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Asia/World Energy Outlook 2011

－Growing Uncertainty over International Energy Trends and the Future of Asia－

The Institute of Energy Economics, Japan (IEEJ)

【Summary】

This report provides a comprehensive energy supply and demand outlook for Asia and the world, through 2035. The Outlook combines analyses of past energy trends, current energy policies and measures to tackle global warming expected and anticipated world economic growth, including the growth in emerging Asian countries. Of particular interest, this report provides a detailed quantitative study of various countries` policy changes/moves, following the Great East Japan Earthquake and the related incident at the Fukushima Daiichi Nuclear Power Station. The report also provides an analysis, mainly with regard to the effects of energy conservation, on Middle East countries which are important as oil- and gas-producing countries.

Low-carbon technologies, which reduce the consumption of fossil fuels, are expected to play an increasingly important role towards achieving global warning objectives, while ensuring more stability in energy supply. Therefore, in addition to a "reference scenario" that reflects current energy and environmental policies, the report provides an analysis of a "technologically advanced scenario". In the scenario, advanced low-carbon technologies become widely available around the world due to the progress in international technology transfers.

Moreover, the report examines a "low nuclear scenario," in which nuclear power development in countries around the world are considerably delayed and reduced as a result of policy changes or other factors after the Fukushima accident, while various measures and technologies are introduced to the same degree as under the "technologically advanced scenario". It analyzes the impact of stagnant nuclear development and compares this scenario also with a "zero nuclear power scenario", **when applicable**.

Additionally, in consideration of the recent global developments toward setting greenhouse gas emissions targets in a time horizon beyond 2035, the report outlines an estimate of how the energy supply and demand balance will change and how the reduction of CO2 emissions will proceed over the period through 2050, based on the assumption of the introduction and dissemination of innovative technologies under each scenario.

【Major conclusions】

■ **Surging energy demand, assurance of stable energy supply and response to global warming**

Under the reference scenario, the world's primary energy consumption will expand by more than 6 billion tons of oil equivalent (Btoe), from 11.2 Btoe in 2009 to 17.3 Btoe in 2035 (an increase of 54%).

Fossil fuels will account for 80% of this growth during the period, continuing to serve as the major energy sources. Asia will lead the growth in the world's primary energy demand, with demand in China and India growing particularly sharply. The demand growth in China and India during that

period will total 2.8 Btoe, accounting for 45% of the world's demand growth. In line with the energy demand growth, many energy-consuming countries will become more dependent on imports for their energy supply, and this may intensify the competition to secure long-term energy resources.

In the whole of ASEAN economies, energy consumption will more than double, almost triple, by 2035, leading to an ever increasing need for imports from outside the region. Energy demand growth in fossil fuel producing countries is also an issue that needs to be carefully watched and regularly reviewed. It is still fresh in our memory that Indonesia, which until recently was an oil-exporting country, became a net oil importer due to an increase in its domestic demand. Energy demand in the world's largest fossil-fuel exporting region, the Middle East, is also expected to grow sharply. In Saudi Arabia, for example, domestic oil consumption in 2035 will reach a level equivalent to almost 50% of its current production. Domestic demand in resource-supplying countries is an important issue to be considered while developing measures to balance/stabilize the international energy markets. The acceleration of investments in upstream developments should ensure sufficient export revenues for those resource-supplying countries while maintaining or even expanding their export capacity.

Given the expectations of growth in fossil fuel demand, ensuring stable energy supply will become increasingly challenging for all major countries. At the same time, global warming is another important worldwide concern that may affect the sustainability of global growth. Therefore, in order to overcome the "3E's and S" challenges (see below), it is important to make increased efforts from a long-term perspective as well as from a comprehensive perspective. As there is no panacea of solutions for those challenges, it is essential to consider all available measures, including "enhanced energy conservation" on the demand side and "safer nuclear technology," "cleaner use of fossil fuels" and "lower-cost renewable energy" on the supply side.

