JPRS L/9500

22 January 1981

Japan Report

(FOUO 5/81)

Energy: Status and Developments

FBIS FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

JPRS L/9500

22 January 1981

JAPAN REPORT

(FOUO 5/81)

ENERGY: STATUS AND DEVELOPMENTS

CONTENTS

JAPAN'S ENERGY CHOICES FOR FUTURE DISCUSSED

Unique Economic, Social Issues

Tokyo NIRA REPORT: MIRAI ENO SENTAKU, ENERUGI O KANGAERU in Japanese Sep 79 pp 10-11

[Excerpt] 1. Problem: Unique Economic and Social Issues Cited

Up to this point we have considered the energy problem common to the world and have considered the associated dilemma for three standpoints. We next look into the special dilemma which confronts Japan and will try to discuss the situation.

Postwar Japan followed a catchup banner in order to overtake the leading countries of the West and succeeded in achieving a high growth often times called "the miracle of Japan." The annual expansion of 10 percent attained during this period was sustained mainly by investment in equipment and expansion of exports. Leading technology from the West was introduced in a never ending manner and the latest equipment of high productivity was installed, and investment followed investment in the pattern of growth which involved. In another direction, the expansion in world trade established by IMF·GAT fixed the exchange rate at 360 yen under which standard Japan expanded its export market, and the restriction called "the international balance of trade ceiling" soon disappeared.

When considered in such a light, the industriousness of the Japanese people and Japan's high educational level are domestic factors which had some bearing, but in the background of this high level of growth to date is the international environment during this period working so advantageously for Japan.

The same can be said for energy. The source of primary energy for Japan was shifted from coal to oil in 1961. At the same time, the quantity of energy imported passed the 50 percent line. Coal which had been the main source of domestically produced energy peaked at about 60 million tons after which it entered a decreasing production trend. This type of change took place in the midst of a worldwide revolution to liquid energy. It may be said that this process was sharply accelerated in the case of Japan which is so deficient in energy resources. The economic advantages of shift to a liquid fuel have already been discussed. As this new stage was entered, Japan which is poor in resources was, conversely, to be in a position to select the most advantageous position in the international energy market. At the same time, this course contributed greatly to Japan's economic growth and nurturing of its international competitive strength.

2. Expected Japanese Economic Growth and Increase in Energy Demand

Today we have caught up with the western countries where "economic strength" is concerned. On the other hand, now that we have lost the objectives which we had hoped to surpass through some reckless moves, a fresh look at our surroundings makes us aware that 1) there is a shift to a changing exchange rate and the appearance of protective trade which have made their appearance in the worldwide economic organization, and degree of freedom and stability are being lost and 2) there are still a large number of unresolved domestic problems including home and living environmental problems. It was fine when technology developed by the leading countries of the world was introduced and we could rely on cheap and abundant oil supply. In a certain sense, it was only necessary to treat the world situation as a casual condition and simply consider how Japan should react to the situation. This is no longer the case. We are now expected to participate and contribute in the construction of new rails along with other major countries. The fate of the Japanese economy which has grown to giant proportions is continuing to influence directions in the world economy. Business recession and excessive small rate of growth result in reduced import and enhanced export pressure to eventually increase unemployment and business failures in other countries.

At the same time, it is necessary to maintain a suitable rate of growth even from the standpoint of the various domestic problems. "We have caught up in the matter of income flow, but we are still a long way off regarding stock [prices] backed by capital, compared to the Western world.

In order to respond to these foreign and domestic expectations, we must maintain a growth rate which is at least slightly higher than the average of the leading countries. On the other hand, this course signifies that there has to be an increase in energy consumption above the average for the other leading countries. Japan's oil import framework which was set at the Tokyo summit is something which may be considered somewhat steep, but there are also some who consider it liberal. It may be possible to read in some of the world's expectations of Japanese growth in this background.

This trend indicates that Japan's share of the world's energy consumption must necessarily increase. Now, in the midst of strengthening the degree of stability of the world's energy situation, would such a course be possible for resource-poor Japan? There may be need for efforts twice that of other countries in conversion to a small energy consumption type industrial structure and living structure.

National Strategy

Tokyo NIRA REPORT: MIRAI ENO SENTAKU, ENERUGI O KANGAERU in Japanese Sep 79 pp 30-49

[Article: "National Energy Strategy"]

[Excerpts] 3-1 Energy Policy and Stable Assurance of Oil

1. Long-term Viewpoints in the Midst of the Second Oil Crisis

The assurance of a stable supply of oil is the most pressing problem if Japan is to continue its stable economic development and improve its people's living from here on.

The decline in oil supply which had its inception with the Iranian political upheaval has caused an abrupt turn in our country's oil situation from the optimistic mode of 2 or 3 years ago. Even after Iran renewed its production, this situation has not eased, and in fact, is becoming even more serious. As seen in the efforts of the United States to assure its supply of light oil through import subsidies and the opposite trend of the European countries who are exhibiting strong resistance against present policies, there is a trend to depart from the race to maintain acquisition of oil for their respective countries. One of the major problems of the future is just how the leading oil consuming countries in joint efforts will deal with this lack in supply of crude oil and the associated high prices.

Even looking at Japan's short term supply and demand picture, the amount of oil imported is far below what was initially anticipated, and the actual situation is that the reserve stockpile is sufficient to cope with consumption. There is also the factor of the rising price of crude oil, and we are preparing to meet an even more serious situation. This may actually be termed the second oil crisis. In the face of this situation, Japan has no effective program other than thoroughly planned energy conservation and raiding its stockpiled oil. There are urgent cries for an expanded policy with regard to oil import, but there is nothing that can serve as a trump card to counter the stringent oil situation.

If this oil situation persists in the future, the Japanese economy will undoubtedly be forced into a recession, and it will become difficult to store enough strength for future conversions. Even though "time" may be purchased toward an energy policy as the result of decreased oil demand due to economic recession, it has to be accompanied by "physical power" to execute any such plan otherwise such an effort is meaningless.

What is important as far as Japan is concerned is to direct our eyes only on this short-term policy. At the present time, Japan's field of choice in the selection of an oil policy has been narrowed down in the extreme, but we must never forget that the establishment of a firm future oil policy and a start in its direction are also very important.

2. Assurance of a Stable Oil Supply Is the Basis of a Comprehensive Energy Policy

Japan's energy supply structure when compared to that of the western countries shows very great weight taken up by oil as the primary energy source, and there is very high dependence on imported oil. Even if Japan were to proceed toward a substitute energy source for oil in the future, such developments and introduction are necessarily associated with various technological and economic problems. While the position of oil in the energy supply structure may gradually ebb, there is no question but that the absolute quantity will see but a very gradual decrease, and oil will continue for a considerably long period to remain as the most important energy source.

Along with the vast quantities which are involved, the assurance of a stable supply of oil also plays an important role in a different sense. The development and introduction of a substitute energy source and the conversion to an energy conserving society, which a society seeking to disengage itself from dependence on oil must see materialize, are associated with the indispensable element that the economic strength of a society dependent on oil as is presently the case be maintained although this may sound paradoxical. Economic growth is a must if a society is to be converted, and the assurance of a stable oil supply and subsequent large price increases caused the economy to stagnate, and we must never forget that this greatly delayed future expansion.

At the same time, as long as oil accounts for the greater fraction of our energy supply, there will be strong demand for an energy buffer capability with oil for the future. The energy demand situation will change constantly with changes in economic growth, delay in timing of energy development, suspended operation of nuclear power plants due to accidents and defects, and delays in energy conservation policies. In the past, these changes in supply and demand were buffered by imported oil or, in other words, the Middle East oil producing countries served as the buffers. There is need from here on that some form of energy be available in reserve as the buffer force. There is no other candidate than oil to fulfill this role when considered from the standpoints of quality, quantity, storage capability, cost, and the social structure.

In the midst of a worsening environment which enfolds the oil supply picture, Japan must by some means or other assure itself of a stable oil supply.

3. Disengagement from Oil Is Not Progressing

In the face of the newly changing energy picture during the 2 years after the oil crisis, the Advisory Committee for Energy responded with its "Energy Stabilizing Policy for the 1975 Decade--Selections of Stable Supply" in August 1975. This policy proposed "a turnaround will be made in the direction to oil which was dictated by the past energy policies, and the next 10 years will be the starting point from disengagement from an energy policy centered on oil," and the experience of the oil crisis was used as the springboard for formulating a specific assurance policy.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000300070035-3

Now, what is the picture 4 years later? The dependency rate on imported oil which accounts for primary energy went from 74.2 percent (1974) to 74.4 percent (1977), and dependence on Middle East oil went from 77.3 percent to 78.0 percent, and the ratio of self-developed oil remained essentially unchanged. The principal factor responsible for this situation has been the very thin awareness of the future energy situation on the part of government, industry, and people abetted by the background of easing worldwide demand for oil. This situation is clearly reflected in the nation's energy budget. The fraction of the government's total budget taken up by energy decreased from 0.66 percent (1970) to 0.53 percent (1978). The United States which has abundant oil resources within its own borders showed a large increase from 0.97 percent to 1.46 percent during the same period, and a comparison shows how Japan's attitude toward its energy policy stands out. Furthermore, tax revenue from energy related sources centered on oil has increased. While assurance of energy stabilization is an important subject, there have been feeble attempts budget-wise to move in such a direction. The increasing tax revenue from energy related sources is being applied just as in the past to the construction of roads in line with this energy consumption. This is the contradictory picture which is presented. Then in October 1978 the Advisory Committee on Energy came up with its "Energy Strategy for the 21st Century" in which it reiterated its stand with something more specific than its previous statement, but the basic policy was essentially the same as before.

4. Resolution of the "Energy Strategy for the 21st Century"

An outline of this "Energy strategy for the 21st Century" is discussed next.

1) Promotion of diversification of oil sources to assure supply

a) Diversification of oil supply sources and procurement rates: The oil supply sources will be dispersed so that at least 30 percent of the total imports will be from Asia. Make all out effort toward self-developed supply sources by direct negotiations with producing countries (DD oil) and by intergovernmental negotiations (DD oil).

b) Promote a stable deal for government oil: Increase the ratio of self-developed oil and GG oil to 30 percent by 1990.

c) Promote crude oil policy: Go to import of crude oil and promote technology to crack crude oil to produce lighter fractions to meet the demand for the lighter fractions.

2) Promote development of oil

Obtain 1.5 million barrels/day equivalent to 20 percent of the nation's demand for oil from self-developed sources by 1990. Expand the capabilities of the Oil Development Public Corporation to this end, and promotion of the development of the continental shelf and the provision of subsidies to the development industries will be planned.

3) Reinforce countermeasures for emergencies

a) Increase oil stockpile: In addition to a 90-day supply for private industry, plan for a 30 million Kl (about 30 days supply) for the country's stockpile according to a long-term plan.

b) Strengthen administrative measures for emergencies.

4) Rational use of oil

Promote rational use of oil through reducing the combustion of crude oil and naphtha.

5) Maintain reasonable price of oil

Entrust the price of oil to a free market and maintain it at an appropriate level.

6) Reinforce constitution of the oil industry

Plan reinforcement and concentration of the oil industry's constitution as an energy industry.

7) International cooperation

Engage in a cooperative system with oil producing countries and leading consumer countries in order to ease oil supply and demand.

3-2 Basic Problems in Development of an Oil Policy

1. Tenacious and Strong Efforts Required To Expand DD Crude Oil

The most pressing problem in the assurance of a stable oil supply is how to stabilize import from the Middle East countries.

The oil-producing countries of the Middle East are on a course to strengthen their control over oil resources. Furthermore, excluding the majors is one of the large objectives in the modernization of the oil-producing countries, and it is expected that there will be greater desire to expand the direct oil sales (DD·GG crude oil) on the part of these oil-producing countries in the future. As a result, the question whether to import DD crude oil will become the crucial point in the stable assurance of Middle East oil. The expansion of DD crude oil will be the top problem for the private system oil industries in which reduction in consumption on the part of the major industries has been reported.

The crude oil supply in the past was dependent almost entirely on the majors. Where the private industries which possessed little negotiating pathways with the oil-producing countries and not many overseas offices to gather information were concerned, it was difficult to alter supply routes, and it was extremely difficult to expand DD crude oil in this present stage of a seller's market. On the other hand, should effort be directed at expanding the DD crude oil supply from a long-range viewpoint, it does not seem impossible to realize in the future. Japan's oil industry which owns its own refineries and is directly tied in with the consumers is undoubtedly inviting crude oil trade centers for the oil-producing countries which are trying to eliminate any intermediate exploitation. The important point here is for Japan's industries to win out in their competition with the majors and be determined to expand DD crude oil.

Economic and technological cooperation with the Middle East countries is not an absolute condition for assurance of a stable oil supply, but the tightening up of foreign relationships, cooperation with construction of petrochemical plants in the Middle East, participation of Japanese industry in Middle East oil refinery operations and import oil products, entry of oil-producing countries' capital into the Japanese market, and all out reception of products of oil-producing countries will undoubtedly be useful in assuring a stable oil supply. The government's role in this matter is very large, and a determined policy in this direction is desirable.

2. Formation of an Appealing Oil Market

It may be said that nationalization of oil by the oil-producing countries is proceeding while the volume of crude oil supply on the part of the majors is decreasing year by year, yet the power of these majors in the international oil market has become stronger than before. Even though we undertake all out expanded direct purchase of oil from the oil-producing countries and increase self-developed oil supply, there is no way but for the Japanese oil supply to depend largely on these majors, and Japan cannot be assured of a stable oil supply without the cooperation of the majors.

Whether the majors plan for a stabilized supply of crude oil and oil products to Japan will depend in the final analysis on what appeal Japan offers as a market. The basis for making this judgment is basically the stability of the government and whether the principles of freedom of industry are formulated. In this respect Japan offers a sufficiently appealing market compared to other countries, and this situation will probably continue in the future. In addition, the profit level has great possibility of being a very large price factor where future oil supply is concerned.

The majors used the Iran crisis as the excuse to come forth with a long-term policy of reducing supply to Japan's private oil companies and thereby caused a great impact. This policy had been transmitted to Japan's private oil industries directly after the previous oil crisis and was further developed by the reduction in oil production resulting from Iran's political upheaval. There are not only restrictions to the volume of crude oil which can be purchased but also a profit motive on the part of the majors to sell at the most advantageous price which stands in the background. It is clear that the majors are planning diversification to energy areas other than oil in the future, and this is probably to be expected when one considers that there must eventually be some other resource to bank on besides oil.

It does not seem likely that the majors are setting long-term strategy only through short-term profit, but there is no doubt that profit is an important judgment matter as far as the Japanese market is concerned. As a result, the price of Japanese oil products will need to be established along the lines of a reasonable product price system which reflects the cost of the crude oil, storage, purification, transport and sales.

3. Overcoming Quality Restrictions Through Demand Introduction

The problems arising from the stringency of the oil supply are not only limited volume and increased cost, but the problem of supply and demand unbalance with respect to quality is also considerable.

1) Reduction in breath of types of crude oil to select resulting from stringent demand and supply situation of oil.

2) Trend of the Middle East oil-producing countries to produce heavier oil and increase in Chinese oil.

3) Increase in demand for light oils due to environmental regulations.

4) Reduction in demand for heavy oil to be used in power production due to increased use of nuclear power, coal, and LNG.

These are the trends to heavy oils in the crude oil supply situation and to light oils in the product demand end which is expected to make the supply and demand unbalance more pronounced in the future. The demand for light oils in the past was resolved by altering the type of crude oil imported, but the range of this adjustment has been greatly curtailed in this time of unstable oil supply. It is possible starting from a given crude oil to alter the yield ratio to a certain degree through the equipment and technology presently available, but the range is rather limited. As a result, the introduction of a demand which is in the form of a rational utilization structure of oil is the course for Japan overall. Speaking in a more specific manner, it may be necessary to revise the present policy of burning crude oil and naphtha in the raw state for power production (this amounted to about 28 million Kl in JFY 1978). At the same time, the present policy of specifying even the type of fuel to be used which is in force in industry and local self-governing groups in their pollution prevention agreements needs to be revised.

In addition, there may be need to study changes in JIS specifications regarding products in order to provide flexibility in supply of intermediate components (lamp oil, light oil, A heavy oil) and supply products in line with the objectives of use. In order to respond to the limitations in quality, there may be need to limit to a certain degree the free selection of fuel on the part of the consumer through a policy on the part of the country which is making the introduction.

Naturally there are limitations even to such a response, and the introduction of heavy oil cracking facilities may eventually be necessary. There is, at the present time, a national project to provide heavy oil cracking facilities being planned in line with the expanded import of Chinese crude oil. There is a trend to the development of a price differential between light crude oil and heavy crude oil, and the sale price of lamp and light oil will be expected to increase considerably. If the cracking cost can cover this price differential, introduction of heavy oil cracking facilities by industry will probably proceed.

4. Utilizing Industrial Activity and Follow Up on Industrial Responsibility

As the age of oil supply instability is entered, the number of problems with regard to an oil policy are numerous, starting with the assurance of a stable supply of crude oil. As long as the oil supply is the foundation of industrial activity and people's living activity, there will be greater need for the role which government plays in the future, but the role which the oil industries must play is even greater.

The policy of this country in the past with regard to this basic oil industry has been to provide management such as issuing permission to set up refinery facilities by means of the oil industry law and reporting the volume of oil and products imported and thereby stabilizing the demand and supply picture and the price of oil products as well as planning development of the oil industry and protecting the consumer. In addition, since oil is a basic material where industry and economy are concerned, various types of directions have been taken by the government with regard to the oil industry reflecting the industrial and economic policies of that particular time.

These practices involved some unavoidable factors from the standpoint of the implementation of this country's economic policy, but the result has been that Japan's oil industry has from way back been associated with a brittle industrial structure, and it is but of a limited activity level compared to overseas oil industries. This is tied in to the situation that the ratio of self-generated capital on the part of the oil industry is about one-third that of other industries and the profit ratio versus sales is but one-half that of other industries.

The mission of Japan's oil industry in sustaining Japanese economy and lifestyle in its role as a basic industry in this increasingly intensifying world oil market is very important. At the same time, there is greater expectation of activity generated by the oil industry itself so that Japan's oil policy can be energetically promoted in the future.

It will be difficult to construct an industrial base which will function properly in the world market if we were to rely only on the protective training policy which the government has been championing up to the present. What is important here is that there is a policy in which the activities of individual industries are actively promoted under the conditions of free competition, efforts to stabilize oil supply including the oil supplying capability enhancement by industry are evaluated, and a policy to subsidize such efforts. As a result, industries which cannot fulfill the roles of basic industry are weeded out or consolidation of industries may proceed.

3-3 Counteracting Interruption to Energy Supply

1. The Highly Possible Interruption of Oil Supply

The oil crisis of 1973 may be said to have been the major national crisis faced by Japan since the end of World War II. The net result was that despite the very small level of lack in oil, Japanese society was faced with deep instability and confusion at that time. At the same time, the Japanese people went through this experience and became aware of the close tie-in of energy and their daily living and to comprehend what a fragile base this energy was founded on.

The declining oil supply which had its start with the Iranian political upheaval is the second oil crisis the effects of which on Japan are becoming a concern. There is already the situation that this reduction in quantity of imported oil has resulted in the use of stockpiled oil, and some serious problems are anticipated in winter when this demand will increase.

The specialists have said that Japan must be prepared to undergo a number of oil supply interruptions of a worldwide scale up to about 1990. The factors responsible for this possibility which have been cited are 1) political instability of the oil-producing countries headed by Iran, 2) promotion of separate peace between Egypt and Israel which represents a confrontation involving specific governmental problem, and 3) large-scale destructive activities on oil production facilities and transportation routes on the part of radical elements.

No matter what the cause may be, if we consider our dependence on imported oil; the thin lines which tie together the history, economics, and politics of the Middle East countries; and the geographical handicap, it cannot be denied that Japan is in a position which can be most easily affected.

Should the future energy demand and supply pursuit era be accurately assessed, the possibility of interruption in the oil supply is expected to increase more and more, and even a slight interruption may cause considerable impact on a worldwide basis.

As a result, the response to an interruption to the energy supply will necessarily involve a fragile resources position, but there is need to place this in the proper perspective as one of the basic subjects among all the country's energy policies.

2. Lessons from the Oil Crisis and Future Response

The oil crisis of 1973 was of rather small scope when the actual reduction in supplies is considered, and it lasted only some 2-3 months. It was of a relatively slight degree as the degree of interruption in oil supplies is concerned. Despite this situation, this oil crisis created some grave problems which reverberated over this country's society and left behind some very important lessons.

First of all, various lack of supplies unnecessarily fostered a feeling of crisis, and society's confusion was intensified. It is now being recognized as a good experience. At that time, Japan's provisions was not simply the accumulation of oil reserves, but it was extremely weak as far as systematic preparations and mental attitude were concerned, and the result was that Japan was one of the consumer countries against which the strategy of the oil-producing countries exploited to the maximum.

Secondly, even though an actual oil insufficiency did not develop, an oil crisis took place, and we experienced the situation showing how important information is. Even when articles actually were not scarce, once the consumers obtain information of a shortage, simply believing this information will by itself bring on a shortage. That is to say, the adverse atmosphere of increase in pseudo demand → actual shortages → increased anxiety on the part of consumers → hoarding is created rather readily. At the same time, just because this is so, there is a good possibility that this cycle can repeat itself in the future.

When the responses to the interruption in oil supplies are classified, there are the preparations for the crisis (before the fact measures) and emergency measures (after the fact countermeasures). On the other hand, basically speaking, reduction in dependency on oil and promotion of the overall energy policy such as reinforcing ties with oil-producing countries are necessary. On the other hand, when we consider Japan's experience in the previous oil crisis and Japan's dependence on oil, the increased amassment of materials such as oil stockpiling may be important as a crisis controlling countermeasure, but, at the same time, the establishment of a crisis control system which operates in an emergency state based on information and determination is also indispensable. The establishment of such an emergency control countermeasure is tied in with quieting down the people in times of emergency.

3. Makeup of the Emergency Control Countermeasure and Problem Areas

Since the previous oil shock, the emergency control countermeasures centered on oil stockpiling have moved in a direction of materialization. The advancing situation and problem areas are summarized below. [see table on following page]

4. Conditions for Promoting Crisis Control Countermeasures

The reinforcement of the various countermeasures are all the more necessary in order to rid ourselves of this crisis without too much difficulty. In such a case, an effective crisis control countermeasure is not realized unless the following policies are developed and acceptance by the people is attained.

1) Bear cost of engaging the crisis

"Safety cannot be purchased without cost" is something the people should be aware of. For example, a larger stockpile is better in terms of number of days of oil supply, but one must not forget that while the greater the number of days of stockpile may be increased, a day's increase in stored oil will involve crude oil cost, capital of about 60 million yen for tank facilities, and interest and manpower cost to make up the tremendous sum of 7 billion yen. There

Type of Counter-Measure	Item	Main laws related to measures	Countermeasures promotion situation and problem areas
demand area	consuming regulations	oil demand and supply rationalization law, electrical industry law	--insufficient system to retrieve information on the part of consumers (mainly large) --distribution line systems and limits of use of electric power are difficult to set up
demand area	quota distribution	oil demand and supply rationalization law	--at the present time, MITI is studying systems divided into private use oil (lighting, gasoline) and to industrial use oil --rationing stamp system readied for private use --no mutual financing system set up between oil companies
demand area	price countermeasure	emergency management law for stabilizing people's activities, price systematization law	--standard prices are designated for lamp oil and LPG during the oil crisis.
supply area	reinforced oil stockpiling	oil stockpiling law	--every company storing oil aiming for a 90-day supply by end of JFY 1979 (about 83 days supply at end of JFY 1978) --the country's stockpile as of end of JFY 1978 was about 5 million Kl stored in tankers. 10 million Kl targeted.
supply area	understanding domestic storage	rationalization law for oil supply and demand	--the oil flow through information system is complete. Rationing system or international financial system link will be problems for future
supply area	destruction of stockpiles	oil demand and supply rationalization law, oil stockpile law	--private and government stockpiles and even individual oil company stockpiles being destroyed will have to be studied through the means of what preparations are necessary
international area	international financing of oil	IAEA oil financing system	--system is essentially complete --financing between domestic oil companies and setting up distribution system which correspond to this sytem are subjects.
international area	accumulation of information from oil-producing countries		--the failure to install centralized information collecting system is problem.

is no other road eventually other than resolving the acquisition of capital and its payment by placing them on the backs of the people.

2) Incentive for executing crisis control countermeasures

The handling of the crisis is not only an important subject for an energy policy, but there is need to consider management in which the various countermeasures for crisis control are promoted automatically. For example, there are the legal responsibilities for reinforcing the oil stockpile. There is also need for a policy which provides not only fiscal aid but strives to increase the stockpile even beyond the required level.

3) Suitable administration of society and economy

The real nature of the energy crisis appears during an economic and social crisis. First of all, suitable administration of the society and economy become the premise for crisis control countermeasures. A monitoring system which feeds back to a central station in short time at least changes in society and economy may need to be established.

4) Concurrence to composed correlation

The basic countermeasure to cope with a crisis is cool action on the part of a nation's people, and any crisis control countermeasure will have little difficulty succeeding should this factor be lost. In the particular case of today's information oriented society, a fraction of disordered actions may lead to confusion over the entire country.

3-4 Point Toward Leading Energy Conservation Countries

1. Conservation of Energy Rivals Resources Development

When the fragile energy supply base and the environmental restriction of this small country are considered, the importance of the subject of conservation of energy cannot be overemphasized. This is an area in which Japan's own unique development is possible compared to the other energy policies, and it has the effect of rivaling the development of a new resource. The accumulation of energy conservation technology and experience not only will help ease Japan's fragile nature but will contribute to conservation of energy for the entire world. Japan once was criticized as the leading country where pollution was concerned, but it presently is ranked with those countries which are leading the world in the matter of preventing pollution. Similar schemes and efforts in the direction of energy conservation are necessary.

The 1973 oil crisis had the effect of creating awareness over a wide area of the necessity for energy conservation. One has to look no further than the steel industries which in JFY 1978 succeeded in reducing energy consumption by 9 percent from among the large energy consuming industries. Great advances have been made in conservation. On the other hand, transportation use and civilian use energies, particularly the latter, reflect the trends to multiple uses of energy as a result of the rise in living standards, and not much progress is seen.

At the present time, IEA has established a 5 percent cutback in oil consumption for 1979 and 1980 as its response to worldwide oil supply and demand stringency. Japan which has a higher degree of dependency on oil than other countries must immediately adopt a "cutdown in oil use" even for the short term. In addition, this last Tokyo summit meeting established the framework for oil import on the part of participating countries not only for the present but up to 1985. Japan's quota for import in 1985 will be 6.3-6.9 million barrels/day, and there will be need for even greater energy conservation efforts from here on if this goal is to be realized and the international cooperative effort is to succeed. The government presently is involved in various economy directing plans, but the basic road to achieve full success is for the individual countryman to become aware of this serious situation and adopt measures to conserve resources and energy.

Japan's energy conservation policies are in the position of simultaneously taking care of the present oil conservation practices and the long-term structural energy conservation directed efforts.

2. Basic Preparation for Urging Energy Conservation Movements

The need for even stronger policy management will probably arise in line with the oil conservation efforts at hand. At the same time, it should be emphasized that this experience will be the basis for the enactment of conservation programs for this type of short-term stringencies which are expected to become future problems.

In another direction, in contrast to this emergency and refuge type "conservation," long-term and structural conservation of energy must be regarded as having even greater significance. There is need to open a path by which conservation of energy as a final effect that truly ties together enhancement of activities of individual industries and household activities.

Consequently, there is need, first of all, to restructure the existing social makeup which stands in the way of these measures and to provide incentives for energy conservation to the different social groups if conservation is to be promoted. Conversely, there is also need to create a negative incentive with regard to costs.

There are roughly four areas in the provisioning of social conditions. The first is to foment awareness of the energy situation. This is a necessary condition not only to energy conservation but to the entire field of energy policies. For example, the drafting of a readily understandable "white paper" as a regular type information medium is a must.

Secondly, the activation of a price mechanism. The upward cost of energy in the short term brings about economy measures, and in the long term, brings about conservation in expenditures for energy and then further to energy conserving type industrial structure.

The third item is the setting up of a legal environment. The conservation of energy law was enacted in June 1979. When one considers the broadness of the conservation of energy concept, this law is but one step forward in the area of energy conservation management. It is hoped that the establishment and enforcement of various specific guidelines will be forthcoming as soon as possible.

The fourth item is the provision of finance and tax conditions. Incentives along the lines of funds and tax breaks should be effective in promoting investment in energy conservation efforts, research and development, and insulation of buildings.

3. Reinforcing Plans To Induce Investment in Conservation of Energy

Reinforced heat management and investment in comparatively short-term recovery type conservation of energy efforts have represented the reduction in energy cost programs of industries since the oil crisis. On the other hand, these practices are presently operating at their limits, and the stage has arrived that new steps requiring even greater investment are in order. The increase in the cost of crude oil since 1979 has increased the advantages from investment in energy conservation. The government must correctly assess these movements and provide management to support such actions. For example, the energy conservation fund whose framework is managed by the Japan Development Bank can be expanded, the conditions for its grants be relaxed, and the range of application be expanded. In addition, there should be a special amortization system for energy conservation facilities. Some effects can also be expected from the reactivation of the energy conservation fund tax education system which was enacted in 1978.

Even in the medium and small industries where energy conservation policies are relatively delayed, technological guidance in the form of the "Energy Conservation Center" established in the fall of 1978 is expected to be helpful. At the same time, the energy conservation fund for medium and small industries granted by the national treasury needs to be expanded, and detailed management is necessary.

In addition, the importance of research and development in promoting conservation of energy cannot be neglected. The government initiated the "Moonlight Plan" in JFY 1978. This project promotes development of large type technology such as MHD power development and waste heat utilization technology system, assistance to development of private conservation of energy technology starting off with solar energy, popularization and standardization of energy conserving equipment, and international joint research. A resolve to become a leading energy conservation technology country in both the hard and soft areas is being aimed for by this country which is so poor in natural resources.

It should not be overlooked that there are many instances in which cooperation between business and industry is overcoming many difficult problem areas. For example, the cost of energy for maintaining excessive product quality is considerable, and cooperation between the developing side and the user side is a must even though this is a technology development problem.

4. Establishing and Assisting Thermal Insulating Standards

The energy conservation efforts on the part of the private sector upon which the greatest expectations can be placed are the insulated construction of homes and buildings. Taking a household as an example, the energy consumption is split roughly 3 ways into heating and cooling (31.3 percent), hot water supply (36.7 percent), and kitchen and other uses (31.8 percent). When one considers that the rise in the standard of living will cause heating and cooling demands to increase at a faster rate in the future, the significance of thermal insulation becomes that much greater. There is a special fund offered by the residential loan treasury for improving home insulation, and this fund needs to be expanded. There is also need to study new subsidy systems and tax breaks for new efforts in management of solar heat use. Homes and buildings represent an area which has been incorporated into the energy conservation law, but the establishment of guidelines on advice related to insulating and heating and cooling to people engaged in construction and practical use of these measures are awaited.

Furthermore, there must be plans to improve the efficiency of energy consuming machines. This area is also included in the energy conservation law. Guidelines will be set up for special machines such as automobiles, and the efforts of the manufacturers in this direction will be encouraged. On the other hand, this move will have little effect unless the consumer selects automobiles of good efficiency. The display of energy efficiency (labeling) has been mandated. There may also be some effect in legally and socially regulating excessive quality and excessive service in the private sector particularly regarding use of air conditioners in the sales and service area.

The difficulty in energy management in the private sector starting with the homes may be based on the problem of requiring a revolution in awareness. On the other hand, we must not lose sight of the fact that this awareness revolution can be abetted from the technology front by measures such as the automation of temperature control. Finally, it can be said that the objectives of energy conservation are concerned not only with direct energy consumption but should also include conservation of resources and energy efforts in all phases of sales and service processes where large quantities of energy are involved.

3-5 Determination To Opt for Nuclear Power

1. Evaluation of the Track Record of Nuclear Power Utilization and Expectations

There is taking place in Japan a degree of confrontation between hopes for nuclear power and an insecurity about nuclear power utilization so complex that it is seen nowhere else. This is the result of the very serious energy situation which has made people look to nuclear energy as a prime candidate to provide this needed power while there are others who feel very unsafe as far as nuclear power is concerned because of the narrow land area and the atomic bomb experience.

There are presently nuclear power plants operating in the major countries of the world which are producing more than 100 million KW. While there are differences between countries, this source of power accounts for 2-5 percent of the primary energy source.

When we review the future nuclear power development plans of different countries, they all project power generation quite beyond that which seems possible from the present scale of construction. The fraction which nuclear power will deliver with respect to all other power sources in 1985 is expected to be 6.7 percent in the United States, 10.3 percent in West Germany, 22.5-23.7 percent in France, 6.0 percent in Great Britain, and 6.7 percent in Japan.

Even the United States which produces more than half of its oil needs from domestic sources and with abundant coal and natural gas resources, Great Britain with its North Sea oil fields, and West Germany with domestic coal deposits have placed nuclear power as one of their prime energy resources. France has decided to use electric power to supply most of its energy needs, and it is following a plan to provide 55 percent of its electric power from nuclear energy in 1985.

As long as it is possible to control the environmental and safety problems associated with the operation of nuclear power plants by technology, there is great significance to the use of nuclear power. Generally speaking, a technology which has come to account for several percent of an energy supply process can have its utilization expanded still further through effort alone.

Japan has to direct greater effort than other countries to the utilization of nuclear energy both as an energy source to tide us over short-term instabilities caused by oil and as the main source of energy for the 21st century after oil is depleted, and efforts in this direction must not be neglected.

2. Difficulty in Understanding Nuclear Power Technology and Safety Judgment

There are also some critical thoughts directed against the use of nuclear power. Thoughts of the effects of radiation on man and the environment, the insecurity about the disposal of radioactive wastes discharged from nuclear reactors, and the effect of warm water discharged from nuclear power plants on fish and marine life are the reasons often given by local people for opposition to the siting of nuclear power plants. There are cases which are fought in the courts, cases being negotiated, and cases taking the form of public demonstrations.

This lack of unity of the nation's people regarding the utilization of nuclear power in the face of the worsening energy situation must be because there is inevitably some feeling of insecurity left. In addition to the difficulty in understanding nuclear power technology and the language used therein, the difficulty in presenting a clearly demonstrable and understandable explanation of the safety aspects is a major reason. The following two points may have to be considered in efforts to resolve this insecurity in the midst of the situation where information is difficult to understand.

The first is the evaluation of safety assessment technology unique to nuclear power and the trust on this assessment. The technology utilized in generating nuclear power was developed over a course of more than 20 years. Generally speaking, the risk accompanying utilization of technology becomes more circumspect as society develops and nuclear power utilization technology is dominated by far more safety oriented standards compared to technology of the past. Some examples which can be given here are safety evaluations on the basis of assumed accidents and methods of risk evaluation. There is no previous example in which as a technology is being developed, methods for assessing safety are being incorporated into the development. This is something which needs to be evaluated and believed.

Another item is demonstrative research on safety in the broad sense of the word. It is a fact that uneasiness cannot be dissipated unless safety can be demonstrated before one's eyes. What will occur under any given circumstance, and how the accompanying phenomena are evaluated must be accurately demonstrated. This involves even more involvement in demonstration research on safety, and the need then becomes to offer specific proof based on actual cases.

3. Independent Nuclear Fuel Cycle and Nuclear Proliferation Safeguards

Promotion of nuclear power utilization will enhance Japan's bargaining power in the international energy market and is also tied in to energy security.

The situation that uranium resources are mostly dependent on imports is no different from that of oil, but the volume of fuel used is extremely small, the fuel is easy to store, and the fuel is used for more than 3 years within a reactor making for a very long period of use as a result of which this fuel may be classed as quasi-domestically produced energy.

In order to develop this bargaining power and be able to freely use this type of nuclear power, there is need to develop independently the facilities and technology for our own enrichment → fuel processing → nuclear reactor → reprocessing facility → fast breeder reactor → waste treatment and disposal system. In order that we can be free of conditions imposed by other countries where our use of uranium fuel is concerned, we need an independent nuclear fuel cycle which we can control. Even to effectively use the uranium fuel which has come into our hands, we will have to have our own enrichment, reprocessing facilities, and fast breeder reactor at hand.

