ARE THE ENERGY OPTIONS LIMITED?

by

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After the World War, Japanese government put the highest priority on the production of domestic coal for the take off towards recovery of industries and society from the miserable ruin. Coal was called as black diamonds at that time. The annual production was increased and reached about fifty million tons a year in ten years and the coal was used for generation of electricity, heating and other energy production, as well as for source materials of chemical production.

However, petroleum gradually replaced coal during the 1950's and the supply of energy by petroleum reached to about the same amount as the energy by coal in 1960. This change was caused rather quickly, accelerated by the economical superiority of petroleum to coal. Petroleum was increasingly supplied at reasonable price from countries mainly in the Middle East. Japan is a country with a long coast line along the Pacific Ocean and is gifted with many good harbours. Accordingly, industries were developed along the so-called Pacific belt-line utilizing petroleum as the energy resource and also as the materials for chemical industries. Thus Japan had entered into an industrial age dependent on petroleum from the coal dependent age in the early 1960's.

In 1973, when the oil crisis occurred the dependence of the energy supply on petroleum had already reached more than 75% of total consumption of energy, and almost 100% of oil was being imported. LNG, LPG and even plenty of coal were also imported. Thus the total dependence of energy supply on imports in 1973 reached more than 90% of the consumption. The government had to prepare a long term energy supply plan of the country, which included conservation of energy, especially that of petroleum, by technological and various energy saving measures in the society and also by developing new energy resources replacing petroleum. The structural change of industries also occurs from energy consuming to others producing products with high additional values per unit energy consumption.

The development of nuclear energy for peaceful uses started in the late 50's, much later than other energy consuming countries. However, it was accelerated after 1973. Recently the nuclear energy is supplying more than 20% of electricity generated, but the amount is still only about 8% of total energy consumption. Slide 1 shows the recent figure and the future outlook of energy demand in Japan.

Slide 1: LONG TERM ENERGY SUPPLY OUTLOOK

Items \ Fiscal Year		1982 (Acutal)		2000	
			%		%
Coal	M — ton	94.5	18.5	160 ~ 170	About 20
Nuclear	M — kW	17.3	6.9	About 62	About 16
Natural Gas [LNG]	M — kℓ	27.0	7.0	64 ~ 66	About 11
Hydro	M — kW	33.4	5.4	About 48.5	About 5
Oil	M — kℓ	240	61.9	250 ~ 260	About 42
Others	—	—	0.3	—	7 ~ 10
Total Supply	M — kℓ	388	100.0	About 600	100.0

Slide 2 is the outlook of installed electric power capacity in Japan.

Slide 2: OUTLOOK OF INSTALLED ELECTRIC POWER CAPACITY IN JAPAN

(Unit: MW)

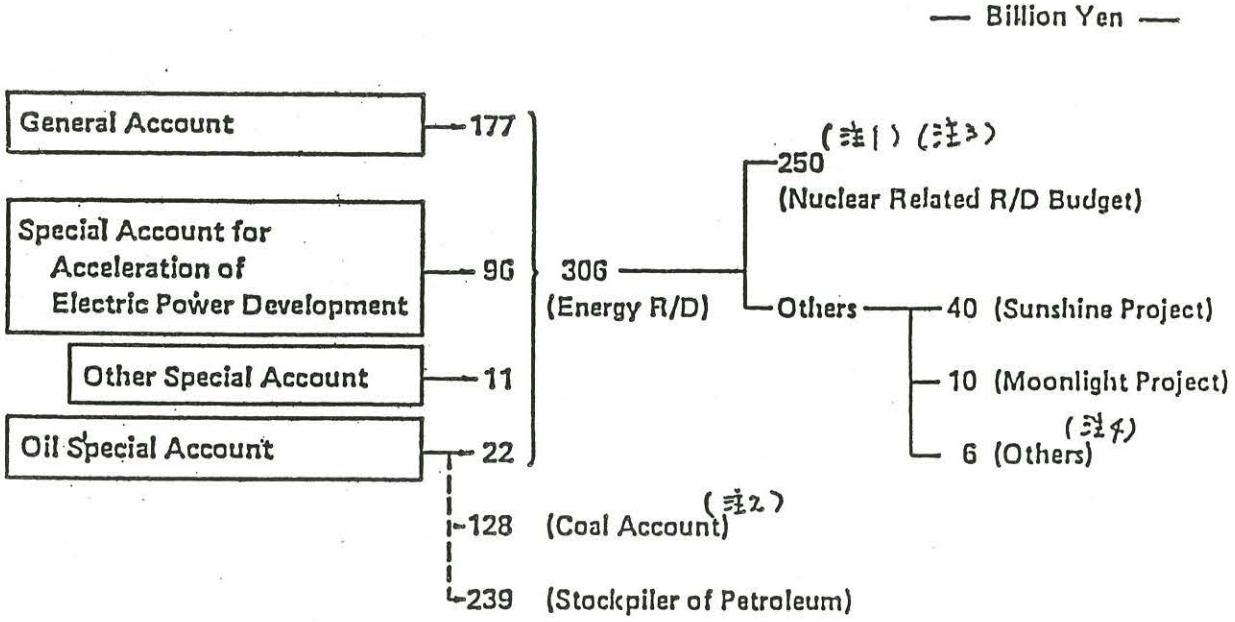
FY \ Items	Fiscal Year 1984		Fiscal Year 1995	
		Rate (%)		Rate (%)
Nuclear	20,560	13.9	48,000	23
Coal	9,630	6.5	21,000	10
LNG	27,150	18.3	43,500	21
Hydro Power	32,830	22.1	42,000	21
Geothermal Power	180	0.1	1,500	0.7
Oil-LPG	57,990	39.1	49,000	24
Total	148,340	100 %	205,000	100 %