(1) Impact of the incident at the Fukushima Daiichi Nuclear Power Station on future nuclear development around the world

The Great East Japan Earthquake and the resulting incident at the Fukushima Daiichi Nuclear Power Station have heightened worldwide concerns over the safety of nuclear power generation. As a result, countries' energy policies have been affected in various ways. Some countries, such as Germany, are moving to abolish or scale back nuclear power generation and significantly cut back on plans to build nuclear power stations. On the other hand, countries that have been aggressively promoting nuclear power are expected to maintain and expand nuclear power generation in the medium to long term from the perspective of overcoming the "3E's" challenges ("Energy security", "Environment" and "Economy").

More than 60% of the world's existing nuclear power generation capacity belongs to countries that have aggressively promoted nuclear power, such as France and Russia, China and India. Consequently, even if the worldwide use of nuclear power becomes very stagnant due to policy changes following the Fukushima incident, nuclear power generation capacity should continue to grow, primarily led by developments in emerging countries. In light of this situation, the world's nuclear power capacity is still expected to grow by almost 50%, from 390 million kilowatts now to 574 million kilowatts in 2035, under the reference scenario. Under the low nuclear scenario, the capacity would increase by 28%, to 500 million kilowatts.

It is therefore essential to ensure the "Safety" aspect of nuclear power generation. It is important for technologically developed countries, including Japan, to make active contributions to the establishment of a global nuclear safety control system. On the other hand, it will also be an important challenge to secure alternative power sources to make up for delays and cutbacks in nuclear power development plans.

If nuclear power generation becomes stagnant worldwide (low nuclear scenario) and thermal power generation is required as an alternative to make up for the resulting decrease in generation, coal consumption would grow by 360 Mtoe (about 500 million tons), oil consumption by 70 Mtoe (about 1.4 million barrels/day), and natural gas consumption by 140 Mtoe (almost 140 bcm or half of the current amount of LNG traded globally). World's CO2 emissions in 2035 would be 7% higher by 2 billion tons, representing an increase of 12% compared with 2005 (under the zero nuclear power generation scenario, the emissions would rise an additional 20%, representing an increase of 20% compared with 2005). As a result of replacing nuclear power with fossil fuel power, cumulative investment in power generation capacity will decrease by 0.6 trillion dollars (because thermal power generation facilities cost less to build). However, the increase in consumption of fossil fuels for thermal power generation leads to additional cumulative costs totaling 2.5 trillion dollars worldwide, increase significantly the overall costs of electricity.

Meanwhile, if renewable energy (e.g., wind and photovoltaic power) is used as an alternative to make up for the decrease in nuclear power generation, 7 to 8 times more in up-front investments in power generation capacity would be required. Additional investments of 4.5 trillion dollars would be required. Assuming that the capacity building cost will decline sharply (this report assumes that the costs of photovoltaic panels and installation will drop to a half of the current level over the period through 2035 on average and the cost of offshore wind power generation will decline to a similar level, to the current cost of onshore wind power generation), investments in renewable energy power generation capacity will be reduced to a similar level to investment in thermal power generation capacity (including fuel cost). However, the cost reduction may be offset by the additional cost of measures to deal with problems related to power grids because large-scale introduction of renewable energy will destabilize the grids.

As was described above, the replacement of nuclear power generation with thermal power generation could produce a considerable impact on sustainable growth from the perspective of both ensuring energy security and dealing with global warming. Therefore, it would be essential that those anticipated challenges associated with renewable energy power are resolved in the near-term (high cost and problems related to power grids). Under the current circumstances, nuclear continues to be recognized as an essential energy source difficult to replace from the global environment, energy security and cost perspectives. Since this recognition has been reflected in the energy policies of countries around the world, nuclear power generation capacity is expected to continue to increase, mainly in Asia, even under the low nuclear scenario. Therefore, it is essential to ensure the safety of nuclear power generation capacity and make use of it.