In another direction, security considerations directed at preventing nuclear proliferation are also important. Nuclear enrichment technology and reprocessing technology can be tied into nuclear weapons production as a result of which a defenseless nuclear proliferation program is associated with many problems. While a supply guarantee system for nuclear fuel was being created and nuclear proliferation at enrichment facilities was being guarded, the reprocessing of spent fuel was suspended for a considerable period in accordance with the policy adopted by the United States which had already been introduced. Japan which must absolutely look to nuclear power in the face of this nuclear power proliferation prevention in which international cooperation is an absolute condition has the responsibility of embracing these two security items in an all out manner. Japan must make specific contributions to nuclear proliferation safeguards such as reinforcing the international observation system, internationalization of enrichment facilities, and study of an international control system for plutonium. In the Asian theater which is so full of complex elements even in the political area, Japan has an important role in promoting the utilization of nuclear power while keeping these problems in balance.

4. Long-Term Strategy for Nuclear Power Development and Problems To Be Faced

As discussed to this point, the thesis for urgent selection of nuclear power spans a wide area. It involves not only technological feasibility which is obvious but also greatly involves various elements of government, society, and economy.

As the elements to be considered increase, so will the insecure material increase. New material for criticism and evaluation are continually coming to the fore such as emphasis on nuclear proliferation safeguards, possibility of obtaining oil and uranium resources, and the safety technology of nuclear reactors as exemplified by the experience of the Three Mile Island incident.

There is need to once more clearly define the role of nuclear power reactors and establish a long-term strategy for nuclear power development in the midst of these energy policies, technological policies, and foreign negotiation policies and in the midst of a large social system in going about a positive program for utilization of nuclear power. Such an approach must be adjustable to accommodate energy, nuclear power industry, safety, science and technology, and fiscal factors. If practical and specific objectives are indicated, they will not only serve as guidelines to nuclear power development but also provide some informative material to the many who are uneasy about the nuclear power program.

At the same time, it is extremely important to fix nuclear power development at its present state in order to plan expansion of reliable nuclear power utilization based on a long-term strategy. The decision whether the next generation will use nuclear power as an energy source will be decided by the performance of the present power plants based mainly on the light water reactors according to whether they will develop the reliability needed by fulfilling the following points.

1) Experience and record of stable operation in which safety assurance takes top priority.

2) Vigorous promotion of improvement and standardization of light water reactors and efforts in establishing independent technology on the overall nuclear fuel cycle.

3) Positive involvement in international joint research and promotion of safety demonstration research.

4) Appropriate coordination between industry and government.

3-6 Efforts To Fix Nuclear Power Utilization

1. Accumulation of Stable Operating Record of Nuclear Power Development

Nuclear power development in Japan started off with a Calder Hall type gas cooled reactor imported from Great Britain, and this was the start of power development for commercial use. This was followed in 1970 by the start in operations of the number one members of the BWR and PWR type light water reactors after which development of light water reactors has continued. Other than the Advanced Converter Reactor (165 KW electrical) prototype which is presently being operated and the prototype of the Fast Breeder Reactor (300,000 KW electrical) for which construction preparations are now under way, the reactors for power use in Japan are all light water reactors except for the aforementioned single gas cooled reactor.

As of July 1979, there were 19 reactors operating producing 12.68 million KW and 9 reactors under construction for producing 8.11 million KW which were under construction or in test operation. In addition, there were 7 reactors designed to produce 7.09 million KW which come under the country's basic electrical power production plan and which are awaiting permits or approval inspection. When all of these reactors go on stream, the total output will be 27.88 million KW. The country's plan calls for 30 million KW in 1985.

The operational situation of a nuclear power reactor is given by its time availability factor which is the average for commercial use reactors. This was 60.4 percent in 1976, 46.6 percent in 1977, and 63.4 percent in 1978, and it is low. There must be a suspension in reactor operation once a year for partial fuel replacement, and there are also the 2-3 months per year when government specified periodic examinations have to be performed. In addition, when a reactor in Japan develops a flaw, all similar reactors have to be shut down to undergo detailed inspection. On the other hand, experiences such as these cause the technology to mature, and there may be need for efforts to provide truly stabilized technology and stabilized operation by directing diligent countermeasures for even the slightest abnormality. Lowered availability factor reduces the economic factors, however, to sacrifice economy at this stage of being at the gate to long-term nuclear power utilization and to emphasize safety is thought to eventually hasten the pathway to effective utilization of nuclear power. As a result of this prudent practice, records of stabilized operation can be accumulated, and this will serve as a fixed necessary condition for society.

2. Independent LWR Technology and Its Modification and Standardization

Nuclear power energy is produced as fruit of research. This is why future energy is said to reside in the brain.

Japan's nuclear power technology is for the most part in line with the world's leading technology, and we should participate in this development not only as benefactors of nuclear power but as creators of resources to be passed to the next generation and thereby contribute to the peaceful utilization of nuclear power.

There are some who say that light water reactor technology is dependent on the United States. On the other hand, excepting the rather small volume of research records which have been amassed thus far, it may be thought presently that the technology has been nearly completely absorbed into a uniquely Japanese technology. When some abnormality is discovered in a same type reactor in the United States, there is need for prudent action such as also inspecting the same type Japanese reactors. At the same time, the more reactors there are of the same kind, the greater will be the wealth of operating experience which will be compiled.

The experience derived from operating and controlling the reactors to date was directed at improvements to the light water reactor the program of which was started in 1975, and plans are under way to design a Japanese type light water reactor. Design will be improved on sites where troubles have been experienced in the past, overall reliability of the reactor will be improved, efficiency of spot inspections and repairs will be improved, these improvements will be employed to stabilize and improve the availability factor, and efforts will be directed to reduce radiation dose to workers. In this manner, an improved nuclear reactor produced by independent technology is planned to be constructed as a standard plant.

All the other countries headed by the United States are studying the possibility of creating a single standard design plant for each maker. The improvement and standardization research being promoted in Japan is characterized in that 1) many makers are coordinating their efforts, 2) by introducing Japanese modifications and improvements, a single standardized reactor will be developed.

On the other hand, the improvement and standardization plan now being promoted amounts to nothing more than partial improvement over the original American reactor. This present design needs to be further improved by increasing the breadth of the improvements, considering reactor abandonment stage, considering followup capability of output load, and improving standard earthquake resistant design and thereby come forth with a Japanese light water reactor built by independent technology.

Time availability factor = [(hr operating time)/(hr overall)] x 100 (percent)
Facilities utilization rate = [(power produced)/(approved output x total hr)] x 100 (percent)

3. International Joint Research and Safety Demonstration Research

There are many objectives that need to be researched in the fabrication of a nuclear fuel cycle. The uranium enrichment facility, reprocessing facility, fast breeder reactor, and radioactive waste management all are in the form of experimental stage facilities under operation or in the stage where demonstration research is being promoted. It is extremely important as an independent road to energy assurance that this technology including the construction and operation will be adequately fixed in place in the form of Japanese technology.

In addition, forgetting the energy problem temporarily, nuclear power technology will be of very great value in nurturing strategic technology in Japan's technology development policy because of the sheer magnitude of the project. This will require the cooperation of scientists and technologists from the various areas and cooperation on the part of universities, research organs, and the industrial world.

Since the facilities to bring the research into the demonstration stage are assuming large-scale proportions, the development funds for research are reaching a gigantic scale. In addition, a number of joint international research projects are being promoted because of the need to conduct the research in a most efficient manner. There is need here for efforts to expand independent technology in a positive manner and overcome the limitations imposed on funds and researchers to accumulate corraborative research results.

Safety demonstration research in light water reactors will not only enhance the ability of light water technology to endure actual trials but also increase its safety and economic aspects, and its basis needs to be made more precise. At the same time, there is need to advance emphasis to a degree greater than in the past on being able to respond to the insecurity with regard to nuclear power technology which is difficult to understand.

The significance of safety research on light water reactors which has been put into practical use already makes it possible to make safety judgments on a quantitative basis and to make the standards even more precise. The fact that objective safety evaluations can be performed has great significance in that it increases the trust the general public will have with regard to safety judgments on nuclear reactors. This safety research is usually performed on actual scale demonstration research, and it assumes the nature of a large research project. In this manner, Japan should promote its independent research together with all out activity in safety research cooperative agreements with the United States, France, and West Germany which were entered into in the past and thereby accumulate demonstrable results.

4. Subjects in Nuclear Power Utilization and Coordination Between Government and Industry

There is a very large number of wide-ranging problems in promoting the utilization of energy from nuclear power.

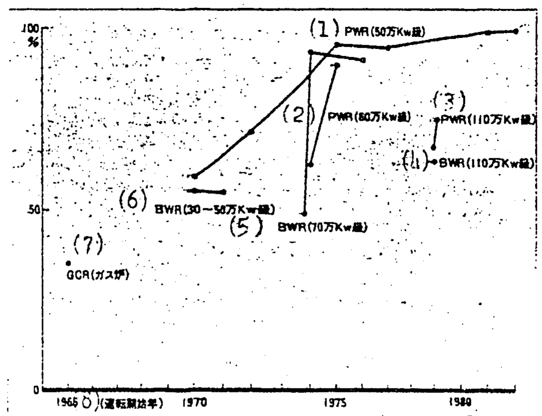
Even when seen from a short-term viewpoint, there are problems such as improvement and standardization of light water reactors, developmental research on nuclear fuel cycle facilities and technology, and their industrialization just to establish in an independent manner nuclear fuel cycle technology centered on the light water reactor. At the same time, there must be efforts to obtain the trust of the people with regard to nuclear power utilization through reinforced safety demonstration research and operation of light water reactors in which safety is the first concern and thereby accumulate actual records.

It is necessary to take advantage of the lessons of the Three Mile Island nuclear power plant and to insure thorough safety control over the operation of nuclear power plants and to clearly define the distribution of responsibilities between the central government office at the locale of the power plant and the district self-governing body. There may also be need for thorough understanding of the thinking that should take place in time of local disaster, the provision of an appropriate system, and the clearly defined and thoroughly understood management accompanying evacuation of the areas under consideration. In addition, people who have been in charge of the nuclear reactor operation during an accident should conduct training on operational judgments and applied construction stages. There also should be recheck of the operation manuals and thorough point inspection of the equipment used daily and stress again the importance of the basic items.

The administration must maintain a balance over this entire wide range and manage things in an appropriate manner. The pursuit of a nuclear power policy which has psychologically complex reactions becomes possible only when there is an administration which can be trusted. The assurance of trust with regard to an administration for safety assurance is particularly important, and the capabilities of the Atomic Energy Safety Committee and the Nuclear Power Administrative Bureau have to be organically activated.

In another direction, the response from the industrial side including nuclear power instrument makers and power companies is also important. The subjects discussed before include many which have to be resolved by the self-awareness of the electric power companies and makers which are the countries' basic industries which must bear the load of tomorrow's energy problems.

Ratio of Domestically Produced Instruments for Use in Nuclear Power Generation Reactors



Key:

(1) PWR (500,000 KW class)
(2) PWR (800,000 KW class)
(3) PWR (1.1 million KW class)
(4) BWR (1.1 million KW class)
(5) BWR (700,000 KW class)
(6) BWR (500,000 KW class)
(7) GDR (gas reactor)
(8) (year operation started)

3-7 Expansion in Coal, LNG

1. Expanded Use of Coal With Introduction of Imported Coal

The substitute for oil as an energy source for which there are the greatest expectations is the utilization of coal.

The coal policy is comprised of three pillars.

1) Sustain 20 million ton/yr production of domestic coal.

2) Promote coal utilization research and development directed at coal gasification and liquefaction.

3) Promote development and import of coal for general use from overseas sources.

Japan has about a billion tons of coal which is considered retrievable economically, and this is about a 50-year supply at the present production level. On the other hand, any increase in domestic coal production is considered difficult because of the uncertain labor supply, the increase in mining cost due to the increasing depth of mining operations, and the increasing differential in price compared to imported coal. There is significance to maintaining production of this purely Japanese produced coal when seen from the standpoint of safe assurance of Japan's energy, and the development of a policy to maintain production hereafter is necessary.

In view of the narrowness of the Japanese land and its environmental restrictions, there are limits to the direct combustion of coal. In addition, coal gasification and liquefaction can make use of already present facilities as a result of which there are some great expectations in this area. Already some active experimentation is taking place in various countries of the world, but it is said that considerable time will be required to bring this technology to the practical stage when seen from the technological and economic areas. With this situation in mind, the development and import of general use coal from overseas will become the main line for large-scale utilization of coal in Japan for the short and medium terms.

The coal producing countries with coal exporting capabilities such as the United States and Australia already have reinforced control over coal on the part of the majors and others, however, there seems to be considerable opportunity left for development and import through capital participation. This is why related industries such as power companies, coal companies, and commercial companies are the central figures involved in the formation of development systems which work toward long-term establishment of coal demand and supply plan and strive to expand at an early stage development and import.

2. Conditions for Hindrance and Abetment of Expansion in Demand for Imported Coal

A large number of obstructions have to be overcome because of the increase in demand for coal that is coming. The construction of coal-fired power plants will be necessary to consume the large-scale introduction of coal, but the present picture is that 16 power plants producing 4.4 million KW are operating on 7.7 million tons of coal. In addition, there are 8 power plants presently under construction or in the planning stage designed to produce 10.7 million KW from a consumption of 25 million tons of coal.

An important factor that is delaying coal utilization is probably the uncertain nature of the future price of oil and coal. At the same time, new installations of coal-fired thermal power plants to be operated by import coal will have to be sited quite a distance from the consumer area because of environmental and port limitations. If this distance exceeds 200 km, the transmission costs will rise to the point that this form of power will be unable to compete with oil-fired thermal power plants, and this will become a major limitation to siting a power plant away from a densely populated area. A coal center concept has great effect in enabling relief from the docking conditions which make large type ships difficult to accommodate and involving the use of small demand units. It is further conceivable that there could be a conversion from oil to coal by industry in general, but when large oil consuming industries using 100,000 Kl or more oil per year are considered, the list is limited to the 4 industries comprised of cement, steel, paper and pulp, and chemicals which account for about 60 sites. In addition, the cement plants are the only places where this conversion can be made in existing facilities.

Along with this economic problem, the solution of problems outside the realm of economics and which are unique to coal is also another major obstacle. The first is the problem of disposing of the ash left by combustion. Coal on the average contains 15 percent ash, and the bulk of this ash is disposed of through in-sea interment. For this purpose there must eventually be a sea area twice the area of the power plant to accept this ash. Regulations on disposal at sea are becoming more stringent, and this cannot help but become one of the limiting factors in the future. The second is the dirty image assigned to coal. Even though environmental standards can be satisfied through the application of desulfurization, denitrification, and electrostatic dust removing units to the smoke, the dirty image which people hold with regard to coal has very great possibility of becoming a major impediment to the siting of coal-fired power plants.

3. LNG Expansion Which Requires Concentration of Demand Scale

There are great hopes for the introduction of LNG which is a clean fuel of high thermal efficiency. The problem with regard to large-scale introduction of LNG eventually resolves itself to the economic aspects. A tremendous capital investment is required to provide the liquefaction facilities, tankers, and storage facilities to take this product from the development stage to the consuming end. In the particular case of Japan which has no pipeline network, the problem focuses on the point whether there will be sufficient demand around the introduction sites to warrant its import. According to calculations made in various projects of the past, an annual import of the order of 3 million tons is projected.

As a result, the LNG project considers its use principally to operate thermal power plants because of the volume limitations followed by use in urban gas lines. Once overdensely populated areas have been converted to LNG and new LNG burning power plants have been built, the introduction into the sparsely populated areas with little inducement factors becomes a problem, and LNG expansion may face a new polarization front. In order to counter such situations, large-scale single liquefaction bases and small-scale multiple unit loading bases could be combined to retain economic operation up to the liquefaction stage. At the same time, the question whether LNG demand can be created in areas other than thermal power plants on a long-term basis will become an important problem in maintaining the minimum economical scale of use. The use of city gas by large industrial users paying special rates is one such example. Consequently, the construction of pipelines to enable use by industry in general may be necessary in order for future expansion to take place.

Research on methanol production is being promoted with the hope that natural gas can be handled in a manner similar to oil. The use of natural gas will be greatly stimulated if this technology can be perfected. In addition, LPG (liquefied petroleum gas) which is produced alongside petroleum and which presently is not utilized should be exploited as much as possible to fire power plants.

4. "Determination" Required for Introduction of Coal, LNG

While the energy substitutes for oil may suffer at the present time in their economic features compared to oil, their introduction should be clearly assigned on volume, time, and geographic aspects within the energy policy. There may be need to accept the economic demerit as the cost for safeguarding dependence on unreliable oil. To be sure, such determination will remove future indecisive elements, and the net effect will be to enhance economics and bring advances in technology as well. The combination of the following means may be necessary to transfer such determination to reality, and the government's role in such a situation is large.

1) Direct Regulations

By narrowing the range of choice by consumers on the type of energy desired, the utilization of alternate energy can be planned. The manner of setting the base of these regulations may be a problem, and there is need for detailed study on the preparation time for technological and economical feasibility, demonstration plant conversion, and new construction related to the use of fuel other than oil for each fuel consuming facility. Where thermal power generation is concerned, IEA has banned further use of oil except for those power plants already in the planning stage. There may also be need in the future to restrict the use of oil to a fixed number of industries other than power plants.

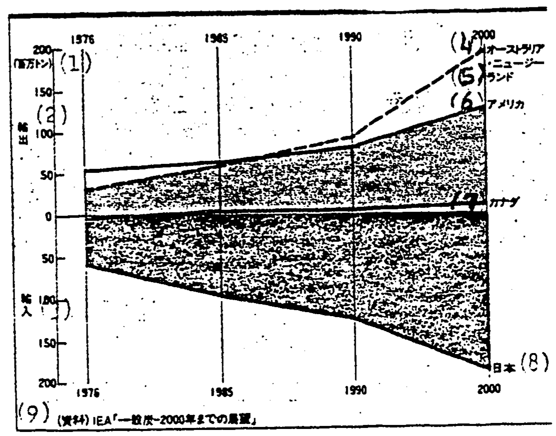
2) Indirect Regulations

The price competitive strength of substitute energy should be strengthened through subsidies and there is need to study means to promote fuel conversion.

3) Subsidies To Promote Introduction

Considerable investment must be made for production at the original site, transport, transport to Japan, storage, and loading in order to promote conversions to substitute energy sources. These investments are saddled with risks evolving from the changes in market conditions, and a portion of this risk should be borne by the public and thereby add incentive to private investment.

Projected Japan's Coal Import and Major Countries' Exports



Key:

(1) (million tons)
(2) export
(3) import
(4) Australia
(5) New Zealand
(6) United States
(7) Canada
(8) Japan
(9) (Source) IEA "Projected Picture of General Use Coal Up to 2000"

3-8 Response to the Electric Power Crisis

1. Characteristics of Electricity as Secondary Energy

Electricity is secondary energy generated from resources such as water power, oil, or uranium (primary energy) and it accounts for about 30 percent of the total energy demand in Japan. It is a readily usable clean energy which is exploited in many ways such as for illumination, power source, and various control applications, and its use is increasing by the year. Electricity is already an essential of living and an artery in industrial operations. It is known to be the central nervous system of the information oriented society, and its roles are too numerous to mention.

Now, what should happen when there is a large power outage? Household appliances such as televisions and refrigerators will no longer be usable, water and gas lines will no longer function, and household activities will be disrupted to no end. At the same time, the railroads will cease to function, signals and ATS will not operate, traffic will be thrown into confusion, and hospitals will be unable to conduct surgery thereby endangering peoples' lives. Computer operation will stop throwing the banking business into confusion, and mass communication, telephone, and radio cannot be used to result in information uneasiness. In addition, production paralysis in the various plants will result in product shortages, and severe roadblocks against production and production capacity will appear everywhere. In this present society which is in a state of complex mutual dependency relationships the social confusion and the damage arising thereof as the result of power outage will probably be of a scale far beyond anything our experiences have taught us.

Many of the arguments which were used in dealing with the interruption of primary energy supply such as of oil are used when treating an energy crisis. On the other hand, not only must we consider the problem of power supply just as in the loss of fuel such as oil, there is need to consider problems unique to a power supply system. The major power outage which occurred in New York did not result from an interruption to the primary energy supply.

Electricity unlike oil cannot be stored, and it cannot be imported from abroad. It has the property of immediate consumption upon generation. Unless this property is duly considered in the countermeasures which are devised, an unpredicted and sudden large power outage may be calamitous.

2. Factors Causing Major Power Outages

The following three factors are thought to be major causes of large power outages:

1) Difficulty in obtaining fuel for power plants:

About 70 percent of the present day power plants are thermal, and more than 90 percent of these thermal plants use oil and LNG. There is no need here to reiterate what effect the inability to obtain this type of fuel will have.

2) Reduction in supply capability due to siting delay of power plants and transmission facilities:

According to the JFY 1979 power facilities plan, the reserve supply rate of electric power is expected to be 6.5 percent (7.8 million KW) in JFY 1983, 3.4 percent (4.38 million KW) in JFY 1984, and 0.2 percent (330,000 KW) in JFY 1985 indicating that this reserve rate is being hard pressed by the demand. These figures show that there will be at least some margin up to 1985, and there will most likely be no shortage. On the other hand, when compared to the concept that states the need for at least 8 percent reserve rate to account for inaccuracies in the predicted rate or unexpected stoppages, we are already in a crisis. During the peak of air conditioner use in summer, a change in air temperature of 1°C will entail a change in 2.60 million KW use. A change in but 3°C will reduce the reserve supply rate for 1983 to zero. In addition, there can be considerable limitation on the operation of power plants operating close to urban centers due to photochemical smog formation. If for some reason a power plant being planned cannot be started because of siting problems such that partial delay has to be taken into consideration, the reserve supply rates up to 1985 will be simply calculated values.

The most important factor to apply against major power outages is how to resolve this siting delay problem.

3) Accidents involving large-scale power plants, transmission, and transformer facilities:

Because renovation of facilities, looping of supply routes, and cooperation between power companies are well advanced in Japan, it is thought that the large-scale power outage of the type experienced in New York will occur with comparatively less probability. On the other hand, should there be insufficient reserve supply rate and a situation of prolonged continuous operation, there is a good possibility that a minor incident can kick off a major outage.

3. Efforts To Conserve Electric Power

The efficient use at the production and consumption ends of power or, in other words, conservation of electric power will become very important to the power demand and supply situation of the future. First of all, development of power conserving appliances, simplification of production processes, reduction of loss rate, and avoidance of wasteful operation of coolers and illumination should be practiced to promote rational use and economy. In another direction, aluminum refineries, electric furnaces, paper and pulp industries and chemical industries which are large power consuming industries must make conversions in production methods. In this manner, power conservation must be practiced on a wide-ranging basis involving the entire national economy. These large power consuming industries may be studying international branch businesses or siting in foreign countries. The establishment of policies and guidance along the lines of conversion and higher level development of industrial structures is desirable from the standpoint of power conservation.

The next important item is to minimize the use of electricity as a thermal source. The conversion efficiency from primary energy such as oil is less than 40 percent, and there are further losses of a little less than 10 percent as power is sent from the power plant to the consumer, and this includes transmission losses, distribution losses, and transformer losses. As a result, the use of electricity as a thermal source will consume more than three times the energy compared to energy supplied by primary energy such as oil. Heating and cooling along with hot water should depend on oil, waste heat utilization, or solar heat wherever possible. In order to encourage such practices, a tax policy which gives incentive to the use of other thermal sources beside electricity should be provided.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000300070035-3

The one item on power conservation which should not be forgotten is the problem of peak demand. When reviewed over the entire year, the peak demand comes in August. The reserve supply rate and the average generation cost are controlled by this peak demand. As a result, reduction in peak demand has great significance on future power supply and demand.

Efforts to save on power by jacking up cooling temperature, taking major vacation breaks during summer, promoting power use late at night, and introducing seasonal rates may be necessary to reduce peak demand.

4. Diversification of Power Sources and Siting Promotion

Assuming that power source development after JFY 1984 can only be as directed by the Power Development Council, the situation will be as if there is no reserve supply rate of electric power. Power supply is a tightrope affair, and only a slight accident or change in demand has the possibility of causing a major outage.

It is an urgent situation that fuel sources be diversified and construction of power plants be promoted in order to resolve this fragile nature of the power supply front. Nuclear power and direct burning of overseas coal in thermal power plants are thought to be the mainstays which will provide the needed energy over the intermediate period.

The IEA has prohibited further construction of oil fired thermal power plants as a basic rule and the Three Mile Island incident has made the already difficult siting problem even more difficult, and the clamor for early introduction of coal-fired plants is increasing. On the other hand, as was discussed before, coal-fired thermal plants are faced with a number of problems which need to be resolved such as the environmental problem, and it will be 10 years before they will become operative even though construction is started immediately; as a result of which it will not resolve the present situation. This is why the only choice left open to make up for this lack of power supply over the next 10 years is to promote expansion of those power plants for which the power companies already have made siting applications and which are mainly light water reactor type power plants.

It goes without amplification that each power company should put every effort into environmental and safety policies while striving to win over the local people through proper PR and explanations in order to promote siting. What is most important of all is for the government to come forth with a clearly defined posture promoting power plant siting.

The various complicated negotiations for siting power plants should be placed in the framework of the functions of various ministries and agencies to process and simplify. The roles and responsibilities of the country and local self-governing units should be clearly defined, and cooperation should be reinforced. In addition, the period for the siting transfer fund should be extended and warm waste water standards should be set up to put the environment and safety standards to an even higher level.

The lead time for power source development is lengthy, and the response to a power crisis will be a race against time.

3-9 Technology Development and Use Popularization of New Energy

1. Significance and Effect of New Energy Technology Development

The development of new energy technology is a worldwide problem. The fact that not only the oil importing countries but the oil producing countries such as Saudi Arabia are conducting research on solar heat utilization attests to the nature of the problem.

Among the new energy sources on which research has been initiated are those which can be expected to be included in large-scale energy supply systems (such as coal liquefaction) and those which will fill the needs of special areas (such as home solar energy utilization, wind power). At the same time, utilization technology of new energy includes those whose development will be promoted over a long term as an energy source after oil and those which can be applied as a supplement to present oil supply inadequacies, and development in line with the times is necessary.

Japan which is a major importer of energy sources and a large consumer country as well has a strategic significance whose importance other countries cannot even conceive of as to the pursuit of this type of research. The major point is the strengthening of the supply structure to assure itself of an independent energy supply source.

In the second place, the submission of material to be used to resolve problems urgent in nature worldwide is the only road by which a resources-poor country such as Japan can contribute to the world's energy supply.

The third point is that should we neglect our efforts at development, we will be taken over completely in research results by other countries, and Japan will be in a disadvantageous position not only in the matter of resources but in utilization technology as well.

In fourth place is the spreading effect and industry stimulating effect of technology development. New energy technology must be developed in a systematic manner from basic research through operational research and through the commercialization stage after its economics are polished up, and various application technologies can be developed in this process which can end up in some new Japanese technology tomorrow.

Even though any large-scale results will not be expected for a while, it is important that these intents are fully recognized and strength be directed presently.

2. Time and Volume of New Energy Development

Research and development on new energy is comparatively well known through terms such as the Sunshine Plan or Solar House. As far as new energy is concerned, the correlation between the time when it will become practical and the quantity of energy which can be obtained should be recognized.

Among the subjects which are being researched as new energy sources include some technology or utilization methods (such as solar energy heating and cooling) which are already in the practicalization stage, some in the basic technology stage (hydrogen energy), some which are being considered for research, and utilization method for some special use (biomass).

There is technology which can provide an energy source for helping to institute an oil economy in the near future, technology for which research must be continued at the present time and which will be targeted to become practical during the disengagement from the oil age a few dozen years ahead, technology which can replace oil and which can serve as a fountain of energy supply, and technology with the property of responding to local demands, but these distinctions are generally not correctly known.

Actually there are some who argue that utilization of solar energy will enable fulfilling many of our electric power needs in the near future and some who claim photosynthesis can be utilized to produce alcohol from plant products which can then be used for household heating and cooling.

Development of new energy technology is a grand plan, and accurate information dissemination on the technology developed is desired to enable its smooth advance.

In addition, the manner in which the step to practicalization of new energy utilization will be taken will be a problem. New energy has to be handled on a commercial base if it is to become practical. No matter how this is done, the question of whether it will find popular acceptance will remain. While there will be some dependence on the movements in the price of oil, an information network must be set up with regard to policy to aid industrialization and on methods to utilize and obtain new technology by the eventual consumers. At the same time, a utilization equipment supply system and consultation system needs to be studied.

3. Promoting Development of Energy Which Can Be Introduced by 1990

It will be emphasized here the need for a portion of the new energy sources to make its appearance as response to the oil supply instability situation. There is no doubt that nuclear fusion, large-scale solar thermal power generation, and power generation utilizing gasified coal which will be central energy sources are important along with the development and spread in use of small energy sources such as solar thermal air conditioning. On the other hand, when the most recent world's energy situation is considered, there is need to look into those sources which can be developed to the practical stage in a short time and with promise of volume great enough to supplement the lack of oil and upgrade their priorities while promoting practicalization research so that they can be incorporated into the supply system as oil substitutes at an early date.

In the provisional long-term energy demand and supply predictions (Advisory Committee for Energy, 1979) it is expected that about 5 percent of Japan's total energy supply in 1990 will be from energy from the Sunshine Plan sources such as solar, new type geothermal, and coal gasification-liquefaction sources. It is needless to say that considerable effort will be required for this plan to materialize.

Technology which may answer this expectation may be represented by the solar battery, coal liquefaction, and deep geothermal power generation. The research subjects related to these technologies are not basic technology problems but problems related to volume production, scaleup, and site surveys. By the concentrated and selective investment of funds and know-how, it may be possible to come forth with a considerable energy supply at an early stage.

There will be a structural tightening in the oil supply and demand situation along about 1990. At this time the situation that these energy sources have come to contribute real power as an oil substitute will be extremely important to the energy strategy which follows.

A moving up in the research plan is necessary to this end, but this is not all. There will be need for fiscal policies for the practicalization stage, management of the utilization and popularization end, and response to problems which will have to be resolved in a stage further in the future.

4. Responsibility for Development Funds and Development Posture

Long lead time and vast sums in investment are required before new energy will materialize in a practical manner. Research results often are proportional to the amount of effort on the part of the research staff. Excluding the nuclear energy portion, the funds invested in new energy research in 1978 totaled about 10 billion yen taking both government and private sources into account. This was but one-ninth that spent in the United States.

As the scale of the experimental facilities becomes larger, the research costs increase in exponential manner. In addition, there is need to consider future subsidies for industrialization, demonstrations to popularize the subject, and information transmittal. The Advisory Committee for Energy estimates that the research and development funds required for the 1975-1985 period will total 740 billion yen. There will also be need for large sums for utilization and popularization in addition to the above, and 640 billion yen will be required just for solar energy.

There is need for thoughts on a nationwide basis on fiscal sources plans to fund these requests including study of the tax structure to encourage new energy development. Not only the nation's responsibility but the risk responsibility to industry accompanying new technology development must be of levels which can be borne by Japan's economic strength or the developments cannot continue. Assuming that Japan's economic strength for some time will be cultured by oil, it may be said that new energy will be born from oil.

Joint research on an international level is under way in order to promote research efficiently while taking responsibility for vast funds. Japan must contribute to the solution of global problems and develop pathways to these solutions including technology cooperation with the oil producing countries and developing countries. A truly international research which mutually exchanges technology and personnel in an active manner is desirable to this end.

The development of a primary energy source for the next century to replace the fossil fuels which will be depleted in our lifetime will be the crowning achievement of a worldwide stature.

Establish Oil Assurance System Suitable for the Structural Insufficiency

The world's oil situation has come to the stage in which the consumer countries have to respond with willfully directed cooperation. Japan agreed to the oil import framework set up at the Tokyo summit. On the other hand, this import framework was not according to the way we would have wanted it, and oil will not be readily available. In another direction, Japan has to depend on oil for more than 50 percent of its energy just as before, at least for a while. Even though we work hard at energy conservation and expansion of alternate energy supplies, no suitable economic growth will be attained unless the necessary oil is assured.

A reawareness of the roles of the government and private sector under the supply system is necessary to assure a stable supply of oil. The main pillar in this direction will be the oil industry to the bitter end. Cooperation with commercial companies should be developed to reinforce overseas activities, expand DD crude oil, and strive for stability in supply which are all highly desirable. At the same time, the role of the government to support these activities of the private sector assumes greater importance than before. Starting with improved diplomatic relations with the Middle East countries, all out promotion of economic cooperation and long-term agreements related to the oil import framework become even more important at the present time.

The Hastening Energy Crisis, Fulfillment of Control Countermeasures

The structural energy crisis proceeds in the form of short-term crises such as demand and supply stringency and escalating prices. Japan which is in a fragile resources position has the urgent duty of setting up crisis control countermeasures. There were some separate crisis countermeasures such as oil stockpiling, consumption control, rationing, and price control which were put into effect after the first oil crisis, and these measures were part of the foundation by which confusion was avoided in this present oil crisis.

Now should the crisis become even more critical, one wonders whether mutual relationships between accurate grasp of the situation and specific application of the individual measures, in other words, the crisis control system, can be exploited sufficiently. Certainly, there are some doubts at the present time. It is only after the reinforcement of certain items such as oil stockpiling and various controls under a state of emergency are established and operated as a system that composed actions on the part of the people are possible. This is an important measure for independently reinforcing the weak resources position of this country.

Expansion of Alternate Energy Supply Headed by Nuclear Energy

The degree of increase in the volume of alternate energy to supplement the energy demand under the limitations imposed on the oil supply is large. This is why there is need to look to the utilization of all forms of energy from here on, and nuclear energy, coal, and LNG will probably be the three main pillars when the scale of the supply and practicality are considered. When judged from a long term basis, LNG has a resources limitation similar to oil while coal is faced with limits in expansion if it is to be burned directly. While it is hoped that coal gasification and liquefaction will become realities in this present century, there is need to consider determined reliance on nuclear power utilization calling on the light water reactors, fast breeder reactor, and eventually nuclear fusion. Nuclear energy is beset with problems such as safety and waste disposal, but these problems probably can be solved eventually through development in the technology and accumulation of operating experience.

The shift from oil to other energy sources will not proceed unless it is entrusted to the market mechanism. Starting with management which will dispel all insecurity on the economic aspects at the initial stage of practicalization, the government should provide positive policies for promoting substitute energy and display strong determination toward practicalization.

Enthusiasm Toward Becoming the Leading Energy Conserving Country

Japan's unique conditions such as resource poor status, very limited land area, and overly dense population will not change over the long run. Such being the case, Japan must lead the world in planning real energy conservation and proceed toward the 21st century seeking to become a resources and energy conservation type society.

If this is to be done, energy conservation efforts must not stop at the emergency avoiding and short-term approaches which are now being taken, but development of energy utilization technology with high efficiency over the long term, development of a higher level industrial structure, and change in living patterns should be structurally enfolded into the economic society.

Japan's industry has prospered in applied technology, and it has adequate power to develop greater energy efficiency. Many great things are expected of industry's ability to come forth with original ideas.

It will be difficult to quickly turn around the present society which has been nurtured on the increasing rate of energy use. On the other hand, a transition to an energy conserving type society is unavoidable. Japan needs to assume the determination of taking a leading role in this effort as it enters the 21st century.

Indispensable Exploitation of Private Activities and Governmental Determination

As long as economic strength and manpower are finite, the selection of various policies and the order by which these policies are implemented are indispensable to the development of an effective energy policy. The exploitation of this leadership is certainly the government's role, and determination with courage can be the result.

In another direction, the role of industry particularly the energy related industries is also large. The desire and activity of industry must be adequately exploited in matters such as assurance of oil, introduction of substitute energy, and technological development for the future. At the same time, individuals, households, and districts should activate their originality and make positive contributions to the effective utilization of energy and resources. In addition, they must assume the economic burden and cooperate with sitings to assure energy for the present and future and thereby shoulder their share of the social cost.

The energy policy requires strict awareness of the present situation and responsible actions on the part of the individual countryman. In this sense, the people and the local governing bodies should serve as the executors of the policy and also serve as instructors.

Race With Time

The limit to increased production of oil which sustained the alarming economic growth of the latter half of the 20th century will surely become real in the near future. The problem of whether we and the next generation can greet a 21st century which fulfills the expectations will depend on how well we are able to achieve the targeted energy policies in the meantime. Society's response to the materialization of energy policies requires a very long lead time way beyond comprehension. We are presently faced with a race against time.

