The Role of Coal in Energy Security

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Introduction

Energy security issues were concerns of the greatest importance during the oil crises. At the start of the 1990s, however, energy security concerns were overshadowed by such emerging factors as (1) limelight-seizing global environmental problems, (2) deregulation and liberalization of energy markets, (3) energies coming to be regarded as ordinary market commodities rather than strategic items, and (4) increasing influence of the market mechanism. Nevertheless, the recent energy situation in the U.S. is an eloquent statement of the fact that energy security is as important now as it was in the days of the oil crisis. It is certainly no secret that coal has played a crucially important role in energy security. This report aims to clarify the role of coal in energy security from viewpoints such as reserves, supply, price and trade.

1. Reserves

The BP-AMOCO Statistics reveal that, as of 2000, proven recoverable reserves of fossil energy amounted to 761.4 billion tons. Of this, coal accounts for 485.2 billion tons oil equivalent, oil 143.2 billion tons, and natural gas 133.0 billion tons. The number of R/P ratio, calculated by dividing proven recoverable reserves by production in 2000, is 227 years for coal, in contrast to 40 years for oil and 61 years for natural gas. Fossil energy as a whole is 96 years in R/P ratio as shown Table 1.

In Asia/Oceania, R/P stands at 159 years for coal, 16 years for oil and 39 years for natural gas—all shorter than their worldwide counterparts. In R/C ratio, which focuses on consumption rather than production, the periods are even shorter: 155 years for coal, 6 years for oil and 38 years for natural gas. These figures reveal the vulnerability of Asia/Oceania in energy resource terms. Particularly for oil, the region’s dependence on outside sources is certain to increase in the years ahead.

The figure of 96 years for R/P ratio of fossil energy as a whole implies the strong likelihood that one hundred years from now global environmental problems will still be serious and energy problems even more so. Yet, reserves and production alike depend greatly on such factors as energy prices, advances in energy development/production technologies, improvements in efficiency on the consumer side, and economic growth. In other words, R/P ratios are not fixed values.

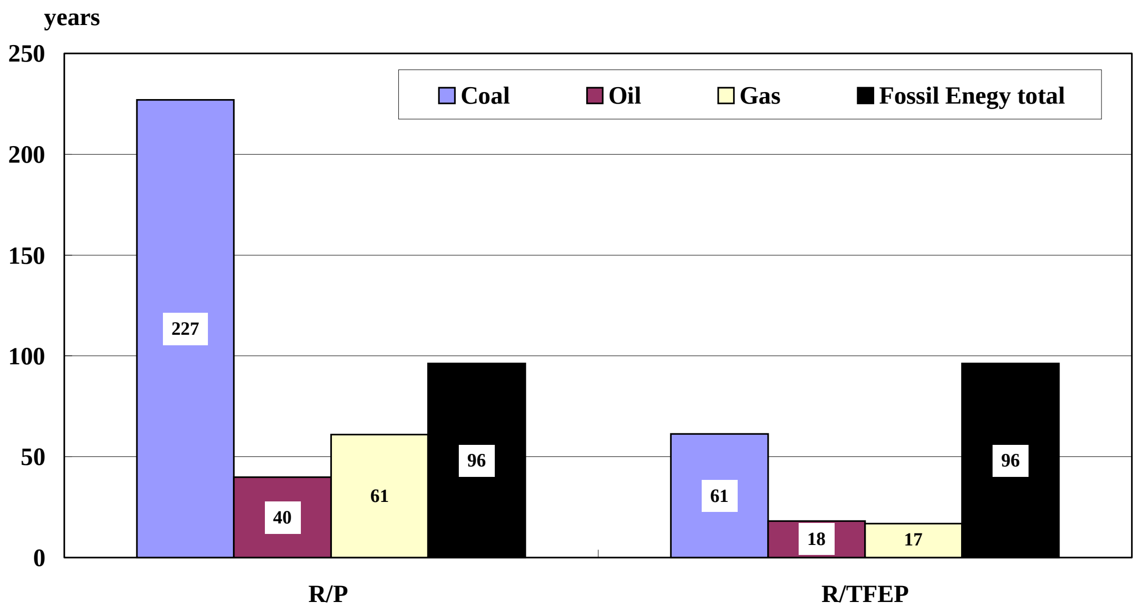
R/P ratios have wide overall recognition and serve as a yardstick for reserves of energy resources. However, since R/P ratios vary depending on production levels from different energy resources, they cannot always provide a proper yardstick with which to compare quantities of resource availability. Also, if the R/P ratio of total fossil energy is accepted as being 96 years, to claim that the R/P of coal, a portion of fossil energy, is 227 years hardly sounds plausible. In this connection, dividing the proven recoverable reserves shown in Table 1 by TFEP (total fossil energy production) produced the result that R/TFEP ratio was 61 years for coal, 18 years for oil, and 17 years for natural gas. These periods are quite different from their R/P ratio (Fig. 1). Coal is as much as 5.7 times larger than oil in R/P ratio, but the differential shrinks to 3.4 times in R/TFEP ratios. Coal's superiority in reserves is a fact, but reserves of coal are not so large as its R/P ratio would suggest.

