

Asia / World Energy Outlook 2006

The Institute of Energy Economics, Japan (IEEJ)

The Institute of Energy Economics, Japan made long-term predictions on the world energy supply and demand situation (up to 2030) with particular focus on Asia, based on the analyses of world trends that are already evident or expected to emerge in the future. This paper reports on major prediction results.

【Major assumptions】

● Economic growth

World: The world economy will grow steadily at a rate of 3.1% per annum during the period 2004 to 2030.

Asia: The economic growth rate will be 5.4% per annum in the entire Asian region (excluding Japan), being 6.1% in China and 5.8% in India.

● Population

The world population will grow from 6.5 billion in 2004 to 8.4 billion in 2030. Within Asia, the population will grow to 1.49 billion in China and to 1.46 billion in India.

● Crude oil price

While the crude oil price was \$51/barrel in 2005 (OECD's average crude oil import price, CIF base) and \$61/barrel in the first half of 2006, the price will come down to \$50/barrel (the real price based on the currency value as at 2005; the same referred hereafter) by 2010. Subsequently, the price will gradually rise again to \$52/barrel in 2020 and to \$56/barrel in 2030.

【Major Results】

● Primary energy consumption

World: The world's primary energy consumption will grow at a rate of 1.7% per annum in the period up to 2030, from 102 Mtoe in 2004 to 159 Mtoe in 2030. Approximately 90% of this growth will be due to an increase in the consumption of fossil fuels.

Asia: Geographically, approximately one half of the expected increase in primary energy consumption will be accounted for by increases in Asia, particularly in China and India. : Around 90% of this growth will be also satisfied with an increase in the consumption of fossil fuels, and coal, in particular, will be responsible for approximately 35%, the largest share among fossil fuels, of the growth in the Asia's primary energy consumption (about 33% with oil and 19% with gas).

● Accelerated shift to electricity and increase in electricity supply

The shift to electricity will continue further in each Asian country as income levels rise. In the next 30 years or so, electricity consumption is expected to grow by a factor of 2.5. Even though coal-fired electric power generation will be the main source of electricity, natural gas-fired electric power generation will become increasingly popular because of its high generation efficiency and environmental compatibility, greatly expanding its share of generated

electricity from 14% in 2004 to 20% in 2030.

● **Expansion of nuclear**

In Asia, where electricity consumption is expected to grow sharply, nuclear power generation will expand rapidly. Of the 114 GW increase in the installed capacity for nuclear power generation expected in the world during the period up to 2030, 110 GW of capacity will be added by new nuclear power plants in Asia. Thus, Asia will contribute most to the expansion of nuclear power generation in the world. The growth will be highest in China and India: the installed capacity for nuclear power generation will expand to 50 GW in China and to 32 GW in India by 2030.

● **Progress in motorization**

In Asia, the number of automobiles owned will increase from 165 million in 2004 to 510 million in 2030. The increased consumption of transport fuel will drive the oil consumption in Asia up from 22 million barrels per day in 2004 to 44 million barrels per day in 2030.

China and India

● **Primary energy demand in China and India**

In 2030, the primary energy consumed by China and India will represent approximately one quarter of the primary energy consumed in the world: these two countries alone will be responsible for approximately 40% of the growth in the world's primary energy consumption (approximately 60% with coal, 40% with oil, 10% with gas and 60% with nuclear power).

● **Motorization in China and India**

The number of automobiles owned in China will grow by about 200 million from 27 million in 2004 to about 233 million in 2030 (about three times as many as the number of automobiles owned in Japan). As a result, oil consumption in China will grow by 10.2 million barrels per day from 6.5 million barrels per day in 2004 to 16.7 million barrels per day in 2030, which is a growth factor of about 2.6.

● **CO₂ emissions**

World: World CO₂ emission is expected to grow at a rate of 1.7% per annum in the period up to 2030, from 7.4 Gt-C in 2004 to 11.4 Gt-C in 2030.

Asia: CO₂ emission in Asia is expected to grow by a factor of 1.9, with the emission of 4.8 Gt-C in 2030. Asia will be responsible for about 60% and China alone for about 30%, of the growth in global CO₂ emission.

【Challenges in the world】

● **Growing world oil demand**

World oil consumption will grow at a mean per-annum rate of 1.5%, from 80 million barrels per day in 2004 to 117 million barrels per day in 2030. Approximately 80% of the increase will have to be met by supplies from OPEC countries, mostly the Middle East. The share of OPEC countries in the oil production of the world will increase from 42% in 2005 to 53% in 2030. The world's oil resources are adequate to meet the projected increase in oil demand to 2030 so long as necessary investments in supply infrastructure, which is a key factor

to stabilize international oil market, are made.

● **Increasing demand for LNG**

World LNG demand will grow at a mean per-annum rate of 5.2%, from 139 million tons in 2005 to 495 million tons in 2030, a growth factor of 3.6. LNG imports in Europe and USA are projected to increase rapidly, mainly because of growing gas demand in power generation sector and the sluggish growth of regional natural gas production. LNG demand in the West may surpass LNG demand in Asia by 2020.

【Challenges in Asia】

● **Increasing dependency on imported oil and on the Middle East**

In Asia, dependency on imported oil is expected to grow from 55% in 2004 to 89% in 2030. Most of the imported crude oil is expected to be procured from the Middle East because of advantages in supply capacity and economy (cost competitiveness). Most importantly, in northeast Asia (Japan, China and South Korea), dependency on the Middle East will increase from 72% in 2004 to 83% in 2030. (China's dependency on the Middle East will increase from 46% in 2004 to 74% in 2030.)

