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# Asia/World Energy Outlook 2007

-- Focusing on China and India Energy Outlook --

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**【Summary】**

This report quantitatively projects and analyzes energy supply and demand in Asia and the world over a long term through 2030, focusing on China and India, based on world trends and changes including globalization of the world economy, economic development of Asian and other emerging market countries, and energy-supplying countries' political, economic and social changes.

The report also provides a detailed analysis and assessment of energy supply and demand for a " technologically advanced case" in which Asian countries will implement a series of energy conservation and environmental protection policies contributing to securing more stable energy supply and to enhancing measures against global warming.

**【Major assumptions】**

● Economic growth

World: The world economy will grow steadily at a rate of 3.1% per annum during the period from 2005 to 2030.

Asia: Asia (excluding Japan) will grow at a rate of 5.3% per annum during the period, continuing to serve as the locomotive for the world economy. Particularly, China and India will grow at respective rates of 6.2% and 6.1%, increasing their presence in the world economy.

● Population

The world population will grow from 6.4 billion in 2005 to 8.2 billion in 2030. Within Asia, population will expand to 1.45 billion in China and 1.49 billion in India. The entire Asian region's population will increase to 4.4 billion, accounting for 54% of the world total.

● Crude oil price

The real crude oil price (the Japanese import price on a C.I.F. basis based on 2006 currency value) will fall from $64/barrel in 2006 ($61/barrel in the first half of 2007) to $52/barrel in 2010 before rising moderately to $55/barrel in 2020 and to $58/barrel in 2030.

**【Major results】**

● World

The world's primary energy consumption will grow at a rate of 1.9% per annum from 10.3

billion tons of oil equivalent (Btoe) in 2005 to 16.5 Btoe in 2030. Fossil fuels will account for 87% of the growth, remaining a major energy source in the future.

Oil demand will increase by 38 million barrels per day (at a rate of 1.6% per annum) from 80 million b/d in 2005 to 118 million b/d. Natural gas demand will expand at a fast rate of 2.5% per annum from 1.9 billion tons in 2005 to 3.6 billion tons in 2030 in terms of liquefied natural gas. Coal demand will grow at a rate of 1.7% per annum, faster than the oil demand rise, from 4.1 billion tons coal equivalent (1 tce is equal to 0.7 toe) in 2005 to 6.3 Btce in 2030.

● Asia

Primary energy consumption

Asian primary energy consumption will grow at a rate of 2.9% per annum, accounting for 53% of the global increase through 2030. In Asia, fossil fuels will occupy 86% of its primary energy consumption growth -- 34% in coal, 29% in oil and 23% in natural gas. Particularly, Asia will remarkably increase coal consumption, accounting for 75% of the increase in global coal consumption.

Progress in electrification and electricity supply

As electrification makes further progress on economic development and improvements in living standards in Asia, electricity consumption will grow 2.5-fold over the next 25 years. Coal thermal power plants backed by abundant coal resources and their economic efficiency will play a central role in meeting the fast electricity consumption growth. Natural gas thermal power plants, which feature higher generation efficiency and environmental friendliness, will also increase steadily, boosting their share of total electricity generation from 13% in 2005 to 20% in 2030. Asia will increase nuclear power plants rapidly, capturing 111 million kilowatts of 139 million kilowatts in additional global nuclear power generation capacity.

Progress in motorization

The number of automobiles owned in Asia will increase from 180 million units in 2005 to 530 million units in 2030 as motorization makes further progress on income growth in Asian developing countries. On the motorization progress coupled with oil consumption growth in other areas, Asia's oil consumption will double from 22 million b/d in 2005 to 43 million b/d in 2030.

● China

On the back of high economic growth, China will expand primary energy consumption at a rate of 3.0% per annum, doubling consumption from 1.49 Btoe in 2005 to 3.13 Btoe in 2030 to account for some 20% of the global total. In 2030, China will consume six times as much energy as Japan and emit nine times as much carbon dioxide as Japan. It will be the largest energy consumer and CO2 emitter in the world.

