Energy Alternatives: Present State and Future Problems

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Implementation of the alternative energy policy

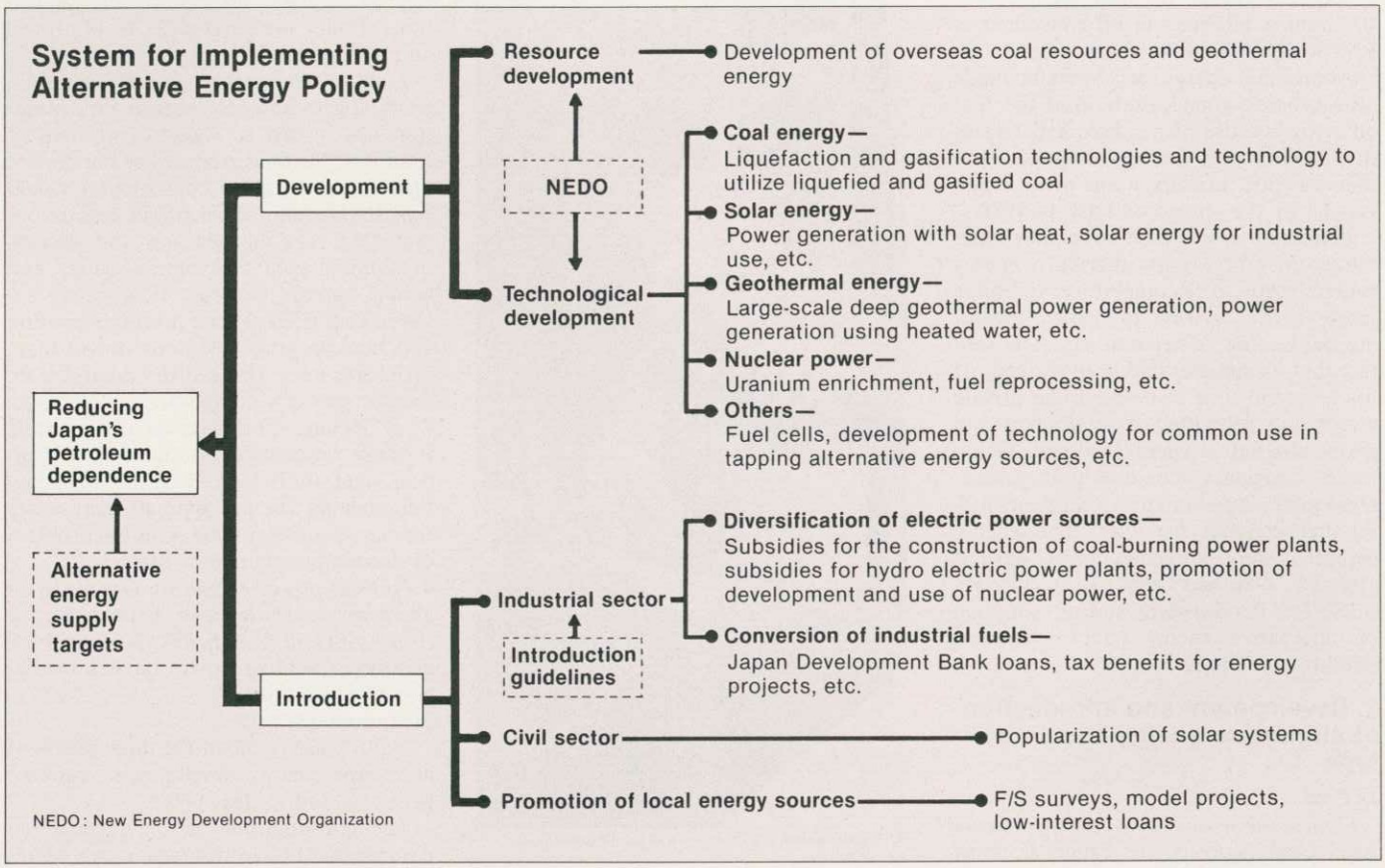
In FY 1980 (April 1980–March 1981) Japan began in earnest to implement its policy of developing energy alternatives to petroleum.

