

GENERAL ASPECTS OF JAPAN'S ENERGY PROBLEM

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As we approach the 21st century, Japan is beset by two causes of anxiety and a sense of crisis. These are the increasingly high proportion of the aged in the population, and the energy problem.

It is intended to discuss the latter, with reference to the present situation and the outlook for the future. Japan is a long, narrow island country which stretches north and south between latitudes 80° and 45° N. It has an area of approximately 370,000 square kilometers and a population of about 110 million, but since some 65% of the land area is mountainous the population density per square kilometer of habitable land is over 700 persons. Since the beginning of the 1950's Japan has followed the same path of industrialization and high economic growth as have the other advanced nations. As a result, Japan has now become a large energy consumer, accounting for about 10% of the world's energy consumption.

Japan is, however, characterized by, firstly, the fact that it is extremely poor in the underground energy resources needed to support industrialization. For example, of Japan's present annual consumption of 350 million kiloliters of oil, only 0.3% is domestically produced. Moreover, three-quarters of Japan's imported oil comes from the Middle East. Since 1973, Japan has depended on imports for over 90% of its primary energy supply. As Japan has a mountainous topography and a high annual rainfall, hydroelectric power generation provides another energy source, but even at its peak in 1955 this accounted for only about 20% of the total energy supply, and at present accounts for only 5%.

A second characteristic is the fact that Japan's industrial sector makes up a far higher proportion of the primary energy demand than in the other advanced nations. In 1972, this figure stood at 63% in Japan, as compared to 39% in the United States, and 52% even in Italy which has the highest proportion of industrial demand among the other advanced nations. On the other hand, the energy consumption ratio of the people's life sector stands at 16% in Japan as against 35% in West Germany and the United Kingdom, and

29% even in the United States which has the lowest ratio among these nations. This problem is bound up with Japan's industrial structure.

The third characteristic is the very high dependence on oil for primary energy, namely 75%. Consequently, Japan's energy picture has two permanent aspects of uncertainty: the possibility of sudden reduction of the oil supply and of chronic shortage over the long term. The first aspect will not be detailed here, as it is entirely a political issue, but I will simply report here the fact that a certain bureaucratic group in the Ministry of International Trade and Industry of Japan carried out a simulation of what would happen if Japan's oil supply were to be suddenly reduced to 30% of its present level over a period of 200 days (in other words, if the supply of Middle Eastern oil were to be cut off), and predicted that three million lives and 70% of the national assets would be lost.

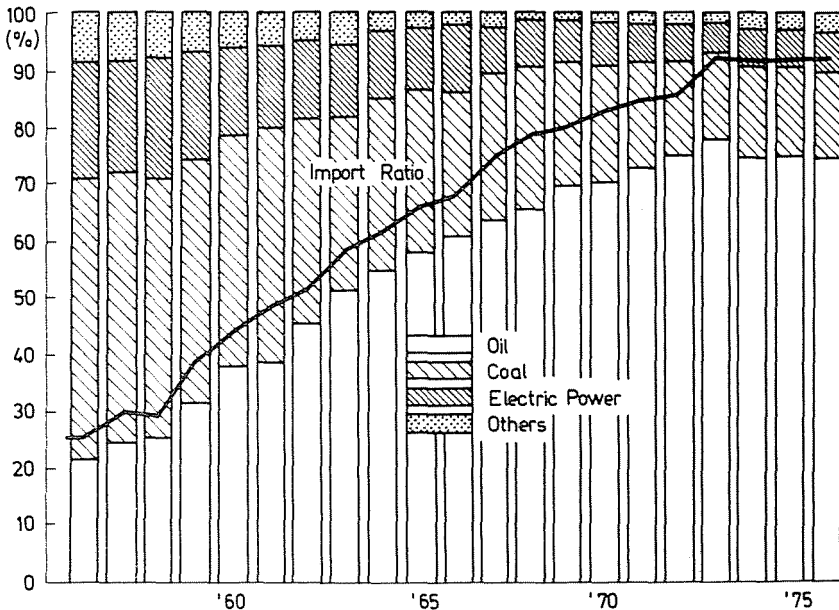


Fig. 1. The Composition of Supply of Primary Energy (in terms of Coal Equivalent) and the Import Ratio of Primary Energy (showing by full line) in Japan from 1956 to 1976