Oil: Oil demand will expand from 6.6 million b/d in 2005 to 15.8 million b/d in 2030 due to fast progress in motorization. As domestic oil production fails to increase, China's dependence on imports for oil supply will rise from 44% in 2005 to 76% in 2030.

Natural gas: Natural gas consumption will increase mainly for urban households and commercial facilities. Gas consumption for electricity generation will also expand steadily for environmental reasons. China's overall natural gas consumption will thus grow at a rate of 9.1% per annum from 40 million tons in 2005 to 360 million tons in 2030.

Coal: Demand for coal mainly for electricity generation will increase from 1.09 billion tons in 2005 to 1.72 billion tons in 2030. Coal will remain the largest energy source, although its share in primary energy consumption will decline from 73% at present to 55%. Iron and steel production will expand from 420 million tons in 2006 to 500 million tons in 2015 before falling back below 400 million tons in 2030. As a result, industrial coal consumption will level off.

● India

Backed by high economic growth, India will expand primary energy consumption at a rate of 4.3% per annum, faster than China. Consumption will thus almost triple from 0.38 Btoe in 2005 to 1.1 Btoe in 2030.

Oil: Oil demand will increase from 2.7 million b/d in 2005 to 7.9 million b/d in 2030, two times as much as 4.2 million b/d in Japan. As oil output declines from 0.8 million b/d in 2005 to 0.6 million b/d in 2030, India's dependence on oil imports will increase sharply from 71% in 2005 to 92% in 2030.

Natural gas: Natural gas demand will grow at a high rate of 4.4% per annum from 30 million tons in 2005 to 150 million tons in 2030.

Coal: Demand for coal mainly for electricity generation will grow at a rate of 3.4% per annum from 210 million tons in 2005 to 480 million tons in 2030. Coal will thus remain the largest energy source, accounting for 44% of primary energy consumption. As India's dependence on coal imports increases in the future, a challenge for Asian countries increasing coal consumption will be to secure coal import sources.

● Impact of energy technology development on Asia

In the technologically advanced case, Asian countries' energy conservation policies will be enhanced further. Energy conservation will be promoted through improvements in electricity generation efficiency, automobile fuel efficiency, household appliance power consumption efficiency and materials industries' energy consumption efficiency. Such improvements may be achieved through appropriate energy-saving measures, as well as assistance in technological and institutional development from Japan and other developed countries with advanced energy conservation

technologies.

Asia: In the technologically advanced case, Asia's primary energy consumption in 2030 will be 17% or 1.1 Btoe less than in the reference case. (Those energy savings are two times as much as Japan's total energy consumption.) Fossil fuel consumption, including coal, will be 21% less and new energy consumption will be 37% more.

China: Primary energy consumption in 2030 in the technologically advanced case will be 2.49 Btoe, 0.64 Btoe less than 3.13 Btoe in the reference case. Coal consumption mainly in industrial and electricity generation sectors will be 510 million tons less. Overall fossil fuel consumption will be 720 million tons less. Energy consumption per unit of GDP in 2030 will improve by 63% from 2005, 20% lower than that of the reference case.

India: Primary energy consumption in 2030 in the technologically advanced case will be 0.88 Btoe, 0.22 Btoe less than 1.1 Btoe in the reference case. Coal consumption mainly in the electricity generation sector will be 160 million tons less. Overall fossil fuel consumption will be 230 million tons less. Energy consumption per GDP unit in 2030 will improve 48% from 2005, 20% lower than that of the reference case.

● CO2 emissions

On the increase in fossil fuel consumption, global CO2 emissions will increase at a rate of 1.8% per annum until 2030. The emissions in 2030 will thus expand 1.6 times from 7.5 billion tons carbon equivalent in 2005 to 11.7 billion tons. Asian CO2 emissions will expand 1.9 times from 2.7 billion tons in 2005 to 5 billion tons in 2030. Asia will account for 55% of the global expansion. China alone will account for some 30% of the global total.

Impact of technology development: Further development of technologies to reduce energy consumption and promote fuel switching will allow Asia to reduce CO2 emissions by 24% (1.2 billion tons which is equivalent to China's emissions and 3.2 times as much as Japan's). Such technology development will thus contribute to enhancing Asian energy security and tackling global warming.

