The Present and Future of Coal from Viewpoint of 3Es

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Introduction

According to a recent report, Japan's primary energy supply in 2002 dropped 2.6% from the previous year. By energy source, however, coal was up 3.2%, oil down 5.0%, LNG down 9.3% and nuclear down 0.3%. This means that all fuels except coal declined from the previous year. Coal, the supply of which totaled 160 million tons in 2002, accounts for 20% of Japan's primary energy supply; it is the second largest after oil and is mainly used in steel making and power generation. This report reviews the present and future of coal as seen from the perspectives of the three Es – energy security, economic efficiency and environment – which are the basic elements of Japan's energy policy.

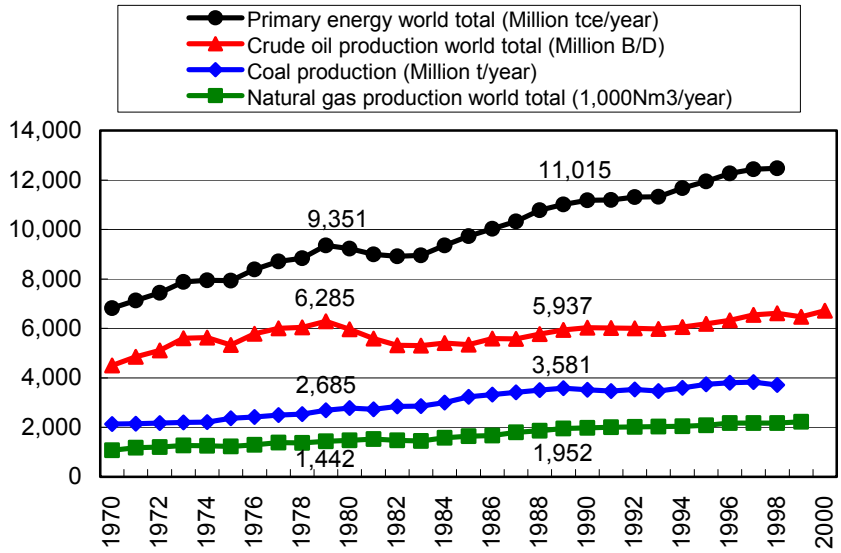
1. Role of coal in energy security

While crude oil market prices keep soaring under the influence of the situation in Iraq, a strong sense of tightening continues to affect the world crude oil supply and demand. On February 27 this year, near futures of WTI (West Texas Intermediate), the marker crude on the New York crude oil futures market, briefly approached $40/bbl, the highest level since October 1990 when the Gulf War was on the point of starting. In addition, the U.S. Department of Energy announced on February 26 that America's immediate crude oil stocks (excluding the government's strategic petroleum reserves) were 271.90 million barrels, down steeply by 14% from the previous corresponding period and at their lowest level for 28 years since 1975.

Focusing on oil and coal supplies after the second oil crisis, Fig. 1 shows that crude oil production fell 6% from 62.85 million B/D in 1979 to 59.37 million B/D in 1989. On the other hand, coal output rose by as much as 33% from 2,685 million tons/year to 3,581 million tons/year over the same period. Similarly, total primary energy output increased 18% from 9,351 million tce (tons coal equivalent) in 1979 to 11,015 million tce in 1989. These figures suggest that during the 1980s, primary energy output increased as a whole but crude oil production remained sluggish, and that coal was a prime contributor to primary energy supply by covering stagnant oil. Beginning around the mid 1980s, oil output turned upward and by 1996 had overtaken the second oil crisis level, which perhaps has been the basic cause of the rise in the price of oil since 1999. As has

happened in the past, conditions now once again appear to be becoming favorable for greater use of coal as an oil substitute. A growing coal demand to substitute oil is noted conspicuously in Japan's electricity sector.