Table 1 Proven Recoverable Reserves of Fossil Energy (2000)

Worldwide	Coal	Oil	Natural gas	Total
R : Proven recoverable reserves (mil. toe)	485,190	143,225	133,017	761,431
P : Production (mil. toe/year)	2,137	3,590	2,181	TFEP＝7,908
R/P (year)	227	40	61	96
R/TFEP (year)	61	18	17	96
Asia/Oceania	Coal	Oil	Natural gas	Total
R : Proven recoverable reserve (mil. toe)	147,043	5,936	9,297	162,276
P : Production (mil. toe/year)	925	381	239	1,544
R/P (year)	159	16	39	105
C : Consumption (mil. toe/year)	947	969	242	2,158
R/C (years)	155	6	38	75

(Source) Prepared from BP AMOCO's "BP Statistical Review of World Energy 2001

Fig.1 R/P and R/TFEP ratio

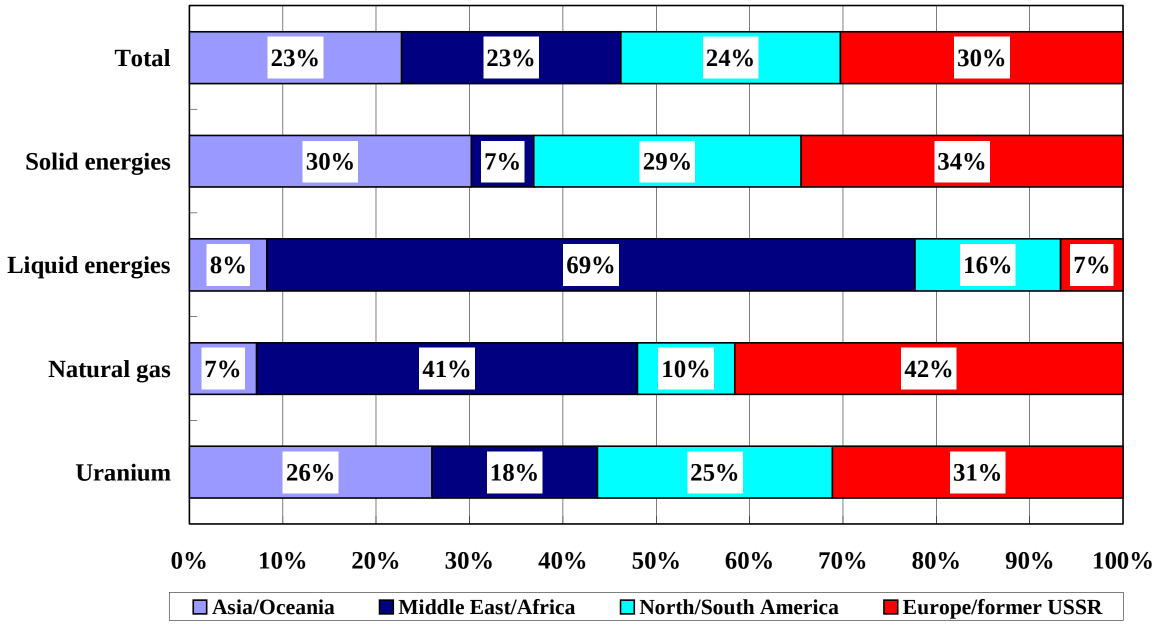


(Source) The same as cited in Table 1.