**【Challenges toward best energy mix】**

Oil: Asia has no room to substantially expand oil production and will have to depend on imports for as much as 84% of its oil demand in 2030. Covering some 80% of Asia's oil consumption increase will be the Middle Eastern OPEC members that are rich with oil resources and more cost competitive than other oil-exporting countries. Steady investment in oil production capacity expansion to meet the demand rise will be the key to the stability of the international oil market.

Natural gas: Asian natural gas production will peak out while gas demand will increase in the electricity generation and consumer sectors. Therefore, demand will expand for LNG and gas

transported from Russia and central Asia via pipelines. As with oil, smooth investment in expansion of production and transportation capacity will be the key to the stabilization of the supply/demand relationship.

Coal: Demand will increase for cheap coal for electricity generation. In order to help prevent global warming, clean coal technologies will have to be developed and introduced to improve generation efficiency. At the same time, efforts should be made to commercialize carbon capture and storage technologies.

Nuclear power: Nuclear energy will play a great role in Asia that has limited room to expand energy supply despite fast-growing demand. Nuclear power, which is also important for helping to prevent global warming, should be introduced as a stable core energy more and more, along with safety-enhancing technologies.

Renewable energy: Renewable energies are mostly produced domestically and are an important option among measures against global warming. Particularly, bioethanol and biodiesel, along with the improvement in automobles'fuel efficiency, are expected to help reduce CO2 emissions in the transportation sector. Asia should enhance systems for practical and efficient promotion of renewable energy diffusion and introduce innovation-supporting policies to further expand use of renewable energies.

**【Energy strategies and problems in China and India】**

Progress in energy conservation in China and India hold the key to promotion of global energy consumption reductions and measures against global warming. The two countries have a great potential to promote energy conservation. But they have the following problems with the promotion of energy conservation. Japan has a great role to play in solving these problems. Japan should redouble efforts to promote energy assistance to China and India.

● Problems in China

Administrative management system: In 2005, the Chinese government created the National Energy Leading Group as a horizontal organization to conduct research and analyses and produce policy recommendations. Meanwhile, there are energy-related groups such as the Energy Bureau, Price Department and Industry Department under the National Development and Reform Committee. The government has failed to specify how these organizations should work out and implement integrated policies. It has thus fallen short of producing practical energy measures. The central government has been trying to shut down small and medium-sized business establishments that are inefficient. But such consolidation has failed to make smooth progress due to the central government's conflict of interest with local governments that are willing to preserve jobs and tax revenues.

Energy price control: Gasoline, diesel oil, electricity and gas prices are put under control by the

government which is concerned that energy price hikes could affect national livelihood. Since electricity prices for households are less than half the Japanese level, incentives to purchase energy-saving electrical appliances cannot work..

Development of statistics: Accurate sector-by-sector and area-by-area energy consumption data are indispensable for setting energy conservation targets. But no data have been available on operations of small and medium-sized refineries in rural regions. It is difficult to grasp accurate consumption of petroleum products.

● Problems in India

Administrative management system: Under the federal government are the Planning Commission for development and implementation of energy policies, the Energy Efficiency Bureau based on the energy conservation law, and five energy-by-energy agencies. State governments are authorized to implement their own policies on electricity and new energies. The energy administration system is segmented into a large number of agencies that have their respective authorities, making it difficult for the federal government to develop and implement comprehensive energy policies.

Energy price control: A price control system for petroleum products was abolished in 2002. Effectively, however, their prices have remained under government control. Despite oil price hikes, home heating oil and liquefied petroleum gas prices for households have been kept at low levels. Electricity prices are set at low levels for households and close to zero for farming under an anti-poverty policy. Incentives to use energy-saving electrical appliances cannot work.

Others: The petroleum product price control has distorted India's oil supply-demand relationship. Private oil firms have shifted to petroleum products exports with greater profit margins, causing an imbalance between domestic oil supply and demand. The electricity price control has discouraged businesses from making relevant investment, leaving electricity supply shortages to be solved.