(2) Other measures to overcome the "3E's and S" challenges

In addition to better ensuring the safety of nuclear power generation (Safety), the following three measures are particularly important:

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① Energy conservation

Energy conservation (improvement in the efficient use of energy on both the supply and demand sides) accounts for 47% of the CO2 reduction potential between the reference and the technologically advanced scenarios. The ratio of energy conservation is expected to be particularly high in regions where steep demand growth is expected, such as Asia and the Middle East. Thus, energy conservation is the most effective means to reduce CO2 emissions, so progress in energy conservation will have a significant impact on global energy security as well as global warming.

② Efficient use of fossil fuels

Fossil fuels will continue to account for most of the world's primary energy consumption. Its ratio to the world's primary energy consumption will drop from 88% in 2009 to 85% under the reference scenario in 2035 and to 77% under the technologically advanced scenario. Therefore, making clean and highly efficient use of, and ensuring a stable supply of fossil fuels will continue to be among the critical challenges for the long term. In order to deal with global warming in the long term, it will also be important to accelerate the development of technologies for CCS plus U (carbon capture and storage, effective use).

③ Expansion of the use of renewable energy

Likewise, in light of the need for energy security and measures to deal with global warming, the importance of renewable energy is certain to grow. Therefore, it is an urgent challenge to strengthen policies, research and development, and infrastructure development activities. It is important to reduce the cost of developing renewable energy and implement measures to resolve its associated supply instability (measures to deal with problems related to power grids), so as to better promote the dissemination of renewable energy.

(3) Outlook through 2050

Under the technologically advanced scenario, the world's CO2 emissions in 2050 will be 29% lower compared with 2005 (9% lower when compared with 1990). Under the low nuclear scenario, the decline in the world's CO2 emissions will be smaller, with the emissions in 2050 being 17% and 7% lower compared with 2005 and 1990, respectively. Under the zero nuclear power scenario, the world's CO2 emissions would be 4% lower compared with 2005 but 23% higher compared with 1990. In other words, in order to achieve the goal of halving the world's CO2 emissions by 2050, it will be necessary not only to introduce technologies that are currently expected to be put into practice but also develop and disseminate new innovative technologies. Under the low nuclear and the zero nuclear power scenarios, in particular, it will be increasingly difficult to sharply reduce greenhouse gas emissions. In order to achieve technological innovation, it will be necessary to enable fundamental breakthroughs and large-scale dissemination of new technologies by making further research and development investments in the fields of nuclear power generation, renewable energy, CCS and other energy conservation technologies.

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■ **Implications for Japan**

For Japan, which is extremely poor in energy resources, ensuring energy security is a particularly important challenge. It will be necessary to take action from the perspective of procuring fossil fuels amid the intensifying competition to secure resources while promoting the introduction of renewable energy. It will also be important to consider making efforts to ensure energy security in the medium to long term through international cooperation, particularly partnership with Asian countries in energy infrastructure development. Moreover, as nuclear power generation will be expanded mainly in Asia, it will be important for Japan to make active contributions to ensuring the security of nuclear power on a global level, based on the lesson of the Fukushima incident, through the formulation of international standards of safety regulations, transfer of safety technologies and personnel training. To do so, it will of course be necessary to promote a national debate and seek national consensus on nuclear power after bringing the Fukushima incident under control, stabilizing the damaged reactors and enhancing the safety of nuclear power stations.

All things considered, Japan, which has technological and institutional advantages, has a very great role to play in this respect. In particular, Japan is competitive in energy-saving and environmental conservation technologies, which play the central role in overcoming the “3E’s and S” challenges. Further development and utilization of those technologies should be a key option of the Japan growth strategy and international energy strategy. In the future, it will be important for Japan to utilize these advanced technologies to step up efforts to overcome the “3E’s and S” challenges simultaneously and accomplish sustainable economic growth as a leading technology-oriented nation.

Contact: report@tky.ieej.or.jp