The leading industrial countries which consumed finite oil resources for the development of a limited population must stand in the forefront and fight this battle. Among these countries, Japan which has no resources at home and which has sustained its industrial system through import of resources from other countries has a responsibility greater than the other countries.

Demand Predictions

Tokyo NIRA REPORT: MIRAI NO SENTAKU ENERUGI O KANGAERU in Japanese Sep 79 pp 53-55

[Text] Provisional Predictions of Long-Term Energy Demand and Supply

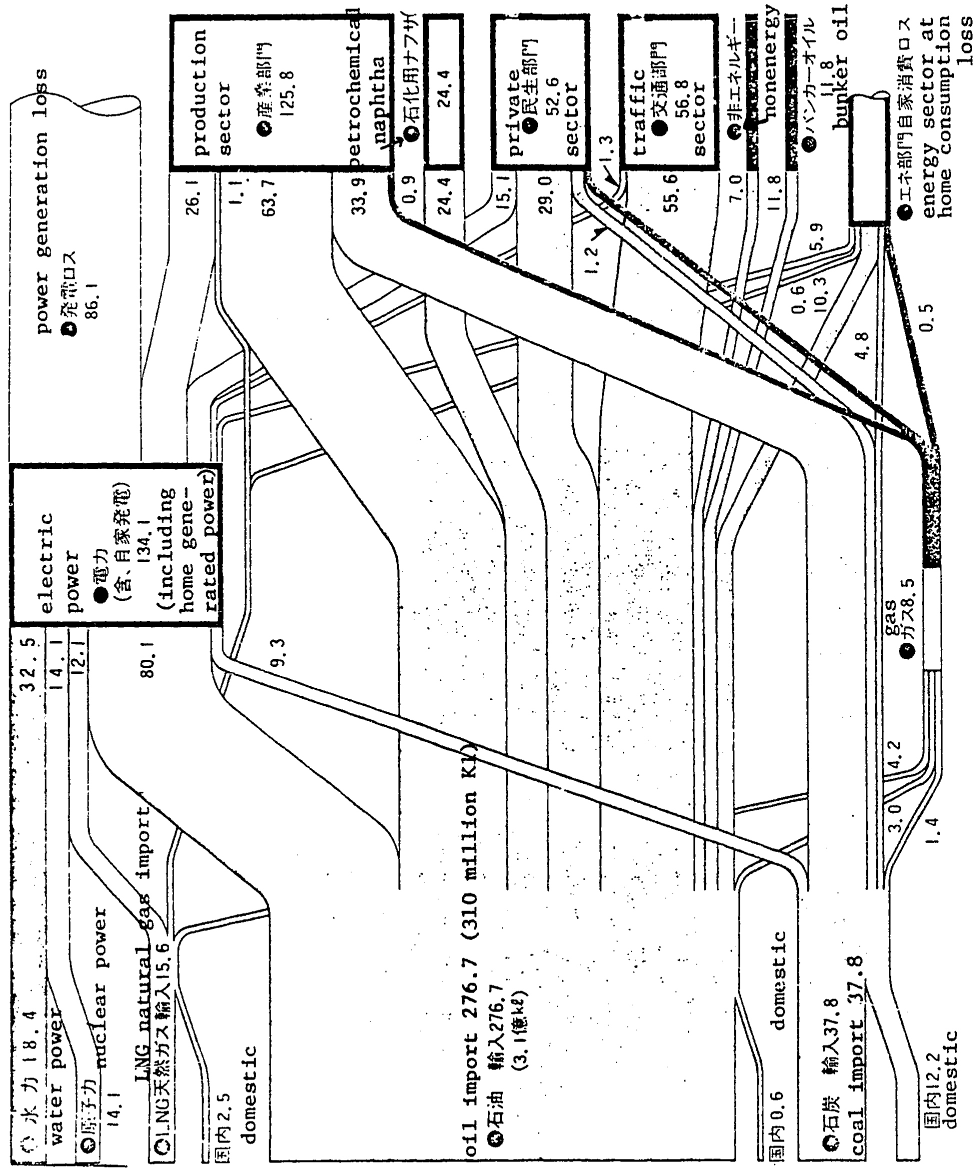
2 年度 / 項目 1	3 52年度(実績)		4 60 年度		65 年度		70 年度	
8 省エネルギー前の需要	27 4.12 億kl		6.62 億kl		8.22 億kl		9.73 億kl	
9 省エネルギー率			12.1 %		14.8 %		17.1 %	
10 省エネルギー後の需要			5.82 億kl		7.00 億kl		8.07 億kl	
11 エネルギー別供給	28 実数	29 構成比 (%)	実 28 数	28 構成比 (%)	実 28 数	29 構成比 (%)	実 28 数	29 構成比 (%)
12 水力 { 一般水力 13	30 1,810 万kW	4.8	2,200 万kW	4.7	2,600 万kW	4.6	3,000 万kW	4.6
揚水 14	805 万kW		1,950 万kW		2,700 万kW		3,350 万kW	
15 地熱	31 15 万kl	0.0	220 万kl	0.4	730 万kl	1.0	1,420 万kl	1.8
16 (うち地熱発電)	(8 万kW)		(100 万kW)		(350 万kW)		(700 万kW)	
17 国内石油・天然ガス	379 万kl	0.9	800 万kl	1.4	950 万kl	1.4	1,400 万 kl	1.7
18 国内石炭	32 1,972 万t	3.2	2,000 万t	2.5	2,000 万t	2.0	2,000 万t	1.8
19 原子力	800 万kW	2.0	3,000 万kW	6.7	5,300 万kW	10.9	7,800 万kW	14.3
20 海外石炭	5,829 万t	11.6	10,100 万t	13.6	14,350 万t	15.6	17,800 万t	16.5
21 (うち一般炭)	(95 万t)		(2,200 万t)		(5,350 万t)		(8,050 万t)	
LNG	839 万t	2.9	2,900 万t	7.2	4,500 万t	9.0	5,000 万t	8.7
22 新燃料油、新エネルギー、その他	31 万kl	0.1	520 万kl	0.9	3,850 万kl	5.5	6,100 万kl	7.6
23 小計	33 1.05 億kl	25.5	2.16 億kl	37.1	3.50 億kl	50.0	4.59 億kl	56.9
24 輸入石油	3.07 億kl	74.5	3.66 億kl	62.9	3.66 億kl 〈3.50 億kl〉	50.0	3.66 億kl 〈3.48 億kl〉	43.1
25 (うちLPG)	(739 万t)		(2,000 万t)		(2,600 万t)		(3,300 万t)	
26 供給合計	4.12 億kl	100.0	5.82 億kl	100.0	7.16 億kl	100.0	8.25 億kl	100.0

34 輸入石油の〈 〉内は需要量。

35 総合エネルギー調査会

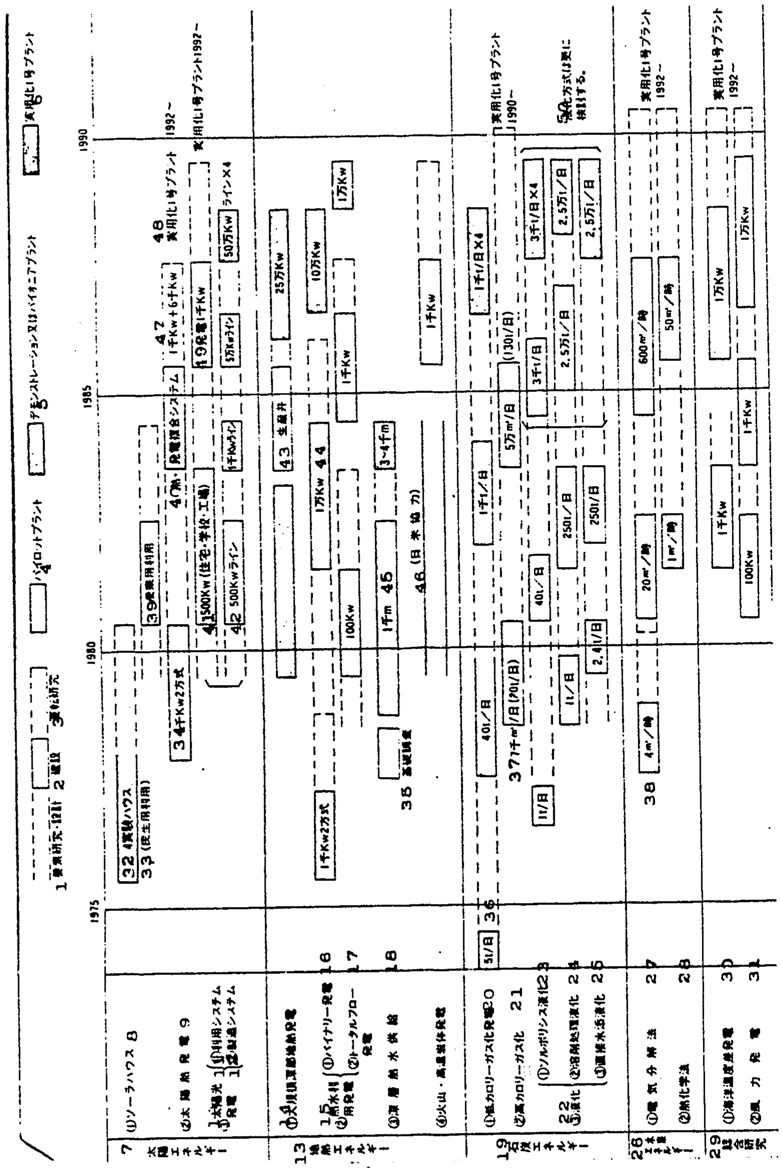
Key:
1. item
2. JFY
3. JFY 1977 (actual record)
4. JFY 1985
5. JFY 1990
6. JFY 1995
7. (August 1979)
8. demand before energy conservation
9. energy conservation rate
10. demand after energy conservation
11. supply by energy types
12. water power
13. general water power
14. raised water
15. geothermal
16. (part used for power generation)
17. domestic oil, natural gas
18. domestic coal
19. nuclear power
20. overseas coal
21. (part which is general use coal)
22. new fuel oil, new energy, others
23. subtotal
24. import oil
25. part which is LPG
26. total supply
27. --- x 10^8 Kl
28. actual number
29. makeup ratio (percent)
30. --- x 10^4 KW
31. --- x 10^4 Kl
32. --- x 10^4 t
33. --- x 10^8 Kl
34. value in < > is demand volume for imported oil
35. Advisory Committee for Energy

Energy Flow Chart in Japan (for 1978) Unit: 10^{13} Kilocalorie (Oil Equivalent per Million Tons) Quantity of Primary Energy Supplied: 382 x 10^{13} Tons



(Source) Japan Research Institute on Energy and Economy Inc.: "Concise Energy Balance Table for 1978 (August 1979). The above includes some provisional values

Plan for New Energy Research and Practicalization



Key:
1. element research, design
2. construction
3. operational research
4. pilot plant
5. demonstration or pioneer plant
6. practicalization plant No 1
7. solar energy
8. solar house
9. solar heat power generation
10. photoelectric generation
11. utilization system
12. production system
13. geothermal energy
14. large scale deep pit geothermal power generation
15. hot water power generation
16. binary power generation
17. total flow power generation
18. deep layer hot water supply
19. coal energy
20. low calorie gas power generation
21. high calorie gasification
22. liquefaction
23. solvolysis liquefaction
24. solvent treatment liquefaction
25. direct hydrogenation liquefaction
26. hydrogen energy
27. electrolytic method
28. thermochemical method
29. comprehensive research
30. sea water temperature differential power generation
31. wind power generation
32. 4 experimental homes
33. private use
34. -- kW Model --
35. basic survey
36. -- t/day
37. --,000 m^3/day (-- t/mo)
38. -- m^3/hr
39. industrial use
40. thermal-power hybrid system
41. -- kW (home, school, plant)
42. -- kW line
43. production well
44. -- 0,000 kW
45. -- 000 m
46. (Japanese-American cooperation)
47. -- 000 kW + -- 000 kW
48. practical plant No 1
49. -- 000 kW power generation
50. liquefaction modes will be studied further

2267
CSO: 4105

Proposed 1981 Budget Allocations

Tokyo SHOWA GOJUROKU NENDO TSUSHO SANGYO SEISAKU NO JUTEN in Japanese Aug 80 pp 9-39

[Text] With respect to oil, which is its main energy source, Japan must strive to further insure a stable supply and increase its stockpile to adequately cope with any emergency situation. Furthermore, on the projected basis of long-range demands for energy sources, efforts must be made to develop alternative energy sources, such as coal, atomic energy, LNG, solar energy, hydraulic power, geothermal energy, etc and to steadily lay the groundwork to prepare for a non-oil-dependent community by replacing oil with other power generating energy sources and to strongly promote the conversion and utilization of alternative energy supplies. As a preliminary step to accomplishing the above, it is necessary to aggressively conserve energy in various demand areas including industries, civilian livelihood, transportation, etc.

From the foregoing standpoints, the following measures are strongly recommended.

1. Insuring a Stable Supply of Oil

(1) Securing Multiple Sources of Crude Oil

While intensifying relationships with oil-producing countries through economic cooperation, personnel interchanges, etc, efforts will be made to diversify crude oil supply sources by strengthening governmental measures such as domestic oil development, GG [government-to-government] crude oil dealing, etc. To do this, a corporate "oil man center" (temporary name) will be established to cooperate in the training of technicians of oil-producing countries and to smooth loan operations projects to purchase oil.

Also, plans will be made to strengthen organizationally national oil enterprises.

(Budget)

Special allocations for coal, oil and alternate energy sources

Of allocations for oil and alternate energy sources

Note: (a) Figures represent the requested amount for JFY 1981 budget and financial investments.
(b) ( ) figures represent figures shown in the initial JFY 1980 budget and financial investments.

"Oil man center" enterprise (subsidies and contracts)	3.298 billion yen (0)
Profit and loss adjustments for currency exchanges in oil-loan purchase projects (Japan Petroleum Development Corporation [JPDC])	1.5 billion yen (0)

(Financial Investments)

Development of national enterprises Japan Development Bank [JDB] loan	15.2 billion yen (included in 53 billion yen for oil)

(2) Promotion of Oil Development

To promote independent development of oil, overseas geological structural surveys, construction of new oil exploration ships, etc will be undertaken and the functional setup of the JPDC will be revised to permit increases in loans for resource exploration enterprises.

To advance Japan's oil development techniques, a "petroleum development university" (temporary name) will be established to systematically train oil development technicians and conduct research and development on technological development of oil sands, oil shales, etc.

Furthermore, to hasten development of domestic natural gas resources, the Fifth Five-Year Domestic Petroleum Gas Resources Development Plan will be recommended.

(Budget)

Special allocations for coal and oil and alternate energy sources

Of allocations for oil and alternate energy sources

Exploration loans (JPDC investment)	118 billion yen (75 billion yen)
Liabilities guarantee fund (JPDC investment)	2.7 billion yen (1 billion yen)
Overseas geological structural survey (JPDC grant)	12.277 billion yen (3.021 billion yen)
Construction of newest oil exploration ship (JPDC investment/grant)	4.028 billion yen (0)
Establishment of "petroleum development university" (JPDC investment/grant)	3.459 billion yen (0)

Unexploited hydrocarbon resources (oil sands, oil shales, etc) Research contract fees for developmental technology, etc	4.312 billion yen (0)
Contract fees for basic research on petroleum and natural gas	7.111 billion yen (4.182 billion yen)
Supplementary fund for natural gas exploration	2.983 billion yen (1.714 billion yen)

(Financial Investments)

Development of continental shelf oil JDB loans	5.9 billion yen (included in 53 billion yen for oil)

(3) Increasing Oil Stockpile

To further increase oil stockpiles, a 90-day civilian supply of oil reserves will be built up and maintained and auxiliary sources will be augmented. Also, for national stockpiles, construction of an oil storage facility having a 30-million kiloliter capacity by the JPDC will continue to be encouraged. Furthermore, to improve the stockpile of LPG (liquefied petroleum gas), oil stockpile systems will be altered and necessary auxiliary measures will be taken.

(Budget)

Special allocations for coal and oil and alternate energy sources

Of allocations for oil and alternate energy sources

Funds to defray interests on investments to increase civilian storage facilities	49.876 billion yen (16.621 billion yen)
Construction of national storage facilities (JPDC investment)	81.3 billion yen (50 billion yen)
Tanker stockpile facilities (JPDC grant, auxiliary fund)	94.775 billion yen (63.526 billion yen)
Joint LPG stockpile company investment	807 million yen (0)
Funds to defray interest on investments to increase LPG storage facilities	308 million yen (0)
Grant for purchase of oil storage facility sites	13.103 billion yen (8.554 billion yen)

[redacted]

(Financial Investments)

Oil stockpile JDB loans	20 billion yen (included in 53 billion yen for oil)
Oil enterprises Okinawa Corporation loans	9.3 billion yen (7.7 billion yen)
Funds to purchase crude oil for stockpile JPDC loans	552.4 billion yen (205.4 billion yen)
Establishment of joint oil stockpile company JPDC loans	26.6 billion yen (23.4 billion yen)
Funds to purchase tankers to stockpile crude oil JPDC loans	122.2 billion yen (327.5 billion yen)
LPG stockpile JDB loans	18.5 billion yen (0)
Funds to purchase LPG for stockpile JPDC loans	6.9 billion yen (0)
Establishment of joint LPG stockpile company JPDC loans	1.3 billion yen (0)

(4) Promotion of Oil-Related Technological Development

To appropriately cope with the increase in heavy crude oil supply and demand for light petroleum products, research and development will be promoted regarding technology to fractionate heavy crude oil and to effectively utilize heavy crude oil residues.

Technological development will be advanced to develop and utilize new fuel oils such as synthetic alcohol from natural gas, oil sands, biomass energy, etc.

(Budget)

Special allocations for coal and oil and alternate energy sources

Of allocations for oil and alternate energy sources

Subsidy for technological research and development of heavy crude oil	7 billion yen (6.8 billion yen)
Technological development for effective utilization of heavy crude oil residues (subsidies, contract fees)	2.987 billion yen (0)
Technological development of new fuels (subsidies, contract fees)	5.481 billion yen (1.8 billion yen)

(Financial Investments)

Heavy crude oil measures JDB loans	1.7 billion yen (included in 53 billion yen for oil)

(5) Establishment of Effective Oil Distribution Channels

To insure smooth distribution of petroleum products within the country, regional offices of the Ministry of International Trade and Industry [MITI] will be augmented and accurate information, pertaining to distribution and consumption, will be gathered and disseminated to consumers.

(Budget)

Special allocations for coal and oil and alternate energy sources

Of allocations for oil and alternate energy sources

Investigation to establish effective oil distribution channels	1.297 billion yen (702 million yen)

(Financial Investments)

Measures to stabilize petroleum demand JDB loans	2.8 billion yen (0)

2. Procurement of Oil Alternative Energy Sources and Electric Power Generation Sites

(1) Alternative Electrical Sources

In order to replace oil as an energy source and to meet international demands to reduce oil electric power generation, coal and atomic energy power generation will be strongly encouraged and hydraulic and geothermal energy sources, which are Japan's valuable national assets, will be developed. In order to accomplish this, with respect to coal power plants, environmental safety measures for smoke disposal will be designed and with respect to accelerating conversion of oil to coal power plants, innovative measures will be planned to greatly assist the process. Furthermore, to increase safety in atomic power generation, inspection of atomic power plants, operational and administrative control systems, safety inspection mechanisms, fire and radiation prevention measures, etc will be greatly strengthened. Also, policies will be devised to deepen the understanding and cooperation of the people regarding atomic power generation.

(Budget)

Safety inspection supervision of atomic power plants (safety inspection, tests, supervision of operational control, etc)	245 million yen (213 million yen)

Atomic power plant administration	271 million yen (418 million yen)
Atomic power plants quality control inspection	20 million yen (0)
Guidance research on development of small hydroelectric plants	17 million yen (0)
Developmental research on hydroelectric power generation	32 million yen (43 million yen)
Survey to promote development of geothermal energy	39 million yen (38 million yen)

Special allocations to promote development of electrical power generation

Of allocations for electric power plant sites

Grants for emergency safety measures of atomic power plants	580 million yen (359 million yen)
Contract fees to test reliability of atomic power plants	11.558 billion yen (7.696 billion yen)
Subsidies to test earthquake-proof reliability of atomic power plants	1.820 billion yen (3.795 billion yen)

Special allocations to diversify electric energy sources

Contract fees to test disposal technology of smoke emission from coal power plants	2.859 billion yen (3.448 billion yen)
Contract fees to test dry-process desulfurization of coal power plants	796 million yen (1.25 billion yen)
Contract fees to test technology for high-efficient dust-gathering technology	80 million yen (0)
Contract fees for preliminary investigation of concentrated ash dumping ground for coal thermal power plant ash disposal center	375 million yen (104 million yen)
Contract fees for actual tests of COM [coal-oil-mixture] conversion of oil thermal power plants	3.178 billion yen (336 million yen)

Promotion of fuel conversion of existing oil thermal power plants (JDB loans)	3.5 million yen (0)
Subsidy for construction of coal thermal power plants	1.234 billion yen (3.45 billion yen)
Contract fees to test improved technology of light water reactors (technology to lower radiation etc)	1.255 billion yen (0)
Subsidy to develop support system for atomic power plants	1.301 billion yen (851 million yen)
Contract fees to improve safety codes of atomic reactors for power generation	1.355 billion yen (1.077 billion yen)
Contract fees to improve anti-earthquake safety codes	561 million yen (452 million yen)
Contract fees to survey and select potential sites for hydroelectric power plants	751 million yen (238 million yen)
Subsidy to develop medium-small hydroelectric power plants	2.133 billion yen (1.557 billion yen)
Subsidy, etc for actual tests of technological reliability of medium-small hydroelectric power plants	227 million yen (0)
Subsidy to investigate feasibility of promoting geothermal power plants	2.83 billion yen (2.597 billion yen)
Subsidy for survey, including drilling, for geothermal power plants	2.725 billion yen (2.398 billion yen)
Contract fees for actual tests for environmental safety of deep, large-scale geothermal power plants	2.622 billion yen (3 billion yen)
(Financial Investments)	
Hydroelectric power generation JDB loans	1.033 billion yen (included in 117.5 billion yen for energy diversification)

Geothermal power generation JDB loans	2.8 billion yen (included in 117.5 billion yen for energy diversification)
Coal thermal power generation JDB loans	41.1 billion yen (included in 117.5 billion yen for energy diversification)
Liquefied gas power generation JDB loans	60.2 billion yen (included in 117.5 billion yen for energy diversification)
Geothermal power generation Hokuto Corporation loans	3.1 billion yen (included in 49.8 billion yen for special allocation)
Conversion of oil fuel thermal power generation JDB loans	43.7 billion yen (0)
Development of atomic power JDB loans	15.7 billion yen (included in 115 billion yen for atomic power generation)
Atomic power plant apparatus JDB loans	176.1 billion yen (included in 115 billion yen for atomic power generation)
Facility to educate and train atomic power plant technicians JDB loans	4.2 billion yen (0)
Operational funds of Electric Power Development Co, Ltd	164.7 billion yen (149.5 billion yen)

(2) Encouragement of Electric Power Sites

In order to promote sites for electric power generation, including atomic power plants, measures will be taken, in accordance with the [electric power source three laws], to financially assist in the control and maintenance of orderly public facilities, to promote electric power source sites and to assist local government areas in which hydroelectric power plants are located, etc. Also, a financial grant system will be set up to assist areas surrounding atomic power plant facilities. Thereby, steps will be taken to improve the livelihood and the understanding of the people in the affected power site areas. To insure the necessary income for these various measures, the tax rate to promote electric power source development will be increased. Furthermore, to advance methodologies to evaluate environmental influences, surveys and investigations will be continued to assess and protect environmental safety.

(Budget)

Environmental survey of electric power source sites	27 million yen (23 million yen)
Investigations to advance methodologies to evaluate environmental influences on electric power source sites	37 million yen (22 million yen)

Special allocations to promote development of electric power source sites

Of allocations for electric power source sites

Grants for maintenance and control of public facilities	157.8 million yen (0)
Grants to promote electric power source sites	275 billion yen (0)
Grants to local government entities where hydroelectric power plants are located	350.1 billion yen (0)
Grants to sites of atomic power plant facilities	309 billion yen (0)
Grants to electric power source sites	42.814 billion yen (41.414 billion yen)
Contract fee to promote planning of electric power source sites	632 billion yen (451 million yen)
Subsidy to promote survey of electric power source sites	110 million yen (0)
Contract fee for promotional measures of atomic power plant sites	221 million yen (0)
Grants for public relations, safety measures, etc	860 million yen (829 million yen)
Subsidy for establishment and maintenance of atomic power public relations and training	487 million yen (385 million yen)
Contract fee for survey and evaluation of environment	1.019 billion yen (1.199 billion yen)
Subsidy for environmental survey of electric power source sites	160 million yen (160 million yen)
(Financial Investments)	
Formation of industrial complex for electric power source sites Regional Promotion and Maintenance Corporation	Included in 19.1 billion yen for formation of central industrial community (0)

(3) Measures To Transfer Okinawa Electric Power Co, Ltd to Civilian Control

In accordance with the cabinet decision of December 1979, measures concerning grants, capital decrease, etc will be taken to transfer the Okinawa Electric Power Co, Ltd to civilian control.

(Budget)

Measures to transfer Okinawa Electric Power Co, Ltd to civilian control	200 million yen (0)

Special allocations for electric power development promotion

Of allocations for diversification of electric power sources

Contract fees for actual tests of marine pumping technology for power generation	104 million yen (0)

(Financial Investments)

Electrical enterprises Okinawa Corporation loans	15.7 billion yen (included in 30 billion yen for industrial development)

3. Promoting Development of Alternate Energy Sources and Stable Energy Supplies

(1) Strengthen Coal Supply System

Strengthen assistance for drilling and development in accordance with the new overall energy development plan and develop overseas coal supply system through construction and promotion of the coal center.

Also, with respect to domestic coal, establish new coal policies.

(Budget)

Special allocations for coal and oil and alternate energy sources

Of allocations for oil and alternate energy sources

Subsidy to investigate possibility of developing overseas coal	482 million yen (220 million yen)
Subsidy for overseas geological structural surveys	366 million yen (200 million yen)
Overseas coal drilling loan enterprises (capital from "New Overall Energy Development Setup"]	5.136 billion yen (3.4 billion yen)

Liabilities guarantee funds of overseas coal development ("New Overall Energy Development Setup"]	2.177 billion yen (500 million yen)
Contract fee for basic designing of coal center	380 million yen (0)
Construction of coal center (JDB loans)	Of the total of 14.1 billion yen (3.759 billion yen included)
Of allocations for coal	
Subsidy to strengthen and maintain interior framework structures of coal mines	12.8 billion yen (10.389 billion yen)
Subsidy to insure coal mine safety (capital from "New Overall Energy Development Setup")	7.932 billion yen (7.069 billion yen)
Loan for plant and equipment investments of coal industries (outlay of "New Overall Energy Development Setup")	7.987 billion yen (3.531 billion yen)
Grant to promote sales of raw coal and mines	1.688 billion yen (2.025 billion yen)
(Financial Investments)	
Coal center JDB loans	1.1 billion yen (included in 12.5 billion yen for alternate energy use promotion)
Coal industry JDB loans	4.2 billion yen (included in 13 billion yen for miscellaneous loans)

(2) Promotion of Development and Use of Atomic Energy

To develop Japanese-type light water reactor, the 3rd-phase improvement standardization program will be started and through actual tests, practical applications of the light water reactor will be advanced.

In order to recycle nuclear fuels, construction of civilian reprocessing plants, ocean uranium recovery projects, uranium enrichment enterprise, adequate disposal measures of radioactive waste materials, etc will be promoted, in addition to which, surveys and research on the practical application of new-type reactors will be encouraged.

(Budget)

Administration of atomic power energy	271 million yen (418 million yen)
Of which, survey to improve standardization of atomic power generation	204 million yen (244 million yen)
Survey to make practical new reactors for power generation	46 million yen (21 million yen)
Measures to insure supply of nuclear fuels	42 million yen (42 million yen)
Measures to dispose of radioactive wastes	74 million yen (74 million yen)
Survey for temporary storage of spent nuclear fuels	35 million yen (22 million yen)

Special allocations to promote electric power source development

Of allocations for electric power source diversification

Contract fees for actual tests to improve technology of light water reactor	1.255 billion yen (0)
Contract fees for survey of multiple uses of light water reactors	77 million yen (0)
Contract fees for actual technological tests of second reprocessing plants	2.219 billion yen (2.011 billion yen)
Subsidy for establishing chemical method of enriching uranium	706 million yen (241 million yen)
Contract fee to develop recovery system of uranium from the ocean	396 million yen (0)
Contract fee to develop system for recovery of solid bodies in ocean reprocessing systems	416 million yen (0)

Of allocations for electric power source sites

Contract fee for actual safety tests of radioactive waste disposals	460 million yen (317 million yen)

(Financial Investments)

Nuclear fuels JDB loans	4 billion yen (included in 115 billion yen for atomic energy)
Reprocessing of spent nuclear fuels JDB loans	12 billion yen (included in 115 billion yen for atomic energy)
Loans for overseas uranium mining Metallic Minerals Industry Corporation	[included] in 2.3 billion yen ([included] in 1.7 billion yen)

(3) Promotion of Development and Use of LNG

To promote the importation of LNG, efforts will be made to assist in the drilling and development of natural gas and in the smooth operations of liquefying the gas. Efforts will be made, too, in expanding the use of LNG.

(Budget)

Special allocations for coal and oil and alternate energy sources

Of allocation for oil and alternate energy sources

Loans for drilling etc (JPDC loans)	118 billion yen (75 billion yen)
Liabilities guarantee funds (JPDC loans)	2.7 billion yen (1 billion yen)
Promoting importation of industrial use LNG (JDB loans)	Included in 14.1 billion yen (included in 375.9 billion yen)
Contract fee for importation of LNG gas for regional gas users	50 million yen (50 million yen)
Contract fee for survey of LNG demand trends	49 million yen (50 million yen)

(Financial Investments)

Promotion of industrial use of LNG	2.5 billion yen (included in 12.5 billion yen for promotional use of alternate energy sources)
Conversion to LNG (JDB loans)	4 billion yen (included in 117.5 billion yen for energy diversification)
Facilities to receive liquefied gas JDB loans	32.4 billion yen (included in 82 billion yen for pollution prevention)

Supply of natural gas supply Hokato Corporation capital	800 million yen (included in the total loan of 1.5 billion yen)

(4) Promotion of Development and Uses of Local Energy

To meet the demands of regional communities, promote the development and uses of hitherto-untapped domestic energy sources by undertaking basic surveys, commercialization steps, public relations for dissemination, etc. of local energy sources.

(Budget)

Special allocations for coal and oil and alternate energy sources

Of allocations for oil and alternate energy sources

Subsidy for survey to develop and use local energy sources	240 million yen (180 million yen)
Subsidy for feasibility study of developing, utilizing and commercializing local energy sources	225 million yen (0)
Subsidy for establishing a modern enterprise in developing and using local energy sources	2 billion yen (0)
Contract fee for actual tests to develop and use local energy sources	521 million yen (0)

(5) Promotion of Technological Development of Alternate Energy Sources

To aggressively advance technology to develop alternative sources including coal uses such as coal liquefaction, gasification, COM [coal-oil-mixture fuel], etc, solar heat, light beam power generation, geothermal energy, hydrogen energy, etc.

Also, to establish a "New Overall Energy Development Setup" as the nucleus for promoting development of alternative energy sources.

(Budget)

Special allocations for coal and oil and alternate energy sources

Of allocations for oil and alternate energy sources

Development of coal liquefaction technology

Sunshine coal liquefaction	10.001 billion yen (3.05 billion yen)
SRC-II coal liquefaction	22.02 billion yen (7.466 billion yen)
EDS coal liquefaction	1.168 billion yen (407 million yen)
Subsidy for technological development of coal high calorization	2.871 billion yen (2.973 billion yen)
Subsidy for technological promotion of coal uses (COM, fluid base, etc)	5.6 billion yen (2.836 billion yen)
Subsidy for development of deep subterranean hot water supply system	717 million yen (262 million yen)
Subsidy for development of hydrogen producing plant	552 million yen (0)
Subsidy for development of applied technology related to alternate sources	4 billion yen (2.4 billion yen)

Special allocations for promotion of electric power sources development

Of allocations for diversification of electric energy sources

Contract fee for development of gasification technology of low calorie coal	2.43 billion yen (1.7 billion yen)
Subsidy for development of practical application of solar ray power generation	4.5 billion yen (1.311 billion yen)
Subsidy for research and development of solar heat power plant	1.14 billion yen (6.423 billion yen)
Subsidy for actual tests, survey, etc of geothermal energy sources	1.095 billion yen (539 million yen)
Subsidy for development of power plant utilizing heated water	677 million yen (357 million yen)
Subsidy for development of large-scale wind power generation plant	500 million yen (0)
Subsidy for development of new electric power generation technology	500 million yen (0)

4. Promotion of Energy Conversion

To promote energy conversion to coal, LNG, etc for industrial uses, finances, tax measures, etc would be liberalized.

(Budget)

Special allocations for coal and oil and alternate energy sources

Of allocations for oil and alternate energy sources

Loan to Japan Development Bank (loan to promote use of alternate energy sources)	14.1 billion yen (3.759 billion yen)

(Financial Investments)

Conversion to coal JDB loan	36.4 billion yen (included in 12.5 billion yen for promotion of alternate sources)
Promotion of import of industrial-use LNG JDB loan	2.5 billion yen (included in 12.5 billion yen for promotion of alternate sources)
Conversion to LNG JDB loan	4 billion yen (included in 117.5 billion yen for energy diversification)
Loan to alternate energy sources Small Business Finance Corporation	Other--included in the total figure of 136.5 billion yen (0)

(2) Promotion and Dissemination of Solar and Gas Cooling Systems

To promote dissemination of the solar system (apparatus using solar heat for cooling and supplying hot water), measures will be strengthened to provide low-interest loans to private homes and business enterprises and financial aid to public facilities.

Also, plans will be made to import LNG and disseminate gas cooling systems to ease the problem of peak uses of electric power during the summer.

(Budget)

Special allocations for coal and oil and alternate energy sources

Of allocations for oil and alternate energy sources

Subsidy, etc for promotion and dissemination of a solar system	9.593 billion yen (5.341 billion yen)

[redacted]

Promotion and dissemination of a gas cooling system (JDB loan)	Included in the figure of 14.1 billion yen (0)

(Financial Investments)

Promotion and dissemination of a gas cooling system JDB loans	7 billion yen (0)

5. Encouragement of Energy Conservation

To aggressively encourage conservation in the energy-consuming fields of industries, national livelihood and transportation, measures will be taken to rigidly apply rules controlling the sound uses of energy, to conduct public relations, education and information dissemination on energy conservation and to adopt steps to encourage the importation of energy conservation devices. Also, plans will be pushed for research and development on energy conservation technologies.

(Budget)

Public information activities concerning resources and energy conservation	136 million yen (125 million yen)
Promoting rational energy utilization	187 million yen (138 million yen)

Special allocations to promote development of electric power sources

Of allocations for diversification of electric power sources

Contract fee for research and development of high performance gas turbines	4.701 billion yen (3.504 billion yen)
Subsidy for technological development of new-type battery power storage system	419 million yen (301 million yen)
Subsidy for research and development of technology to generate power from fuel batteries	101 million yen (0)

Special allocations for coal and oil and alternate energy sources

Of allocations for oil and alternate energy sources

Contract fee for research and development of technological system to utilize waste heat	783 million yen (850 million yen)

(Financial Investments)

Effective uses of energy JDB loan	35.1 billion yen (included in 23 billion yen for resources and energy conservation)
Loan for energy conservation Smaller Business Finance Corporation	Included in miscellaneous loan of 136.5 billion yen (included in miscellaneous loan of 75 billion yen)
Loan for energy conservation People's Finance Corporation	Included in miscellaneous loan of 150.5 billion yen (included in miscellaneous loan of 137.5 billion yen)

6. Promotion of Energy-Related Plant and Equipment Investments

To adequately cope with the severe energy crisis and to strongly support new energy countermeasures through industrial plant and equipment investments, special means will be resorted to such as to create an "overall tax system to promote energy resources" (temporary name) which includes the triad of procuring a stable oil supply, developing alternate energy sources and encouraging energy conservation measures.