As regards the second aspect of uncertainty, namely, the longterm reduction of the oil supply, this is related to the problem of the world oil supply and demand. Setting aside the question of whether the exhaustion of the world's oil resources will come in 30 years' time or in 50, it is clear that the oil supply will begin to gradually decline, accompanied by a rise in price, after reaching a peak between 1985 and 1990. We have set the years between now and 1990 as a transition period during which we must free ourselves from our

heavy dependence on oil. The problem is what will be the energy supply we will depend on after the year 2000, and what will tide us over the transition period until then?

The scale of Japan's energy demand will be determined by the continued level of our economic growth, and the industrial and consumption structures we adapt. Conversely, the state of the energy supply is also an important factor which determines the tempo of economic growth. Japan's economic growth is gradually turning in the direction of deceleration. However, since on the one hand, there is also a strong demand for maintenance of economic growth we must estimate a growth rate of about 6% in the period 1975—1985, and about 4% in the period 1985—2000. During this time, the population is expected to grow from the present 110 million to 140 million by 2000, and the annual income level per capita from its present level of \$2,800 to \$7,700. On the other hand, in the industrial structure there will be a continued trend toward knowledge-intensive industries and a service economy, with the proportion of added value in the service industries to the total GNP being expanded from the present 54% to 60%, while the proportion of added value in industries with high energy consumption will decrease from the present level of 9% to 6%.

Given these conditions, the first problem we must consider in looking at the future prospects of Japan's energy situation, is that of energy conservation. Although the industrial sector's share of the total energy consumption is expected to decrease to 54% by 2000, since energy conservation in each industry will be carried out under the pressure of high energy costs, this drive can be expected to be active in both the technology and the equipment areas, reaching an energy saving of about 7 to 11%. Nevertheless, by 2000 the total energy consumption will have reached approximately 1,100 million tons in terms of oil equivalent or nearly three times its present level, (and about 60% of that of the United States). Further, individual energy consumption will increase from 3.5 tons at present to 8 tons. To secure energy supplies of this magnitude will call for considerable efforts, while, as mentioned earlier, the oil supply contains some extremely uncertain factors.

What alternative energy sources can be considered as suitable to replace oil between now and the year 2000? The possibilities are nuclear energy, coal, and natural gas. Nuclear power development involves many difficult problems, such as securing uranium resources, safety, reprocessing, waste disposal, etc., and in particular the cause of these problems can be seen to lie in the fact that the research stage and the commercialization stage exist in confusion within the development process. The question of plant location is also difficult, with residents' movements being launched against the establishment of nuclear power plants. Japan's present nuclear power generation amounts to 9.56 million kW (16 stations), the second highest in the world, after the United States. However, if 15 to 20% of the total energy supply in the year 2000 is to be

provided by nuclear power, a development scale of 100 million to 150 million kW will be necessary. Possible new energy sources in the post-oil age after the year 2000 include natural energy sources such as solar, geothermal, oceanic and wind energy; nuclear energy generated by fast breeder reactors and nuclear fusion; gasification and liquefaction of coal; hydrogen energy, etc. The development of these new technologies will form projects on a national scale, requiring enormous funds and a considerable lead time.

Tokai University is presently engaged in research and development on clean energy that is wind energy and hydrogen energy, which we are promoting from the viewpoint of the importance of securing clean energy for the future (including secondary energy), and the importance of providing small, localized independent energy supply systems adapted to Japan's geographical conditions (i.e., an archipelago made up of about 3500 small, scattered islands). This opportunity to introduce a small part of this work here at this symposium is highly appreciated. Although there is no time to go into such important aspects as environmental problems, and the relationship with the energy situation of other nations, a short comment is made very briefly, on the present conditions and future outlook of Japan's energy situation.

Summary

The present situation of Japan's energy supply and outlooks for the future are dealt with. Substitution of conventional — first of all the imported oil — energies by natural energy sources such as solar, geothermal and wind energy, as well as the idea of energy conservation are briefly discussed.

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