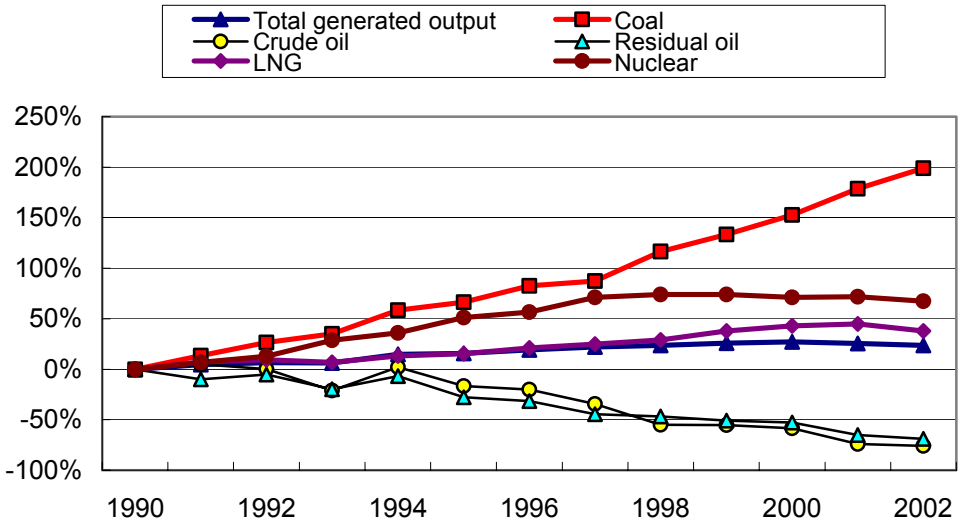
Fig. 1 World's Primary Energy and Fossil Fuel Production



Source: Prepared from IEEJ, EDMC Data Bank

Fig. 2 shows the yearly growth rates of fuel consumption over 1990 levels recorded by ten electric utilities.

Fig. 2 Growth of Generating Fuel Consumption by Electric Utilities over 1990 Records



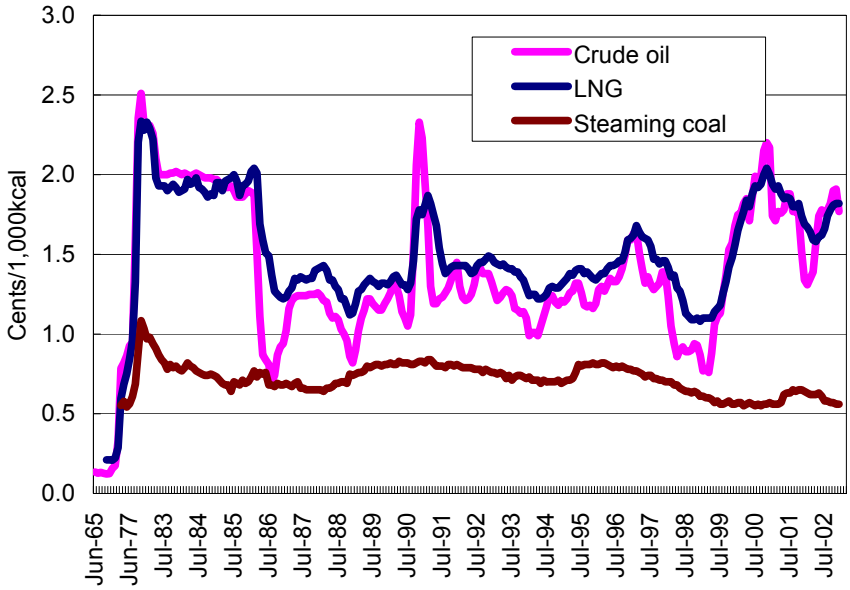
Source: Prepared from IEEJ, EDMC Data Bank

Since 1990 the growth of residual and crude oil consumption has been falling in the long run, whereas coal, LNG and nuclear uses have been outgrowing their generated output. Coal consumption in particular, which has been expanding markedly since 1998, had tripled 1990 records by 2002. From now on, with liberalization of electricity under way, price-competitive coal as compared with rival fuels is likely to occupy an important position in the electricity sector.