(Financial Investments)

Energy resources JDB loans	609.2 billion yen (321 billion yen)

7. Promotion of Energy Communication

In response to their increasing interest and to obtain their understanding and cooperation regarding the energy problem, communication will be widely promoted with the nation's people. Aggressive steps will be taken as follows: draft a white paper on energy; undertake public information, education and dissemination activities concerning energy conservation through an energy center (juridical); conduct public relations activities concerning alternative energy sources through the new "energy promotion foundation" (juridical); sponsor public address activities to gain support for electric power source sites; disseminate information concerning oil through the regional offices of the MITI, etc.

(Budget)

Public information activities concerning resources and energy conservation	136 million yen (125 million yen)

Special allocations for coal and oil and alternate energy sources

Of allocations for oil and alternate energy sources

Contract fee for basic survey to promote education concerning alternate energy sources	46 million yen

Special allocations for promotion of electric power development

Of allocations for electric power source sites

Contract fee to formulate plans to promote electric power source sites	632 million yen (451 million yen)
Subsidy for survey to promote electric power source sites	110 million yen (0)
Grants for public information and safety measures	860 million yen (829 million yen)

8. Insure Stable Supply of Natural Resources

(1) Promotion of Mineral Resources Development

To insure a long-range and stable supply of mineral resources, prospecting for domestic and overseas ore deposits will be encouraged and survey and mining technologies of ocean floor manganese modules will be developed.

Also, through stockpiling of copper, lead, zinc and aluminum, imports will be stabilized and the operations of the minerals industry will be placed on a firm basis.

(Budget)

Wide-ranging geological structural survey	891 million yen (865 million yen)
Detailed geological structural survey	1.057 billion yen (1.005 billion yen)
Survey for new mineral deposits	1.464 billion yen (1.402 billion yen)
Basic survey for overseas mineral resources	787 million yen (707 million yen)
Status survey of mineral resources on deep ocean floor beds and survey to develop probing techniques	1.579 billion yen (1.105 billion yen)

Research and development of large-scale industrial technologies

Development of recovery system of manganese modules	75 million yen (0)
Stockpiling of nonferrous metals to stabilize imports	345 million yen (476 million yen)
Operational funds for Metallic Ore Industry Enterprise Group [MOIEG]	622 million yen (574 million yen)
Basic survey enterprises for cooperative resources development	2.150 billion yen (1.802 billion yen)

(Financial Investments)

Loan for domestic drilling	MOIEG	3.6 billion yen (2.2 billion yen)
Loan for overseas drilling	MOIEG	2.3 billion yen (1.7 billion yen)
Stockpiling of nonferrous metals to stabilize imports	MOIEG	2.54 billion yen (1.15 billion yen)
Capital loan to stabilize metallic ore industries	MOIEG	12.5 billion yen (9.7 billion yen)

(2) Promotion of Water Resources

Increase aid to enterprises using water for industrial purposes and to stabilize the supply of industrial-use water. Also, to meet the pressing demands for water in recent years, promote efforts to produce water and to rationalize the application and use of water.

(Budget)

Measures to insure water supply for industrial use	149 million yen (145 million yen)
Public water works for industrial purposes	14.739 billion yen (15.259 billion yen)
Subsidy to Water Resources Development Corporation (National Land Agency figures)	5.957 billion yen (5.178 billion yen)
Subsidy for industrial water works for Okinawa (Okinawa Development Agency figures)	2.454 billion yen (2.126 billion yen)

Measures to promote water production	216 million yen (165 million yen)
(Financial Investments)	
Effective uses of water resources JDB loans	4 billion yen (included in 23 billion yen for resources and energy conservation)
Promotion of machinery and equipment to conserve water JDB loans	8 million yen (0)

Part 2. Road to Technological Nation

Technological renovation is the motivating power of social development and creates opportunities for new developments.

As we welcome the 1980's, we are faced with the tasks of maintaining social vitality and improving the quality of the people's lives, despite energy restrictions, but as an effective solution, great expectations are placed on technological developments. Japan's goal for the 1980's is the creation of a technologically independent country.

In particular, for Japan which was heavily dependent on technological imports from advanced countries to become one of its members, to become a technologically independent country in the 1980's, it must focus on the mastery of energy technology which will create next-generation industries and overcome energy handicaps. At the same time, while utilizing to the maximum the potentials of governmental and nongovernmental assets, Japan must develop innovative, creative technology and become the world's leading technological leader.

In view of the foregoing, the following policies will be aggressively pursued.

1. Promotion of Fundamental Technological Development Aimed at Creation of Next-Generation Industries

In order for Japan to follow the path of a technological country, it must fully muster the forces of government and civilian organizations to concentrate on the research and development of basic-level industrial technology which has lagged behind various western countries. Japan must basically develop and strengthen the fundamental technologies related to new materials (fine ceramics, functional polymers, etc), biotechnology, new functional elements, etc which will become indispensable in the establishment of next-generation industries expected to flourish in the 1990's. A "next-generation research and development of basic industrial technology" (temporary name) should be organized to actively utilize civilian potentials under an organized effective developmental system.

(Budget)

Research and development of next-generation basic industrial technology	5.183 billion yen (0)

2. Promotion of Energy Technological Development

(1) Promotion of Sunshine Plan, Etc

The Sunshine Plan will be aggressively pushed to enable the early contribution to Japan's supply of new energy sources such as solar, geothermal, coal and hydrogen sources.

While actively utilizing the energetic and creative efforts of civilian counterparts, a subsidy system to encourage technology which will develop alternate energy sources will be established. Particularly, the practical application of new power generation technology will be supported.

(Budget)

Research and development of new energy technology	7.33 billion yen (7.122 billion yen)
Solar energy	2.395 billion yen (1.76 billion yen)
Geothermal energy	1.802 billion yen (2.002 billion yen)
Coal energy	925 million yen (819 million yen)
Hydrogen energy	468 million yen (502 million yen)
Overall research	922 million yen (551 million yen)

Special allocations for promotion of electric power source development

Of allocations for diversification of electric power sources

Technological development of coal liquefaction	2.43 billion yen (1.7 billion yen)
Technological development of geothermal energy	6.99 billion yen (5.742 billion yen)
Technological development of solar energy	5.64 billion yen (7.734 billion yen)
Overall research	500 million yen (0)
Subsidy to develop applicability of new power generation technology	500 million yen (0)

Special allocations for coal and oil and alternate energy sources

Of allocations for oil and alternate energy sources

Technological development of coal liquefaction	12.872 billion yen (6.033 billion yen)
Technological development of geothermal energy	717 million yen (262 million yen)
Technological development of solar energy	240 million yen (51 million yen)
Technological development of hydrogen sources	552 million yen (0)
Subsidy to develop applicability of alternate energy technology	4 billion yen (2.4 billion yen)

(2) Promotion of Moonlight Plan

To strongly promote conservation in industrial processes utilizing energy, development of large-scale as well as innovative and fundamental technologies will be encouraged, but simultaneously, the Moonlight Plan will be strongly pushed as part of the plan to promote research and development within the civilian sector.

(Budget)

Research and development of energy conservation technology	3.383 billion yen (3.121 billion yen)
Technological system to use waste heat	127 million yen (173 million yen)
MHD power generation	651 million yen (1.322 billion yen)
High-efficiency gas turbine	1.017 billion yen (728 million yen)
New-type battery power storage system	250 million yen (51 million yen)
Fuel battery power generation system	263 million yen (0)
Innovative, fundamental energy conservation technology	250 million yen (202 million yen)
Software technological survey of energy conservation	21 million yen (9 million yen)

Aid to energy conservation technological development	625 million yen (467 million yen)
Standardization of energy conservation	62 million yen (57 million yen)

Special allocations for promotion of electric power source development

Of allocations for diversification of electric power sources

High-efficiency gas turbine	4.701 billion yen (3.504 billion yen)
New-type battery power storage system	419 million yen (301 million yen)
Fuel battery power generation system	101 million yen (0)

Special allocations for coal and oil and alternate energy sources

Of allocations for oil and alternate energy sources

Technological system to use waste heat	783 million yen (850 million yen)

3. Promotion of Large-Scale Projects

To develop leading, far-reaching industrial technologies, which are significant and urgent from the national economic standpoint, a large-scale project system will be used and research and development will be promoted through close co-ordination of the government, industrial circles and the academic world.

In 1981, research and development of two projects, the new manganese module mining system and the high-speed S&T calculating system, were started while research and development of seven on-going projects were continued.

(Budget)

Research and development of large-scale industrial technology	14.235 billion yen (13.534 billion yen)
New projects	
Manganese module mining system	75 million yen (0)
High-speed S&T calculation system	75 million yen (0)
On-going projects	
Manufacturing olefin from heavy crude oil	3.417 billion yen (2.436 billion yen)

Aircraft jet engine	2.01 billion yen (2.063 billion yen)
Technological system to reprocess resources	1.557 billion yen (2.543 billion yen)
Duplicative production system using high performance radar	2.88 billion yen (2.825 billion yen)
Calculation control system using light beams	2.527 billion yen (927 million yen)
Manufacturing basic chemical products using carbon monoxide	951 million yen (49 million yen)
Producing oil from ocean floor beds	4.903 billion yen (3.183 billion yen)

4. Strengthening Technological Development

To encourage technological development in the civilian sector, a system will be devised to effectively utilize financial aids for research and development of important technologies and to establish a financial loan system to commercialize new technologies.

Also, further strengthen the leading research and development projects of national laboratories and research organs.

(Budget)

Research and development of important technologies	2.762 billion yen (2.762 billion yen)
Special research of laboratories	4.947 billion yen (4.933 billion yen)

(Financial Investments)

Promotion of domestic technologies JDB loans	50 billion yen (48 billion yen)
Loans to commercialize new technologies Smaller Business Finance Corporation	Included in the miscellaneous loan of 1.365 billion yen (included in the 75 billion yen miscellaneous loan)

5. Promotion of Social System and Technological Development for the People's Social Welfare

To promote the advancement of the people's welfare and as part of a social system which contributes to the building of attractive communities, permanent residence [machinery] system and healthcare network systems, which are requirements to establish permanent residencies in outlying areas, will be developed and encouraged. Also, from the standpoint of creating a society with full social benefits, technological development of medical and social welfare equipment which cannot be rapidly developed by civilians will be emphasized. In 1981, as part of the international project to assist the handicapped, research and development will be started of industrial-use social welfare apparatus which will create labor opportunities and meaningful lives for the handicapped.

(Budget)

Development of permanent residency machinery system	378 million yen (21 million yen)
Development of healthcare network system	284 million yen (222 million yen)
Research and development of medical and social welfare equipment technologies	1.001 billion yen (895 million yen)

Special allocations for coal and oil and alternate energy sources

Of allocations for oil and alternate energy sources

Contract fee for developmental and planning survey of community energy system using alternative energy sources	321 million yen (41 million yen)

9134
CSO: 4105

ENERGY CONSERVATION EFFORTS, NEW ALTERNATE ENERGY SOURCES

Major Industries' Programs

Tokyo KEIZAI TEMBO in Japanese 1 Sep 80 pp 5-65

[Article: "Progress Report on Major Industries' Conservation Programs"]

[Excerpt] Japan Is the Leading Country Involved in "Energy Conservation"

Needless to say, it was "oil" which played the principal role in sustaining Japan's high degree of economic growth. In fact, there is some tendency to refer to today's Japan half cynically as the "country floated by oil." Now this oil is about to become a very important strategic product in the very near future, and chronic shortages are about to set in. Development of new energy to replace oil is being actively promoted, but the earliest date such efforts can be expected to materialize is at the start of the 21st century, and there is no recourse until that time but to bite hard into energy conservation. This is the vaguely apprehensive situation which has evolved.

Disengagement From Oil Is Top Command to Japan

Energy specialists both in Japan and elsewhere have been sounding the alarm that "the oil which had a principal role in sustaining human standards of living will be burned away in a little over a dozen years." They also say "the oil demand and supply picture within 10 years or so will be a major reduction in supply, and oil will be short." In the particular case of Japan which is a resourceless country depending on imported foreign oil for three-fourths of its energy, the oil shock of the end of 1973 served to normalize the country.

The reason it is felt that oil will soon become short in supply is the known oil reserves which are discovered every year have not kept up with the world's oil consumption. The Long-Term Energy Vision Research Committee which is the inquiry organ of the Director of the Conservation of Energy Agency in the Ministry of International Trade and Industry predicts that the peak in oil production will come somewhere between the end of the 1980 decade and the early part of the 1990's. Furthermore, there is the question of when the Middle East countries, which produce more than two-thirds of the oil, excluding the communist countries, will shift to a policy of retaining their oil, and such a policy can result in reduced oil production at an even earlier stage.

What will befall Japan if such a situation should materialize? According to the projections of the Advisory Committee for Energy (inquiry organ of the Ministry of International Trade and Industry) compiled in June 1977, there will be need to import more than 500 million Kl of oil in 1985 as long as Japan takes no drastic actions to cut back on oil consumption, and the assurance of such a volume is difficult to say the least. This is why this committee proposes energy conservation of 10 percent of the total energy consumed.

At the same time, it was decided at the Venice Summit this past May to lower the elastic rate of energy consumption versus GNP growth rate (ratio of rate of increase in energy consumption to economic growth) to 0.6 percent as a long-term goal and to lower the fraction of primary energy contributed by oil to 40 percent. It was further decided that greater effort should be put into the development of alternate energy and increase the contribution of alternate energy to between 15 and 20 million barrels (1 barrel = 159 liters) equivalent per month within 10 years, and agreement was reached between the leaders of the leading countries.

On the other hand, attainment of this target is considered very difficult for Japan to achieve because its fraction of energy consumption attributable to oil is particularly high. This fraction averages about 45 percent for the whole world, but only Italy and Japan among the leading countries use more than 70 percent. In Japan's situation, its domestic oil production was about 700,000 Kl (1976) which contributed but 0.2 percent of the country's needs. Even when the oil produced by independent development of Japanese industries in overseas locations was added in, only about 9 percent of the necessary volume was produced. In order to cover this shortage, Japan has to import 99.8 percent of the oil it needs from overseas.

Another difficulty is the polarization in the import sources. When the oil imports in 1976 are considered according to locale, the Mid-East countries supplied 80 percent, Southeast Asia 17 percent, and the African continent 3 percent showing the overwhelming reliance on Mid-East oil. Now, these Mid-East countries are in constant turmoil politically, and the higher oil price policy of OPEC (Organization of Oil Producing Countries) is continually pushing the price of oil upwards. The fraction of total import value taken up by oil was 16 percent about the time of the first oil shock, but the outlay for oil presently accounts for about 40 percent. In addition, there has been no increase in volume of oil imported since 1973, and the actual volume imported in JFY 1979 was 17 million Kl. The same level is expected to be maintained during 1980.

This situation clearly shows that Japan's energy supply can be put into a state of ready confusion by movements of the supply side be it by locale or by the degree of dependency.

Advent of the Third Oil Shock

Such being the case, is there no possibility that any new fields will be developed in profusion and the world's oil supply will increase?

There has been considerable spread in the ultimate oil reserves (the amount man can recover) estimated by specialists. Very recently, however, these estimates have settled down at about 2 trillion barrels (320 billion Kl) and 1.5 trillion barrels (240 billion Kl) if the communist bloc is excluded. Mr J.D. Moody (former vice president of Mobil Oil) who is said to be a most authoritative man on this problem stated in a 1975 report that 297 billion barrels out of this 2 trillion barrels have already been produced and there are 740 billion barrels of recognized reserves left. Consequently, there should be 964 billion barrels yet to be discovered.

On the other hand, it is the general opinion that the greater part of these undiscovered 964 billion barrels lies in the ocean areas and the polar regions where the natural environment presents an extreme challenge. Such being the case, some time will be required before the necessary test borings are made and the reserves established before production from these sources can start.

There is a saying among the specialists that "Saudi Arabia will take care of the balance of the world's oil needs from here on." This is because the reserves and production volume of the free country sphere except Saudi Arabia are at highly different levels.

The present production of oil from the giant of oil producing countries Saudi Arabia is about 3.4 billion barrels. It also has established reserves of about 100 billion barrels. If the present production level is maintained, its oil reserve will be depleted in about 33-34 years. Now, should this duration be 20 years or less than 30 years, there will be some instability to maintaining production at this present level.

The net effect will be increasing possibility of production controls or reduced production. To be sure there are many more oil fields being discovered in Saudi Arabia compared to other oil producing countries, and it is the general feeling that its production life will actually be somewhat longer.

It is said that thinking along the lines of resources preservation on the part of oil producing countries or the maintaining of price levels is becoming stronger in the Saudi mind. Take the example of Kuwait which is said to possess the top class oil field at Bulgan. It had been producing 35 million barrels a day from a country with but a little under 1 million when it found it was approaching the oil recovery period of 35 years, and it dropped its production so that now it is said to produce just half of what it had produced before. It has selected a road in which it will use up its oil at a slower pace and extend its period of production in this manner. There is no guarantee that Saudi Arabia will not follow the same path as well.

Professor Fumitaro Tomizuka of the Tokyo Economic University stated, "There is increasing clamor to drop the production to 45 or 60 million barrels from the present 90 million barrels per day on the part of Saudi Arabia to establish its economy and other needs. The remaining 40-50 million barrels will be produced according to the demand from the oil consuming countries. Is it not expecting too much to hope that this condition can continue over a long period?" He added further, "Should Saudi Arabia undergo a major change in policy with respect to oil production, will this not herald the arrival of the third oil shock?"

Substitute Energy Whose Expectations Run Ahead of Fact

Certainly, this is also a byproduct of this second oil shock. This byproduct is the economy in oil and the turn to other energy. President Masao Mukaizaka of the Japan Energy Economic Research Institute had this statement to make with regard to this situation: "Since the price of oil went up several notches, everyone is economizing on its consumption, and conversion to any other forms of energy is being attempted. In this manner conservation of energy had made considerable advance."

The group which is working most feverishly in this direction is the production world which consumes 57 percent of the energy. When the subject of conservation of energy comes up, there is a strong impression of "protection," and there is the tendency to think less of developing technology for new forms of energy. According to calculations performed by specialists along this line, assuming a 1 percent saving in the energy consumption of JFY 1975, an equivalent of 3.9 million Kl would have been saved. If one is to now develop an oil field with this level of production, several hundred million dollars will be required. In other words, conservation of energy has this very great effect.

In another direction, energy conversion is presently being promoted rather actively. This is exemplified by the switchover to nuclear power, coal, and liquefied natural gas (LNG). According to the long-term provisional energy demand and supply estimates compiled last year by the Advisory Committee on Energy which is the inquiry organ of the Ministry of International Trade and Industry, nuclear power production is expected to grow from the present 150 million KW to a five-fold increase of 640 million KW after 15 years in 1995. A goal of 7-8 fold increase in the use of coal has been envisioned over the same 15-year period. On the other hand, nuclear power is still saddled with the problem of safety, and the siting problem is the most perplexing in the world. Furthermore, the price of nuclear fuel and the disposal of spent fuel are becoming problems, and the economics thereof are also coming under fire.

A certain top echelon man of Tokyo Electric Power said, "Even when we talk about promoting conversion to alternate energy such as nuclear power and coal, time is required to make this conversion, and this conversion cannot be made overnight. When one thinks along this line, oil is a must. Until the conversion to alternate energy can be made, we need to put forth all effort to stabilize the situation in the Mid-East to assure ourselves a fixed, stable supply of oil at least for the 1980's." He pointed out the importance of oil in this manner.

On the other hand, interest in coal has been on the increase in Japan over the past several years, and the number of companies setting out on the development of coal for general use in foreign countries such as Australia has increased. At the same time, the power companies are looking anew at the construction of coal-fired thermal power plants. It is said that there are still 10 times the known reserves of coal compared to oil. According to data compiled by the World Energy Council, there is roughly 10.8 trillion tons of coal reserves in the world, and 1.4 trillion tons has already been established. Out of this total 600 million tons can be mined economically. If the present rate of consumption (about 3 billion tons per year) were to be maintained, there is sufficient coal to last us another 200 years.

On the other hand, the fact that a coal-fired thermal power plant is to be constructed does not necessarily ease the siting problem compared to nuclear power. This is because the environmental and transportation problems become major bottlenecks. This is why liquefaction of coal is being attempted to provide a clean form of energy from coal. On 1 August, construction of a plant to house the so-called SRC II process which is a joint project of Japan, the United States, and West Germany was started in the state of West Virginia in the United States. It will be some time in the future when coal can be converted to an alternate form of oil just as the name of the process implies.

In addition, energy utilization technology along the lines of solar, geothermal, and wind power energy is being researched under the large project title the "Sunshine Project," and considerable success has already been achieved. On the other hand, any real progress is not anticipated until the "start of the 21st century," according to the consensus of the experts.

Ministry of International Trade and Industry Also Pushes Conservation of Energy

While all this is being said and done, there is need to hurry this conversion from oil. While it may be said that energy conservation measures are being promoted by industry, these efforts presently are limited to improvements in operational areas where little money is involved or in small-scale projects such as the reuse of hot waste water. The mixed combustion of oil and coal now being introduced by the cement industry in which large investment was made to bring about major changes in the production process is an example of a major conversion effort. There is an increasingly strong voice being heard from the industrial ranks that "there is need for tax credits for investment."

Spurred by such movements, the Ministry of International Trade and Industry is proposing to come forth in the next JFY with a "Comprehensive Energy Countermeasures Investment Tax Reduction" plan. This plan proposes a 10 percent reduction in the tax on investments directed at energy conservation, alternate energy, and oil stockpiling. According to the calculations of this ministry, the investments are expected to total 3 trillion yen of which 300 billion yen will be tax exempt. It will be interesting to note whether the tempo of conversion to energy conservation will be speeded up by such measures.

As mentioned before, there is a trend to evaluate the industrial world's energy conservation countermeasures as being fairly well advanced. "The thermal efficiencies of the automobile engines and thermal power plants are the tops in the world. At the same time, the steel industry has put all out effort in heat control, and their efforts already are said to be at their technological limits. Any problem areas will probably be in the plants of medium and small industries and business buildings where thermal control may not yet be up to par with the large industrial buildings. This is an area where the government or administration can play a major role." (Professor Hirata of the University of Tokyo.) This is how some experts view the situation.

In any event, energy conservation is a subject which cannot be avoided in an age when oil will disappear. Even though it may be said that the results of the industrial world are progressing in an orderly manner, there is need for greater efforts including the private sector as well. "It would be possible to realize economy of the scale now being practiced by nuclear power generation." In this manner, it seems that even greater developments are possible as long as the investment and technology are provided.

"Steel Industry"

President Saito of Nippon Steel Corporation came forth to push energy conservation and disengagement from oil to the foreground. He stated "As industry becomes this large, it no longer can conduct business under an uncertain oil situation. The energy conservation policies put into effect after the first oil shock in 1973 were fairly fruitful and these efforts should be extended still further. When one refers to the steel industry, he is discussing a large oil consuming industry which belongs to the extreme right wing of the industry. Disengagement from this position is a fight on which the industry's life or death may depend." Attention was directed to this situation.

President Eijiro Saito of Nippon Steel Corporation has been living a life of ease since this spring. This is because all the large steelmaking companies except for Nippon Kokan have been experiencing the most profitable periods in their history (the previous 3 months). As is well known, President Saito is the leader of this industry (president of the steelmaker's alliance), and this good record on the part of the steel industry is very rewarding to him.

The "main role" of this favorable record is directly the increase in export values which took place in an orderly manner, but there is another phase which should not be overlooked which is the "energy conservation" and "disengagement from oil strategy." Looking at the actual cost savings realized by the various steelmaking companies led by Nippon Steel during the year of 1979, Nippon Steel reduced costs by 30 billion yen, Nippon Kokan 20 billion yen, Sumitomo Metal Industries 34 billion yen, and Kobe Steel 16 billion yen, and all these companies realized a high level of savings. A rough estimate of the savings realized by these 5 companies totals 100 billion yen. The effect of this industry's efforts to improve its picture should be evident.

These efforts at energy conservation and disengagement from oil were started immediately after the first oil shock at the end of 1973. As a result, fuel oil consumption was reduced to 49 percent during the 6 years which followed. The oil consumption of 134.6 million Kl in JFY 1973 was lowered to 66.7 million Kl in JFY 1979.

This disengagement from oil seems to be progressing still further during JFY 1980. According to figures released by the Japan Steelmakers' Alliance, the volume of crude oil used by the blast furnace makers will be lowered about 35 percent from that of JFY 1979, and this can be reduced to one half by limiting the use of oil to blowing into the blast furnace. This is also a reduction of more than 30 percent in the consumption of oil-resembling fuels such as lamp oil, light oil, and LNG (liquefied natural gas).

With this actual record in his background, President Saito said, "We are now entering a period when this disengagement from oil is going to have a large effect even in terms of economics. This energy conservation move itself is the foundation of the anti-OPEC strategy. The other industries should learn from the steel industry." He stated this with great fervor, and he plans to continue to preach the doctrine of energy conservation to other companies including the members of the steelmakers' alliance.

There are some who say that "this is an admission on the part of the steelmakers that they have been using energy recklessly in the past" according to a reverse explanation that is offered. On the other hand, all the steelmakers are not only enjoying great profit but this effect is eventually expected to diffuse out to other industrial worlds without doubt.

Savings Exceeding 160 Billion Yen

As everyone is aware, Mr Saito became president of Nippon Steel as "pinch-hitter" for former President Tasaka who had been revered as the prince of Nippon Steel before he died suddenly in January 1977. This was in the midst of a recession for the steel industry, and Saito started to introduce rational operation to the Kamaishi Steelmaking Plant and introduce efficiency into the entire operations of the company. He was able in the course of but 2 years to meet the obligations of Nippon Steel with but 70 percent operation.

What were most outstanding were the results attained in energy conservation and lowered costs. Following these effects through the years, the energy consumed per ton of crude steel produced at the time of the company's consolidation (March 1970) was 62 million kilocalories which was reduced to 56 million kilocalories for the first part of 1979. The first phase energy conservation plan put into effect in 1974 was aimed to "10 percent reduction," but this goal was realized during the first half of 1978, 2 years earlier than the initially anticipated date. The rate realized was 10.4 percent.

When one speaks of 1 percent of the energy consumed by Nippon Steel, he is talking about a quantity of oil greater than that carried by a tanker having a 200,000 ton capacity. Now 10.4 percent is 10.4 times the above volume, and this is equivalent to 65 million kl when converted to oil equivalent. This is equivalent to 9 days supply of oil for Japan.

Of the 10.4 percent that was realized, about half can be attributed to facilities improvements and the remainder to improvements in operating procedures.

It was initially estimated that about a 3 percent savings could be realized through improved operations, but the final effect was that this source was responsible for 5.7 percent and greatly exceeded the value (4.7 percent) achieved by the facilities.

The lowering in blast furnace fuel ratio stands out as an example of operational efforts. Fuel ratio in this case refers to the energy required (coke + crude oil) to produce 1 ton of pig iron. This is the index which is noted most carefully in energy conservation. This is because the blast furnace is the large energy consuming stage in which 70 percent of the 60 million kilocalories required to produce 1 ton of crude steel is consumed and 80 percent of this consumption is attributable to the blast furnace fuel ratio. In other words, a reduction of even 1 kilogram in this blast furnace fuel ratio is very effective as far as the energy conservation effect is concerned.

In the 1978 record of Nippon Steel, 4 of its blast furnaces headed by the Kimizu No 4 recorded reduction of 440 [sic] kilograms and even the average was 457 kilograms. This was the first time a reduction of more than 450 kilograms had been realized in Japan, and this event drew the attention of the industry.

At the same time, new effects have gradually been introduced into the steelmaking sector and the rolling mills, and the energy conservation effects in these areas during the past 2 years have been outstanding. In this manner, about 40 billion yen in plant investment was made for this first phase energy conservation plan, and the reduction in cost realized during this period was about 160 billion yen.

Eagerly Promote Rationalization of Facilities

On top of these results to date, Nippon Steel is presently in the midst of developing its second phase energy conservation plan intended to save another 9 percent by 1983. One stage of this plan is to develop an "oil-less steelmaking plant" where not one drop of oil will be used, and there has been some concrete steps taken in this direction already.

This plan involves complete elimination of oil blown into the blast furnace and operation simply with coke. This mode has already been put into operation at the No 2 blast furnace of Sakai Plant, No 1 blast furnace of the Kamaishi Plant, No 1 furnace of the Muroran Plant, No 3 furnace of the Hirohata Plant, and No 3 furnace of the Nagoya Plant. In this manner, 6 of 16 operating blast furnaces are now oil-less. They are all operating without mishap, and President Saito says, "We will try to convert all our other blast furnaces to this mode of operation as quickly as possible" in the basic plan he disclosed.

Should all the blast furnaces be converted into all coke operation, the next area to consider is elimination of the use of oil in the blooming and rolling processes. The half finished product is heated with crude oil in the blooming and rolling processes. If it were possible to utilize the heat in the steel ingot itself along with heat discarded from the blast furnace and conversion furnace and substitute for the use of oil, the oil-less steelmaking plant will become a reality.

In another direction, energy conservation countermeasures in the rolling mill area are being directed at cutting down on the rolling process. The major processes involved are (1) continuous casting, (2) direct transmission to rolling, (3) introduction of hot piece, and (4) continuous annealing, and major emphasis is on continuous casting. Continuous casting eliminates the uniform heating process fromthe blooming method used before involving steelmaking → blooming → uniform heating → rolling, and the processes from steelmaking through rolling are continuous. This will result in eliminating the heat required for uniform heating and the cooling following blooming.

Nippon Steel used but 20 percent rate of continuous rolling before the oil shock, but this rate was increased to 43 percent in 1979 by the expansion of its facilities, and it presently exceeds 50 percent. Since then the facilities at Nagoya, Sakai, and Oita have been completed (about 50 billion yen) and a start has been made at the Muroran Plant, and the company is pointing toward 70 percent in 1981. This is the process next to the iron making process as far as energy consumption is concerned, and even greater attention is being directed at speedup in this direction.

The establishment of technology to recover medium and low level waste heat is a problem that needs to be resolved in the future. To be sure, this type of technology development will require a long time and involve large-scale research and development as well as investment. Since Nippon Steel is accepting this challenge, there seems to be the feeling that the problem will be resolved. On the other hand, there seems to be no fixed goal for this research and development, and concerned people of the industry are stressing that "the industry is putting forth all out effort but the government should also help with the financing and give tax breaks so that this joint effort will promote the system."

Fresh Brainpower, Technological Laboratories

Nippon Steel has thus far been promoting comprehensive studies on its various steelmaking plants with regard to energy conservation, energy use situation, and economic countermeasures, and the net result has been that about 7 percent economy has been realized in its second phase plan considerably before the targeted date. The present estimate is that close to 9 percent economy will be possible by 1983.

The original plan targeted a saving of 14 million Kl crude oil per year worth 35 billion yen but this further increase in saving of 2 percent will cause an upward revision. Besides the installation of an energy countermeasure technology headquarters headed by Vice President Toyota, an energy engineering research center was established in the production technology laboratory. There is adequate organizational strength, and efforts are being successively directed at attaining the various goals.

This production technology laboratory plays an important role in the disengagement from oil strategy. Put into simple terms, it may be called the new "brains" of Nippon Steel. The top echelon of this production technology laboratory is the research headquarters which is staffed with the large complement of 2,500 people. Since research and development will be meaningless unless it eventually benefits the steelmaking plant, one of the features of this setup is that there are more project leaders who come from the ranks of the plant technologists rather than pure researchers.

Large project research is particularly important to industrial strategy and needs to be carried out as quickly as possible. To this end the technologists must be able to move both laterally and vertically. In the case of the aforementioned oil-less steelmaking promotion, the ideas coming from these technologists played very major roles in the fulfillment of the objective.

In any event, the steelmaking industry seems to have arrived at an age of "technology" above anything of the past. As President Saito said, "We will enter the 1980's on the wings of technological innovations" in describing the future. A close study shows that the steel industry is advancing by its technology while the informed say, "The steel industry may be classed as a knowledge gathering industry."

If one is to proceed along the path to disengagement from oil, it is only with the background compiled by the steel industry that such a course becomes possible. Nippon Steel will exploit this technological strength and abundant manpower which sustains its organizational strength along with its overwhelming sales strength to keep leading the world in matters related to steel. The position of President Saito in this industry is on its way to a higher level.

"Power Industry": Electric Power Development Company Puts Faith in Its Advent Into the 1980's Through Diversification

The depletion of oil resources is the impetus for the power industry to develop its strategy for independence from oil. This movement is particularly intense at Tokyo Electric Power where the entire company under the command of President Hiraiwa is completely engaged in introducing coal, LNG, and nuclear power into its operations. Needless to say, Tokyo Electric is the top power company, and its President Hiraiwa also ties together this industry as the chairman of the power industry alliance. He also has the important post of vice chairman in charge of energy in the Federation of Economic Organizations. It may be that President Hiraiwa's pride is driving Tokyo Electric in its intense disengagement from oil strategy.

Industrial Effort at Fuel Conversion

In the midst of worldwide efforts at "disengagement from oil" by the electric power industry, our electric power industry is directing major effort at the construction of purely coal-fired thermal power plants.

The 10 power companies (the 9 power companies and the Electric Power Development Company), according to published reports, are planning to increase power production from coal-fired plants from the present (as of the end of 1979) 37 million KW by 5.3 times 10 years later by the end of 1989 to 194.5 million KW.

Only a year ago, coal was considered "a dirty fuel which is not suited to Japan which has such strict environmental regulations." This was the concept that was indoctrinated into the construction of coal-fired thermal power plants, and this present situation represents a conversion of the power industry as the 1980 decade is entered.

The manner in which this shift to "coal heat" on the part of the power industry was decisively imprinted was when President Sotoshi Hiraiwa of Tokyo Power Development Company (chairman of the Electric Power Industry Alliance) announced at the 1979 annual report last May that "part of this company's thermal power production will be converted to coal."

Inasmuch as President Hiraiwa is the leader of the electric power industry, his clear stance is emphasizing "coal" as an alternative energy source for oil cannot help but have a major effect on the industry.

President Hiraiwa has also played a prominent part in the fiscal world having been active in the Japan Committee for Economic Development. He is presently vice chairman in charge of energy in the Federation of Economic Organizations and also spokesman for the electric power industry. His activities in many fields is common knowledge.

In order that the electric power industry smoothly convert from its present oil-fired thermal power plants to coal, boilers, denitrification equipment, desulfurization equipment, and dust removal facilities have to be modified or newly installed in the reclamation management that the government has decreed, and the time has come for Mr Hiraiwa to exploit his skills.

Specific plans in this direction are now under study at the Electric Power Industry Alliance, and it is planned to start off activating funds from the Development Bank. In this respect, the Resources and Energy Agency of the Ministry of International Trade and Industry has deemed this reclamation management necessary, and it plans to actively promote this policy during the next JFY.

The reason the electric power industry is leaning toward coal as though it has been struck in that direction is because this is the trend throughout the world. Japan has a record of very high dependence on oil, and it was told at the cabinet meeting of the International Energy Authority (IEA) last May to "make all efforts to reduce its dependence on oil-fired thermal power generation." This is the criticism that this country has been experiencing. This is why the leaning toward coal-fired plants is greater than most other countries.

Minister Sasaki (at that time) of the Ministry of International Trade and Industry who was present at this cabinet meeting transmitted this message to President Hiraiwa, and this has also been one of the impetus for the power companies' leaning to coal.

Fulfillment of Nuclear Power, LNG

In the midst of this changing situation in the energy picture, the statement was made that "the three pillars of alternative energy are nuclear power, liquefied natural gas (LNG), and coal, and we should energetically promote these nonoil sources of power development" (President Hiraiwa), and this is the basis of Tokyo Electric Power's disengagement from oil strategy.

Looking at the power sources makeup according to different types as proposed by this company (excluding power purchased from outside), oil-fired thermal plants will see their contribution decrease from the 41 percent as of the end of JFY 1979 to 31 percent in JFY 1984 and to 20 percent in JFY 1989. In this manner, there will be a large decrease in the absolute quantity.

In contrast, the contribution of nuclear power will increase from 15 percent to 18 percent and then to 25 percent. At the same time, the contribution of water power will increase from 11 percent to 15 percent in 10 years. This includes raised water power, and the ordinary water power contribution will decrease from 7 percent to 4 percent. The use of LNG and LPG (liquefied petroleum gas) will increase in power output slightly from 33 to 35 percent. Coal is expected to go from zero to 5 percent.