● **Sharp increase in the oil traffic through the Strait of Malacca**

With the increasing dependency of Asia on imported oil and on the Middle East, the transportation of oil through the Malacca/Singapore Strait (i.e. Strait of Malacca) will grow from 11.7 million barrels per day in 2004 to 24 million barrels per day in 2030. Accordingly, the number of very large crude carriers (VLCCs) passing through the Strait will increase from about 4,200 vessels per year in 2004 to 8,300 vessels per year in 2030. Thus, the congestion problem in the Strait of Malacca is expected to become much more severe.

● **Growing investment on energy infrastructures**

In the period 2004 to 2030, Asia will require a total investment of about 7.8 trillion dollars (real price based on the currency value as at 2004) on energy infrastructure (including upstream and downstream investment in the oil, gas and coal sectors and total investment in the electric power sector). This translates into new annual investment of about 300 billion dollars, required mostly in the electric power sector.

● **The possible impact of faster development of energy technologies in Asia**

In "Technological Advanced Scenario" (assuming the implementation of a series of energy and environmental policies that will contribute to more stability of energy supply and the reinforcement of global warming countermeasures), primary energy consumption in Asia in 2030 is expected to be 15% less compared with the reference case and CO₂ emissions are expected to be 23% less (achieving a reduction equivalent to the present level of CO₂ emission by China, which is 3.2 times as large as the CO₂ emission by Japan). Again in comparison with the reference case scenario, fossil fuel consumption is expected to decrease by 20%, while the use of other forms of energy is expected to increase by the following percentages: 14% for nuclear power, 34% for hydro power and 63% for renewable energies. The assumed energy and environmental policies greatly contributes to ensure energy supply and mitigate global warming problems in Asia.

【Implications】

■ Assurance of energy security

In Asia, as dependency on imported oil and on the Middle East increases with a sharp growth in oil demand, energy security will become an important issue. While it is naturally important for the individual countries to promote cooperative relations with the Middle East countries and to make efforts to secure their own energy supplies, there is also a possibility that excessive pursuit of the national interest by any single country could damage the energy security of the rest of the region. It is consequently becoming increasingly important for the issue to be treated as one in which all countries in the region have a common stake.

■ Response to global environmental problems

The outlook for a rapid increase in CO₂ emissions in China and other countries in Asia (excluding Japan) only indicates that a far larger and greater overall cost benefit (from the mitigation of environmental burden) therefore would be achieved by pursuing the transfer of energy conservation and environmental technologies to other economies in Asia and the other regions where the demand for energy is booming. Thus, it is important for Japan to reduce its CO₂ emission strictly by strengthening domestic measures while contributing to the progress of environmental efforts in Asia by transferring energy-saving and environmental technologies to other Asian countries.

■ Pursuit of energy “Best Mix”

The pursuit of the best energy mix is another item with which each economy could approach in relation to its own level of energy demand, available resources, level of technology, and economic conditions. It is however extremely important to retain the perspective of optimizing the mix in the whole Asian region.

- **Coal:** Coal demand is expected to grow in Asia, particularly due to demand from the electric power generation sector. Efforts should be made for the development and wider utilization of clean coal technologies(CCT).

- **Natural gas:** Natural gas demand is expected to grow in Asia, particularly due to demand from the electric power generation and residential/commercial sectors, calling for measures that enable the more economic use of natural gas. In view of a sharp increase in LNG demand in USA and Europe, it is also important to develop a future-oriented strategy for ensuring the security of gas supplies.

- **Nuclear power:** In Asia, because of the scarcity of domestic energy resources, nuclear power generation will play a major role in ensuring a stable supply of electricity and in overcoming environmental problems in the interests of the public. It is important that we should maintain and increase the share of nuclear power generation, seeing it as a core source of energy supply.

- **Renewable energies:** Most renewable energies are produced domestically and moreover, they constitute an important option for combating global warming. We should ensure wider use of renewable energies by reinforcing the implementation of effective and efficient measures for promoting their use and by introducing policies in support of technological innovations.

【Conclusions】

For Asia to simultaneously achieve its “3S” goals (security of supply; sustainability by solving global environmental problems; and stability of the market), each Asian country, in a manner that befits the energy supply-demand structure of the country and the prevailing state of economic development, should accelerate the decarbonization of energy supplies through diversification of energy supply sources, energy-conservation and a shift to alternative fuels and strengthen its efforts toward achieving the best energy mix.

In the context of these efforts, Japan will have a tremendous role to play in Asia, with its advantages in terms of technology, economic power and legislative design. Of pivotal importance in the context of Japan’s international energy strategy will be our efforts to further develop and utilize energy-conservation and environmental preservation technologies, in which we already excel, as well as the technologies and know-how unique to Japan which is a leading country in the area of nuclear power generation. It is, thus, crucial for Japan to support the advancement of its economy through extensive use of these technologies, and to contribute to Asian economy and environment.

【Positioning on the forecasts given in this report】

This report presents estimates based on a set of assumptions with a logically and quantitatively integrated prediction method. Considering various uncertainty factors, there can be considerable deviation from these estimates. Therefore, we performed sensitivity analyses using the technological advanced scenario, the results of which are included in this report. We hope that these forecasts serve as a reference and basis for studies and discussions concerning energy supply and demand in the future.

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