2. Regional Distribution of Resources

A widely accepted theory maintains that coal resources are more or less evenly distributed worldwide, with little maldistribution. This theory appears to need some corrections, for the reasons given below.

Fig .2 Distribution of Proven Recoverable Reserves of Principal Primary Energies



(Source) Prepared from WEC, ”Survey of Energy Resources”.

Fig. 2 illustrates the distributions of principal primary energies, including solid energies (anthracite + bituminous + subbituminous + lignite + peat), liquid energies (crude oil + NGL + tar sand + oil shale), natural gas and uranium, in the various regions—namely Asia/Pacific, the Middle East/Africa, North/South America, and Europe/former Soviet Union.

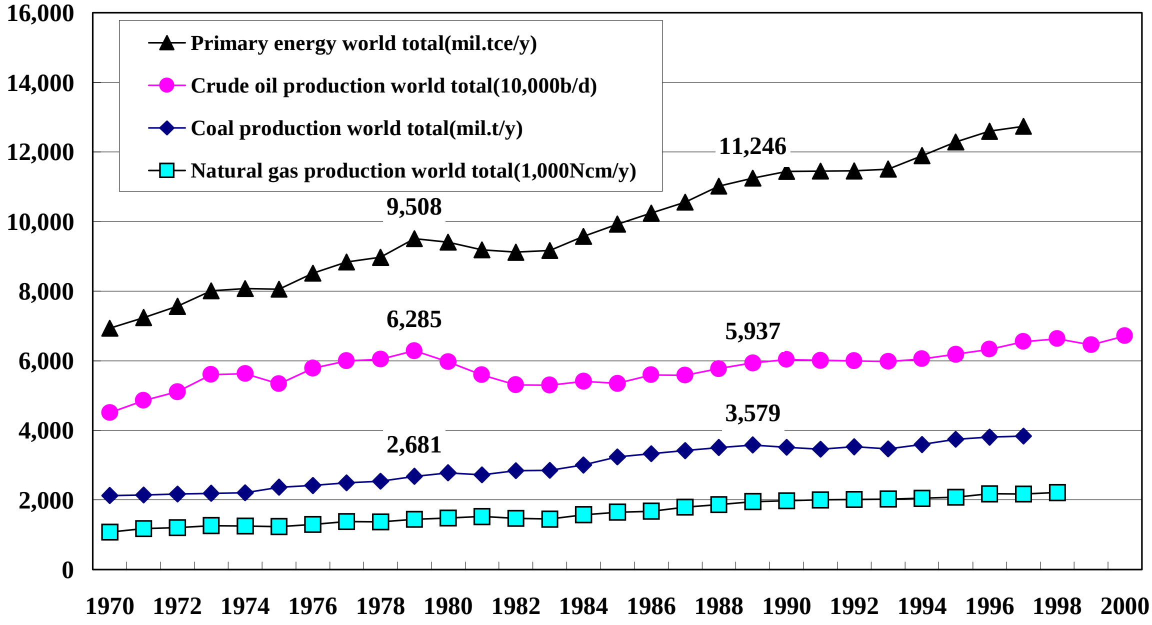
Among the principal primary energies, uranium is the most evenly distributed. In the case of liquid energies, 69% of reserves are concentrated in the Middle East/Africa. Natural gas reserves also show maldistribution, with 42% found in Europe/the former Soviet Union, and 41% in the Middle East/Africa. On the other hand, solid energies are scarce in the Middle East/Africa, with a mere 7% of reserves found there, but are spread fairly evenly throughout the rest of the world.

From a worldwide perspective, the principal primary energies are more or less evenly distributed. This argument, however, is a product of a synthesis of the distribution characteristics of coal, oil and natural gas. Therefore, instead of arguing that “coal reserves are evenly distributed,” it would be more correct to say: “The distribution characteristics of coal complement those of oil and natural gas, with primary energies thus being distributed more or less evenly across the world and making up the best energy mix in reserve terms.”