Among the above, nuclear power and LNG remain as "legacies" of the system of the late Ichiryu Kikawada (former president) which are test monuments to see whether the coal-fired plants which the Hiraiwa regime sponsors will succeed. Going in order, the power source picture where nuclear power and LNG is concerned shows the nuclear power plant picture as: the No 6 reactor starting operations and the Fukushima No 1 Nuclear Power Plant (Soba-gun, Fukushima Prefecture) being completed. From the time of its conception to completion it will take 20 years, and its total output will be 4.696 million KW.

Following this Fukushima No 1 is the No 2 nuclear power plant which is presently in the final stages of construction. This plant is located about 12 km south of No 1. It is sited on an area of 15 million Km^2, and it is comprised of 4 nuclear power plants capable of producing 1.1 million KW. The timetable for initiation of operations is the No 1 unit in 1982 and the No 2 unit in 1983.

As mentioned before, President Hiraiwa inherited this operational plan from his predecessor, the late Mr Kikawada, and he attacked this problem with earnest. This was because the cost of uranium fuel had dropped, and the power generation cost was lower than that of oil or coal. He has strong feelings for more nuclear power plant sitings but there is a civilian rank and file which has strong distrust of nuclear power, and the siting of these new reactors is a headache. It is said that this is why a new siting method not attempted before will be developed in the near future.

One of these methods is the introduction of the third sector mode in which the participation of the local people is subscribed for the power source development. It has been indicated that one of the reasons electric power source development does not proceed is the small profit that accrues to the local people.

This mode seeks to dissolve this opposition by requesting capital investment from the local governing organ, and planning this siting along with promoting the local welfare. Tokyo Electric is planning to locate its plant at Kashiwazaki in Niigata Prefecture, but it is also studying the possibility of cooperating with Tohoku Power to site power plants at Aomori Prefecture and Shimokita. It is now in the process of negotiations with the people concerned.

In another direction, maximum scale development is planned for LNG over the next 10 years. According to this plan, new power development capability for 92.8 million KW will be created over the next 10 years, and the output will be increased from the present 110 million KW to 193.9 million KW. As mentioned before, this source of energy will account for the top power production. Some specific sites are the No 1 and No 2 units at Ogishima in Kawasaki City (each with output of 1 million KW), No 1 and No 2 units at Tomizu in Chiba Prefecture (same output as above), and the conversions of present oil-fired power plants to LNG at Kawasaki and Yokohama.

There is need now for increased volume of LNG. LNG is presently imported from Alaska, Brunei, and Abu Dhabi. This will be augmented in JFY 1983 by import from Sarawak. The present import of 6.22 million tons per year is expected to be increased to 12 million tons in 1982 or almost double the present rate.

The advantages of using LNG to generate electric power are headed by its nonpolluting property. In addition, its price is expected to remain stable over a long period. Although its price is going up every year, it is cheaper calorie wise compared to crude oil or naphtha. These are all expected to keep power costs down.

Perfected System for Coal-Fired Thermal Power

Tokyo Electric is putting greater effort into the aforementioned coal-fired plant development compared to nuclear power or LNG. While formal applications for the sites have been made, they seem to be the three sites of the former Mito target range in Ibaraki Prefecture, North Ibaraki City, and Soma in Fukushima Prefecture. Of these three sites, the one under attack is the project proposed to be built on the former target range of the American forces at Mito. This involves construction of a million KW power plant, and this is synchronized with the Ibaraki Prefecture distribution harbor and bay plan, but the plans have not been finalized. The company seems to be planning initiation of operations of the No 1 unit in 1988, and it is presently awaiting the emergence of interested local parties.

Where Soma is concerned, Fukushima Prefecture is planning the Soma Industrial Development centered on Soma Port, and this power plant was the first phase of this plan. This will likely be a joint thermal power plant with Tohoku Electric Power. This power plant is expected to be of the 600,000 KW class. The remaining North Ibaraki City plan yielded priority to the Mito target range locale, and this site has not as yet been formally applied for. Should coal-fired plant plans for these 3 sites actually be realized, there will be 5-6 million KW available from coal-fired plants by 1990.

Where execution of these plans are concerned, President Hiraiwa said, "Pollution from coal-fired thermal power plants must be completely eliminated," thereby indicating his wish for complete control over the waste problem. This is certainly something to be noted. Last year Tokyo Electric had already undertaken jointly with Tohoku Power and Tokiwa Kyoka to utilize smoke from the Mochirai Power Plant to promote the development of a pollution prevention system.

In addition, it entered into joint development with the four boilermakers including Mitsubishi Heavy Industries, Hitachi Limited, Ishikawajima Harima Heavy Industries, and Kawasaki Heavy Industries for a new denitrification technology "intraboiler denitrification method." When oil or coal is thermolyzed at high temperature, there is a sudden voilent reduction process. This behavior is utilized to carry out direct reduction denitrification of NO_x within the boiler.

This is said to be a direct denitrification technology of which there is no other example in the world. In any event, Tokyo Electric which had been experiencing difficulties in greeting the "age of coal" achieved a major plus which is tied in with preventing environmental pollution. Without further ado, a pollution prevention proposal for the Mito target range power plant incorporating this denitrification process has been made with the hope of winning the local people over.

Plan Long-Term Stable Supply

The electric power industry is presently placed in a very harsh environment. Tokyo Electric is certainly no exception. While it may be said that it was granted a raise in rates this spring, its plant investments for 1980 will climb to 1 trillion 263.6 billion yen (this was 976.5 billion yen in 1979), and there has to be large investment as before if electric power is to be supplied cheaply. At the same time, large sums have to be expended for research and development costs to enable disengagement from oil.

In addition, this financial burden on the industry will be on an increasing trend even over the long haul. According to the government's "long-term energy estimates," it is said that Japan is expected to develop a hundred trillion yen of alternative energy over the next 10 years, and 60 trillion yen will have to be borne by the power companies. These figures surely make one wonder.

Calculating along this line, Tokyo Electric's load will be about 20 trillion yen or about 2 trillion yen per year for alternate energy development. This involves the expenditure of large sums for effects which will appear far in the future. This clearly shows what large sums have to be expended for very long-term projects.

Tokyo Electric has considered these estimates and will have to get the money ready. As everyone knows, Tokyo Electric is the top among the power companies. In its position it must take the leading role to strive to stabilize power supply not only for the present but for the future as well.

To this end, the funding preparation must always be conducted in a smooth manner. When one talks about funding preparation on the part of power companies, one generally thinks of bond flotations, and Tokyo Electric is Japan's largest floater of ordinary bonds. At the same time, the articles of incorporation were partially amended at the last general stockholders meeting to allow floating convertible corporate bonds to facilitate fund acquisition. In this manner, it is making various efforts.

President Hiraiwa constantly states, "We must avoid the situation in which long-term stabilization in the fiscal front and the power supply front cannot be maintained." If, by chance, Tokyo Electric's status should weaken and its path to funds acquisition be closed, not only will the development of alternate energy be out of the question but the dependence on oil on the part of the power industry cannot be rectified.

In this manner, Mr Hiraiwa is conducting business with the national interest in mind. At the same time, he ascended to the Kikawada philosophy of "the conscience of the fiscal world" and always tries to function as a business working for the public benefit and holds dear his contacts with consumers. Be that as it may, he is the top man in the complex and difficult electric power business, and this role in the days to come is extremely important.

Mitsubishi Cement Leads in Kiln Energy Conservation

Shift to a Comprehensive Resources Company Centered on Cement

When diverse consumption of oil is mentioned, the cement industry takes up the extreme right wing. It was a natural consequence of the oil shock that this industry sought to make the conversion from oil to coal. The one company in this area which stands out in its efforts is the Mitsubishi Mining and Cement Company.

Lead With New Kilns

Mitsubishi Mining and Cement is a business established on the two pillars of resources development and cement. The feature of its cement business is the several NSP (rotary pottery) kilns which have set standards for energy conservation. More than 90 percent of its kilns are of this type. Onodo Cement has 70 percent, Nippon Cement 60 percent, and Sumitomo Cement 40 percent, and this comparison should show the high rate of Mitsubishi NSP kilns.

All the cement companies have been making all out conversion to these NSP kilns over the past couple of years. Mitsubishi's rival Onoda Cement 2 years ago converted its Tsukumi No 5 and No 4 kilns to NSP type. This was followed by the conversion of its Kamiiso No 6 in May of last year, and it is aiming for a 90 percent conversion, the same as Mitsubishi, by the end of March 1981.

At the same time, Nippon Cement is aiming for 80 percent by the end of April 1981, and its average conversion was 60 percent as of the last 4 months of operation. Going to Sumitomo Cement, its low rate of conversion was noted earlier.

As things stand now, the efforts of the other cement companies in kiln conversion are gradually reducing the superiority which Mitsubishi enjoyed, but this company still leads the others in productivity despite this situation.

The reason the cement companies are actively converting to NSP kilns is that this industry uses a very large volume of C heavy oil as fuel. The cement industry follows the electric power and steel industries in its consumption of heavy oil and the price of heavy oil greatly controls the movements of this industry. It is said that the industry's average consumption of C heavy oil per ton of cement produced is 18 liters. The old moist type kiln which is not much used presently uses the prodigious amount of 120-130 liters but this can be reduced to 70-75 liters. This alone should demonstrate this urgency to convert.

As far as this point is concerned, Mitsubishi was a later starter in the business as a result of which it had few old facilities, and it was able to introduce efficient kilns much faster than the other companies. It is not known whether it is the personnel or the business itself which brings in this profitable operation, but this is irony in view of this situation enabling the company to maintain its strong position in the price competition.

After the first oil shock, all the cement companies were operating in the red, but Mitsubishi was the exception. It possessed a high rate of NSP kiln use and was able to minimize the increased production cost caused by the increase in the price of oil.

The new kilns also have the advantage that roughly half the operating personnel is required compared to the old type kilns to produce the same quantity of cement. Sumitomo Cement and other companies saddled with the fuel inefficient old type kilns are burdened with this excessive manpower cost, and Sumitomo Cement reported a loss of 2.8 billion yen for the period ending in March 1976 vividly displaying this difference.

50 Percent Mixed Coal Combustion System

With the escalating price of oil in mind, Mitsubishi Cement plans to introduce mixed combustion of oil with 50 percent coal for calcining of cement, and it hopes to make this conversion by the end of this year. This company already has been using mixed combustion of oil with coal at the two plants of Kurozaki and Higashidani (both in north Kyushu), but this rate of conversion is still at a little better than 10 percent where the overall company is concerned. The company plans to increase this to 50 percent in one sweep. The supply and cost of C heavy oil for fuel are expected to become more and more unfavorable from here on, and this approach cannot help but be a plus factor for this company.

Work has already started on this conversion to mixed coal combustion at the Kaida Plant (Kaida City in Fukuoka Prefecture) since last February and all four of the kilns there will start on this mixed combustion in June. This new facility has three coal pulverizers, belt conveyers, and coal dryers which are all being installed at one site. The coal will then be transported by belt conveyers to the respective kilns.

It is anticipated that the tremendous amount of 480,000 tons of coal will be used per year at this site, and a very large coal storage is required. It is said that purchase of this coal from Kyushu Electric Power has already been negotiated. Excepting that amount contributed by domestically produced coal (20 percent of the total used), the greater part of this coal will come from overseas sources. It is planned to make do with spot purchases for the time being, but the long-term plan is to go into joint development with Mitsubishi Corporation in Australia.

Assure Coal From Overseas Sources

This is why energy development at this point is directed more at coal rather than oil. This company presently holds under a separate company organization the two mines at Otabari and Takashima. However, production from these two sites is insufficient. This is why it is promoting development in Australia as was mentioned before.

This is the Wark Warse coal field, and it has already been shown to have a recognized deposit of 650 million tons. The first shipment may be as early as next year. Other than as fuel for this company's cement operations, a portion is expected to be directed to electric power development (500,000 tons per year).

If overseas coal is to be used, it would be advantageous to site the cement plants along the coast. Plants located inland incur the added transportation cost putting them at a disadvantage. In this respect, this company's main plants at Kurozaki, Higashidani, and Kaida are all model plants sited along the neighboring seas and are admirably suited for receiving overseas coal.

As is evident from this overseas coal development, this company "does not simply operate as a cement producing company but is aiming to become a comprehensive resources company" (President Kobayashi). This company presently produces and deals in other than cement, crushed rock, artificial light aggregate, and various construction material. It also mines and deals in oil, coal, and minerals.

In this respect, this company presents much greater diversification compared to other companies, and it possesses great antirecession resistance in line with the productivity of its cement production. It is an industry formed by the merger and reorganization of the two different areas of the cement industry and mining, and it is only natural that diversification should be advanced, however, its degree of diversification is of no ordinary level.

The emphasis in this diversification from now on will be on energy development as is to be expected. This area includes oil and uranium development in addition to coal. This company participates in oil development as a member of the Mitsubishi Group of which Mitsubishi Oil Development is the central figure. It has capital investments in Overseas Uranium Development (Co) and International Resources Development (Co) for uranium development. It also dispatches personnel to overseas assignments to aid in these developments. This company should present an awesome status 5 to 10 years from now.

Fuji Electric

Tokyo DENKI SHIMBUN in Japanese 25 Aug 80 p 3

[Text] The energy problem which had its inception with the first oil crisis and was greatly accelerated by last year's Iranian revolution is today the subject of top concern in this world. In August of last year Fuji Electric established its New Energy Development Committee headed by President Fukushige Shishido, and this company is planning active development of new energy sources.

(Prospects of Energy Supplies)

Japan's total national production increased by 30 times over the past 25 years as the result of its high rate of growth, and its living has become highly enriched. On the other hand, our energy requirements also increased by 7.5 times, and the volume of oil imported about 30 times to about 300 million Kl per year.

In another direction, the world's energy consumption also increased 3 times, and its oil consumption increased 4-5 times. Although the rate of increase was not as high as of Japan, the energy supply and demand relationships underwent basic changes in the picture that has evolved.

Now, there are presently more than a hundred and several dozen large and small countries in this world including the leading countries, the developing countries, and undeveloped countries, and the per capita use of energy averages out to 1.9 KW of primary energy. It ranges from 10 KW for the United States to less than 0.2 KW in some countries.

Of the total energy consumed, more than 75 percent of the people in the world consume less than 2 KW/capita indicative of their low consumption, and the energy demand gap envisioned for the future will not be anything that can be viewed with favor.

Reduce Dependency on Oil by 50 Percent

Japan's long-term "energy supply and demand plan" which was drawn up in 1979 proposes a reduction of 50 percent of the oil consumed which accounts for 75 percent of the primary energy used by Japan and thereby lower the total consumption of oil to 3.5-3.7 hundred million Kl per year.

The major policies to achieve this reduction include 1) thorough implementation of energy conservation practices, 2) diversification of overseas energy supply sources through the promotion of oil, LNG, and nuclear power, 3) increase the fraction of domestically produced energy such as hydropower and geothermal power. These are in the plans.

It is assumed that vast sums of money and a long time will be required in order to develop the necessary technology, and these developments are something which cannot be covered by any single private enterprise. Since 1974, Japan has been promoting national projects such as the Sunshine Program and the Moonlight Program, and Fuji Electric has been putting forth all of its technology to participate over a wide area.

At the same time, the "new energy comprehensive development organ" was created as a special corporation in October of this year through government and private funds to serve as the central organ for alternate energy countermeasures promotion, and a system by which government, academic, and private areas can cooperate to resolve the energy problem has been formed.

Utilization of Low Density Energy Sources

The major problem associated with new energy development is the economic problem of just how to produce good quality energy at low cost, but there are also two or three salient points from a technological viewpoint.

The first feature in anything which may be termed new energy is generally low in energy density. In the particular situation when economy is required to enable miniaturization, it is very difficult to find a low density objective. Among those sources which may be called natural sources, they are usually found rather abundantly, however, the energy density is so low that energy recovery is difficult.

Another feature is the irregular nature of the generation of these energy forms making difficult coordination between the demand and time factors. In the case of fossil fuel in which energy is already in concentrated form, this energy can be readily acquired, but the accumulation of solar energy, wind energy, and low temperature warm waste heat is not readily accomplished.

There are many ways of storing energy, but the method which is exploited to the maximum is raised water hydropower. At the same time, chemical energy storage in the form of hydrogen energy is expected to provide a clean energy source, and its utilization in fuel cells is being looked on with great interest.

New Energy at Hand

Development Situation at Fuji Electric

Solar Energy

There is already rapid expansion in the market for the use of solar heat to provide hot water and heat in the nature of the so-called solar house. Since 1978, Fuji Electric has been conducting field tests to gather basic data, and standard designs have been drawn up for use in business establishments, mansions, and homes. There are many contacts being made in this regard. The problems to be pursued from now on are improvement in heat collecting efficiency and permanency and, for the long term, a combination with solar photoelectric power generation.

Attention in the area of photoelectric power generation utilizing sunlight is focused on the amorphous silicon solar battery. This mode involves the use of

[redacted]

very thin cells of the order of 0.5 μm so that the power used in producing this cell can be reduced to 1/10 - 1/50 required to produce crystalline silicon solar batteries giving this approach very high possibility of producing a low cost battery.

On the other hand, there are still many technological problems to be resolved such as improving the efficiency from the present 2.5 percent to about 10 percent, the completion of permanency tests, and the establishment of a mass production technology.

Fuel Cells

The fuel cell which does not utilize any combustion process but directly converts chemical energy to power has the features of low polluting and low noise and is looked on with great interest as a future source of dispersive type power which can be distributed throughout consumer areas and for peak load use batteries. If energy storage in the form of hydrogen can be developed, the conversion of this hydrogen to electric power is thought to be the optimum method of converting this power.

In 1972 Fuji Electric developed a 10 KW alkali cell which was the first in Japan, but it has since transferred its attention to the development of phosphoric acid type fuel cell which can use city gas, LNG, or methanol in place of pure hydrogen.

Power Generation Through Wind Power, Wave Power

It is thought difficult to use power generation through wind power or wave power to provide a large volume of alternate energy, and it is expected that these power sources will be utilized in areas between mountains and coastal shores.

Fuji Electric has been participating in the "Windtopia Plan" of the Agency of Science and Technology and in the design of the experimental ship "Kaimei" being produced by the Center for Marine Science and Technology and has made some valuable contributions.

Geothermal Power Generation

Japan which has but 0.3 percent of the world's land area has 76 active volcanoes crammed within its narrow confines, and this makes up 9.2 percent of the world's active volcanoes. Thus, it may be said to be located in a powerful geothermal belt, but the total operating capacity at the present time is but 162,000 KW, and there is room for much more expansion from here on.

Fuji Electric developed the first practical geothermal power plant facility in Japan which is located in Kowakien in Hakone which is a 30 KW small power plant but the first of its kind.

Since then this company has continued research and development in this area, and last year it exported a 40,000 KW geothermal plant to El Salvador. This plant converts hot water to steam through two pressure stages in the two-stage flash process that is utilized, and it is said that a 30 percent increase in output can be realized compared to utilization of steam directly.

Since then two 55,000 KW units consigned to the United States and one 6,000 KW unit destined for Iceland have been shipped. An order was received this year from the Philippines for three 37,500 KW units which are presently under construction.

Small Hydroelectric Power Generation

The rise in cost of oil has elevated small-scale hydroelectric generation which hitherto had been considered uneconomical at a paying level. There is presently active development of small-scale hydroelectric power plants from a few hundred to several thousand KW taking place all over the world.

The tubular turbine is being exploited with particular advantage in small-scale hydroelectric power generation. Fuji Electric started delivery of this type of turbine from 20 years ago, and it has already delivered 19 units of the several thousand KW class.

System costdown through standardization and systematization are the main subjects of technological developments in this area, and there are already serialized equipment items which have been developed through comprehensive studies.

Conservation Bill Revised

Tokyo SHO ENERUGI in Japanese Aug 80 pp 8-15

[Article by Takahiro Fujii of the Energy Conservation Coordination Division, Natural Resources and Energy Agency: "'Bill' To Promote Energy Conservation Revised"]

[Text] 1. Outline of Revisions

Special compensation for energy conservation facilities was set up in 1978 with 13 types of facilities including heat exchangers, waste heat boilers, and waste pressure recovery facilities as objectives.

The applicable time limits for these facilities was 31 March 1980, however, in view of the importance of energy conservation, extension, expansion, and reinforcement of this system was requested, and the tax system revision in JFY 1980 revised the applicable period, facilities covered, and rate of special compensation.

As a result, the applicable period of this system was extended 2 years for nearly all of the facilities of the past as indicated in Table 1, and some facilities were newly included.

Table 1. Energy Conservation Facilities Qualifying for Special Compensation

(Ministry of Treasury Report of 31 March 1980 <Revision of Ministry of Treasury Report of May 1973> Excerpt)

Facility in Question	Applicable Period
1. Heat exchanger (limited to one of the following categories which applies)	
1. unit for preheating fuel or air with waste combustion heat (including heat exhausted from medium being heated) (including special fans used with the facility)	1 April 1978 to 31 March 1982
2. coldness from liquefaction of liquefied natural gas is utilized (excluding those used in gas industry)	same as above
3. total heat heat exchangers (those used for heat exchange of sensible heat or latent heat of discharge gas to feed gas in which treatment volume is greater than 1,000 cubic meters per hour	same as above
4. heat pipe type sensible heat exchanger (those making heat exchange of sensible heat from waste gas to feed gas with treatment volume of more than 2,000 cubic meters per hour)	from 1 April 1980 to 31 March 1982
2. Boilers utilizing waste heat (limited to one of the following categories which applies)	
1. those generating steam using waste combustion heat (including heat discharged from medium to be heated) (includes special pumps and distribution lines also installed)	1 April 1978 to 31 March 1982
2. those with mechanism to automatically control flow ratio between air and fuel for combustion in accordance with changes in boiler steam pressure and those with heat exchangers to preheat air for combustion or water to the boiler using waste combustion heat from boiler (including special pumps and distribution lines)	from 1 April 1980 to 31 March 1982
3. Waste pressure recovery facility (including those recovering and utilizing waste pressure from gases generated by a manufacturing process (including liquefied gas) along with turbines, distribution lines, and automatic control equipment installed alongside)	1 April 1978 to 31 March 1982

Table 1. [continued]

Facility in Question	Applicable Period
4. Dehumidifying fans for industrial furnaces (limited to one of the following categories which applies) 1. those using lithium chloride or other dehumidifying agent and the accompanying moisture absorbers, regenerators, pumps, and distribution lines 2. those which dehumidify by cooling the air circulated and the accompanying coolers, air coolers, heat exexchangers, cold water tank pumps, and distribution lines 3. those combining the feature of the preceding two types including the accompanying equipment	1 April 1978 to 31 March 1982
5. Energy conserving type industrial furnace (limited to whichever of the following categories applies) 1. those industrial furnaces operating at temperatures above 500°C in which the preheating zone of the raw material with waste combustion heat is unitized with the heating zone of the furnace and in which the temperature differential between the waste gas temperature at the furnace waste gas outlet and the temperature within the furnace is at least 150°C 2. those industrial furnaces with internal temperature greater than 500°C which is created anew from the furnace bed in which more than 50 percent of the wall section within the furnace is comprised of insulating material of bulk density less than 1.3 excepting the furnace bed 3. those with mechanism to automatically control flow ratio of air for combustion and fuel according to variations in the in-furnace temperature or the combustion heat 4. those employing jet flow impact heating in which the injection rate of the heating jet is greater than 50 meters per second	1 April 1978 to 31 March 1982
6. Branched ventilation cupola (limited to those with mechanism to blow in air for combustion through 2-stage seating and accompanying air flow control equipment)	from 1 April 1980 to 31 March 1982
7. Steam drain recovery apparatus (recover steam drain after use for reutilization limited to steam traps, drain pumps, and distribution lines as well as drain filters and drain tanks)	1 April 1978 to 31 March 1982

Table 1. [continued]

Facility in Question	Applicable Period
8. Steam accumulator (those which stabilize boiler load fluctuations caused by changes in volume of steam used which automatically regulate the steam stored and generated	1 April 1978 to 31 March 1982
9. Modified double absorption type cold water unit (limited to those which do double regeneration or more during the circulatory process of the water cooler using lithium bromide or other absorbing solution which have mechanism to preheat combustion use air or said absorbing solution or make hot water using waste heat from the regeneration process or condensation process and including accompanying special distribution lines	from 1 April 1980 to 31 March 1982
10. Cold box casting mold (those which set casting sand using chemically setting reaction (excluding combustion reaction) or organic viscous material and using amine gas as medium and limited to those with casting frame area greater than 0.09 square meters (in the case of core molds, those with core weight greater than 1 kg)	1 April 1978 to 31 March 1982
11. Heat pump type heat source (this is a heat pump type air conditioner or chilling unit)(limited to those with reciprocating type or rotary type compressor) in which the rate of power consumption is 30 KW or more along with the accompanying special heat recovery distribution lines, pumps, and heat storage tanks.	1 April 1978 to 31 March 1982
12. Heat retaining wall for storage tanks (this is installed on the outer wall of facility to store heat in a copper tank and is limited to those insulating materials of at least 10 mm thickness and thermal conductivity of less than 0.1 kilocalories per hour per meter)	1 April 1979 to 31 March 1982
13. Medium and low temperature waste heat utilization power generation facility (this is a facility which utilizes waste heat from industrial processes to generate electric power)(limited to those in which the temperature at the inlet to the evaporator is less than 500°C) (excluding those power plants used by commercial power companies) and is limited to those which also have evaporator, turbine, generator, condenser, pumps, distribution lines, and automatic control device and includes special preheaters (limited to those which preheat medium with said waste heat) or heat storage tank	from 1 April 1980 to 31 March 1982

Table 1. [continued]

Facility in Question	Applicable Period
14. High performance radiating type heating facility (limited to one of the following examples) 1. facility which generates heat by combustion (limited to those with combusting capability of at least 10,000 kilocalories per hour) in which heating is accomplished by radiating heat from a combustion facility, radiation tube, or reflector plate (it will be limited to that type and include the special automatic control device, fans, and vacuum pumps which are installed at the same time) 2. one in which electric heat or hot water is used to heat the floor, and radiation from this floor is used for heating (when installed together with heat generator, heat storage plate (limited to those with total area greater than 100 square meters), or thermally insulating plate, it will be limited to that type along with the special automatic control device, pumps, and distribution lines which are installed at the same time)	From 1 April 1980 to 31 March 1982
15. Power load regulating device (limited to one of each of the following categories) 1. one in which the power load is automatically regulated through the manipulation of a circuit connected to the unit operating on electricity so that the power load does not exceed a standard value set beforehand (when used together with a power scanning facility or an automatic control device, it will be limited to such a device, and include special detector device or electric relay which is installed at the same time) 2. variable speed device which regulates power load by automatically varying the rpm of the output shaft through a fluid joint according to a rpm control device or its output by automatically varying the rpm of the output shaft according to the power required by the device being driven by an electric motor (including the special automatic regulator, detector, switches, and transformers that are installed at the same time) 3. one which regulates the power load by automatically controlling illumination based on control signals generated according to a previously set program (when installed with special illumination control device or	From 1 April 1980 to 31 March 1982

Table 1 [continued]

Facility in Question	Applicable Period
device which operates or adjusts lighting, it will be limited to that type and will include distribution lines for signal relay use)	
16. Marine diesel engine (limited to diesel engines with fuel consumption rate of 155 grams per horsepower per hour or less installed on a ship to replace a steam turbine as the prime power (ship launched after 1 June 1971 which is a container vessel of greater than 40,000 tons displacement or a tanker of total displacement of 100,000 tons or more) and including the speed reduction device installed at the same time)	From 1 April 1980 to 31 March 1982

Remarks: 1) Those whose applicable period is between 1 April 1980 to 31 March 1982 are newly added devices.

2) The "solar heat utilizing cooling facility" of the past was classified as an oil substitute energy facility and was not listed.

2. Outline of Newly Added Facilities

The newly added facilities are as follows:

2.1 Heat Pipe Type Sensible Heat Exchanger

The facility in question here uses sensible heat from waste gas for heat exchange to heat feed gas, and it is a heat pipe type sensible heat exchanger with treatment capacity of more than 2,000 m^3/hr.

2.2 Boiler Utilizing Waste Heat (No 2 in Table 2)

This boiler uses combustion waste gas heat from the boiler to preheat the feed air for combustion or feed water to the boiler. It is an energy conserving type boiler with improved efficiency.

The waste heat contained in the discharge gas from a boiler is effectively utilized to heat air supplied to the boiler for combustion or water fed to the boiler for conversion to steam. The waste heat is subjected to heat exchange with air or water being fed to the boiler so the air or water enters the boiler section with this extra heat, and there is a corresponding reduction in the fuel required to operate the boiler.

In addition to the condition that the facility under consideration be a boiler which uses heat in its waste gas for utilization through heat exchange, there is the condition that the flow ratio between the air for combustion and the

Table 2. Schedule of Certifying Groups of Specifications for Newly Added Energy Conservation Equipment

Number in Table 5 of Ministry of Treasury	No	Name of Device	Name of Group
1	4	heat pipe type moist heat exchanger	(under study)
2	2	waste heat utilizing boiler	Japan Industrial Machine Industry Association (Co)
6		divided flow cupola	Japan Casting Machine Industry Association
9		improved double effect absorption type water cooler	Japan Freezer and Air Conditioning Industrial Association
13		medium and low temperature waste heat utilizing generator	Energy Conservation Center (Inc)
14	1	high performance radiative type heater	Japan Heater Equipment Industrial Association
	2		Home Equipment Systems Cooperative
15	1 - 3	power load controller	(under study)
16		marine diesel engine	(under study)

fuel is automatically controlled by a mechanism which functions according to changes in steel pressure within the boiler. The size of the boiler considered here is one whose rated steam production is 30 tons per hour or less.

Boiler types according to their construction include "cylindrical smoke tube furnace boiler," "water pipe type boiler," and "flow through boiler." An example of a "cylindrical smoke tube furnace type boiler" is shown in Figure 1.

2.3 Divided Blower Type Cupola

Cupolas are most widely utilized as cast iron melting furnaces and they have construction in which the insides of a cylindrically shaped steel plate shell are lined with refractory material. Starting material base metal and coke are charged from the top of the furnace while air for the combustion is sent in from the furnace bottom section to melt the metal.

The divided blower type cupola (see Figure 2) which has been designated as subject of the present special compensation act has a two stage or more seating and has a construction in which air for combustion is divided for blowing

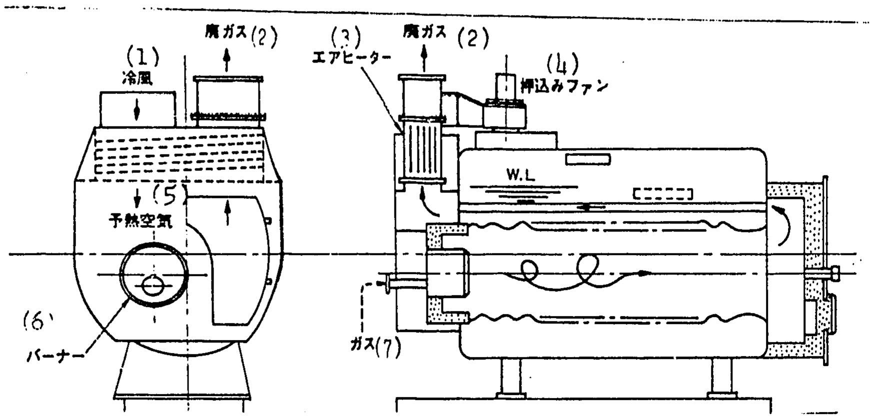
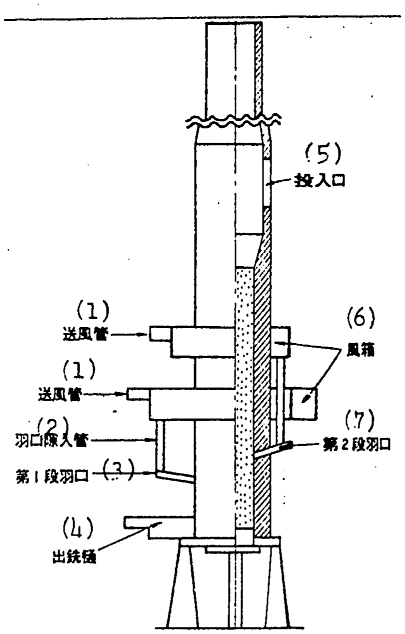


Figure 1. Example of Cylindrical Smoke Tube Furnace Type Boiler

Key:

(1) cold air
(2) waste gas
(3) air heater
(4) pusher fan
(5) preheated air
(6) burner
(7) gas



Key:

(1) blower tube
(2) seating gap inlet tube
(3) first stage seating
(4) pig iron spout
(5) charging port
(6) air box
(7) second stage seating

Figure 2. Divided Blower Type Cupola Constructional Diagram (Example)

into the furnace. By employing divided blowing, secondary burning of the gas formed within the cupola is accomplished thereby expanding the heated zone and preheating the raw material base metal as a result of which thermal efficiency is greatly improved.

When the cupola of the past and this divided blower type cupola are compared, the divided blower type has at least twice as many seating stages (3-6 seatings per stage) along with at least double the air boxes, orifices, valves, and fans. At the same time, more precise air flow control becomes necessary. Furthermore, the operation of this furnace requires much more detailed operating know-how for adjusting the quantity of bed coke (coke initially charged) between the seatings for each stage and setting the air flow rate at each seating.

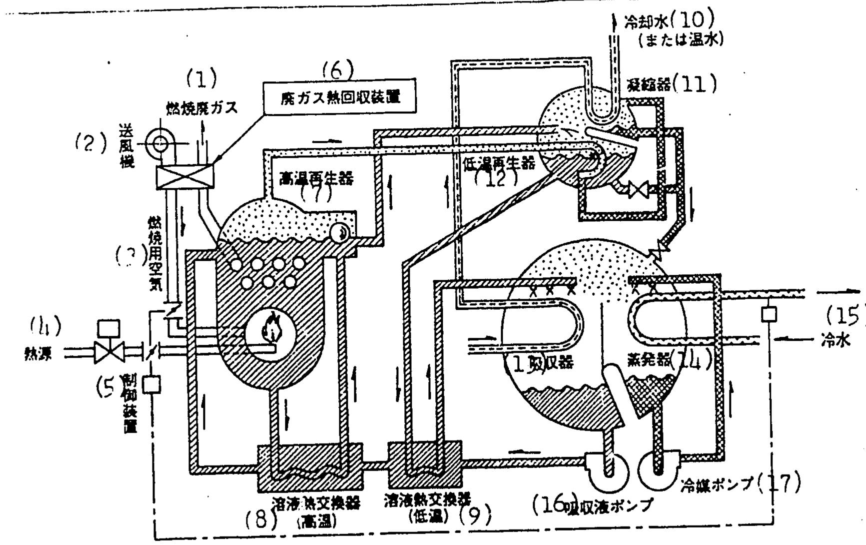


Figure 3. Example of Improved Double Effect Absorbing Type Water Cooler (With Waste Gas Heat Recovery Facility)

Key:
(1) waste combustion gas
(2) blower
(3) air for combustion
(4) heat source
(5) control device
(6) waste gas heat recovery device
(7) high temperature regenerator
(8) solution heat exchanger (high temperature)
(9) solution heat exchanger (low temperature)
(10) coolant water (or hot water)
(11) condenser
(12) low temperature regenerator
(13) absorber
(14) evaporator
(15) cold water
(16) absorber liquid pump
(17) coolant pump

2.4 Improved Double Effect Absorbing Type Water Cooler

The improved double effect absorbing type water cooler is designed to enable greater energy conservation over the double effect absorbing type water coolers of the past by installing a mechanism which recovers heat from: (1) combustion discharge gas discarded from the high temperature regenerator; or (2) heat retained in the coolant drain for the low temperature regenerator or condenser return, and the heat is used to preheat air fed to the combustion, heat the absorber solution, or make hot water and thereby reduce fuel consumption (see Figure 3).

2.5 Generator Utilizing Medium and Low Temperature Waste Heat

This is a facility which recovers and utilizes waste heat from manufacturing processes which was not fully utilized in the past. This is the so-called medium and low temperature waste heat at temperatures below 500°C.

The waste heat that is recovered is introduced into the evaporator where it vaporizes water or freon. The heat medium that is vaporized in this manner enters the turbine, and the expansion energy of this gas drives the turbine to provide rotary power. A generator connected to the shaft of this turbine generates electric power. Since the thermal medium leaving the turbine is in gaseous state, it is condensed back to a liquid in the condenser. The thermal medium reformed into liquid is again introduced into the evaporator. This cycle is repeated to utilize the waste heat energy to generate electric power.