It will be noted that even by every efforts of develing nuclear energy, the dependence of the supply of energy on oil and LNG combined toether is estimated to exceed 50% in the year 2000. It is considered that the domestic production of coal will be limited under 20 million tons a year according to the natural and economic conditions of coal mines. Accordingly almost 90% of coal in slide 1 must be imported. Those figures show that in the year 2000, Japan will still have to depend 70% of her energy supply on importation.

Through the bitter experience in the 70's and by considering the outlook of the energy supply in the future, the Japanese government continues to make every effort for decreasing the dependence of the energy supply on petroleum.

Slide 3 shows the energy related R&D budget of the government in 1985.

Slide 3: ENERGY RELATED R&D BUDGET



It will be noted that the maximum amount is allocated to the R&D for nuclear development. Slide 4 is the break down of the nuclear budget.

Slide 4: F.Y. 1984 and 1985 NUCLEAR BUDGET

— Billion yen —

Items	FY 1984	FY 1985
Nuclear Safety	24.9	23.8
Nuclear Fuel Cycle	65.1	66.1
Advanced Reactors FBR ATR (HWR) HTGR	82.0	98.3
Fusion	35.2	38.4
Nuclear Ship	7.8	9.7
Public Relations	60.0	68.7

As Japan has almost no uranium resources, the major budget is allocated to the development of advanced nuclear reactors with better efficiency of utilizing uranium and for the establishment of an independent domestic nuclear fuel cycle which is closely related to the better use of uranium and also with another important field of public acceptance.

The stress is also laid on other projects for decreasing the dependence on petroleum, which are shown in the next slides.

Slide 5: SUNSHINE PROJECTS

		1984 F.Y.
1.	Solar Energy	8.9
2.	Geothermal Energy	6.9
3.	Coal Liquefaction and Gasification	22.4
4.	Others	1.6
	Total ca.	40
		(10^9 Yen)

Slide 6: MOONLIGHT PROJECTS FOR ENERGY CONSERVATION

		1984 F.Y.
1.	High Temperature Gas Turbine	2.6
2.	Batteries for Electric Power Storage	1.2
3.	Fuel Cells	3.7
4.	Stirling Engines	1.2
5.	Heat Pump	0.1
6.	Others	0.8
	Total ca.	10
		(10^9 Yen)

Slide 5 shows the project called "Sunshine" which is directed towards developing a new domestic source of energy and the better use of coal.

Slide 6 shows the project called "Moonlight" which is directed towards energy conservation. Item 6 includes such projects as the development of cogenerating systems and energy storage measures other than batteries, such as chemical, thermal or mechanical methods.

It is essentially necessary for the future to stimulate and support related basic research. Slide 7 shows the project in universities being carried out by budget especially allocated by the government. Basic research in the field of nuclear energy is included in item 6.

Slide 7: BASIC STUDIES IN UNIVERSITIES

1. Biomass Energy
2. Photosynthesis
3. Natural Energy (Solar,Geothermal etc)
4. High Efficient Utilization of Thermal Energy
5. Efficient Utilization of Electricty
6. Others

The measures being taken by the government to support the total system of R&D in the country is briefly shown in slide 8.

Slide 8: SUPPORTING SYSTEM

1. Organizing Cooperations
2. Financial Assistance
3. Evaluation System
4. Standardization
5. International Cooperation

It is not an easy task to estimate the amount and structure of energy demand and supply in the future of many years to come. Those are dependent on many complicated domestic and international conditions, such as economic and social development, political relations, advancement of science and technology and structural change of industries and society.

At the same time, those conditions are often strongly influenced by the amount of supply and the cost of energy. This is an interrelated and really complicated system. Moreover, it usually takes a long lead time to increase energy supply in a large amount either by technological, economic or other measures.

Furthermore, the options for the supply of energy are rather limited depending on the circumstance of the country. For example, in the case of Japan, the promising options for supplying energy enough to meet the needs of the future is limited to import petroleum, LNG, coal and uranium in limited amounts as far as possible and develop measures to utilize the imported resources which are saving and raising the efficiency of their use. However, I consider that R&D on such items which may not develop along the options as mentioned above are worthwhile to be carried out at least to some extent from such view points as to meet various needs of local or remote places or to meet the unforseeable future change in the society or international relations.

In some countries, the land is too big and the problem of transportation of energy is more serious than obtaining the energy resources. In some others, as the country consists of thousands of small islands and the demand on an island is too small to build power plants of economical size.

When the complicated nature of the problem is taken into account, the future prospect should be flexible with due considerations and efforts for international co-operation, as well as for better combination of various kinds of energy within the country to meet needs or conditions of local areas. There may be some limited options for energy supply. But they may change in the future and will be different in different countries.

I hope that the above considerations, together with the development of science and technology will be able to widen the option of energy supply appropriate to each country of the world.

Thank you very much.