2. Economic superiority of coal

The price of coal is sometimes thought to be linked to the oil price, but the actual situation proves that this belief is less true than claimed. In equivalent heat quantity terms (per 1,000 kcal), Fig. 3 shows that the CIF price of coal in Japan has been cheaper and more stable than that of crude oil and LNG. While the LNG price is virtually linked to the crude oil price, the linkage between coal and oil prices has clearly been loosening from 1986 onward. In particular, the coal price remained unaffected when the crude oil price spiked under the influence of the Gulf crisis in 1991. Moreover, despite rising crude oil prices since the spring of 1999, the coal price conversely began to fall and finally managed to recover to an adjusted level by 2001. Looked at another way, without stable supplies of cheap coal, the prices of crude oil and natural gas would have been much more volatile. Coal has thus made no small contribution to the price stability of all energies.

Fig. 3 Average Import Energy Prices (CIF in Japan)



Source: Prepared from IEEJ, EDMC Data Bank

The International Energy Agency (IEA) states that in Japan, coal-fired power is more expensive than nuclear power but cheaper than gas-fired power (Table 1).

Table 1 Japan's Generating Costs in 1992 Price (Mills/kWh)

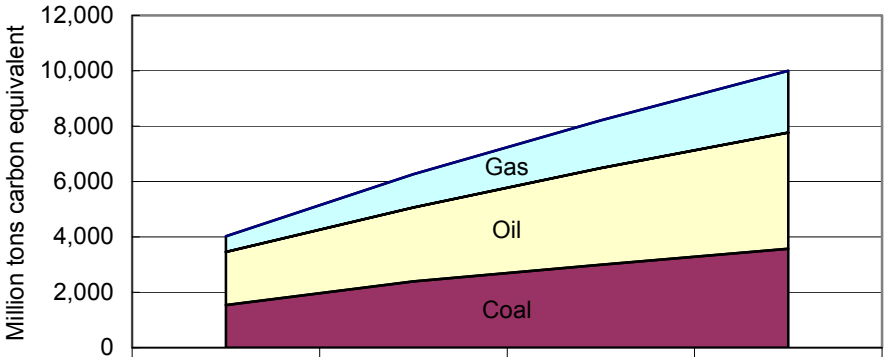
	Nuclear	Coal	Gas-fired power
Construction cost	24.4	20.6	12.7
Operating/maintenance costs	10.9	7.9	6.9
Fuel cost	18.3	34.5	57.7
Total	53.6	63.0	77.3

Source: OECD-IEA, Projected Costs of Generating Electricity Update 1992

3. Mission of coal in global warming abatement

The IEA states in its "World Energy Outlook 2000" that CO_2 emissions resulting from fossil fuel burning will grow 2.1% a year between 1997 and 2020, reaching 8,204 Mt-C (million tons carbon equivalent) in 2010 and 10,004 Mt-C in 2020 (Fig. 4). Checking the growth of CO_2 emissions in the period from 1997 to 2020 by fuel, coal-attributable CO_2 emissions are projected to grow by 1.8% a year, oil-attributable by 2.0%, and gas-attributable by 2.7%, the highest figure. These figures also mean that the demand for each energy source is expected to grow at an identical rate to that of the projected emissions growth. Given that incremental energy demand comes largely from developing countries, the future growth of CO_2 emissions will also depend chiefly on the developing countries, in which coal generally occupies a sizeable share in the energy mix.

Fig. 4 Projections for World's CO_2 Emissions by Energy Source



	1971	1997	2010	2020
Gas	571	1,205	1,716	2,236
Oil	1,911	2,674	3,490	4,199
Coal	1,541	2,389	2,998	3,568
Total	4,024	6,268	8,204	10,004

Source: Prepared from IEA, "World Energy Outlook 2000."