The facility under consideration is limited to one which uses heat at temperature below 500°C. When the temperature of this waste gas exceeds 500°C, it is thought that similar measures can be adopted using generation modes used in the past. As a result, this type of power generation is not limited to utilizing heat at temperature below 500°C.

At the same time, this facility is limited to one consisting of a system made of a series of constitutive elements. That is to say, it consists of evaporator, turbine, condenser, pumps, distribution pipes, and automatic control devices (see Figure 4).

2.6 High Performance Radiating Type Heating Facility

The first stage combustion gas of a high performance radiating type heater is directed through a radiating tube made of metal, and the heat radiating from this tube in the form of infrared radiation is used to provide only the necessary heat to enable great conservation in energy compared to the convection type total chamber heating. It is a so-called "infrared radiative type heating facility."

The facility under consideration is limited to one consisting of a combustion facility, radiating tube, and reflector plate which are necessary elements of the facility both construction wise and configuration wise.

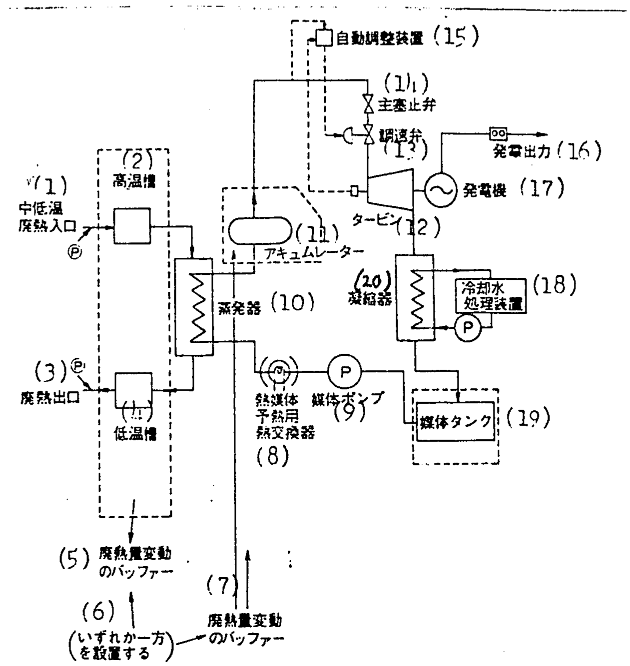


Figure 4. Conceptual Flow Sheet of Medium and Low Temperature Waste Heat Utilizing Power Generation

Key:
(1) medium and low temperature waste heat inlet
(2) high temperature tank
(3) waste heat outlet
(4) low temperature tank
(5) waste heat volume change buffer
(6) (one or the other is installed)
(7) waste heat volume change buffer
(8) heat exchanger for heating thermal medium
(9) medium buffer
(10) evaporator
(11) accumulator
(12) turbine
(13) flow regulating valve
(14) main check valve
(15) automatic control device
(16) generated output
(17) generator
(18) coolant water treatment device
(19) medium tank

This type of heater can be divided into the draw-in combustion type and the push-in combustion type depending on the difference in the way air is brought in. An example of a draw-in type is shown in Figure 5.

The floor is heated by the heat generator installed at the floor surface and heated by electricity or hot water, and radiation of heat from the floor surface does the heating. This is the so-called "floor heating facility."

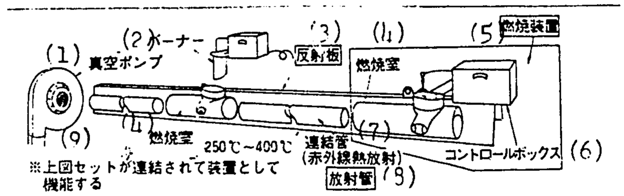


Figure 5. Example of No 1 Installation (Draw-in Combustion Type)

Key:
(1) vacuum pump
(2) burner
(3) reflector plate
(4) combustion chamber
(5) combustion facility
(6) control box
(7) connecting tube (for radiating infrared energy)
(8) radiating tube)
(9) * the set shown above is connected to provide the necessary functions

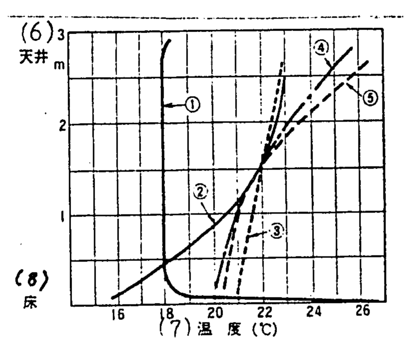
The floor heating mode is more advantageous in energy conservation compared to other heating modes because of the following reasons.

(イ) It is radiative heating

As long as the sun's rays are received directly on a body, good heat is obtained even on a winter's day when the air temperature is low. The floor heater functions in a similar way to utilize most of the heat as dispersed radiation, and it provides a feeling of warmth without raising the room temperature very much.

(ロ) Heating efficiency is good when the temperature distribution is uniform vertically

A temperature distribution of the type illustrated in Figure 6 is obtained in the case of floor heating, and the following effects are created.



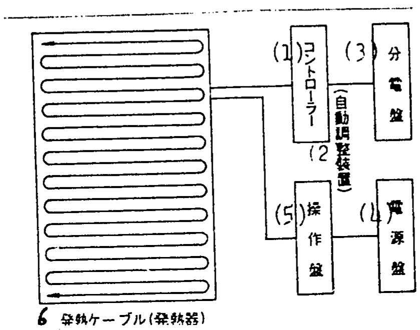
Key:
(1) floor heater
(2) fan coil floor installation
(3) hot water radiator
(4) steam radiator
(5) convector
(6) ceiling
(7) temperature
(8) floor

Figure 6. Temperature Distribution of Floor Heater Fan Coil Floor Installation

a. The same feeling of warmth is sensed as with other heating modes even when the room temperature is low, and the heating load is decreased.

b. The temperature differential within a room is very small as a result of which heat losses of the type associated with space heaters are lowered.

Since the facility under consideration is limited to those with the construction described here, it is limited to that which is installed together with heat generator, heat storage plate and thermally insulating plate (see Figure 7 and Figure 8).



Key:
(1) controller
(2) automatic controller
(3) distribution panel
(4) power panel
(5) operating panel
(6) heating cable (heater)

Figure 7. System Diagram of Electric Floor Heating Cable System

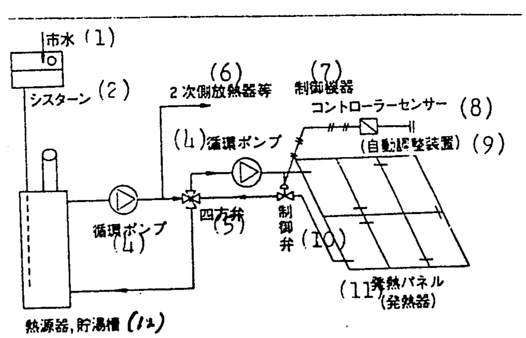


Figure 8. System Diagram of Hot Water Floor Heating Panel System

Key:
(1) city water
(2) cisterm
(3) heat source and storage tank
(4) circulating pump
(5) 4-way valve
(6) secondary side radiator
(7) controller
(8) controller sensor
(9) automatic regulator
(10) control valve
(11) heat generating panel (heat generator)
(12) heat source, heat reservoir

2.7 Power Load Regulating Device

(1) Number 1 power load regulating device

The device under consideration here successively operates a circuit with which it is connected to increase or lower the demand power when the demand load exceeds a standard value or comes close to exceeding it. It is sometimes called a demand controller.

This device is particularly useful for cooling operations in summer to adjust the demand power during peak load period.

The objective of this special compensation is a combination of power scanning device, automatic control device (power control device), signal detector, and relays which effectively function as a single system to exploit its capabilities as an energy conservation assembly. The power scanning device and automatic control device are the heart of this assembly, and this compensation is limited to the situation when both of these units are present.

The power scanning device measures the current power used through the power meters and signal detector and calculates and estimates power demands at given intervals. The automatic control device (power control device) issues a command to operate a circuit connected to the electrical unit in use according to a preset program whenever the estimated value exceeds a set value. The relay receives the command from the automatic circuit control and opens or closes the circuit (see Figure 9).

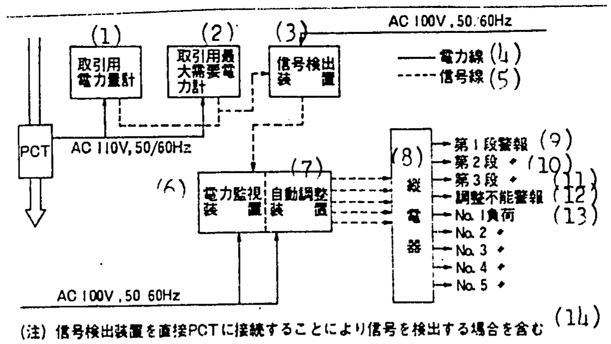


Figure 9. Example of Circuit Makeup

Key:
(1) input power meter
(2) maximum input demand power meter
(3) signal detector
(4) power line
(5) signal line
(6) power scanning device
(7) automatic control device
(8) vertical panel
(9) 1st stage alarm
(10) second stage alarm
(11) third stage alarm
(12) control incapability alarm
(13) No. - load
(14) Note: including the situation in which the signal detector is connected directly to the PCT to detect signals

(2) Number 2 power load regulating device

When the control of air flow or moisture in a facility employing electrical units such as compressor, pump, or fan is through the adjustment of a damper or similar mechanism, the energy supplied the motor is dissipated as frictional heat loss (net result is rise in air or water temperature). The unit in consideration here controls the rpm of the motor in such cases and supplies electrical energy according to the load and thereby lowers the power used. It is commonly called a motor rpm controller (see Figure 10).

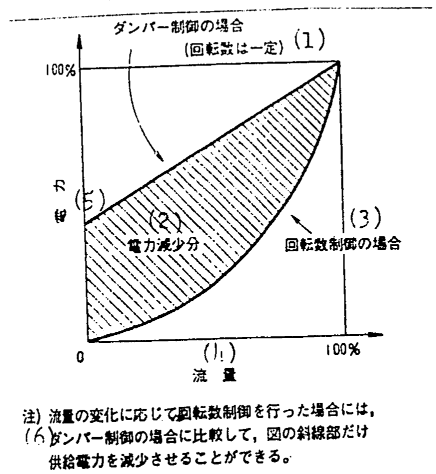


Figure 10. Example of Power Conservation by RPM Control

(Key)
(1) case of damper control (fixed rpm)
(2) fraction of power reduction
(3) case of rpm control
(4) flow rate
(5) power
(6) Note: When rpm control is exercised by varying flow rate, the power supplied can be reduced by the shaded section in the figure compared to the case of camper control

The types in use include those which control the rpm of the motor itself and those which control the rpm of the motor shaft through a fluid joint (broad sense: fluid joint and fluid torque converter).

(3) Number 3 power load regulating device

The unit under consideration here automatically controls the illumination in a factory or a business establishment according to a preset schedule to conform to the working conditions and thereby reduce the power used. It is sometimes called illumination scheduling device.

Take the example of a small retail store. Lighting is adjusted for the preparatory work prior to opening the store, the varying situations according to the number of customers in the store, precise calculations period, and inventory check after store closing according to necessity and locality and thereby effect substantial decrease in illumination power.

Methods of controlling degree of illumination include those given in (イ) and (ロ) below.

(イ) Method in which distribution lines are systematically deployed beforehand to provide the necessary illumination to the necessary places (see Figure 11).

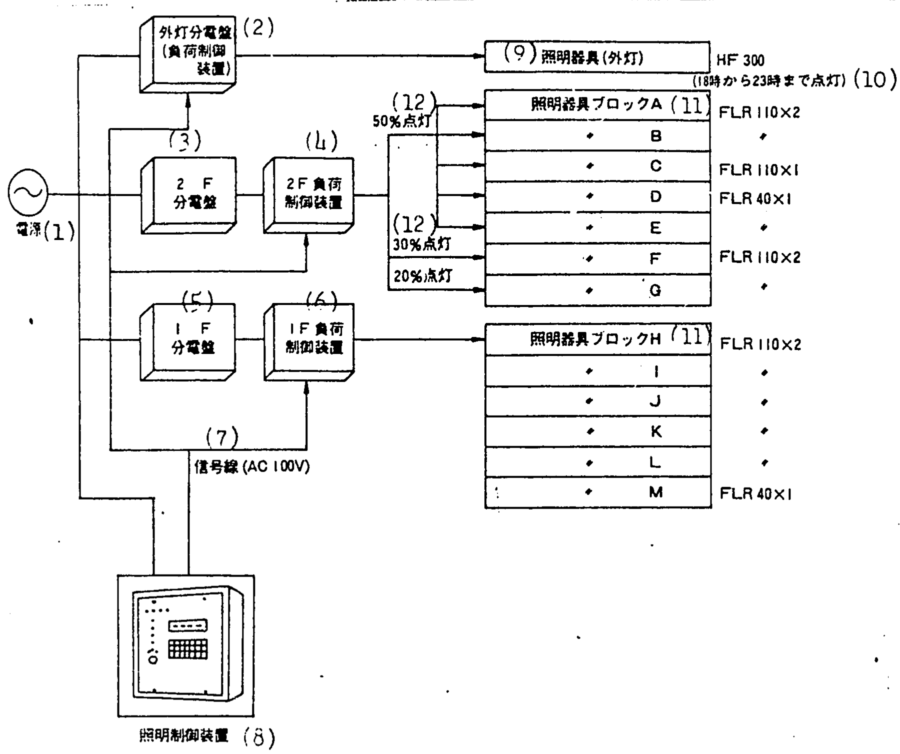


Figure 11. Example of System Makeup

Key:

(1) power supply
(2) external light panel (load control device)
(3) 2F panel
(4) 2F load control device
(5) IF panel
(6) 1F load (control panel
(7) signal line
(8) illumination control device
(9) lights (external lights)
(10) (lit between 8-23 hours)
(11) light block - -
(12) -- percent lit

(◇) No systematic distribution lines are installed but signals from a lighting panel are followed to turn off or adjust the illumination load according to some fixed conditions.

2.8 Marine Diesel Engine

The item under consideration here is a diesel engine whose consumption rate is 155 grams per horsepower per hour or less. In addition, there are the limitations according to application and to container vessels of more than a preset scale.

3. Certification System Such as Specifications for Energy Conservation Devices

In order that the special compensation system for energy conservation devices be truly effective, necessary information relative to the energy conservation unit in question should be made available to the party which has installed the unit in his workplace (hereafter called "user") and the certification of a third party that said unit conforms to the tax system.

Following this viewpoint, an energy conservation center (incorporated) and industrial groups tied in with the energy conservation facilities of the various ministries have become the nucleus for setting up certification systems for specifications associated with energy conservation facilities.

By attaching the certification certificate issued by this system to the application for special tax status, the tax office will have a useful reference, and this system is very advantageous to the user.

The inclusion of this certification is not required by law.

A schedule of certifying corporations of newly added equipment is given in Table 2.

Biomass Energy

Tokyo TSUSAN JANARU in Japanese May 80 pp 120-124

[Article by Hideo Otaka, chief of the Chemistry Products Division, Basic Industries Bureau: "Development of Biomass Energy"]

[Excerpts] Introduction

The present world economy is controlled by the energy supply structure centered on oil. The most recent changes in the international oil situation have heightened the possibility that a worldwide oil shortage may be in the offing by the later 1990's. The "Provisional Long-Term Energy Supply and Demand Perspective" drafted last August by the Advisory Committee for Energy has positioned the roles for various oil energy substitutes, and alcohol which is a biomass energy has been classed under the heading of "new fuel oil." Although its share of the overall energy supply in Japan is but a few percent, it will probably play an important position in closing the energy gap in the demand and supply area for the present light and medium oil products (gasoline, lamp oil, light oil, etc) whose demand is expected to increase in the future.

Dr Calvin a recipient of the Nobel prize in chemistry (famous for the Calvin cycle in photosynthesis) stated in 1974, "We must consider from here the utilization of energy from plants which is a renewable energy in place of fossil energy." In September 1976 he stated further, "We will extract components similar to oil from the Euphorbia family including such plants as Asasango [phonetic] and Holt grass, and an acre production of 10-15 barrels/yr at a cost of 3-10 dollars a barrel can be realized according to our estimates." Brazil in 1975 announced its "national alcohol plan" in which alcohol is to be produced from sugarcane and sweet potato to be used as automobile fuel and chemical industry raw material.

In this manner, the curtain has been raised for a new age in which energy is to be directly taken from plants in what may be termed as energy renaissance. Up to the 19th century, man obtained more than 90 percent of his energy from wood and wood materials. Back in the 1935 era, Japan was producing considerable quantity of fuel alcohol.

Now, just what is biomass? Looking at Figure 1 [not reproduced], academically speaking, "biomass is the flora in the natural world (production man)--animals (consumer)--microorganism (analyst)--inorganic material which are all involved in the change in cycles as is." Put in simpler terms, it refers to the total quantity of flora and fauna. It is estimated that there are presently 2 trillion tons of biomass on this earth (most of it is plants). If this biomass were effectively converted and utilized, a large volume of clean and renewable energy becomes available. Furthermore, it is also useful as a source of chemical raw materials. In this manner, research and development on technology to convert and utilize biomass is one of the big hopes in the oil alternate energy picture.

Such being the case, what specific plans are there along this line?

Methods of Utilizing Biomass

Alcohol Fermentation

Man has been producing spirits (alcohol) from cereals and potato tubers since time immemorial, and this alcohol fermentation technology applied to various plant materials is the pathway envisioned. At the present time, the greatest production in the world is from sugarcane in Brazil, and this is followed by the production from corn in the United States. These are all mixed with gasoline to be used as automobile fuel (gasohol) while a portion is used as raw material for the chemical industry in the production of ethylene and similar products.

Another type of alcohol is produced from cellulose (plant fiber) which is a main component of plants. This is something we have in great volume even in

Japan because it is incorporated in forest material, urban trash, rice straw, and such agricultural waste products. Even production from such presently unused sources is expected to yield 9 million kiloliters when converted to alcohol (see Table 1), and adding forest products to the above gives a very large figure. Alcohol production from this cellulose is presently in the development stage, and it is being taken up as a Ministry of International Industry and Trade project as will be discussed later.

Table 1. Estimated Quantity of Unutilized Biomass and the Potential Alcohol Production From This Source

Item Type	Number (10,000 t/yr)	Fiber fraction (%)	Fiber quantity (10,000 t/yr)	Alcohol conversion rate (%)	Possible alcohol production (10,000 Kl/yr)
Rice straw	1,259	30	378	55	208
Rice hull	252	40	101	55	56
Other agricultural wastes	1,280	20	256	55	128
Forest wastes	2,580	25	645	50	322
Urban trash	2,300	18	414	50	207
Total	7,671	--	1,794	--	921

Methane Fermentation

This technology involves the fermentation of organic wastes such as livestock waste, seaweed, and urban and industrial wastes to produce methane which is then used to generate electric power or put to household use. At the present time, there is a plant considered to hold considerable promise being developed in the United States which is giant kelp (macrocysis) 60 meters in length, 20-25 kilograms in weight, and having a growth rate of 50 centimeters per day. This kelp is being cultivated, dried, and fermented on a large scale at the experimental farm of the Integrated Societies Corp., General Electric Corp. located at the San Diego Naval Laboratory. It is estimated that 1,000-6,000 tons/day of kelp can be harvested from a 100 square mile sea area and energy can be recovered at a cost of 14-15 dollars per million Btu methane (1 Btu = 0.25 kcal). The possibility of using Makombu [a type of seaweed] is being considered in Japan.

Oil Forming Plants

This is a plan to directly extract oil of the same type hydrocarbons as petroleum contained in eucalyptus, blue coral tree (literal), or Holt [phonetic] grass. It will be used as a gasoline substitute and chemical raw material. Professor Sakuzo Taketa of Mie University reported last year at a scientific meeting in the United States on some good results obtained on gasoline engine tests using fuel produced from the eucalyptus plant, and the superiority of this fuel has suddenly become the center of attention. In February of this year, the Suzuki Automobile Company conducted actual running tests of a eucalyptus-fueled automobile and reported the same performance as that of a regular gasoline engine but with exhaust gas production 1/10 to 1/5 that of gasoline. Now, what yields and costs are associated with this source of energy?

The eucalyptus leaf contains about 4 percent volatile oils, and roughly 25 kilograms of leaf is required to produce one liter of oil. If it were possible to apply a simple method of separation such as steam distillation, a production cost of about 100 yen/liter is thought possible. This plant is presently being cultivated in large scale in Brazil and Australia for pulp because of its rapid growth, and the cultivation technology has been established. What is left is the development of a comprehensive utilization system of eucalyptus.

Where Holt grass is concerned, large-scale experimental plantings are under way under the direction of the aforementioned Dr Calvin. The Sekisui Kaseihin Kogyo (Co) has a plot of about 6,000 blue coral trees under cultivation in Okinawa where oil extraction experiments are under way.

The big advantage of these plants is that they can be cultivated in semiarid lands not suited for food production. Furthermore, they are fast growers. Non-oil producing and developing countries in Africa and Southeast Asia are coming to Japan for technological cooperation. These countries are in a state of ravaged economy as the result of the cost of oil, and this may be a very significant advance once the economic cooperation is established.

The Ministry of International Industry and Trade's budget for biomass related developments is shown in Table 2. The following are the principal items.

Establishment of a Biomass Liaison Committee

A biomass liaison committee will be established with representatives from the ranks of experienced academic people and private industry to be engaged in information exchange and project promotion.

Development of Biomass Resources Production and Utilization Technology

Research and development period: The 7-year period starting in 1980.

Table 2. Biomass Related Budget (JFY 1980)

	Item	Assessed value (million yen)	Explanation
1	(General accounts) Promoting biomass utilization	2	A biomass liaison committee (provisional name) will be established within this ministry to facilitate mutual information exchange between the research and development projects within the country engaged in biomass utilization technology development, insure smooth project operation, and study methods of specifically promoting research and development.
2	(Special account for coal, oil, and oil alternate energy countermeasures (provisional name)) Subsidies for new fuel oil technology development businesses		
	(1) decomposition and fermentation technology development (cellulose conversion process technology)	244	Microorganisms are used to decompose and ferment cellulose which is an unutilized biomass resource to produce alcohol in the technology to be developed.
	(2) development of technology for alcohol production by fixed yeast	122	Yeast is enveloped and fixed within a polymeric matrix in the fixed microorganism which will be developed to work on raw materials such as starch and molasses and produce alcohol continuously in the technology to be developed.
3	New fuel oil development survey trust fund Feasibility study on biomass resources for large volume production project both domestic and foreign	49	Survey and research on economic production system for utilization of biomass resources both domestic and foreign (potato, sugarcane, wastes) for use in alcohol production
4	Special account for sole alcohol business research and development on alcohol production from domestic resources and unutilized resources	36	Conduct test research on alcohol production utilization from domestic raw materials (molasses from Okinawa, etc) and unutilized resources (waste fruit juices)
5	(General accounts) Subsidies for research and development cooperative business (alcohol business using plant materials)	11	Conduct surveys to establish operating conditions and equipment suited to the development of alcohol production technology for developing countries utilizing plant material
	Total	464	

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000300070035-3

Overall research and development cost: about 30 million yen. The JFY 1980 budget is roughly 400 million yen. "Development of technology for cellulose degradation and fermentation."

The purpose of this project is to develop the technology by which cellulose, which is an abundant raw material in Japan, is efficiently converted into ethyl alcohol by the use of microorganisms and the technology for the utilization of this product as well as to establish energy conservation technology focused on engineering technology. The raw materials to be tested include sugarcane, rice straw, and rice hull.

Contents of Technological Department

(a) Establishment of pretreatment technology (electron beam treatment, physical and chemical treatment)

(b) Establishment of fermentation technology including search for decomposition and fermentation microorganisms

(c) Establishment of waste liquid treatment technology

(d) Establishment of energy conserving distillation technology

(e) Establishment of system technology (pilot plant)

(Development of Technology for Production of Alcohol With Fixed Yeast)

The methods presently in use will be improved and converted to continuous production methods, operational equipment will be simplified, and energy conservation and overall costdown will be targeted.

Contents of Technological Development

(a) Search for fermentation organisms suited to continuous fermentation technology

(b) Establishment of yeast stabilizing conditions for long-term stability

(c) Establishment of system technology

As roughly reviewed above, the biomass utilization plan has just been initiated, and various leads will be pursued from here on. It is thought that the development of the following systems technology is necessary in order to utilize biomass as an effective energy resource.

(1) production, recovery, and collection of biomass
(2) recovery and utilization of waste materials
(3) evaluation of environmental effects

Should the utilization technology for biomass be developed, not only will it be possible to plan for diversification of energy sources to effectively utilize hitherto unutiiized resources but also to promote local energy sources which will aid the local economy. At the same time, a very useful tool for promoting technological and economic cooperation to developing countries will be developed.

These events are in conformity with the items: (1) international contribution of a "large economic nation"; (2) supplement to "small country with respect to resources"; and (3) establishment of both "active strength" and "elbowroom."

'Local Energy System'

Tokyo TSUSAN JANARU in Japanese Jun 80 pp 78-84

[Article by Hiroteru Kawada, chief of New Alternate Energy Department, Natural Resources and Energy Agency: "Report on Development of 'Local Energy System' and Its Practical Application"]

[Excerpt] Based on this viewpoint, the Ministry of International Trade and Industry placed in its JFY 1980 budget subsidies for survey projects by local governments for development and utilization of local energy and plans to go into all out engagement into basic technological development.

The subject of development and utilization surveys on local energy systems will be discussed below.

Significance of Development and Utilization

The energy situation which pervaded this country during the recent period is becoming more and more precipitous as the result of the impetus given by the Iranian revolution. In light of this situation, the planning of assurance of a stable supply of energy has become an important problem from the standpoint of improving the people's welfare and stabilizing the economy even more than in the past. This will entail even greater efforts in energy conservation and movements to assure ourselves of a stable supply of oil. There is also need to revise the energy structure which depends so greatly on oil and actively promote development and introduction of energy and resources to take the place of oil.

The "provisional long-term energy supply and demand perspective" issued by the Demand and Supply Subgroup of the Advisory Committee for Energy in August of last year (intermediate report) cited the need to reduce the fraction of the primary energy contributed by imported oil from the present (JFY 1977) of 74.5 percent to about 50 percent by JFY 1990.

Nuclear energy, coal, and LNG are among the principal candidates to become oil alternate energy, and these are expected to be supplemented by hitherto unutilized forms of energy such as solar, geothermal, wind power, small and medium hydroelectric power, and biomass type natural energies to balance the large volume now accounted for by oil. There is also hope that waste heat and wastes can also be utilized. These should be exploited as much as possible and effectively utilized.

On the System

Local energy system refers to an energy supply system which utilizes energy resources close at hand and does not necessarily tie in with present energy supply and demand systems and is operated mainly by local companies according to the local supply and demand structure and in which the supply structure is tied in organically with the local situation to comprise a dispersed energy demand and supply system.

Energy resources under consideration for local energy systems include: (1) solar, geothermal, medium and small hydroelectric power, wind power, biomass, and sea energy type so-called natural energies; (2) trash-burning plants and power plants, waste heat utilization from various sources, utilization of waste heat and waste material from various industrial wastes including waste water; and (3) combinations or multiple uses of the above.

Among the energy sources cited above, there are some which are already in practical use and some which are in the research and development stage. The scale of utilization is very broad starting with individual home scale then individual industry and group scale unit application up to district level. The volume which can be handled by these units is presently very limited, but it is useful in supplementing the present energy supply systems.

Features of the System

The following three features can be offered for the local energy system.

(1) It is a clean oil alternate energy, and its impact on the environment is small. Fossil energies such as oil and coal are associated with the emission of NO_x, SO_x, and dust thereby necessitating pollution prevention controls. Since local energy systems use mainly natural forms of energy, it may be said to be an overall clean form of energy system. In fact, it utilizes energy from waste products and thereby serves to lighten the impact on the environment.

(2) It is a creative type energy. Where we had been consuming finite energy as represented by oil, this system utilizes reusable forms of natural energy found in a given region or waste heat and waste products energy which is produced according to the local need by a local society, and this system is thereby cultured and propagated. As the result of this system, a consumer who hithertofore had been on a one-way road of energy consumption, by participating in the energy producing activities known as local energy system, will be shifted from his former passive state to an active state. At the same time, there will be a contribution to expanded volume in domestically produced energy.

(3) It is a community energy. As represented by the maintenance of a large capacity electric power source remotely located from the demand center, the energy supply system of the past more often than not was one in which the supply source and the demand area were considerably removed from each other. In contrast, the local energy system consists of small-scale and locally dispersed supply system which responds to the demands of the local society. It develops and utilizes local energy within the local area, and it is an energy supply system having strong local restorative and welfare providing properties.

Resources Characteristics and Trends in Technology Development

The resources characteristics of local energy, trends in technology development, and principal applications at the present time are compiled in Table 2.

Problem Areas in System Development and Utilization

With the exception of a small number of examples, local energy system development and utilization at the present time is still far from attaining the practical stage. The following problem areas need to be resolved if this program is to be actively promoted from here on.

(1) Information related problems: The public which is accustomed to using oil in large volume at low cost does not take too fondly to local energy except for some small minority. Despite the presence of precious domestic energy about us, we have inadequate information with regard to the reserves, uses, and manner of utilization of this energy.

(2) Technology related problems: Generally speaking, local energy is low density and unstable energy, and considerable difficulty will be encountered at the present time in order to provide sufficient quality and volume for industrial use. The technological response to this situation has been focused mainly on large-scale technology pursuing the present scale merit principle, and technology development directed at medium and small-scale utilization has been delayed.

(3) Cost related problems: The cost area is very closely related to the technology problem. At the present time, with the exception of some geothermal plants, the economics of local energy systems is frequently much higher than that of present energy sources headed by oil. The reason for this situation is the aforementioned delay in basic research and development and technology development as a result of which the efficiencies of energy recovery and utilization are low. At the same time, demand has not developed adequately making for a small market as a result of which there is as yet no standardization and mass production of equipment. Furthermore, this is a dispersed system with small scale per item that it becomes unavoidable that the investment at the initial stage per unit is comparatively high (on the other hand, initial investment load is recovered in the future through the running cost while it is actually recovered through the fixed costs alone).

(4) System front related problems: The various supply businesses in the future energy policies and the various systems related to technology development for these businesses generally are based on the premise of large-scale and concentrated supply system such that there are many facets which are not suited to the development and introduction of locally dispersed type local energy.

(5) Promotion main body related problems: While it is to be expected that the local residents, industries, groups, and self-governing bodies will actively play the role of main bodies in the development and utilization of local energy, the present situation is such that there is lack of awareness of the need, lack of information and experience, and lack of establishment of the main bodies for organization popularization and enlightenment and cooperative industrialization.

Promotional Plan for Development and Utilization

In order to promote local energy development and utilization, there is need to: (1) establish a principal body to promote development and utilization; (2) obtain information of local energy resources reserve and set up a development and utilization plan based on the information; (3) promote technology development; (4) promote industrialization and activate popularization and enlightenment; and (5) resolve procurement of funds necessary to development and utilization, and industrialization type problems have to be approached with a development and utilization promotion plan which organically ties together man, material, and money. These points will be elaborated in detail below.

Principal Body To Promote Development and Utilization

Development and utilization of local energy is designed to supply energy in a manner suitable to the characteristics of the region using local energy resources to fulfill local energy demands, and the active participation of the local residents is necessary to its development. To this end the local residents must fully appreciate the significance of local energy development and utilization and independently devise the manner in which this development and utilization can be attained. That is to say, local energy is not a problem to be considered from the viewpoint of quantitative assurance of local energy but should aid local promotion, employment, and welfare as well as improve the living standards of the local people. Looking at the local energy development and utilization systems, the present picture is that, with the exception of a small segment, the local people are not participating as the main body in promoting development and utilization plans on an organized basis. Consequently, it is thought important, for the time being at least, that the prefecture, cities, towns, and villages which are the local self-governing bodies take the principal roles in actively promoting development and utilization. To this end, the local self-governing body must take hold of the energy problem as its own problem and create a consensus at the self-governing body level on the need for local energy development and utilization.

Establishment of a Development and Utilization Plan

In setting out to promote development and utilization of local energy, the first step is the grasp of the actual local energy demand situation. This demand needs to be classified according to block or to type of application and be studied from a systematic angle to follow monthly as well as annual changes and thoroughly understand the energy demand structure of the region. Only after this approach has been taken should means of fulfilling the actual demand through the available supply be studied. As far as the supply side is concerned, the actual picture of local energy reserves and potential sources have to be established and accurate surveys based on what can be recovered and used are necessary. To this end, it should not be the average reserves but detailed surveys which take into account energy resources characteristics such as temperature levels, energy forms, daily changes, monthly changes, and annual changes are necessary to enable site selection. This data on both the demand side and the supply side should be the basis to construct the local energy development and utilization plan.

Promotion of Technology Development and Industrialization

As stated before, a local energy system is not on a level with existing energy supply systems both from the technology and cost viewpoints as a result of which it is not yet sufficiently reliable to assure a stable supply of a fixed fraction of the energy supplied by existing systems both in quantity and quality. On the other hand, a local energy system is (1) a local energy system while being associated with initial investment load per energy unit which is considerable, it utilizes natural energy and waste heat and waste materials so that the running cost is quite advantageous compared to existing systems. (2) The recent large increases in the price of oil has brought about considerable lowering of the profit line. (3) Should the market expand in the future as the result of energetic popularization and enlightenment programs, mass production will become possible, and the possibility of costdowns becomes greater. (4) As the result of promotion of development and utilization technology and exchange and disclosure of technology development information, the collection efficiency of energy can be improved while equipment and systems can be improved to enable lowered costs as a result of which this system will in the future be able to supplement existing systems to a certain degree.

To this end the country and the local self-governing bodies must join as one and actively promote leading and basic technology development. At the same time, they should subsidize and promote technological development by private industry. Furthermore, they should use model industries to study the possibility of industrialization. In addition, a more specific aid will be the provision of adequate subsidy management at the initial stages so that the people, industries, and self-governing bodies which conduct business using local energy can have their initial investment load and risk lowered.

Development and Utilization of Local Energy and the Procurement of Capital Required for Industrialization

In the development and utilization of local energy the mode of obtaining capital for the main body of development and utilization and for the industrial scale, contents, utilization application, and technology development stages are again diverse. On the other hand, as mentioned before, the overall picture is that the initial investment load is large, and the need for some sort of subsidy management to lower this load arises in many cases.

At the present time, there are already a number of examples in which development and utilization of local energy is being pursued on the part of what is considered leading local self-governing bodies to independently seek subsidy management for the utilization of solar systems, medium and small waterpower systems, or power generation systems using trash.

At the same time, the country has included in its JFY 1980 budget stipends for funds which various prefectural organizations can draw on in local energy related matters and to subsidize surveys directed at exploring the reserve level and development possibilities of local energy. Furthermore, subsidy funds have been budgeted for solar systems, geothermal systems, and medium and small hydropower systems. In addition, energy forms such as wind power, sea power, and biomass which are not yet in the practicalization stage are the subjects of research on leading and basic technological development directed toward industrialization under the comprehensive research program of the Sunshine Program.

Concluding Statements

As discussed above, the development and utilization of local energy is still beset with a large number of problems awaiting resolution with regard to the volume of potential supply, its stability, and its economic aspects. On the other hand, a country so lacking in natural resources as Japan must muster the efforts of all its people to avail itself of the undeveloped local energy which is around us. At the same time, the nation must position a local energy system promotion program into its energy policy and develop this policy to improve the stability of the energy supply of local society and to expand the volume of the country's energy through the people's actions. To this end (1) there must be subsidies management in the form of loans and tax breaks to promote local energy development and utilization; (2) promotion of leading and basic technology; and (3) organization of popularization and enlightenment structure to promote development and utilization of local energy.