Japan lacks domestic energy resources, and the process of achieving high economic growth increased her dependence on inexpensive and plentiful petroleum. Today Japan depends more on petroleum than any other major industrial nation. Almost all this oil is imported, making the energy supply structure extremely fragile.

The instability of the international petroleum situation was dramatized in the 1970s by two oil crises, the first in late 1973 and the second at the end of 1978.

At the summit conference of the advanced industrial nations in Tokyo in June 1979, the participating countries agreed not only to set petroleum import targets but also to promote the development of alternative energy sources. International cooperation in this area is being orchestrated by the International Energy Agency (IEA).

Recognizing the need for international cooperation among advanced oil-consuming countries, Japan designated fiscal 1980 as the "initial year of alternative energy," and established a framework for implementing its alternative energy policy through a series of legislative measures. These included the promulgation of the Law Concerning Promotion of Development and Introduction of Energy Alterna-



tives to Petroleum (May 1980), the establishment of a special account system (May 1980), the establishment of the New Energy Development Organization (NEDO) (October 1980) and the drawing up of alternative energy supply targets (November 1980).

The Japanese government vigorously implemented this policy, while private corporations began to switch from petroleum to other relatively inexpensive energy sources. As a result, Japan's petroleum dependence dropped from 77% in FY 1973 to 62% in FY 1982. This is dramatic proof of the progress made in the development and introduction of alternative energy.

Progress in development and introduction of alternative energy

1. Development and introduction of alternative energy

The supply of alternative energy in Japan in FY 1982 reached 149 million kiloliters in oil equivalent, about 1.6 times more than the 91 million kiloliters in FY 1973 when the world was rocked by the first oil crisis. These figures show that the development and introduction of alternative energy has progressed smoothly. In fact, the total energy supply diminished appreciably during this same period, from 407 million kiloliters in oil equivalent in 1973 to 389 million kiloliters in 1982.

Alternative energy development made little progress immediately after the first oil crisis because of a subsequent relaxation in the supply-demand situation. And that was how matters stood when Japan was hit by the second oil crisis in 1978.

Petroleum prices rose so rapidly after the second oil crisis that alternative energy sources began to be competitive with oil in some energy intensive industries, including the electric power industry. The very fact that oil supplies had been choked off for a second time also shook the private sector and prompted it to develop and adopt alternative energy sources. Meanwhile, budgetary measures and government policy on alternative energy, including tax benefits for alternative energy projects, were implemented in earnest after FY 1980 and began to produce results. The development and introduction of alternative energy have progressed steadily ever since.

2. Development and introduction of alternative energy source by type

1) Coal

Coal is the world's most plentiful fossil fuel. Coal deposits are found in most countries, making it Japan's most dependable source of alternative energy.

The coal supply in FY 1982 amounted to 94.5 million tons, accounting for 18.5% of the total primary energy supply. In recent years, imports of steam coal have increased markedly, from 1.68 million tons in FY 1959 to 14.61 million tons in FY 1982.

To facilitate the expanded use of coal in the future, it is necessary to establish a so-called coal chain, a new system embracing all stages from coal resource development to final consumption. The coal chain requires accelerating coal projects overseas, improving transport, storage and distribution, and facilitating consumption while giving due consideration to environmental safety. The development of coal utilization technology, such as COM (Coal Oil Mixture), and assistance to industry for changing over from petroleum to coal are also essential.

Diversified policy measures to meet these many needs have been pursued vigorously since 1980. Coal prices are projected to generally match the inflation rate, making it vital to conduct studies now on the proper price level, taking into account projected demand for electric power after 1995 and other factors.

Photo: Asahi Shimbun

An expert examines crushed coal for liquefaction experiments.

2) Nuclear power

Nuclear power has evolved into a quasi-domestic energy source with the establishment of Japan's own nuclear fuel cycle. Nuclear power offers numerous advantages, including its economy and its potential to provide stable supplies of huge amounts of energy. It is counted upon to play a pivotal role in reducing Japan's dependence on petroleum, and ranks with coal as a leading alternative energy source.