In terms of CO_2 intensity (Mt-C/Mtoe, on a net calorific value basis), coal comes out at 1.08, higher than crude oil at 0.837 and natural gas at 0.641. The question is whether fuel switching can really curb the growth of CO_2 emissions. According to Fig. 4, coal-attributable CO_2 emissions will amount to 3,568 Mt-C in 2020. Assuming that gas will have replaced the entirety of coal use by 2020, total CO_2 emissions could be reduced by about 15% from 10,004 Mt-C to 8,553 Mt-C. This would nevertheless be a hefty 36% larger than the 6,268 Mt-C produced in 1997. Thus, fuel switching cannot be regarded as a radical solution that would put a stop to the growth of CO_2 emissions. Worse, coal-to-gas switching, which contributes to the doubling of gas demand and thus halves the R/P of gas, would cause a more serious problem for future generations by precipitating depletion of non-renewable gas resources. Aside from the problems caused for future generations, any fuel switching-based scenario would appear to be extremely unrealistic because of unavoidable adverse impacts on energy security and the economy in view of inadequate supply capacity and routes, energy price volatility, etc.

The right course of action to arrest global warming is to improve efficiency of energy use and promote global commitments. What actions, then, are available for coal? Although China is already the world's largest coal consumer comparable to the U.S., the U.S. Energy Information Administration projected in its "International Energy Outlook 2002" that the Chinese coal demand – which was 975 million tons in 1999 – will increase to 2,351 million tons by 2020. Also, given that coal covers 60~70% of China's primary energy needs, coal is positioned as an energy of vital importance. The problem is that CO_2 emissions resulting from China's coal consumption are extremely large and have a serious impact on global warming. If the Chinese cal consumption were reduced by 10%, for instance, by increasing the thermal efficiency of coal use in China, over 100 million tons of coal use could be saved. Thus, it is clear that helping China increase the efficiency of its coal use can be a trump card in reducing the world's CO_2 emissions. According to calculation results, generating efficiencies average 35~36% for the Chinese coal-fired power plants, and only 25~26% for small-scale coal-fired plants. Replacing China's coal-fired power plants with more efficient plants of supercritical-pressure type could save 97.60 million tons of coal, which is equivalent to 20% of the coal burned at China's coal-fired power plants in 1999. (For details, see Mimuroto & Koizumi, "Global Warming Abatement and Coal Supply and Demand," http://eneken.ieej.or.jp)

While China intends to promote the introduction of efficient power generating systems, it is possible that a crucial element of such efforts on the part of China may involve cooperation with foreign capital. Japan has coal-fired power plants of supercritical and ultra supercritical pressure type characterized by outstanding thermal efficiency, the

construction and operation of which has been well demonstrated. Thus, in the field of clean coal technologies, Japan may have a large number of opportunities to provide many developing countries with technological cooperation. This type of cooperation, if realized, could be a good means of activating the Kyoto Mechanism. In this context, not only domestic measures but also global commitments are very important in the arena of coal.

4. The future image of coal

As already mentioned, coal has been playing a key role in both energy security and economic efficiency. The direction in which coal should contribute to global warming abatement has also been outlined above. From now on, coal is expected to perform an ever-more-important mission both in bolstering the security of stable energy supply and achieving global warming abatement economically and constantly. Because the growing energy demand expected along with the strong economic growth of the Asian developing countries, notably China and India, will be met chiefly by coal, further increases in CO_2 emissions are very likely as well. In this context, it will be a matter of increasing importance to help such coal-dominated areas upgrade the efficiency of their coal use by virtue of clean coal technologies. Given these near-term prospects, the task of realizing global warming abatement essentially requires the most economical and effective commitments to be made from global perspectives. To this end, the Kyoto Mechanism needs to be implemented effectively. Despite the fact that such great expectations are held for the Kyoto Mechanism, the critical problem is that the U.S. and developing countries do not take part in the Kyoto Protocol. This problem must be solved through constructive debates in the coming second commitment period.

Among its other contributions, coal has done much to securing stable energy supply in the most inexpensive way. Given the present energy environment against the background of the Iraqi problem, nuclear-related troubles, surging energy demand in Asia and other factors, the mission of coal as a reliable energy source is becoming even greater.

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