**【Implications for the international energy situation and Japan's response】**

In Asia, which expands oil demand rapidly and increases the dependence on oil imports from the Middle East, it is a key challenge to secure stable energy supply. Asian countries must enhance relations with Middle Eastern oil-producing countries, which are growing more important as oil sources, and make their respective strategies for supply procurement. But a single country's excessive energy procurement operations could affect energy security for the whole of Asia. Asian countries share the interest as energy consumers and should be united to address energy problems for their entire region.

● Implications for the international energy situation

The implications of Chinese and Indian moves for the international energy situation are

divided into two groups -- (1) structural problems emerging from growing energy demand and (2) their moves' influences on the market. Regarding energy security, the first implications bring about (a) a tighter energy supply-demand relationship on the international market and higher prices, (b) a seller's market and (c) the relative decline of Japan's presence. With regard to the environment, these structural problems may cause greater environmental loads including increased greenhouse gas emissions. Regarding energy security, the second implication lead to (a) "politicization" of the market through the two countries' efforts to obtain energy resources, (b) their exclusive moves' adverse effects on international political and economic relations, and (c) destabilization of the market through their panicky moves. With regard to the environment, the two countries' moves could complicate international negotiations on the global warming problem.

● Japan's desirable measures and strategy

The measures that Japan should take from the perspective of energy security may center on preemptive ones to prevent the Chinese and Indian problems from emerging. They include (1) promotion of policy talks, (2) energy conservation assistance, (3) environmental technology assistance, (4) assistance in diversification of energy sources and expansion of energy supply capacity, and (5) assistance in stockpiling oil. Japan may be able to utilize its accumulated know-how and technologies for such a wide range of measures. These measures are mostly effective for environmental conservation. Particularly, Japan's assistance to other Asian countries is important in energy conservation, environmental conservation technologies and expansion of clean energy supply. Regarding environmental conservation, the most important challenge is to incorporate the two big greenhouse gas emitters into an international framework. A post-Kyoto Protocol framework for emission reductions should cover all major greenhouse gas emitters while securing fairness, effectiveness and efficiency.

● Japan's joint pursuit of common interest with and energy assistance to China and India

Asian developing countries' fast-increasing CO2 emissions indicate that the transfer of advanced energy conservation and environmental technologies to these countries to reduce environmental loads would be effective in terms of the cost-benefit analysis for the whole of Asia and contribute to environmental conservation. Therefore, it is important for Japan to develop a strategy to optimize the whole of Asia including China and India. In this sense, the view that Japan shares interests with China and India in energy security and environmental conservation should be established and enhanced. In order to harmonize and simultaneously achieve national and global interests in solving energy security and environmental problems, Japan should utilize its accumulated know-how, knowledge and technologies for energy assistance (mainly in energy conservation) to China and India under its international energy strategy.

・Transfer of energy-saving and environmental conservation measures
・Assistance in capacity building toward development of statistical data
・Transfer of experiences and know-how for development of legal and other institutional systems
・Acceptance of trainees mainly in energy management

**【Conclusion】**

In order to simultaneously achieve the three key objectives -- security of supply, sustainability of environment and stability of the market -- in Asia, regional countries should enhance their efforts to attain the best energy mix by diversifying energy supply sources and promoting a shift to non-carbon energy sources through energy conservation and fuel switching, in line with their respective energy supply-demand structures and economic development stages.

Japan, which has technological, economic and institutional advantages over other Asian countries, has a great role to play in this respect. Particularly, Japan is strong in energy-saving and environmental conservation technologies that play a central role in achieving the three key objectives simultaneously. Further development and utilization of excellent energy-saving and environmental conservation technologies should be a key pillar of Japan's international energy strategy. It is important for Japan to utilize these excellent technologies for stepping up efforts to achieve the three key objectives and enhance its domestic economic infrastructure.

**【Position of this outlook】**

This outlook represents an estimate based on theoretical and numerical integrity under certain assumptions. Given various uncertainties, estimated figures can be expected to change considerably. But we would be happy to see our outlook serve as a reference or base for predicting future energy supply and demand.

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