At present, 24 nuclear power plants with an authorized capacity of 17.18 million kilowatts are operating in Japan. Thirteen plants with a combined capacity of 12.9 million kilowatts are under construction, while seven plants with a combined capacity of 12.9 million kilowatts were in preparatory stages as of September 1, 1983. Japanese nuclear power plants have been operating at a high level, with their utilization rate exceeding 60% of capacity since FY 1980.

In order to facilitate the siting of nuclear power plants, it is important to vigorously implement safety measures and with the understanding and support of local residents as well as the public at large. Over the longer term, it is also important to develop an advanced thermal reactor (ATR) and introduce a new siting formula, while developing technology to diversify nuclear power applications. Policy measures must be improved and strengthened.

Light water reactor power generation technology is now fully mature, and attention has shifted to ways to improve its economy. Further increases in the cost of nuclear power plant construction would send the cost of nuclear power generation, including fuel reprocessing and decommissioning aged reactors, soaring, and would narrow the cost differential between coal-fired electric power generation and nuclear power. Various downstream problems must be resolved to maintain nuclear power's comparative advantage. They include cutting construction costs through rationalization and standardization, and shortening construction time. Lengthening the life span of light water reactors is another issue, as is the problem of decommissioning old reactors.

Nuclear power's share of Japan's overall energy supply is rising. Efforts to curb rising costs in this field will contribute greatly to holding down Japan's overall energy expenditure.

3) Natural gas

Natural gas is one of the three pillars of alternative energy development, ranking with coal and nuclear power.

The consumption of LNG (liquefied natural gas) by electric power companies

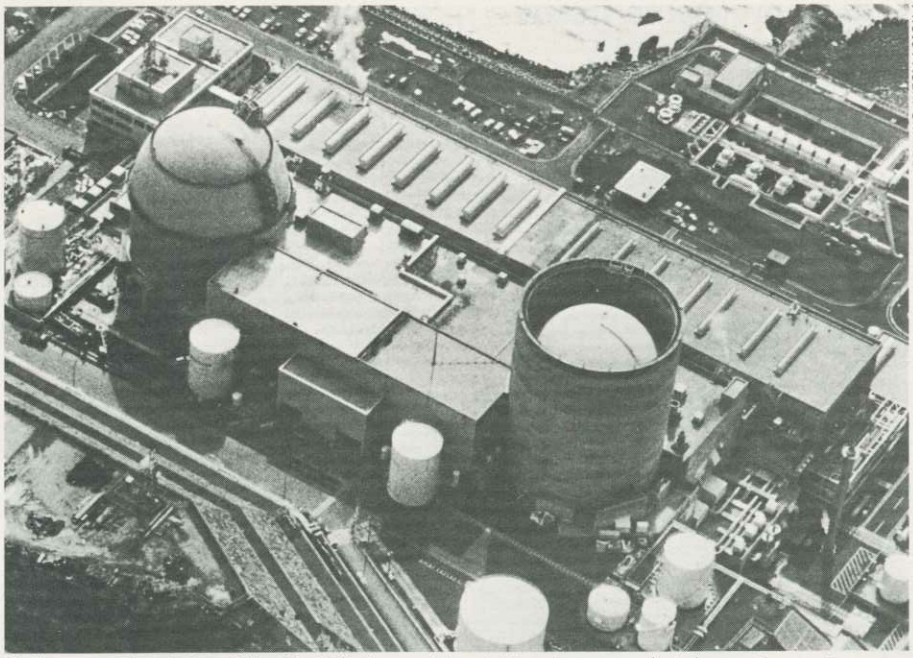


Photo: Asahi Shimbun

Nuclear power plant in Ikata, Ehime Pref. This is one of Japan's 23 nuclear power plants in operation as of July 1982.

Photo: WWP

The tubes for the natural gas pipeline being laid near Shgorod, west of the Ural mountains. Japan buys a large amount of natural gas from the Soviet Union.

and city gas companies has increased conspicuously, reaching 27 million kiloliters in oil equivalent by FY 1982.