Local Energy System

	Energy Classification	Characteristics of Energy Resources	Directions in Technological Development	Principal Utilization Applications at the Present Time
waste heat and waste materials utilization energy	Utilization waste heat energy	Utilization of waste heat from trash incinerators, factories, and power plants. There are energy sources such as the cold heat associated with the vaporization of LNG, and there is good possibility that diverse applications are possible such as conversion to power generation. As far as the quality of energy is concerned, it is greatly controlled by the type and quantity of trash	The technology for heat generation and hot water supply by utilization of trash incineration and waste heat from factories has already been demonstrated, and it is presently in the practicalization and popularization stage. Problems remaining to be solved are prevention of corrosion and eliminating dust troubles. Cold heat from LNG vaporization is being utilized in a practical manner in refrigeration units, and a LNG vaporization cold heat power generation system is presently in the demonstration stage.	There are presently (as of March 1978) 26 sites over the entire country (as of 1978) where power generation from trash incineration power plants is under way. There are some who not only supply their own power needs but also sell power to power companies. There are also some examples in which public facilities and hot water pools are being supplied with hot water. There is presently only a single site which utilizes factory waste heat, and this heat is used to provide a hot water supply which is circulated to about 500 homes. There is also a number of examples in which factory heat and waste factory energy are being activated and used within the plant. At the present time, the LNG cold heat is utilized by cold storage operators and by liquid nitrogen and liquid argon production businesses.
waste heat and waste materials utilization energy	Waste utilization energy	This is mainly utilization of household wastes, utilization of wastes, and utilization of plant wastes to energy recycling. It may be said that energy from wastes utilization is mainly recovered as methane fermentation fuel and used in the form of chemical energy	Methane fermentation technology using urban sewage has been partly practicalized in the form of a medium temperature fermentation system. Dry gasification of urban wastes has also become practical. Methane fermentation by urban trash treatment is presently in the research and development stage. There are many examples in which wood wastes utilization technology has been put to practical use, and utilization technology to fit these energy forms to the needs of the user is presently being developed.	An example of methane fermentation using livestock waste is that in which waste from hogs is used to heat the animal pens. There are some examples in which hothouses are heated by this route. Methane fermentation using liquid wastes from factories is directed mainly to fuel and heating utilization. There is fuel formed from woody wastes such as from sawdust and tree bark, but this production peaked in 1969 and has been declining. Studies are under way to pelletize these wastes to produce general household fuel and fuel for vinyl houses. Many types of fuel producing processes are being studied, but the volume is still rather small.
system utilization energy	Chemical energy (hydrogen)	fuel cell power generation (NG utilization)		
system utilization energy	Multiple uses	energy conservation urban mechanical system community energy system total utility system		

Table 1. Objectives of Local Energy System

Energy Classification	Energy Type			Example of Energy Conversion and Utilization
Solar	thermal energy			solar thermal power generation solar thermal multiple utilization (solar system)
	photoenergy			solar photoelectric power generation
Wind power	kinetic energy			wind power generation wind power multiple utilization
Medium and small hydropower	positional energy			medium and small hydroelectric power generation medium and small multiple utilization of water power
Geothermal	thermal energy			geothermal power generation multiple purpose geothermal power generation
Biomass	chemical energy			utilization of alcohol as fuel (methyl, ethyl alcohol) biomass utilization
Marine	kinetic energy	wave power		wave power generation multiple utilization of wave power
	positional energy	tides		tidal power generation multiple utilization of tides
	thermal energy	temperature differential		temperature differential power generation multiple utilization of temperature differential
Waste heat utilization	thermal energy	trash incineration waste heat		trash incinerator power generation multiple utilization of trash incineration heat
		waste heat from factory powerplants		factory waste heat power generation, furnace top pressure power generation multiple utilization of factory and power generator waste heat
		LNG liquefaction cold heat		LNG liquefaction cold heat power generation multiple utilization of LNG liquefaction cold heat
Waste products utilization	chemical energy	household waste	garbage and trash	utilization of methane fermentation gas from trash treatment
			plastic wastes	utilization of dry distillation gas from trash treatment
		excreta	human	utilization of methane fermentation gas from treatment of sewage (treated)
			animals	utilization of methane fermentation gas from treatment of animal wastes
		factory waste products	waste liquid	factory wastes for methane fermentation
			woody materials	waste wood for fuel (such as Ogalite)
System utilization	chemical energy	hydrogen		fuel cell power generation (NG utilization
	compound use			energy conservation urban mechanical system community energy system total utility system

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000300070035-3

Table 2. Characteristics of Local Energy Resources and Trends in Technological Development and Utilization

Energy Classification	Characteristics of Energy Resource	Trends in Technology Development	Principal Present Applications
Solar energy	This is energy with the greatest reserves, its worldwide polarization is small, and it is the source of all forms of energy. On the other hand, its energy density is low as a result of which technological problems arise in its recovery for high level of utilization.	At the present time, thermal utilization of solar energy is in the stage of practicalization to provide household hot water, heat some public facilities, and heat in solar house for residential use. Power generation using solar heat is still in the development stage. Solar photoelectric power generation is associated with high manufacturing cost.	Heating, cooling, and hot water supply for solar house which is a practical example of solar heat utilization. Small solar battery (used as satellite power supply type very specialized application) utilizing sunlight
Wind power energy	It is distributed in geographical and time polarization patterns and has low energy density. The use of wind power energy has a long history, and it has been used to power small generators and provide mechanical power (for pumping water). When the ease of conversion to electric power heat and the potential of future multiple uses are considered, this form of power is thought to have great potential for certain locales.	Small-scale power generation and power conversion is already practical, and medium and large-scale wind power generation is under research and development at the present time and nearing the demonstration stage. Multiple utilization of wind power by conversion to heat, conversion to compressed air and conversion to hydrogen energy is in the research and development stage.	Small and medium-scale wind power generators are being used as household power source, observation use power source, and remote island power source.
Small and medium hydropower energy	Medium and small hydroelectric power plants are distributed over the entire country, but local weather conditions are particularly favorable in Tohoku, Chubu, and Hokuriku districts. The quality of energy is controlled by the rainfall, and there is need for active development of this source as an unlimited energy source.	Small and medium hydroelectric power plants are already in the practical stage, and policies to promote development are now under study. On the other hand, medium and small hydroelectric power plants are costly compared to existing power plants, and a number of technological problems are left with regard to lowering the cost of power generation systems.	Construction of medium and small hydroelectric power plants is increasing with local self-governing bodies, agricultural cooperatives, and land improvement districts serving as the organs pushing the construction. The power generated is designed for self use, and any excess is sold to power companies.

(natural energy)

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000300070035-3

Table 2. [continued]

Energy Classification	Characteristics of Energy Resource	Trends in Technology Development	Principal Present Applications
Geothermal energy	Geothermal energy is dispersed through resources such as shallow hot water systems, deep hot water systems, high temperature rock, volcanic energy, and nonvolcanic hot water systems. It is estimated that there are 220 potential geothermal zones in Japan. Since these geothermal areas are usually located near sites of natural beauty, there is need to harmonize such geothermal development with the environment.	It may be said that geothermal power generation using shallow hot water systems is already in the practical stage, and technological development on deep hot water system and high temperature rock systems utilization is still in the research and development stage. Multiple purpose and wide area hot water supply technology is beset with problems such as corrosion and is still in the research stage.	Geothermal power generation is presently under way at six sites operating on shallow hot water systems, and the power is supplied to the general run of consumers. There are many examples in which geothermal energy is used as heat source for hothouses.
Biomass	In a direct sense, this refers to plant life. In an energy resources sense, it refers not only to forests and agricultural type flora but also organic materials formed and discarded by animal life. It can be converted to thermal energy by combustion, turned or converted into chemical energy such as methane and alcohol. This energy source assumes great potential when the biomass available in the seas is considered.	Technology to produce alcohol from sugar cane has already reached the practical stage in Brazil, and there is research and development under way to use a variety of plant materials such as sweet potatoes to produce fuel. Production of methane from animal wastes is already at the practical stage.	Alcohol is being produced in Brazil from sugar cane and is being mixed with gasoline and used as fuel for automobiles. Except for utilization of wastes, this approach has not attained the practical stage in Japan.
Marine energy	This refers to energy in the sea in the form of wave power, tides, sea currents, and temperature differential. These forms of energy are found all over the oceans and are associated with unlimited reserves of perpetual nature. The individual forms display geographical bias in distribution.	Small scale wave power generation is already in the practical stage, and medium and large scale plants are now approaching the demonstration stage. Sea water temperature differential power generation is presently in the research and development stage and expected to enter the demonstration stage in the near future. Research is being continued on the production of fresh water exploiting this sea water temperature differential.	A specific example is the power source being used to light buoys utilizing wave power. There is presently a 2,000 kw power plant under experimentation in the Yamagata Prefecture as an example of a large scale plant. Sea water temperature differential power generation is presently in the research and development stage, and it has not yet come up to the practical stage.

(The Geothermal energy, Biomass and Marine energy rows are bracketed as: natural energy)

Solar Energy

Tokyo DENKI GAKKAISHI in Japanese May 80 pp 45-53

[Article by Tatsuo Tani, Energy Department, Electrotechnical Laboratory: "Development of Solar Energy"]

[Excerpt] 1. Introduction

The energy resources problem facing the world recently is fluid and does not permit any optimism, and this problem is felt particularly deeply in Japan which is a resource poor country. This situation is prompting great thought toward the development of alternate energy to replace the energy resources used presently, and research and development directed at obtaining alternate forms of energy is under way in the various countries of the world.

Full-fledged research and development on solar energy and other substitute energies in Japan was initiated in JFY 1974, and the results are gradually becoming practical.

The conditions an alternate energy must fulfill are, first of all, it must be abundant in volume, it must be nonpolluting and safe, and it should be expected to maintain a low price structure in the future. This paper will discuss the status of research and development on solar energy utilization technology both domestic and foreign and include some of the prospects for the future.

2. Meteorological Survey in Japan

The knowledge of the quantitative energy available from incident sunlight and the elucidation of its properties are extremely important to the development of solar energy utilization technology.

Meteorological surveys in Japan have been promoted in Japan centered mainly on the efforts of the Meteorological Society of Japan since JFY 1974, and the meteorological pattern has been clarified [1]. The results are discussed below.

2.1 Distribution by Locales of Total Incident Sunlight

Daily sunlight observation data from 60 sites throughout the country provided by the Meteorological Agency were the basis for a study on the estimation of the total incident sunlight. The various factors which are thought to affect this total incident sunlight value were studied such as physical factors along with case example analysis and statistical analysis to derive the following regression equation.

$$Q/Q_0 = 0.146 + 0.534\ S/S_0 + 0.047\ G_{10} + 0.036 \sin H \quad \text{.................... (1)}$$

(Data number: 39 sites, duration: 966 months, multiple correlation coefficient: 0.965, standard error: 0.018)

Q: average monthly incident sunlight (estimated value)

Q_0: average monthly planar incident sunlight outside atmosphere (calculated value)

S: monthly daylight duration (measured value)

S_0: possible monthly daylight duration (calculated value)

G_{10}: ratio of number of days (observed value) in month when snowfall exceeds 10 cm (0-1)

H: sun's southern altitude on the 15th day of month (calculated value)

This equation enables the estimation of the total incident sunlight Q with an error of 5 percent.

Q values were calculated for every month of the year on each of 153 sites throughout the country, and the various statistical values which were derived are discussed below.

(1) Northwest seasonal wind in winter: The equal value line in winter runs parallel to the Japanese archipelago, and this line clearly displays the adverse weather of the Japan Sea side and the good weather to the Pacific Ocean side. The ratio of fair days is extreme in December and approaches the ratio 1:3.

(2) Rainy season: The northward pattern of the rainy season line in May-July is evident. The variations in June and July are greater than in other months indicating the wide variation in rainy season activity year to year.

(3) Ocean fog: The small incident sunlight at the southeast and northeast regions of Hokkaido can be attributed to the well-known ocean fogs which blanket this area.

(4) Average incident sunlight in Japan: The average incident sunlight over the entire country becomes maximum in May with a value of 410 $cal\text{-}cm^{-2}day^{-1}$ while the minimum is about 150 $cal\text{-}cm^{-2}day^{-1}$ in December. The average for the year is 290 $cal\text{-}cm^{-2}day^{-1}$. Excepting June and July, there is a variation of 8-12 percent per month while the yearly average undergoes about 3-5 percent variation.

As stated above, the average incident sunlight on Japan is 290 $cal\text{-}cm^{-2}day^{-1}$, and this value is about the same reported for the European countries such as northern Italy, Switzerland, southern France, Spain, and Portugal and southern Canada in North America. The greater part of the African continent received more than 50 percent compared to Japan along with the Middle and Near East countries, India, southern Burma, southern Thailand, Australia, and western, north and south America which border the Pacific Ocean. Assigning these countries the classification of sunlight resource rich countries, Japan comes under the classification of a medium sunlight country, and central and northern Europe are resources-poor countries.

2.2 Directly Transmitted Sunlight, Diffuse Sunlight

Observational data on directly transmitted and diffuse sunlight are poor, and the data on hand have limited applicability as a result of which continuous observations on these values were initiated in JFY 1975. At the same time, research on sunlight characteristics and estimation of directly transmitted sunlight are being continued.

At the present time, the following are the sites where observations have been completed or are being contemplated.

Sapporo (Meteorological Agency), Sendai (Japan Meteorological Society), Matsumoto (Meteorological Agency), Nagoya (Japan Meteorological Society), Fukuoka (Japan Meteorological Society), Kagoshima (Japan Meteorological Society, completed).

In another direction, meteorological observations were initiated in March 1977 at the site being prepared for a 1 MW solar thermal power generation plant (Nio-machi, Kagawa Prefecture). The data obtained here will be applied to the construction and design as well as the post construction maintenance, operation, and research.

3. Direct Utilization of Solar Thermal Energy

3.1 Solar Thermal Heating and Cooling

Solar heating and cooling and hot water production designed for residential use, collective homes, and public facilities along with research and development on solar thermal heating and cooling are under way in Japan, and data collection and analysis of the various systems are under way. The temperature of the heat collected is of the order of 100°C which is comparatively low, so that it is expected to become the first type to become practical. The technological results obtained during the past few years are truly remarkable. This approach is progressing satisfactorily, technologically speaking, from the standpoint of stabilizing the energy supply, and the problem is economic. An example simulating the economics of this system is next described. This simulation will be based on the sunlight data for the different areas of Japan and the present (1978) cost basis to clearly show what level of economics the solar thermal heating and cooling systems occupy.

The results obtained for a single unit of 100 m^2 floor area of a 2-story and 2-unit terrace home of concrete construction using solar thermal heating and cooling are shown in Table 1. This table was thought to apply to a site in the suburbs of Tokyo in which FOM is the index of the economic nature and 1/FOM is cost of installations for the solar thermal system/cost of yearly saving in energy. According to these results, (1) improved durability (20 years), (2) rise in cost of energy (10 percent), (3) costdown (assumed to be 70 percent taking into account standardization and mass production), and (4) improved performance of system (increase in energy saved, miniaturization of necessary systems) and the four conditions which would enable comparison of

Table 1. Comparison of Estimated Values Between Yearly Simulation and Effect Estimation Table

System	Cooling + heating + hot water system
A. Regional nature	suburbs
B. Heat holding property of building	good
C. Heat collecting area	50 m^2
D. Heat storage capacity	0.12 t/m^2
E. Temperature holding property of heat storage layer	(good) 0.2 $kcal/m^2h°C$
F. Set temperature	cool 85°C, warm 50°C
G. Backup site	series
H. Collector position	south
I. Collector angle	latitude -10°

Type of Property	Yearly simulation	Estimated value from effect estimation table	Unit
Total dependency rate on sun for year	79.94	79.86± 3.06	percent solar
Quantity of energy saved for year (including power)	9,842.75	9,657.50±448.93	Mcal/year
Cost of energy saved for year (versus gas)	98.49	100.31± 5.24	1,000 yen/year
Cost of energy saved for year (versus lamp oil)	45.96	46.86± 2.64	1,000 yen/year
1/FOM (versus gas)	42.02	38.80± 3.53	
1/FOM (versus lamp oil)	90.06	85.08± 9.43	

its economy with that of gas should one of the conditions be fulfilled. Should two of these four conditions be fulfilled, its economy is expected to compete favorably with that of lamp oil [13].

Estimates were made on the volume of energy consumed in the past, number of dwellings, and heating and cooling loads in a number of studies directed at estimating the rate of increased use of solar systems.

According to the results of one of these studies conducted by the Advisory Committee for Energy, there will be 3 million hot water heaters, 80,000 heating and cooling systems, 10,000 heating and cooling and hot water systems in 1985 operating on solar energy which are expected to increase to 6 million, 400,000, and 200,000 respectively in 1990.

According to a report of the Air Conditioning and Sanitation Engineering Society's solar thermal heating and cooling committee, a program to break up the development into 3 stages up to the year 2000 will show the solar dependency rates displayed in Table 2. While these are rather bold estimates, it is estimated that there will be 4×10^7 homes in the year 2000, and the solar dependency rate will be 15.2 percent of the heating, cooling, and hot water supply energy of these homes.

Table 2. Estimated Solar Dependence of Residential Heating, Cooling, and Hot Water Supply (Japan)

1 期	2 年代	3 住宅戸数 (10^4戸)	4 給湯 (10^{12} kcal/a)		5 暖房 (10^{12} kcal/a)		6 冷房 (10^{12} kcal/a)		7 太陽依存率 (%)
			T	S	T	S	T	S	
I	1980年まで	830	76	3	106	0.1	15	—	1.4
II	1990年まで	835	135	18	155	5.4	27	0.05	7.3
III	2000年まで	840	200	44	200	23.1	80	0.35	15.2

9 T: 全所要エネルギー, S: 太陽依存エネルギー

Key:
(1) period
(2) year span
(3) number of homes (10^6 homes)
(4) hot water supply
(5) heating
(6) cooling
(7) solar dependence rate
(8) up to --
(9) T: total energy required
S: solar dependent energy

Research is being hastened in Japan to enable system demonstration in order to popularize this solar system as much as possible, and it has been decided to provide a subsidy system to fund public industrial bodies and local self-governing bodies from JFY 1980.

In another direction, research is being promoted on solar heating and cooling systems in the different countries of the world, and there has been some clamor about the need for international cooperative efforts. The IEA is presently conducting cooperative research on the following five items:

(1) Modeling and simulation of solar heating and cooling systems

(2) Research and development on solar heating and cooling components

(3) Methods of testing solar heat collectors

(4) Compilation of incident sun handbook and development of simple incident sunlight gauge

(5) Application of existing meteorological data to solar energy utilization

Japan is participating in research on items (1)-(3) and some interesting results are expected.

As discussed above, research and development on solar heating and cooling is being conducted on various fronts, and the following items have become clarified in Japan with respect to the application of solar systems to homes.

(i) Considerable energy conservation can be realized through the use of solar heat.

(ii) The solar system is capable of adequately handling the increase in heating and cooling energy anticipated for the future.

(iii) The thermal insulation of buildings is simple both from the work involved and the economics, and the effect is substantial.

(iv) The vacuum glass collector has high performance, and by selecting a collecting area which represents a good balance between load and area, the performance can be exploited to provide maximum effect.

(v) There is an optimum volume of the heat reservoir tied into the heat collecting area. A heat storage capacity which is too small results in very pronounced deterioration in the solar dependence rate, and too large a storage capacity does not necessarily improve the solar dependence rate. Energy loss such as loss in stored heat becomes very noticeable particularly when the heat reservoir has poor heat retaining property or high temperature energy is stored.

Research and development subjects left for future resolution are as follows:

(a) Exchange and treatment of information handled between various countries on hardware which is seeing development yearly.

(b) Study of the economics under various differing conditions through year-round system simulation.

(c) Improvement of overall safety and establishment of evaluation methods including weatherability and wear of the system and equipment.

(d) Study of possibility of applying the solar heating, cooling, and hot water supply system to other areas for alternate energy.

(e) Research and development and study of possibility of very simple systems designed to aid developing countries.

(f) Research and development and study on possibility of effective systems designed for technological cooperation or product export to oil producing countries.

(g) Surveys on the areas and conditions with greatest promise of most effective practicalization of solar systems and their marketability.

4. Solar Power Generation

4.1 Status of Research and Development in Japan

Research and development of solar thermal power generation has been under way in Japan since JFY 1974 as one phase of the Sunshine Program and is being promoted through close ties between the national research organs and industry. A small scale solar thermal power generation system is being used to conduct basic research on solar thermal power generation at the Electrotechnical Laboratory. In another direction, the Electric Power Development Company is constructing a pilot plant at Nio-machi in Kagawa Prefecture using a curved collector mode and a tower collector mode, and it is expected that installation will be completed in JFY 1980 and this will be followed by 2 years of operational research.

The rated output of this plant is MWe, and the standards used in the construction are such that power generation of rated output can be produced when the incident sunlight intensity is 0.75 kW/m^2 on the normal surface for the 2 hours following the meridian in summer or spring. The heat storage capacity of the plant can be developed from 3 hours rated operation and stored in pressurized water heat reservoir (sensible heat storage) or a molten salt heat reservoir (latent heat thermal reservoir). The turbine inlet conditions for the respective plants are 343°C and 15 ata (curved surface heat collector) and 187°C and 12 ata (tower heat collector) respectively.

The principal purpose of the construction of the solar energy thermal power generator and the operational research is to demonstrate that the technology is available to construct a solar thermal power plant. At the same time, it should bring out various technological problems and allow the accumulation of production processes and operational data. It will also allow studies on the economics as a commercial plant. In this manner the completion of the solar thermal power generation plant is within firing range, and hopes for solar thermal power generation are increasing.

In addition, thermal and electric double solar system (solar total energy system) with the objective of multiple utilization of solar energy is under basic research as another application of solar energy thermal power generation.

which is being pursued at the Electrotechnical Laboratory. This system directs collected solar heat for conversion to electrical energy, industrial process heat, or utilization in heating and cooling. It utilizes low density solar energy to a wide range of diverse applications to not only improve the operating rate of the system but to improve the efficiency as well.

There is the following energy demand pattern in Japan which lies in the background of the development of this system. That is to say, the long-term energy demand predictions for Japan are taken up for the greater fraction by the industrial sector. For example, between 60 and 66 percent of the total energy demand in the year 2000 is expected to be accounted for by the industrial sector [5]. The breakdown in energy consumption per plant in Japan at the present time is shown in Table 3. The volume of energy consumed both as electrical and thermal energy at a light industry plant is about 500 kWe electric and 3,000 kWt, and the ratio between the 2 is 1:6 [6]. Furthermore, the final state of energy demand in Japan is expected to assume the pattern shown in Table 4, and thermal energy below 350°C makes up 47 percent of the total [7].

Table 3. Energy Consumed Per Industrial Plant in Japan

Industry	Electrical energy (kWe)	Thermal energy (kWt)	Ratio kWt/kWe
Light industrial system	529.6	3,093.7	5.84
Chemical-steel systems	2,576.0	49,600.5	19.25
Machine-metal systems	1,422.4	3,125.0	2.2

Table 4. Final State of Energy Demand in Japan

Thermal energy		68 percent
	100°C less than	22 percent
	100 - 315°C	25 percent
	315 - 600°C	6 percent
	600°C less than	15 percent
Liquid fuel for transport (for automobile use)		20 percent
Electrical energy		12 percent

According to the results of certain studies, the installation of sunlight and heat collectors on the roofs of factories and in the surrounding yards in Japan will be able to supply more than 50 percent of the necessary energy consumed in a production plant [6]. There are any number of problems which need to be resolved in the development of a system to accommodate changes in incident sunlight and changes in load, but success with such a system is expected in the future.

In addition, plants are under consideration in which solar energy thermal collectors are installed in the yard of an existing power plant and used as heat source to supply hot water to the power plant. This plant not only will enable improved overall efficiency of existing power plants, but also makes fuel economy possible. The existing large capacity thermal power plants possess considerable open space. Even making allowances for the necessary yard area to conform to safety and environmental specifications, it should be possible to install sunlight and thermal energy collectors which take up 10-20 percent of the overall area.

We assume here a combined solar thermal and firepowered power generation plant including a 1,000 MWe LNG fired thermal power plant in whose surrounding yard sunlight and solar energy collectors are installed (collecting area 30,000 m^2) and the thermal energy obtained from these collectors is used to heat the water supply. According to the results of this study, the overall efficiency of this combination plant is about 0.2 percent better than that of the firepowered plant alone, and the volume of LNG which can be saved is about 1,100 ton/year. If now 10 plants throughout the country are converted to this type of power plant, this will be a saving of 10,000 tons per year and 150,000 tons for the 15 years of the assumed life of the power plant [8].

At the same time, the use of a combination plant renders unnecessary major improvement to the high pressure heater. When the volume of steam entering a high pressure heater is small compared to the volume of exhaust gas from the high pressure turbine, any effect from the variations in heat collected by the solar thermal energy collector is thought to be small, and there seems to be no factor to greatly affect operational control and maintenance. When all of these points are taken under consideration, this mode has great promise for the future depending on the construction costs of solar thermal energy collectors.

4.2 Economics of Solar Thermal Power Generation

The solution of various technological problems and the establishment of systems which rank high in comparison to the construction costs of existing power plants or unit cost of electric power are extremely important in order to enable practicalization of solar thermal energy power plants, and so that solar thermal power plants are not saddled with fuel costs. Since the energy source is solar energy, should the use of gigantic sunlight and solar thermal energy collectors which have to stand for long periods outdoors become necessary, it is imperative that these collectors maintain optical precision over long intervals, and the operating rate can suffer in comparison with existing power plants even though heat reservoirs are installed. In this manner, this type of power plant differs from power plants of the past, and the cost is expected to rise.

At the present, there are more than 10 solar thermal energy power plants under construction or in the planning stage throughout the world, and the capacity of these plants covers the wide range from very small to about 10 MWe.

The present construction cost of solar thermal power plants and that predicted for the future are compared in Figure 1 [10] [not reproduced]. The cost of constructing solar thermal power plants is greater than that of existing power plants (nuclear power, coal fired thermal) but it is predicted that costs will come down to the stage that they will become competitive in the 1990 decade.

In Japan, what may be an existing power plant with which the present solar thermal energy power plant can be compared is probably a hydroelectric power plant. The cost of constructing hydroelectric power plants presently is about 500,000 yen/kWe, the cost of power generation is estimated to be 30-40 yen/kWh, and there are many factors common to both modes. It is estimated that the 1 MWe solar thermal energy power generating pilot plant in Japan is associated with construction cost on an order greater than the construction cost of a hydroelectric power plant. There is need for efforts to lower the cost to the abovementioned levels through future research and development efforts.

On the other hand, a breakdown of the construction costs of the pilot plant according to different facilities shows the fraction of the total cost taken up in both modes by the sunlight and thermal energy collectors is about 50 percent. At the same time, the construction of the collector unit of a 10 MW pilot plant in the United States accounts for about 70 percent of the total cost, and this demonstrates what a large fraction of the total cost is taken up by these light and heat collectors. In this manner, the construction of sunlight and solar thermal energy collectors at as low a rate as possible is one of the major subjects to be tackled in order to lower the construction costs of these plants.

The development of sunlight collectors for a 10 MW pilot plant is being promoted in the United States, and the second phase development plan has just been initiated to enable future practicalization.

The purposes of this research are:

(1) Establish design for low cost, large volume production type sunlight collector (heliostat)

(2) Conduct detailed economic evaluation

(3) Anticipate popularization effect to the industrial world on a wide scale

(4) Recognize research and development subjects

4.3 Energy Analysis for Solar Thermal Power Generation

Energy analysis of solar thermal power plants is being conducted in Japan. The purpose of an energy analysis is to compare the energy directly and indirectly necessary to construct a solar thermal energy power plant and the energy generated by a solar thermal power plant and the comparison of the directions in improvement research on the constitutive elements of a power plant seen from the standpoint of the volume of energy taken, and the results of similar analysis with other power generation modes.

There are a number of methods for conducting energy analysis, and the one which is being studied at the present time is the one in which Japan's industrially related tables are the basic data to determine and analyze directly the quantity of energy (energy content) necessary to produce 1 unit of product is some well known product area.

The analytical results obtained using a mechanical makeup of the 1 MWe solar thermal power pilot plant presently under construction are shown in Figure 4. Assuming that the power plant puts out 1,000 hours rated power a year, it will generate 1 MWh during the course of the year, and its utilization rate will be 34.5 years using curved light collectors and 22.1 years using a tower collector in order to recover the energy required for the construction. On the other hand, should the utilization rate be doubled (2,000 hours rated output per year), it was found that primary steel products and glass used in the light and heat collectors require a large amount of energy. This was why analyses were conducted on the following three cases.

(1) The glass thickness is limited to 2 mm

(2) The primary steel material used in these light collectors is reduced to one-half

(3) The thickness of glass is reduced to 2 mm and the primary steel material used in the light collectors is reduced to one-half.

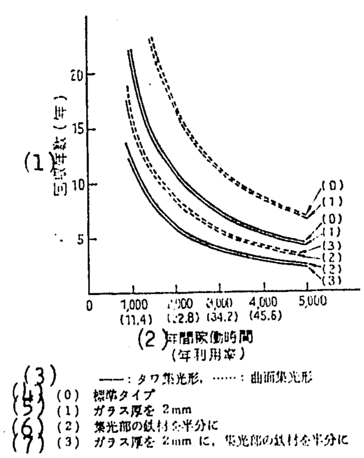


Figure 4. Annual Operating Rate and Number of Years for Recovery

Key: (1) number of years for recovery (years)
(2) annual operating rate (utilization rate for year)
(3) -: tower sunlight collector, ...: curved sunlight collector
(4) standard type
(5) glass thickness 2 mm
(6) steel materials in light collector reduced by one-half
(7) glass thickness reduced to 2 mm and steel materials in reflector reduced to one-half

On the other hand, there are a number of technological and economic problems which need to be solved before this practical stage can be realized. First of all, research to improve the constitutive elements making up a solar thermal power plant needs to be continued. For example, the sunlight and solar thermal energy collectors should be constructed of material requiring small energy input in order to lower costs. This is a type of structural improvement research that needs to be conducted. There is also need to develop heat storage facilities which are adapted to Japan's weather conditions and load patterns. At the same time, it is needless to say that the energy input should be small and the cost should be low on the materials used.

Furthermore, there is need to compile detailed data through operational research on the 1 MWe pilot plant and thereby establish the optimum operating mode of a solar thermal power plant adapted to the meteorological conditions of Japan. Simulation methods have to be used to make this study, and further detailed research is required.

Here are listed some of the future forms of solar thermal power generation:

(1) Power generation solely by solar thermal energy

(2) Compound thermal-electrical solar system

(3) Hybrid or repowering system compounding existing type power plants with solar thermal power plants

Where power generation solely by solar thermal energy is concerned, research and development needs to be directed at large capacity and low cost of the basic system for the future. It is anticipated that this energy source will shoulder a fraction of this country's future energy demands. At the same time, these developments can be expected to become important export technology to be used in international cooperative efforts in the near future.

There is need to promote research and development on compound solar thermal and electric power generation as an effective utilization of solar energy in the future taking into consideration energy demand patterns and incident sunlight patterns. Medium and small systems should be targeted to establish systems conforming to the demand patterns and the sunlight patterns.

All country scale studies on the possibility of combining solar systems with existing power systems are necessary in the area of hybrid and repowering systems. At the same time, there is need for detailed studies on technological problems and on the conservation of energy effect. There is ample ground to say that the results of such studies will enable the practical development of the optimum mode in the near future.

5. Solar Photoelectric Power Generation

5.1 Status of Solar Photoelectric Power Generation

Research and development is being promoted in Japan on the establishment of a technologically and economically sound new photoelectric power generation mode in direct contrast to the present power generation modes by about 1990. The research and development subjects being pursued on solar photoelectric power generation in Japan are listed in Table 5. At the same time, the following subjects are presently being researched.

Table 5. Research and Development Subjects on Solar Photoelectric Power Generation

low cost solar battery	development of mass production technology of low cost starting materials
	development of technology for producing low cost base plates
	development of mass production technology of low cost and highly efficient cells
	development of mass production technology of high efficiency and low cost modules
photoelectric power generation system	development of technology to tie in with power networks
	development of technology to absorb variations in power production (such as accumulation)
	development of utilization states on the way to development
standard evaluation and measurement methods	development of methods to measure and evaluate starting materials
	development of methods to measure and evaluate cells
	development of methods to measure and evaluate modules
	establishment of base body for the actual facility
	international cooperation related items

(1) Development and methods of evaluation of high efficiency and low cost solar batteries.

(2) Research on solar photoelectric power generation systems particularly research directed at the relationships with power systems.

In the area of solar photoelectric power generation medium and small capacity dispersed power generation utilizing buildings in the consumer areas and their surroundings exploiting the features of this system is being studied for application on, for example, the roofs of residences and elementary and middle schools.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000300070035-3

The United States is actively promoting research and development on solar photoelectric power generation with a budget close to 100 million dollars per year. The foundation of this American development plan is the following:

(1) Solar photoelectric power generation has the potential of providing a great amount of electric energy, and it has the capability of providing a considerable fraction of the future energy supply.

(2) Once the technological and economic problems are overcome, this form of power generation should be capable of holding its own with existing methods of power generation.

(3) A plan which invites market interest is important, and the government should adopt a policy of purchasing solar batteries to vigorously activate private interest.

The generation of 50 million kW by solar photoelectric power is targeted by the year 2000.

Independent plans are being promoted in EC, France, United Kingdom, West Germany, and Italy. The new energy development plan adopted by EC has divided the period after 1975 into the first stage (4 years) and the second stage (5 years), and it plans to design and construct power generation plants to generate 2,000 kW during the second stage. A 1,000 kW power plant will be constructed in the northern part of Europe to use various types of solar batteries and be connected to existing networks. At the same time, it is planned to conduct comparative evaluation on the various types of solar photoelectric power plants.

5.2 Economics of Solar Photoelectric Power Generation

The economics of solar photoelectric power generation will be explained through the description of a representative situation in the United States to be used as reference material for this country.

Active research and development on solar photoelectric power generation has been under way for the past several years, and some of the recent research results are as follows:

(1) It became possible to lower incidental cost and manufacturing cost to one-tenth of the former levels.

(2) The objective of attaining the possibility of lowering cost of silicon material to one-fifth was realized.

(3) Light collectors were lowered in price by $2/Wp.

(4) An incidental cost of $1-2/Wp can be expected to create an explosive development of the market.

Looking at the cost anticipated for 1990, the incidental price predicted for 1986 is $0.5 Wp, and the system energy cost is 12-18 yen/kWH (60-80 mils/kWH) [12]. The anticipated production of solar batteries and the price for both Japan and the United States are shown in Figure 5.

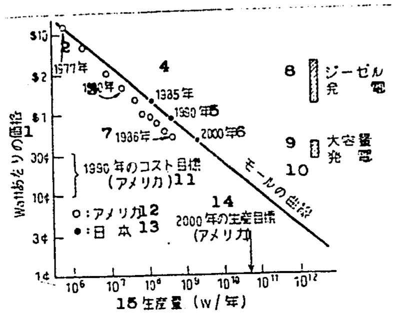


Figure 5. Mol's Predicted Curve and Comparison of Predicted Japanese-American Solar Battery Production

Key:

(1) cost per watt
(2) 1977
(3) 1980
(4) 1985
(5) 1990
(6) 2000
(7) 1936
(8) diesel power generation
(9) large capacity power generation
(10) Mol's curve
(11) targeted cost for the United States
(12) America
(13) Japan
(14) production goal for year 2000 (United States)
(15) production volume (W/year)

In addition, fund subsidies are being granted to Sandia Laboratories, MIT, NASA, and SERI in order to open up the initial market aimed at test evaluation system design, standardization, and energy conservation, and plans are under way to operate 20-500 Wp systems in homes, irrigation projects, permanent tests, and load supply use (prototype system) all over the country.

If construction cost of about 500,000 yen/kW for solar photoelectric power generation (similar to flow-in type hydroelectric power plant) is to be realized under the weather conditions of Japan, the solar battery alley (cell, support stand, land replacement, etc)/m^2 cost should be suppressed to 12,000 yen/m^2 or less when plant efficiency is 10 percent and to 9,000 yen/m^2 or less when the plant efficiency is 7.5 percent according to a certain report [19]. This is something which needs to be given adequate consideration in future development goals.

5.3 Power Generation in Space

The reason space power generation (SSPS) is being supported in the United States is because the solar energy density is 1.4 times that on earth outside the earth's atmosphere, and power generation is possible in a nearly constant manner, independent of night and day and weather. As a result, it becomes possible to generate power utilizing solar energy 10 times that of the earth based figure. At the same time, this environment is in vacuum and low temperature as a result of which the lasting property of the equipment becomes much greater than what can be expected on earth, and the end result is that such a system is very economical. At the present time, NASA is the central organ studying this possibility, and it plans to complete plans for the generation of 8 million kW or so by the year 2000. It may be that the space power generation system may become possible in the future through international cooperative research.

