

IEEJ Outlook 2020

Energy,
Environment
and Economy

Coping with the increasingly challenging energy trilemma (3Es)

“IEEJ Outlook 2020” analyses the challenges facing energy transition from the 3Es perspective, as well as the outlook for global energy supply and demand through 2050. Demand in the Emerging Market and Developing Economies will surge, with room to grow after 2050. In Asia, where imports grow, the sources of supply will diversify, including the possibility of expanding imports from North America. Its dependence on the Middle East, however, will exceed half the imports and therefore mitigating the risk of supply disruptions remains an issue.

Whilst demand for liquefied natural gas (LNG) in Asia will continue to grow, price competitiveness will have a major impact on it. The increase in LNG imports makes energy supply security even more important, and it is necessary to strengthen the cooperation efforts with international markets.

Renewable energies such as solar photovoltaic (PV) and wind power generation, whose costs are rapidly declining, will play a major role in the pursuit of low carbonisation and sustainability. The continuation of policy support in the medium and long term is indispensable for the sustainable expansion of the introduction. Due to natural variability, however, there are several challenges to the mass introduction of renewable energy.

To address climate change issues, a “pragmatic approach” from a long-term perspective is important.

Overview of the global energy market by 2050

In Asia, where energy imports are increasing, the sources of supply will diversify, including the possibility of increasing imports from North America. Asia’s fossil fuel import dependence on the Middle East will be more than 50%, making it necessary to reduce the risk of supply disruptions. On the other hand, oil and natural gas exporting revenues for the Middle East vary by as much as \$1.3 trillion between the Reference and the Advanced Technologies Scenarios.

- In the Emerging Market and Developing Economies, where demand is increasing rapidly, consumption per capita in 2050 will be less than half that in the Advanced Economies, leaving room for further growth in demand. In the Reference Scenario under the current trend, natural gas will become the second largest energy source after oil, surpassing coal, which peaks around 2040. Renewable energy will increase significantly, but there will be little progress in eliminating fossil fuels.
- More than 60% of the increase in energy demand will be concentrated in Asia. However, as production within the Asian region cannot keep up with the increase in demand, imports will increase. As a result, about 80% of energy traded internationally will go to Asia. While an increase in oil imports from North America is expected, crude oil from the Middle East will still account for more than 70% of the region’s imports. As such, mitigating the risk of supply disruptions remains a challenge.
- In the Advanced Technologies Scenario, which considers the strengthening of energy and environmental policies, the increase in fossil fuel demand is restrained compared to the Reference Scenario, and prices are lower. Oil and natural gas export revenues for the Middle East decrease by the equivalent to 13% of its GDP, raising the issue of the urgency of shifting away from an economy that excessively depend on the uncertainty of fuel exports.

- In the Advanced Technologies Scenario, carbon-free power sources account for about 80% of the power generation mix. In some regions, the generating capacity of variable renewable energy (VRE) exceeds maximum demand, requiring drastic grid stabilisation measures. Carbon dioxide (CO₂) emissions will peak in the mid-2020s and fall by 23% in 2050 from the 2017 level, far from halving greenhouse gas emissions.

A “pragmatic”, or a total cost minimisation approach based on a long-term perspective is important in dealing with climate change issues.

To keep the temperature rise to below 2°C, innovative technologies and measures to reduce emissions beyond the Advanced Technologies Scenario must be developed. The wisdom and ingenuity to minimise the total cost from a long-term perspective are crucial.

- There are many uncertainties associated with cost minimisation approaches (or cost-benefit analysis). It has been pointed out that irreversible changes in the earth system, called tipping elements, could lead to a shift to a “Hothouse Earth.”
- However, tipping elements often take a very long time to develop, so the impacts of short-term climate policies are relatively small. It is an important task for humankind to further refine the analysis, including these points, and to examine appropriate policies.

Price competitiveness will affect LNG demand in Asia. Supply security becomes even more important.

LNG demand in Asia will increase, but price competitiveness will considerably influence the expansion. Asia will need to strengthen its efforts to ensure supply security by utilising the international market.

- Demand for natural gas in Asia grows, but LNG demand will be greatly affected by price competitiveness in the power generation sector, where demand potential is particularly high. Demand increases at an annual rate of 6.1% in the Low Price Case (\$5.4/MBtu in 2050), while it stays at an annual rate of 2.4% in the High Price Case (\$17.5/MBtu in 2050).
- Dependence on imports increases from 32% in 2017 to 49% in 2050, making supply security even more important. LNG hungry Asia can strengthen security by benefiting from expanding its liquefaction capacity and utilising the flexibility of other markets like the US, Europe, and China.

Challenges for high penetration of renewable energies

Solar PV and wind power generation spreads rapidly with the lowering of generating cost. At the same time, high integration costs due to natural variability, “cannibalisation effect” and risks of supply disruptions due to natural variability pose major challenges.

- VREs will rapidly become widespread by 2050, as power generation costs are falling. However, the trends vary since the abundance of such resources varies greatly by country and region.
- Under high penetration of VREs, the “integration costs” caused by the intermittent output are expected to increase.
- Very high shares of VRE will require additional policy measures to deal with the challenges: (1) Declines in the value of VRE facilities due to the “cannibalisation effect”, caused by very low marginal costs, (2) Risks related to supply disruptions caused by natural variability, such as windless periods or “dark doldrums”, and (3) Social acceptability for large-scale land use.
- To achieve very high VRE shares, electricity storage is essential. In addition to batteries and pumped hydro storage that respond to hourly and daily fluctuations, hydrogen storage or power-to-gas technologies, that respond to seasonal fluctuations, can also be useful.