Steps to promote LNG-fired thermal power generation are being taken to generate demand commensurate with the great scale of supply. At the same time, measures are also being taken to encourage industries to switch to LNG and to accelerate the popularization of gas-cooling systems in a bid to increase demand for natural gas among gas-consuming urban industries.

4) Hydropower

The supply of hydroelectric power is smaller than that of the preceding sources of alternative energy. However, it remains important as a clean, renewable domestic energy source.

At present, Japan has standard hydropower plants with a combined capacity of 19.4 million kilowatts and pumped storage hydropower plants with a combined capacity of 14 million kilowatts.

There is little hope of new construction of large-scale hydropower plants. Instead, the siting of small- and medium-sized hydropower plants in numerous locations will be the mainstream of future hydropower development. The government is granting subsidies to finance the construction of these smaller facilities while conducting a fifth survey of hydropower generation potential.

5) Geothermal energy

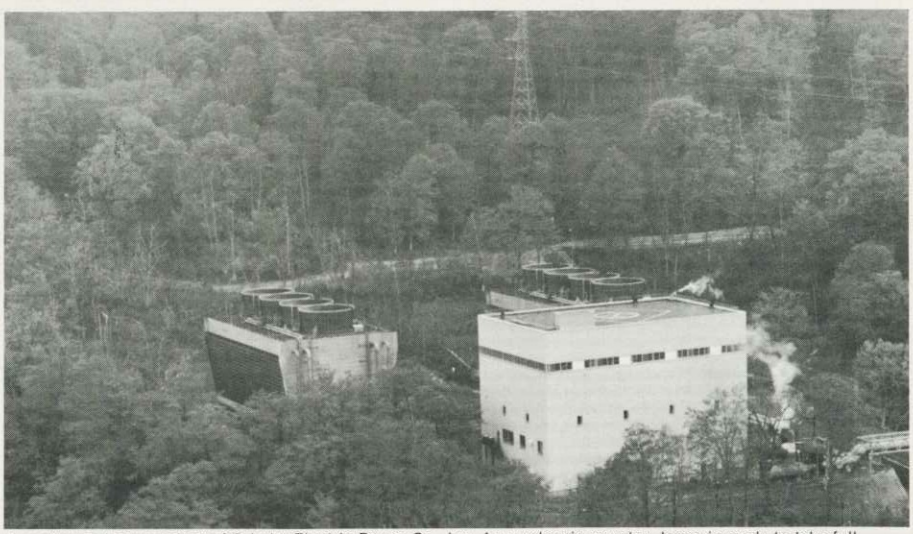
Geothermal heat is a valuable energy source available in huge quantities because Japan is a volcanic country. Vigorous efforts are being made to develop geothermal energy with due consideration paid to protecting the natural environment.

At present, eight geothermal power plants with a combined capacity of 215,000 kilowatts are operating in the country. A thorough survey into the distribution of geothermal heat resources is needed to establish a consensus on harmonizing geothermal heat development with the natural environment, and as preparation for extracting geothermal heat from greater depths and developing technology to utilize heated water.

6) New energy

In Japan at present, firewood, charcoal and solar systems annually supply approximately 900,000 kiloliters of energy in oil equivalent. The supply of energy from new sources, such as solar thermal, photovoltaic and others (coal liquefaction, gasahol, biomass, wind, waves, ocean thermal energy, waste heat, and energy from garbage and wastes) is expected to increase greatly as a result of vigorous promotion of the development of new technologies.

The Sunshine Project was started in FY 1974 to promote technological development in the energy field. Other important



A geothermal power plant of Tohoku Electric Power Co., Inc. As a volcanic country, Japan is ready to take full advantage of its geothermal heat energy source.

projects have passed the basic research stage and are now at the point of plant development. The New Energy Development Organization (NEDO) was established in FY 1980 as a nucleus organization to coordinate and promote these efforts.

NEDO's budget in FY 1983 for the development of alternative energy, including coal liquefaction and gasification, solar energy, and projects to develop coal resources, is ¥101 billion.

