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The Institute of Energy Economics, Japan

IEEJ Outlook 2019

Energy transition and a thorny path for the 3E challenges

Energy, Environment and Economy

The "IEEJ Outlook 2019" analyses the global energy supply and demand through 2050, as well as the challenges of a global energy transition from the 3E-perspective. All future increases in global energy demand will come from non-OECD countries. The gap between energy supply and demand in Asia will widen, increasing its dependence on imports. The cumulative investment required for energy supply is $67 trillion, or 1.5% of GDP. Fuel and electricity supply will each account for half of the total investments. The world's demand for electricity will double, and economic and social dependence on electricity will increase. In addition to oil, which has been at the core of discussions on energy security, it is desirable to systematically develop the ability to respond to power supply disruptions. Asia's surging electricity demand will be met by rapidly growing renewable energy and natural gas, as well as with cheap and abundant coal, which will remain a major power source. A total ban on the construction of coal-fired power plants would reduce CO_2 emissions, but it is necessary to pay attention to trade-offs with energy security, electricity costs, etc.

An overview of the global energy market and climate change responses through 2050

The gap between energy supply and demand in Asia will widen, increasing its dependence on imports. The additional investments required for the Advanced Technologies Scenario is $8 trillion. Asia can recover enough of its investments by reducing its fuel import spending, but the Middle East will see a sharp drop in its exports.

- All future increases in global energy demand will come from non-OECD countries. OECD countries, on the other hand, continue to decouple energy consumption and economic growth. Under the "Reference Scenario," the global demand for electricity will double and the economic and social dependence on electricity will increase. While the rapid and steady spread of renewable energy and natural gas is expected to power the rapidly growing demand for electricity in Asia, cheap and abundant coal will remain a major power source.
- Strong demand for oil and natural gas in Asia far exceeds the growth in production in the region, widening the supply-demand gap. Imports will increase significantly, with about 80% of the energy traded internationally going to Asia. In particular, the oil import spending will increase rapidly, and the total spent on energy imports from outside the region will increase from 1.6% to 3.0% of GDP.
- Under the "Advanced Technologies Scenario," in which energy and environmental policies are strengthened, a cumulative total of 35 Gtoe of energy can be saved compared to the Reference Scenario. Oil demand will peak in 2030 before declining thereafter. CO_2 emissions will peak in the mid-2020s and decrease by 11% from 2016 levels by 2050. However, in order to realise an emission path that will keep the temperature rise at 2°C, further reduction policies and the development of innovative technologies are necessary. From a long-term perspective, the wisdom and ingenuity to minimise the total cost of climate change are essential.
- Under the Reference Scenario, the cumulative investment required for energy supply is $67 trillion, or 1.5% of GDP. Fuel and electricity supply each account for half of the total investments. Under the Advanced Technologies Scenario, an additional investment of $8 trillion is required, including investment in energy efficiency. In Asia, it is possible to recover enough of it through reduced import spending. On the other hand, exports from the Middle East and others will shrink sharply. The ratio of electricity-related investment, including power saving (energy efficiency), to the total energy investment

will stand at 52% in the Reference Scenario and 61% in the Advanced Technologies Scenario, underscoring the importance of investment in the power sector.

Need to restructure the oil and electricity supply security system

Up until now, oil has been at the core of the discussions on energy security. It is important to continue strengthening the security of oil but it is also desirable to develop a security system to cope with electricity supply disruptions, as demand for electricity increases.

- The risk of oil supply disruption remains present. Depending on developments in Iran, which is attracting attention, oil prices may rise sharply. The disruption of large-scale oil supplies could be particularly severe. If Middle East oil production falls by 10 Mb/d and other oil-producing countries fail to increase production to compensate, the world economy would shrink by 9%, particularly in Asia.
- Power outage, which is the supply disruption of electricity, has large regional difference. In some low-income countries, power outages are more than 10% a year. In developed countries, power transmission and distribution automation has shortened power outage time, but new risks such as (1) increasing dependence on specific energy sources, (2) being a duck curve of net load due to increased solar PV power generation, (3) plant shutdown due to economic efficiency, and (4) cyber attack are attracting attention.
- In terms of measures to deal with supply disruptions, oil and electricity have many common points such as diversification, redundancy, and diversification, but they are different from each other in terms of ensuring the ability to deal with supply disruptions. In the case of oil, a certain degree of institutional security to cope with supply disruptions is provided through stockpiling systems and the international cooperation by IEA member countries. It is also important to support economic stabilisation in oil-producing countries in the future.
- In the case of electricity, there is no guarantee of reserve power generation capacity in preparation for power outages. It is desirable to establish a security system for electricity, including the use of new technologies such as artificial intelligence and Internet of things.

Consider the impact of anti-coal-fired power generation

If the construction of new coal-fired power plants is banned after 2020, CO_2 emissions could be reduced by up to 7 Gt in 2050. However, it is necessary to pay attention to the trade-off relationship with energy security, the electricity cost issue, etc.

- In the Reference Scenario, more than the half of the increases in CO_2 emission up to 2050 is direct emissions from the power generation sector. Movements such as “ESG investment” and “Divestment”, which suggest refraining from investing in or withdrawing from coal-fired power plants, are spreading.
- If new coal-fired power plants are totally banned after 2020, coal consumption could be reduced by 2.3 Gtce in 2050, and CO_2 emissions could be reduced by 3 Gt in the case of substitution by natural gas-fired power generation and 7 Gt in the case of substitution by solar PV / wind power generation.
- Reducing coal consumption is inextricably linked to the explosive increase in alternative energy consumption. The enormous additional demand presents us with major security challenges such as stable supply of natural gas and electricity, economic efficiency, etc. The impact of this energy transition is particularly pronounced in Asia, which is heavily dependent on coal, but the rise in natural gas prices extends beyond Asia, where increases in natural gas demand are less.
- Countries that can abolish coal-fired power generation should steadily promote it. On the other hand, in countries where it is difficult to abolish coal or have better alternatives to CO_2 reduction must consider their priorities. Even in such countries, however, efforts must be made to replace low-efficiency coal-fired power plants with highly efficient ones, and at the same time, to develop the environment to reduce coal-fired power generation. To this end, developed countries must be prepared to provide financial and technical assistance.

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