3. Supply (Oil Substitution)

Regarding oil and coal supplies since the second oil crisis, crude oil production declined 6% from 62.85 million B/D in 1979 to 59.37 million B/D in 1989. In sharp contrast, coal production soared by as much as 33% from 2.68 billion tons to 3.58 billion tons over the same period (Fig. 3).

Fig.3 World's Crude Oil and Coal Production



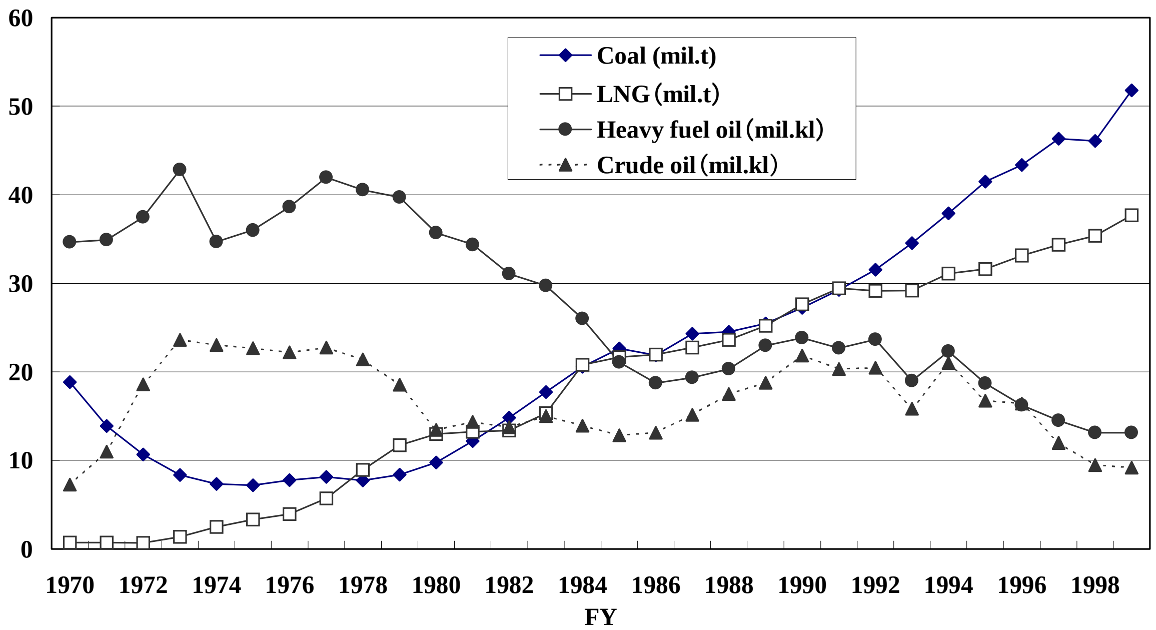
(Source) Prepared from the UN Energy Statistical Yearbooks.

Also during this period, total primary energy production increased by 18% from 9.51 billion tons coal equivalent to 11.25 billion tons. These figures suggest that, despite the growth of total primary energy production in the 1980s, oil production slumped and coal not only covered this reduced oil production but also constituted a key supply source of primary energy.

Around the mid 1990s oil production picked up, and by 1996 had outstripped the second oil crisis level, which perhaps was the basic factor behind the oil price spikes that have occurred since 1999. As in the past, a situation now appears to be forming in which coal again plays a prominent role as a viable oil alternative.

Greater demand for coal resulting from oil substitution is a conspicuous feature of fossil fuel consumption trends in Japan's electricity sector (Fig. 4). Since 1980, use of heavy fuel and crude oil in Japan's electricity production has declined steadily, while coal and LNG use has been constantly on the rise. In particular, coal consumption recorded its highest growth in the 1990s. In the days ahead, along with ongoing electricity liberalization, use of coal, with its superior price competitiveness, will become more important than ever for the electricity sector.