Future problems in the development and introduction of alternative energy

A common feature of projects to develop and introduce alternative energy is that the lead time is long and the risk great. It is obvious that the development and introduction of alternative energy must be promoted systematically, without being swayed by short-term changes in the energy situation.

Accordingly, the Subcommittee on Energy Alternatives to Petroleum (chairman, Jiro Enjoji, adviser to the *Nihon Keizai Shimbun* newspaper) was established within the Advisory Committee for Energy in April 1982. This writer, as a member of this subcommittee, has participated in discussions on the future man-

NEDO experimental house in Yokosuka, Kanagawa Pref., with photovoltaic power system

Photovoltaic power generation system at Tsukuba University in Ibaraki Pref.

Japan's Supply of Non-Oil Energy Sources

Energy Source	Fiscal 1979			Fiscal 1980			Fiscal 1981			Fiscal 1982			
	In proper unit	In crude oil terms (mil. kl)	%	In proper unit	In crude oil terms (mil. kl)	%	In proper unit	In crude oil terms (mil. kl)	%	In proper unit	In crude oil terms (mil. kl)	%	1982/1981 (% changes
Coal	78.3 mil. tons	61.5	49	92.4 mil. tons	71.7	50	97.8 mil. tons	74.9	50	94.5 mil. tons	72.0	48	-3.9
Natural gas	23.0 mil. kl	23.0	18	25.9 mil. kl	25.9	18	26.2 mil. kl	26.2	18	27.0 mil. kl	27.0	18	3.1
Nuclear power	70.4 bil. kwh	18.4	15	82.6 bil. kwh	21.6	15	87.2 bil. kwh	22.9	15	102.4 bil. kwh	26.7	18	16.6
Hydraulic power	85.0 bil. kwh	22.1	18	92.1 bil. kwh	24.0	17	90.2 bil. kwh	23.6	16	84.0 bil. kwh	21.9	15	-7.2
Geothermal power	0.3 mil. kl*	0.3	0	0.3 mil. kl*	0.3	0	0.35 mil. kl*	0.4	0	0.4 mil. kl*	0.4	0	—
Other non-oil energy	0.5 mil. kl*	0.5	0	0.7 mil. kl*	0.7	0	0.8 mil. kl*	0.8	1	0.9 mil. kl*	0.9	1	—
Total		126	100		144	100		149	100		149	100	0

Note: *In terms of crude oil

agement of alternative energy policy. The subcommittee published a report summarizing its deliberations on August 23, 1982. The principal aim of the report was to lay out guidelines for this policy, which is now ready for full implementation. The outline of the report is as follows:

1. The short-term trend in the international oil situation is toward further relaxation, but this will reverse over the medium term. Alternative energy policy should be implemented without being swayed by short-term shifts in the international oil situation.
2. As regards conventional energy sources, the present formula of using a mix of energies (principally coal, nuclear power and LNG, supplemented by hydropower and geothermal) should be continued. An appropriate policy for each energy source should be clarified and measures implemented based on the status of development.
3. As regards new energy sources, the following measures are indicated: (a) accelerating development as a matter of top priority with a view toward adding these sources to the frontline of energy supply, (b) utilizing the vitality of the private sector in new energy development in order to improve the energy supply system and promote efficient technological development, (c) promoting international cooperation in new energy development, essential from the standpoint of both sharing the labor costs and risks attendant on development and mutually benefiting from global technical development efforts, and (d) expanding the role of NEDO in accelerating technical development.

The government is implementing its alternative energy policy in line with the points made in the report.

It has become necessary to redefine the future course of energy policy in line with the dramatic changes that have taken place in the energy situation, including the lowering of the Organization of Petroleum Exporting Countries' bench mark crude oil price in March 1983 for the first time since the cartel was established in September 1960. To this end the Basic Policy Sectional Meeting of the Basic Problems Subcommittee and the Supply and Demand Subcommittee of the Advisory Committee for Energy conducted a joint study under the chairmanship of Jiro Enjoji, in which this writer also participated. An interim report on the basic direction of Japan's future energy policy was drawn up on August 22, 1983.

