, the ATS assumes that, taking feasibility into account, energy security and climate change mitigation efforts are strengthened and that all relevant technologies are deployed to the maximum extent possible.

There are two major approaches to developing long-term outlooks: forecasting and backcasting. The IEEJ Outlook adopts the former. Starting from the present, it constructs plausible future pathways by incorporating, over time, the different changes assumed under each scenario. Backcasting, by contrast, begins with a predefined future objective, such as achieving carbon neutrality by 2050, and then works backward to determine how the gap between the present and that goal can be closed. The implications of the results derived from these two approaches are fundamentally different. Therefore, it is essential to understand which methodology underlies a particular outlook. Failure to distinguish between forecasting and backcasting can lead to significant misinterpretation of the conclusions and policy implications of the analysis.

Our analysis indicates that fossil fuels will remain part of the global energy mix through 2050 under both scenarios. Given the constraints of technology readiness and cost, it is difficult to envision a future in which the world completely eliminates fossil fuel use within the time remaining. Energy demand in emerging markets and developing economies (EMDEs) is expected to continue growing, and renewable energy alone is unlikely to be sufficient to meet that increase. Even in the power sector, where substituting fossil fuels with renewables is comparatively easier, renewable energy is expected to cover most of the incremental growth in electricity demand rather than replace the existing generation currently provided by fossil fuels. Looking at the energy system as a whole, including heat demand, economically viable alternatives to fossil fuels have yet to be identified for certain industrial processes and sectors such as aviation. For these reasons, ensuring a stable supply of fossil fuels will remain important for the foreseeable future, and continued investment will be essential to secure adequate supply.

In theory, the phase-out of fossil fuels could be accelerated if cost considerations were set aside. In practice, however, recent events demonstrate how difficult such an approach would be to implement. Most recently, large-scale unrest in France in mid-October has been attributed, at least in part, to the hardship caused by inflation. In the United States, with the midterm elections approaching, the Trump administration has been making strenuous efforts to reduce diesel prices. Both cases suggest that public tolerance for rising living costs is limited. It is difficult to persuade people with the argument that “short-term sacrifices will lead to long-term gains,” and many governments face a political environment in which policies that impose additional financial burdens on households are increasingly difficult to pursue.

Yet, progress toward decarbonization, particularly in the power sector, is expected to continue steadily. Up to a certain penetration level, before the system integration costs associated with variable renewable energy become a significant constraint; renewables represent an economically rational choice in many countries. Moreover, the heightened emphasis on improving energy self-sufficiency following the experience of the Strait of Hormuz blockade is likely to provide additional momentum for renewable energy deployment.

Electricity demand is also expected to continue growing. By 2050, global electricity consumption is projected to increase to roughly 1.6 times its 2024 level in the REF and 1.8 times in the ATS. It is important, however, to understand that this growth does not come solely from data centers. On a global basis, the expansion of electricity demand is driven even more by the electrification of end-use energy consumption and by rising demand for space cooling/heating. Renewable energy will play a central role in meeting this growing demand for electricity. As noted earlier, however, its expansion is unlikely to be sufficient to displace thermal power generation on a large scale. Consequently, if the objective is to reduce CO₂ emissions as much and as quickly as possible, low-carbonizing thermal power generation or the deployment of carbon capture and storage (CCS) will be indispensable.

In the REF, the resulting global CO₂ emissions reduction is moderate, falling from approximately 35.5 GtCO₂ in 2024 to around 32.5 GtCO₂ by 2050. This relatively modest reduction reflects the fact that the impacts of the Strait of Hormuz blockade work in both directions with respect to emissions. On the one hand, heightened concerns over the risks associated with oil and gas imports accelerate electrification and the deployment of renewable energy and nuclear power in importing countries. On the other hand, they also encourage a shift back toward coal in some countries, offsetting part of the emissions reductions achieved elsewhere.

In the ATS, the pace of emissions reduction accelerates significantly, with global CO₂ emissions

falling to approximately 14.2 GtCO₂ by 2050. Under this scenario, the increase in global average temperature would be limited to roughly 2°C, with a probability of 50 percent. The remaining global carbon budget is being depleted rapidly, and regrettably, limiting warming to 1.5°C has become unattainable. While the transformations assumed under the ATS will not be easy to achieve, they remain within the bounds of technical and economic feasibility. I hope that the world will continue to make every effort it can, even if only little by little, to bring about a better future.

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