Fig. 4 Fuel Consumption in Japan's Electricity Production



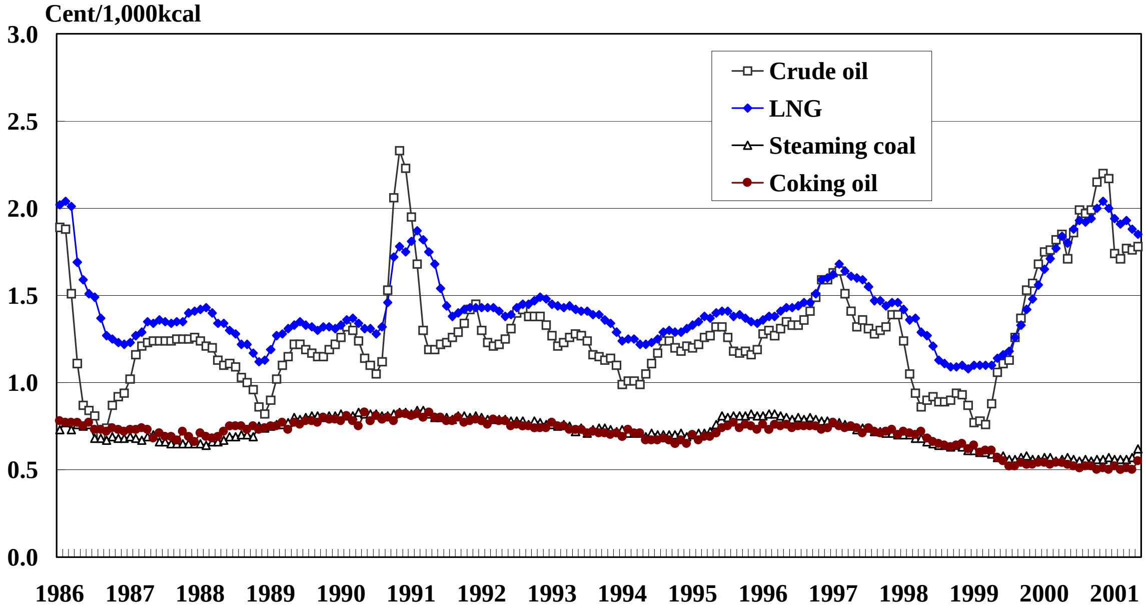
(Source) Prepared from IEEJ, EDMC Database

4. Price (Stability)

Some argue that the price of coal is linked to that of oil. In reality, however, this linkage is less strong than generally believed. Comparing the CIF price of coal in Japan with that of rival energies in terms of equivalent heat quantities (per 1,000 kcal), coal is cheaper and more price-stable than either crude oil or LNG (Fig. 5). Certainly the LNG price is linked to the crude oil price. However, the price of coal since 1986 has shown little linkage to that of crude oil. Particularly when the crude oil price shot up in the wake of the Gulf crisis, the price of coal remained largely unshaken. Also, in the face of crude oil price spikes since the spring of 1999, the price of coal moved in the opposite direction, and fell sharply. It was not until 2001 that its price began to recover.

As already mentioned, growing coal production as a result of oil substitution allowed constant supplies of low-priced coal which, in turn, made a not inconsiderable contribution to curbing price rises of crude oil and natural gas, among others.

Fig. 5 Per Calorie CIF Prices in Japan



(Source) Prepared from IEEJ, EDMC Database.