Although a fundamental change in the government's alternative energy policy is not presently called for, the interim report did make the following proposals.

In developing and introducing alternative energy, it is necessary to clarify further the role of each energy source. In other words, in order to reduce Japan's dependence on petroleum, the development and adoption of alternative energy must take place systematically and steadily. As for each type of alternative energy, supply stability, economy, applications, and local needs should be evaluated from an overall perspective. The development and introduction of each energy source should be promoted by giving full play to the market mechanism, with a view to creating an energy supply structure which best suits Japan in terms of both security and cost.

In light of the above, the following steps are essential for alternative energy development.

(a) As regards LNG, supply flexibility must be attained and prices brought down.

(b) As regards uranium, the proportion of overseas uranium resources developed by Japan for import must be raised and supply sources diversified in order to ensure a stable long-term supply.

(c) As regards new energy technology, now that the wide-ranging projects currently underway are advancing beyond the initial stage, the time has come to re-evaluate the medium-term economic viability of each. It is essential to conduct an overall evaluation of each project not only from the standpoint of its economic feasibility but also in light of energy security considerations and international cooperation. The development of new energy technology must be promoted efficiently on a priority basis.

The future direction for principal new energy development projects is as follows:

(1) Projects to be pushed vigorously:
Coal liquefaction and gasification (to unify under a single NEDO formula the three existing projects for bituminous coal liquefaction), photovoltaic, fuel cells, etc.

(2) Projects to continue at present levels:
Solar thermal power generation, generation of hydrogen by electrolysis.

As regards liquefaction of bituminous coal, this writer, acting as chairman of the Subcommittee on Coal Liquefaction, has compiled a report on the future development path for coal liquefaction technology. The report was published on August 26, 1983, following approval by the Alternative Energy Committee of the Advisory Committee for Energy and the New Energy Technology Development Committee (chaired by Toshiwo Doko, honorary president of Keidanren) of the Industrial Technology Council. The report recommended that Japan move systematically from the current experimental plant research stage to work on pilot plants.

Conclusion

According to a report prepared by the International Institute for Application System Analysis (IIASA), global per-capita energy consumption in the year 2030 will increase only 25% over that in 1975, assuming continued low economic growth. Even with this small increase, however, the report says conventional petroleum resources will prove insufficient. It concludes that it will be necessary to develop synthetic oil. In the event of a shortage of conventional oil, the report adds, there will naturally be expanded use of alternative energy sources, including nuclear power, natural gas and direct burning of coal.

As is evident from the above, the need for alternative energy remains fundamentally unchanged. What is needed is the steady and systematic introduction of alternative energy sources, grounded on a longer perspective and macroeconomic considerations, and unswayed by transient changes in the energy situation such as the current easing of the oil supply-demand situation.

What the recent relaxation in energy supplies does afford us is more time to develop and introduce alternative energy sources before the next crunch comes. We must not waste this precious chance. ●

narks		Fiscal 1979	Fiscal 1980	Fiscal 1981	Fiscal 1982
am coal l. tons)	Domestic	10.09	11.40	11.45	12.09
	Imported	1.68	7.11	12.37	14.61
ing coal l. tons)	Domestic	7.66	6.67	5.99	5.29
	Imported	56.66	64.52	65.70	61.64
nestic natural gas cubic meters)		2.35	2.15	2.10	2.08
orted LNG l. tons)		16.78	16.83	16.91	17.58
clear power	Capacity (mil. kw)	15.00	15.50[a]	16.10[b]	17.20[c]
	Plant utilization (% of capacity)	54.6	60.8	61.7	67.6
draulic power l. kw)	General	180.80	19.00	19.30	19.40
	Pumping	9.50	10.80	12.30	14.00
othermal power	Capacity (1,000kw)	157	162	165	215
	Output (bil. kwh)	1.10	1.09	1.15	1.25

s: a Genkai No.2 Reactor (559,000kw) went into operation.
b Ikata No.2 Reactor (566,000kw) went into operation.
c No.1 Reactor (1.1 million kw) at Fukushima Nuclear Power Station II went into operation.

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