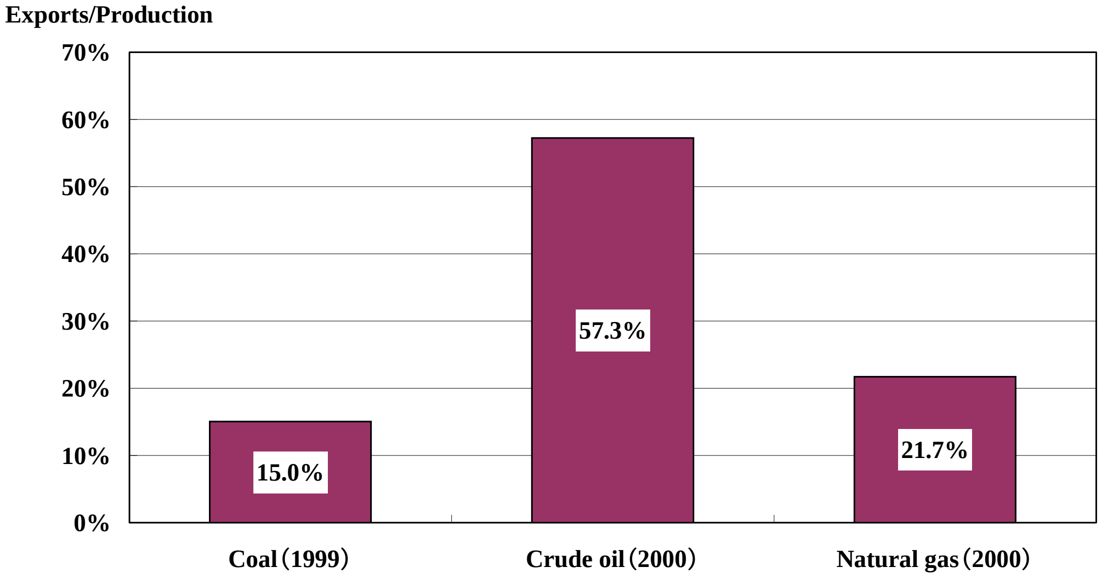
5. Trade (Export Ratio)

The ratio of coal exports to world coal production is 15%, smaller than that of oil (57%) and natural gas (22%) (Fig. 6). The low export ratio reflects greater domestic consumption, and the big domestic market can serve to ease volatility in the small export market.

Taking the U.S. past records as an example, the export ratio to domestic coal production has been limited to within a range of 5 – 10%, with the overwhelming portion consumed at home. In the U.S., the coal market price, which primarily reflects the electricity-led domestic demand, has been staying more or less constant. The export price (benchmark price) of steaming coal rose in 1991 – 1992 and 1994 – 1996, reaching a peak of about US$40/ton. Interestingly, U.S. coal exports grew when the price was high. This was because, when the export price rose above the domestic price, the coal originally destined for the domestic market was diverted to exports. Resultant greater exportable supplies ease supply and demand on the market, which checks upward pressures on the benchmark-price, thus sending the price down. Namely, by changing the destination of U.S. coals from the domestic to export markets, export price rises can be curbed, which ultimately contributes to price stabilization.*

* "An Analysis of Steaming Coal Price Trends", Energy in Japan, No.162 March 2000.

Fig.6 Rations of exports to World Energy Production



(Source) Prepared from BP AMOCO,"BP Statically Review2001"and "Coal Information 2000"

Conclusions

The recent "energy crunch" in the U.S. reminds us anew that energy crises tend to steal up and burst out unexpectedly. Last May, President Bush unveiled a new "National Energy Policy," whose salient point is that it revives energy security as a top priority. Specific measures cited include a plan for the U.S. to boost its domestic energy supply capacity. A realistic measure that can be genuinely effective in stabilizing oil and gas prices will be to increase coal supplies while taking necessary action to protect the environment.

While Asia's energy demand is expected to keep surging ahead, numerous projects are being planned for the promotion of natural gas development and imports. In order to implement such projects effectively, it will be imperative to reinforce energy security by seeking the best energy mix through advanced use of coal, a well-established policy in Asia's supply and demand records.

Advanced coal use critically involves the development and dissemination of clean coal technologies (CCT). In this field, Japan has a number of outstanding achievements to its credit, including efficient coal-fired technologies (e.g. pulverized coal firing, pressurized fluidized-bed boilers), desulfurization, denitration, sophisticated handling (e.g. coal water mixture, coal cartridge system), and effective utilization of coal ash. Moreover, Japan is now engaged in the development of such advanced CCT as the integrated coal gasification combined cycle (IGCC) and direct iron ore smelting reduction (DIOS). With such technical capabilities at its disposal, Japan must play a key role in technology transfer and new technology development in order to help Asian economies upgrade their coal use. Efforts of this kind will eventually lead to the enhancement of energy security.