5.4 Future Problems

As mentioned before, there is need to conduct research on a system exploiting the characteristics of the solar photoelectric power generation system as well as to establish evaluation methods for the development of high efficiency and lost cost solar batteries. At the same time, vigorous policies for the initial development are also important.

6. Other Energy Sources

Methods of producing hydrogen by solar energy include the direct thermolytic method and the thermochemical dissociation method. There is as yet no effective reaction process which has been established, but some active research and development as a source of energy for the future is desirable. In addition, the conversion of solar energy to chemical energy through photosynthetic plants is being studied although there is considerable difference in yields between different ecological systems. Research is being conducted aimed at utilizing this photosynthetic capability of plants as an energy source.

(1) Plant solar battery

(2) Hydrogen energy through the photodecomposition of water

(3) Chemical energy stored in biomass

These types of energy are conceivable, and many of these sources are presently being studied at the basic research stage. It is hoped that research and development on the elucidation of the photosynthetic phenomenon will be promoted and methods of its utilization and the development of photosynthetic industrial processes exploiting the capabilities of plants are followed.

7. Final Statements

The above has been a discussion on the status of solar energy utilization technology and its future prospects.

The scope of solar energy utilization technology is very wide and diverse. There is need for efforts to introduce and assimilate technology and eliminate technological and economic problems. On the other hand, there are any number of unsolved problems, and a long term and well-organized research and development system to pursue these subjects is desirable.

(Received 4 February 1980)

'Solar House'

Tokyo SHUKAN SHINCHO in Japanese 8 May 80 p 25

[Article: "Present Status and Future of 'Solar House' Development Examined"]

[Text] "Slim Hope" of Cost Lowering by Technological Development

Unlike firepower, water power, or nuclear power which generates concentrated energy in vast quantities at some centralized spot, the mode of generating necessary energy for a given site for local utilization is called "local energy."

This local energy system can be thought to draw on a number of different energy sources such as wind power, wave power, or geothermal heat. Solar energy is also one such candidate, and various technology has been developed and part of it put to practical use to make solar energy serve as a power source for wristwatches; provide hot water, heating, and cooling for homes; and even to power medium scale electric power generators.

Among these different applications, the home which uses solar energy, the so-called solar house, has appeared on the wave of an energy conservation boom and increasingly become the subject of great attention. This system generates hot water through solar heat to supply hot water to the bathroom and kitchen as well as to heat and cool the house. Systems are now in use ranging from the most simple "hot water supply" to "heating and hot water supply" and to "heating, cooling, and hot water supply" in an increasingly complex manner.

For example, there are two buildings in Minato-ku of Tokyo where actual systems have been in use since 2 years ago. There are 24 heat collector plates aligned on the roof which are connected to two 200-liter solar hot water heaters. These hot water heaters supply hot water. Warmwater circulates between the 1,500-liter heat storage tank located below and the heat collector plates, and this hot water is used to supply heat to the central heater in winter and as the heat source to operate the cooler which supplies cold water for cooling in the summer.

The cost of installing just this solar heat utilizing section was about 6 million yen in addition to which the central air conditioning system cost about 8 million yen for a total of close to 14 million yen. According to the calculations of specialists in the field, this investment can be amortized in about 20 years, and this is particularly advantageous in view of the anticipated rise in cost of oil and electric power.

To be sure, there are only a limited number of homes which can install such systems. Setting aside certain special buildings such as offices of power companies, primary schools, hospitals annexed to universities, and experimental solar homes under study by the Science and Technology Agency, the user is burdened with a vast installation cost.

According to a survey conducted by the Association to Promote Solar Systems (incorporated, established in 1978, representing 37 makers in related fields), there is presently a total of about 4,600 solar homes in all of Japan. Of this total, the so-called homes account for about 4,050 units. The remainder is distributed between industry and public buildings. The "homes" which are outfitted with the ultimate hot water supply, heating, and cooling facilities do not even add up to 50. When surveyed for geographical distribution, they are found deployed from Hokkaido to Okinawa, but 70-80 percent of this total is concentrated in the Kanto and Kinki districts.

Even this association admits that "the 1,100 units in 1978 increased to 2,600 in 1979, and this small rate in popular use is due to the high construction cost." Improvement in performance through technological development and mass production are being considered as a means to overcome this situation, and it has been predicted that "since the performance of these heat collector plates is now at the top level in the world, we think that considerable lowering in cost can be realized once the technology to produce heat reservoir tanks is improved."

Furthermore, the JFY 1980 government budget includes subsidies for public use, and a low interest loan system for private parties was instituted in April. This has brought the comment from the large makers that "we may grow to a 1 billion yen market in the next 1 or 2 years."

On the other hand, the results obtained by the Science and Technology Agency in its 3 years of study begun in the spring of 1975 on an experimental solar house located in Kusaka City of Saitama Prefecture indicated that "this system is still uneconomical." Also the results of a study conducted in the United States reported "amortization of this system will require 12 years. Should the price of oil rise to 35 dollars a barrel, this figure probably can be cut down to about 4 years." Here again, the conclusion "uneconomical" was drawn. There are some specialists in Japan presently who calculate that "a hot water supply and heating and cooling system will require 25 years for amortization."

At the present time, there seems to be little hope that this energy source can disengage itself from its role as supporting actor to provide household energy. This is just the same situation as the role of the electric automobile with regard to the gasoline automobile.

Geothermal Energy

Tokyo DENKI GAKKAI ZASSHI in Japanese May 80 pp 54-57

[Article by Masaaki Shibatani and Akira Ichikawa of the Sunshine Program Headquarters, Electric Power Development Co: "Development of Geothermal Energy"]

[Text] Introduction

It was in 1904 (Italy) when geothermal energy was first used to generate electric power. Since then there has been gradual development of geothermal power generation in various countries of the world headed by the United States. At the present time, the total power generated throughout the world through this source of energy including the 168,000 kW (Table 1) generated in Japan amounts to about 2 million kW, and this total exceeds 2.5 million kW if the units presently under construction are included.

Table 1. Geothermal Power Generation in Japan (as of March 1979)

Name of Company	Name of Power Plant	Location	Output (kW)
Japan Heavy Chemical Industry Co.	Matsukawa	Matsuo-mura, Iwate-ken	22,000
Kyushu Power (Co)	Otake	Kujyu-cho, Oita-ken	11,000
Mitsubishi Metal (Co)	Onuma	Kasumi-machi, Akita-ken	10,000 (8,600)
Electric Power Development (Co)	Onikubi	Naruko-machi, Miyagi-ken	25,000 (12,500)
Kyushu Power (Co)	Hachijobara	Kujyu-machi, Oita-ken	50,000 (27,000)
Japan Heavy Chemical Industry (Co) Tohoku Electric Power (Co)	Katsuneda	Danseki-machi, Iwate-ken	50,000
Total			168,000

The value in ( ) with output is the recognized output actually used.

In another direction, the Sunshine Program was initiated in July 1974 in Japan for new energy development to respond to the changing worldwide energy situation, and promotion of development of geothermal energy is woven into this plan.

It is said that Japan has a reserve of geothermal energy which amounts to about 10 percent of what is present in the entire world, and this is why there are great expectations that this will be developed as a purely domestically produced energy.

Here we will discuss the present status of geothermal energy in Japan and future prospects.

2. Geothermal Resources

The interior of the earth contains decay heat from radioactive materials present in the rocks which make up the earth's crust and the heat stored in the magma localized in the shallow section under the crust (a few km to several dozen km), and this heat is present in great quantity. There is a considerable amount of thermal energy which is released in a steady manner to the surface from the interior of the earth through thermal conduction. Of the two thermal sources mentioned above, the former is a nonvolcanic thermal source while the latter is a volcanic thermal source found in volcanic regions.

When these different forms of geothermal energy are utilized at the earth's surface, the first mentioned heat flow through thermal conduction is associated with such a small thermal flux per unit area that it cannot be utilized, and it becomes necessary to resort to the use of a fluid which captures the high thermal energy discharged by these underground thermal sources and transport the energy to the surface. This fluid medium includes naturally occurring fluids (rain water) as well as artificially introduced and removed fluids from the surface.

When rain water seeps through cracks in the rock and enters the depths below, it comes in contact with the thermal energy discharged from these heat sources and is converted into hot water or steam. If this section is overlaid by cap rock, a hot water reservoir is formed. By drilling toward this type of hot water reservoir, it becomes possible to draw up to the surface high temperature and high pressure fluid which can be used.

On the other hand, despite the abundance of thermal sources underground, there are some geologic structures where rain water seeps below with difficulty. In order to utilize the abundant geothermal energy from such regions, it becomes necessary to introduce and withdraw fluid from the surface.

In this manner, the geothermal resources including those retrievable through the use of artificial fluid systems which are thought to lie underground are listed in Table 2.

Table 2. Types of Geothermal Resources and Calculated Reserves

Resource Type	Description of Resource	Reserves in Power Equivalent	State of Utilization
1. Shallow hot water systems	Mainly found in volcanic zones with depth between 100 m-2 km Temperature about 100-250°C.	130 million kW (steam) 50 million kW (hot water)	Steam is type presently found. It is expected that compounding with a total flow power generation mode will be adopted in the near future. Hot water for binary power generation.
2. Deep hot water system	Found in same zones as 1), but these are found in greater depths depth 2-5 km, temperature 250-350°C.	60 million kW (steam 20 million kW (hot water)	same as above
3. Deep layer hot water	While not directly tied in to volcanoes, it is found at 3-5 km depth in regions with high temperature gradient.	10 million kW (hot water)	For binary power generation and diversely used for cooling and agriculture
4. Deep layer warm water	Found in the Kanto District where there is temperature gradient in the ground. Temperature 70-100°C.	2 x 10^{11} kcal/s·cent (the efficiency is good because it is used as thermal energy	Temperature is low, but this is mostly available in large urban spheres and is used for local cooling.
5. High temperature rock	Found in high temperature sections about active volcanoes but not necessarily tied in with the volcano. High temperature regions of 200-300°C are found at shallow depths.	70 million kW	By forming an artificial hot water system, used in steam, binary, and 2-phase flow power generation (depends on quality of steam recovered)
6. Volcanic energy	Energy resident in magna.	600 million kW	Such as direct power. generation.

Source: Geothermal Subsection data, Agency of Industrial Science and Technology (January 1974)

[redacted]

Geothermal power generation to date nearly all utilizes the shallow hot water systems listed in Table 2. It is anticipated that there are large scale high temperature and high pressure hot water retaining layers at greater depth than these shallow hot water systems in geothermal zones, and it is thought that future development of geothermal energy will be with these deep sections in mind. Another direction for geothermal energy is the development of thermal sources without the use of accompanying fluid, and this is called high temperature rock power generation and volcano power generation.

Present Status of Geothermal Energy Development

Generally speaking, the development of a geothermal power plant can be divided into the two stages of survey of the stored state of the geothermal resource and the search and drilling to obtain the energy along with the construction of the power plant. There are problems unique to geothermal energy present in each of these stages, and research and development to resolve these problems is actively being promoted.

3.1 Development of Search and Excavation Technology

Some of the reasons development of geothermal resources on a commercial basis is not yet on track include the time and funds required to search for energy stores commensurate with industry's requirements and the search of volume of steam, lowered performance of producing wells, and interference between different wells as the result mainly of changes in underground activity such that the uncertain nature of predicting the available energy is encountered. In order to remove such uncertainty, it is necessary, above all, to improve the search and layer study technologies. The probe can be in the form of surface investigation and boring. The results of these probes are compiled and the geological structure, underground heat, and hydrologic structure are evaluated. Probes through boring are very expensive, and this is why the various surface investigations are emphasized as judgment material.

The goal of geothermal resources probes is discovery of the thermal source as well as the hot water reservoir layer. It is generally the case that the volcanic regions where these resources are found were once areas of high geologic activity such that the underground structure is very complicated in most cases. This is one of the major factors which lowers the precision of any probe. Any improvement in precision overall depends on improvement in the precision of individual probes and the development of new probe methods of high precision. To this end, the present practice is to emphasize understanding of the underground heat unique to the geothermal resource and the hydrologic structure, and great attention is being directed to the development of electromagnetic studies, released heat surveys, and chemical probes.

The main purpose of an electromagnetic probe is to follow the distribution in underground electrical conductivity. There is the method using an artificial electromagnetic field which is directed at comparatively shallow layers as probe targets (AFMT method) and the deep probe method using natural electromagnetic field where deep layers are concerned. Research is being continued on the hardware and software for both of these methods in order to improve the S/N ratio (signal versus noise ratio) and to develop methods for two or three dimensional analysis.

In measuring the quantity of discharged heat which is an important index of thermal energy reserve the in-well temperature detection layer as mainly utilized up to now, but there is, at present, research being promoted on the thermo camera and the Resources Exploration Satellite as methods of probing for volume of discharged heat.

The method involving the thermo camera includes the surface thermal photographic method and the aerial thermal photographic method, and data collection and treatment along with analytic technology are being developed for both methods. The method utilizing the Resources Exploration Satellite is called the remote sensing method, and it is effective not only for surveys on volume of heat discharged but for the analysis of terrain structure as well.

There is also a myriad of gases ascending from the deep layer regions, and these are thought to be taken up by the underground soil. Very recently attention has been directed at the correlation between mercury in this soil and geothermal activity, and this is drawing great interest as a new probe method. Not only mercury but various gases such as helium are thought to be valuable sources of information on the underground structure, and research is under way to clarify the corresponding relationships between concentration and isotropic composition versus geologic structure.

Probes and layer surveys through borings are themselves very costly approaches. Because the combination of the results of test borings with the results of the aforementioned surface probes enable the ultimate decision on the scale of the geothermal plant which should be constructed, this type of probe occupies a very important position in the development of geothermal plants. There is need to make continuous measurements of the resistance rate, temperature, and pressure within the boring. The improvement in in-pit measurement technology is presently the main subject of research and development in this area.

Developments are being pursued on cables and various sensors which can withstand the corrosive nature of high temperature and high pressure geothermal hot water, a system which uses an underwater camera as part of an image transmitting system, and bore hole samplers which collect hot fluid as is from the boring. Measurements made in the pit are the only way to collect raw information of the underground structure, and some useful research results are awaited.

Various borings for different purposes are made not only for the investigation but for the development of the geothermal resource, and the drilling technology owes a great deal to the drilling technology developed in the oil fields. On the other hand, the high temperature measurements unique to geothermal wells are expected to encounter even higher temperature layers particularly as future drillings probe into even greater depths, and the development of drilling technology to cope with these high temperatures become urgent.

Feasibility data is being accumulated on new drilling methods for drilling into high temperature layers. At the same time, heat resistant bits and blowout prevention devices are under test production and development.

It is difficult to guarantee stability of muddy water to be used for geothermal drilling under these high temperature conditions, and the Sunshine Program is promoting development of stable muddy water for high temperature use which does not gel even at 300°C. In addition, development of cements capable of use under the high temperature conditions and the development of cement additives are being promoted.

3.2 Research and Development on Power Generation Technology

It may be said that the geothermal fluid obtained as the result of the probes and drillings is used to determine how geothermal energy can be recovered efficiently. This information is then used to design the power generation system best fitted to the thermal properties of the geothermal fluid.

Geothermal power generation to date has utilized only the shallow section hot water systems listed in Table 2 as the geothermal resource, and the ultimate mode is a power generation system using steam alone. High quality natural steam resources are being utilized for power generation at the laderos [phonetic] in Italy, the geysers in the United States, and at Matsukawa in Japan [steam type in Figure 1 (a)]. Power generation using steam separated from its water component and low pressure steam obtained by pressure reduction (flashing) of hot water is being practiced at Wailakei in New Zealand and Hachijobara in Japan [Figure 1 (c), 2-stage flash]. The rest are for the most part those which utilize steam obtained by water-vapor separation [Figure 1(b)].

No matter what mode is used, the geothermal power plants to date have sent back hot water whose major portion was not used to the underground without having utilized the greater protion of its heat. When the hot water is at high temperature (150°C or more), the 2-stage flash technique described above becomes effective, but this approach is not rewarding if the water is of medium to low temperature (90-150°C). It is said that these medium and low temperature hot water resources are much more plentiful in the United States than high temperature hot water resources and high temperature steam resources, and the effective utilization of these medium and low temperature hot water energy sources is a major subject for future geothermal energy development.

There is no great difference in this situation compared to that in Japan, and power generation utilizing this hot water energy source is being considered. It is taken up in the binary power generation mode being studied under the Sunshine Program, and research and development is being pursued.

As shown in Figure 2, the binary power generation mode transmits the thermal energy in the medium and low temperature hot water to a secondary medium (low boiling point medium), and the vapor of this secondary medium is allowed to expand in a turbine and generate power. Research and development on this mode

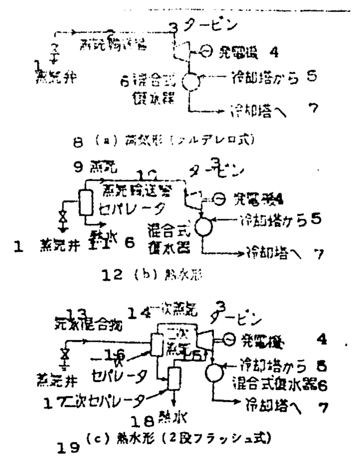


Figure 1. Existing Geothermal Power Generation Modes

Key:

1. steam valve
2. steam transport pipe
3. turbine
4. power generator
5. from cooling tower
6. mixing type condenser
7. to cooling tower
8. steam type (Laldero type)
9. steam
10. steam transport pipe
11. hot water
12. hot water type
13. steam-water mixture
14. primary steam
15. secondary steam
16. primary separator
17. secondary separator
18. hot water
19. hot water type (2-stage flash)

of power generation was initiated with the advent of the Sunshine Program in 1974. Test operations are under way presently at Nigorigawa in Hokkaido and Otake in Kyushu (both are 1,000 kW class) where the combined steam and hot water power generation mode is being studied. Research and development on the binary power generation mode has made considerable progress as noted above, but the following problems remain to be resolved before greater efficiency in hot water utilization and lowering in unit cost of power generation using large-scale generating plants can be realized.

(1) Research and development on the optimum secondary medium for the power generation system and research on the optimum thermal cycle using this medium: The medium used in the above pilot plant is freon (R-114) and iso-butane, and the thermal cycle is a subcritical Rankine cycle. These media cannot be said to be always optimum from the standpoint of the power generation system, and there is need to screen a long list of possible candidates to select a medium which best fits the various conditions required (economics,

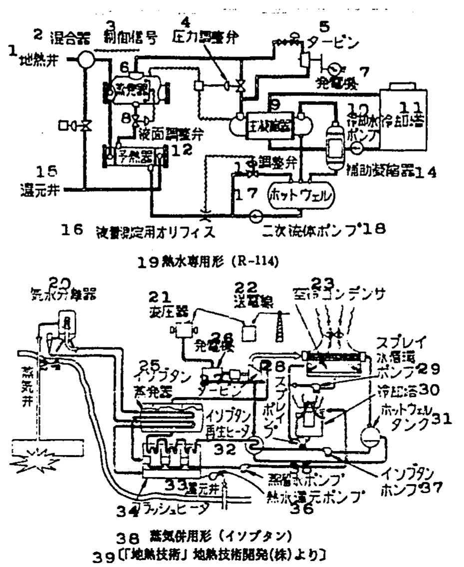


Figure 2. Binary Power Generation Mode

Key:
1. geothermal valve
2. mixer
3. control signal
4. pressure regulating valve
5. turbine
6. evaporator
7. power generator
8. liquid surface control valve
9. main condenser
10. coolant water pump
11. cooling tower
12. preheater
13. regulating valve
14. auxiliary condenser
15. return valve
16. liquid volume measuring orifice
17. hot well
18. secondary fluid pump
19. strictly hot water type (R-114)
20. steam-water separator
21. transformer
22. transmission lines
23. air cooled condenser
24. steam valve
25. isobutane evaporator
26. power generator
27. turbine
28. spray pump
29. spray water circulation pump
30. cooling tower
31. hot well tank
32. isobutane regenerating heater
33. return well
34. flash heater
35. distilled water pump
36. hot water return pump
37. isobutane pump
38. steam conbination type (isobutane)
39. from [Geothermal Development] issued by Geothermal Technology Development (Co.)

safety, operability) for the power generation system. At the same time, there is need to study a superheated heated steam cycle and a supercritical cycle to determine the best cycle to be used in conjunction with said medium.

(2) Research in making heat exchanger highly efficient: The cost of the heat exchangers accounts for about 40 percent of the construction cost of a binary power generation plant, and there is need to make the heat exchanger more efficient and more compact in order to lower the cost of this mode of power production.

(3) Research on medium seal technology: There is need for added emphasis on research to develop technology to seal the system against leakage of the medium to outside the system because the medium is costly and for the sake of safety when this medium is flammable.

(4) Research on materials used in plant equipment: Geothermal hot water is associated with diverse physical and chemical properties, and research and development on materials which can withstand these severe conditions is a must.

(5) Study on measure to reduce in-plant power requirements: The in-plant power rate of the pilot plant is about 40 percent, and studies are in order to increase the net power and lower the cost of per unit power through lowering power needs of the different equipment.

In another direction development is being promoted on a total flow power generation system using 2-phase flow without separating steam and water from geothermal fluid, and development of a 2-phase rotary expansion unit using the principle of a rotary engine is being pushed. Present efforts include research on internal seals to minimize internal leaks, research on mode of supplying homogeneous vapor-liquid mixture, and research to fully grasp the expansion properties of 2-phase flow.

As indicated under the column of utilization state in Table 2, a great many more geothermal resources will become usable should the binary power generation mode or total flow power generation become practical. The role of the development of these power generation systems in the overall geothermal energy development system is very large, and some major results are awaited.

As shown in Table 2, geothermal resources coming under the classification of the long-term plan which are not associated with natural flowing fluid systems include high temperature rock and volcanic energies. Feasibility studies on high temperature rock power generation have already been initiated, and research on technology to crush high temperature rock and studies on heat extraction methods are under way.

4. Multiple Utilization and Future Prospects

The use of geothermal energy in diverse applications other than for power generation has long been awaited from the standpoints of effective utilization of energy and benefits to the local society. Geothermal energy is already being used in Japan to provide local hot water, melt snow off highways, and heat greenhouses. The use of the warm water discharged from a geothermal power plant to such multiple uses raises the overall energy utilization rate. There are also positive contributions to local society, and the early solution of the various problems is in order.

Technological problems have been the major subject of this discussion on the present status in the development of geothermal energy, and finally we will place geothermal energy in its relationship to the entire energy picture and discuss what development can be expected in the future.

As was shown in Table 1, the total output from geothermal power plants in Japan is presently about 168,000 kW. According to the estimates of the Advisory Committee for Energy (August 1979), the utilization of geothermal energy is predicted to be the equivalent of 14.2 million Kl including 7 million kW power generation in 1995. This amounts to 1.8 percent of the total energy supply (about 825 million Kl), and geothermal energy at this time is expected to make up a fraction of the total energy supply comparable with oil and coal. It is said that there is a potential 20 million kW which can be produced under present technology. Since there are estimated reserves of the magnitude listed in Table 2, geothermal energy has the potential of assuming a major role among the overall energy resources once development of probe and drilling technology and development of power generation technology such as binary power generation proceed satisfactorily.

In addition, should utilization of high temperature rock power generation or volcanic energy utilization become possible, great things can be expected from geothermal energy not only as a purely domestic energy but also as a source of considerable energy.

The use of data on results of the Sunshine Program made available by the Agency of Industrial Science and Technology of the Ministry of International Trade and Industry is hereby acknowledged.

(Received 21 January 1980)

Technology Assessments

Tokyo NIHON KEIZAI SHIMBUN in Japanese 29 Jul 80 p 12

[Article by Nobuyoshi Namiki: "Expert Raises Problematical Issues on Energy; 'Technology' Inaccurately Assessed"]

[Text] An international meeting related to energy was held during the early part of July in West Berlin sponsored by the Atlantic Institute. Experts from the United States, Europe, and Germany discussed energy for 3 whole days making for very interesting sessions, but a frank impression at the end of this meeting was that energy development and energy policies are at the stage that discussion still has not really begun in earnest. The three Harvard professors in advance; Stoubeau, Yagin, and Nye led the list of learned people from different countries along with the administrative people headed by Rankske of IEA (International Energy Authority) must have made, pardon the expression, a very poor impression on the practical people headed by the representatives of Exxon and BP. Or it may be that they had seen into the truth and had humbled themselves and maintained silence. What follows are the basic points on the energy problem and energy policies which came to my mind under the mental stimulation of this meeting.

The Majors' "Clouded" Judgments

The following points can be offered as rationale why the energy discussion did not go into the intended track.

First of all, any time any statement from an international organ, different national government, or majors' company will have a great effect, it is inevitable that there will be restrictions to the opinions stated. Man is a weak creature, and the people in the giant bureaucratic organizations who have difficulty keeping their opinions to themselves will choose the path to not even consider the issue from the start rather than make an indiscreet statement and take the risk of making a slip of the tongue. Even though there are people who think in exceptional manner, the present bureaucracies have the same reaction as though such people do not exist.

Citing an example here, Exxon compiled its perspectives of the world's energy picture for year 2000 which was released in October of last year. The premises upon which these figures were based included a barrel of oil costing 25 dollars in 1985 and 28 dollars in 1990 (.979 price). The report gave the price as being of December 1979, and the time relationship is questionable. These represent price levels which are very low compared to the price of oil set by the most recent OPEC (Association of Oil Exporting Countries) general meeting of 31-37 dollars making them hard to believe. The author at that time reported in the Japan Economic Research Center interim report on his perspectives that the price of oil in 1984 would rise to 61.5 dollars per barrel (cost at that time). Our estimates seem much more accurate than those of the giant Exxon. On the other hand, Exxon does not enjoy the luxury of closely approaching the truth. This is because OPEC will most assuredly use Exxon's figures as a basis for raising its price. On the other hand, this is the way in which Exxon's entry into the alternate energy field is hindered.

Looking at another example, Chief Stofas of the Industrial Policy Bureau of the Ministry of Industry in France asserted at the Berlin Conference that the price of oil will not increase drastically hereafter. When we look at last year's increase in the price of oil from 13 dollars a barrel on 1 January of last year to a little less than 3 times in the short period of a year and a half as the result of the Iranian revolution and the situation in the Middle East where the stimulation caused by the Islamic religious revolutions motivate sharp price increases, this is again one type of rash language. Even government officials can make no such statement. It seems that France's energy development actually is a technology system with no consideration of the cost picture but appears more like development based on the principle that technology is supreme.

In the second place, the past record of energy policies make difficult any turn away from such policies. When some few dozen billions of yen was expended in the past on some decision, the government officials could not help but maintain that the project was a significant success. The fiscal officials were also implicated as a result of which they were in no position but to go along. After the prototype of the ATR (new converter reactor, heavy water reactor) "Fugen," there was the question of whether to proceed in earnest on a purely domestically developed heavy water reactor or to introduce the Canadian CANDU (Canadian heavy water reactor). At this time there was the change in the situation as will be described later, and it appeared that this matter was no longer of much significance as a subject of policy.

Interference With Serious Countermeasures on the Part of Private Industry

In the third place, the various technological evaluations (includes cost evaluation) on energy related matters are vague, and there is little information which offers much credibility.

For example, OPEC relayed the information to the different countries that the development cost of oil from tar sands and oil shale as alternate energy for oil was 4-5 dollars per barrel. This information plus the erroneous information provided by Professor Vernon of Harvard and Professor Howtucker of Stanford of the great flexibility in the price of oil to Secretary Kissinger and his staff were cause for a basic flaw in their vision. In other words, the inevitability of easing in demand and supply and the drop in cost following the oil crisis as associated with the latter thesis and the drop in price would be to about 4-5 dollars a barrel as promised by the former were the conclusions which were drawn. This was why the only policies which were drafted were defensive in nature such as cutting down on use of oil and establishing an oil financing structure. The superlegislative administrative leadership of the American President, who proposed emergency increase in production of oil and similar commodities as being the only solution to the situation, did not sit well in most minds.

Since then the cost of developing alternate energy began to rise with time, and the economics committee of OPEC predicted a rise in the price of oil to 35-55 dollars a barrel (1979). Now the cost of developing alternate energy actually is a function of the price of oil. This is because the increase in the price of oil leads to increased cost of the raw materials required for the production of coal and related alternate energies.

In addition, it seems that the cost of developing the fast breeder reactor (FBR) will eventually be greater. It is said that the Super Phoenix (1.2 million kW) which France is planning will not realize scale merit unless it is made even larger. We don't have to go to fast breeder reactors but can see clearly even with the light water reactors that when the energy required to process the radioactive wastes and the energy required to dismantle spent reactors are considered, the net energy balance (the reciprocal of the ratio of the multiple of the energies required to construct the facility and to the procurement of fuel to the pure energy produced) is small. The ratios usually mentioned such as 7.6 and 17 do not take into account these expenditures of energy.

An even more basic problem is the cost evaluation or the technological evaluation of the various solar (sun) energy projects which are still very unclear. This is what weakens the arguments of solar energy development protagonists headed by Barry Commoner. In addition, the same type situation applies to the thesis of Emory Robbins who champions energy soft pass. This situation, on the other hand, cannot be held accountable to Commoner and Robbins but can be laid at the doorsteps of the different governments which do not collect and process such basic information in their true light.

In the fourth place, one result of the inaccuracy and insufficiency in this type of necessary information has been the hindrance to private industry in their ability to make realistic response to these new situations. In the past any investment of private industry in energy conservation was of an emergency management in which the investment could be recouped in about 2 years. Even then, there were considerable wastes in the past, and the net result was that economy in energy progressed. For example, it is said that the Lockheed Company was able to effect roughly 59 percent economy at its Los Angeles district factory group with virtually no new investment between 1972 and 1977. On the other hand, essentially no start was made toward real development of actual investment for energy conservation in the form of so-called new energy industries, development of new products for energy conservation, and active development of alternate energy such as solar energy.

Because of the lack of the necessary information, the present status is that the response of industry is still in the state it was before the advent of the energy industries. It may be expected that necessary information will become available from here on and that we will be ushering in an age of actual new energy industries within possibly 3 or 4 years.

Nuclear Energy Is Also Rapidly Becoming Exhausted

We will now look at, first of all, some long-term prospects which are considered reliable in order to predict the directions to be taken by energy policies in the future.

The estimated reserves of the fossil fuels including coal, oil, and natural gas which were the basis for sustaining the industrial revolution is 6.16 trillion Kl in oil equivalent. Even when considerable economy is realized, this source of energy cannot be expected to last more than a hundred years. If only oil and natural gas were used, they will be depleted by the turn of the century.

Next, we consider nuclear energy which emerged anew along about the 1940's. The fast breeder reactor which uses uranium 238 as fuel can produce 3.7 trillion Kl oil equivalent of energy. Since this is based on a cost of 15 dollars per pound for the mining of uranium, this supply will increase with increasing price of oil and may attain a level comparable to the fossil fuels.

Looking next at nuclear fusion, the reaction which was first attempted was the D-T reaction (D is heavy water, T is tritium). Since the lithium which is the starting material for making tritium is available only to the extent of 700,000 tons, this is equivalent to 5.3 trillion Kl when converted to oil. This is less than that for fossil fuels. Almost unlimited energy can be realized through nuclear fusion when the D-D reaction is used (100 million times the energy of the D-T reaction), and this is something which is in the distant future as far as its technology is concerned.

Thirdly, there is solar energy which mankind has utilized from the earliest days of history and which can provide 17 trillion Kl per year (these figures were provided by Keiichi Mochizuki). This is a tremendous quantity, but it can only be utilized in very dilute form. On the other hand, since fossil fuel and the D-T reaction energy sources are expected to be depleted rather rapidly, the transition to a new solar energy age may possibly take place fairly rapidly.

Government Has Insufficient Awareness of "Coal"

Now, what types of conclusions can be drawn regarding policy from this situation on the foundation of these resources?

First of all, where coal, oil, and natural gas type fossil fuels are concerned, it is very clear that a new age of coal has been entered.

The majors who are quick to seize every opportunity purchased all the available coal mines in different parts of the world they could get hold of since the oil crisis and laid the foundations for comprehensive energy industrialization. On the other hand, a new fuel law with respect to coal is under development, and there should be contact with the comprehensive companies of Japan. The attendees from BP whom I met in Berlin indicated that the Japanese M Company had indicated interest in their coal fuel technology which was an indication that the present technology is practical.

An influential Shell personality on his visit to Japan last year said the French and Japanese governments were both directing great efforts at the utilization of nuclear energy, but he said that Japan should consider applying Shell's coal related work. I replied that we should develop coal without fail and that the Japanese Government should not put that much faith in nuclear energy policies. I was surprised, however, that this Shell man had that much faith in the Japanese Government. At the conference being held at the Kusumigaseki hall at the present time, it was said that there was very little difference between the public acceptance of nuclear reactors and for coal fired plants, and there is about the same level of opposition to both energy modes. This is why it was concluded that coal is not practical. Could these people be serious in taking such a stand since it does not seem that problems such as sulfur content, fuel efficiency, and disposal of ash cannot be solved. Certainly, these problems should be more readily resolved than the difficulties associated with nuclear energy.

I get the impression that energy related personnel in the private ranks have already started making preparations for the arrival of the new coal age. The government must quickly make a public display of its awareness of this situation.

Furthermore, where the financial organs lent money to industry during the overly fluid times to purchase land, there is no mention since the oil crisis of money being loaned to industry to secure foreign coal. What can the reason be? It would be fortunate if the infirmity with age of the economic world is not causing a loss in the pioneer spirit.

If it is the case that oil sand or oil shale eventually becomes a practical source of oil, it will be difficult for Japan to become involved in this development in a major way. The same applies to coal gasification and liquefaction. Such being the case, the direct combustion of coal may be the most practical approach for Japan to take in this new coal era.

Next, we look at the nuclear energy system, and it is the social principle that there are many areas of doubt regarding the use of nuclear energy in Japan which is a country of very few resources. There are some who as individuals have their doubts, but the stand that the public is 100 percent behind nuclear power is probably not only limited to politicians and government officials but to members of the financial world as well. It would be fortunate if we do not repeat the story of the naked king. Could it have been this was the type of person who thoroughly opposed raising the yen rate before the Nixon shock?

Australia decided not to initiate operation of its newly constructed nuclear power plant. Sweden has allowed only the operation of already built nuclear power plants and those under construction presently. In the last presidential election, the Democratic Party adopted as its slogan stopping new construction of nuclear reactor power plants. As of July 1978, there was present power generation capability of 71 power plants (with total capacity of 50 gigawatts, 1 gigawatt = 1 million kW) with 90 more plants (100 gigawatts) under construction or whose construction was approved. In addition, there were 45 plants (45 gigawatts) on order but which had not been approved. There have been essentially no new orders since 1977. It is possible that there will be increased order cancellations compared to before the Three Mile Island incident. Some scholars in close touch with the United States Government have clearly set forth in figures the incomplete nature of the light water reactors. Would it be possible for scholars close to the government to take such an attitude in Japan?

Now, what direction should Japan's future nuclear energy policy take from here on?

In 1965 Milton Shaw who at that time was chief of the Nuclear Development Agency of the Atomic Energy Commission shifted the policy abruptly from light water reactors to fast breeder reactors. Up to this point he had been considering an intermediate in the form of a second generation reactor. This change in philosophy on the part of Shaw is correct as far as the efficient utilization or uranium is concerned.

Need Also for Long-Term Civilized Development

When I consider the position to which nuclear power has been placed in today's world, I think that the fate of nuclear energy will be determined by whether the fast breeder reactor will come close to its expected performance in determining the fate of this form of energy. Should the fast breeder reactor falter, the nuclear age will become just a buried episode in man's history. According to present plans, large fast breeder reactors from the principal countries will make their appearance in the 1980's and 1990's. These results will then be used to determine the future direction of nuclear policy. The treatment and disposition of radioactive wastes needs to be researched in the meanwhile. ATR and other similar subjects are but secondary problems.

Finally we come to solar energy. It is possible that the central theme of the new energy industry is the utilization of solar energy. It may be possible to recover the costs of an ordinary hot water heater in 3-5 years should the price of oil rise to its anticipated level.

Ambitious projects such as the heliostat which is the pride and joy of France are not associated with economic advantages.

Water power has been used from time immemorial, and it is possible that wind power may one day become practical in certain localities.

On the other hand, biomass (energy from flora) utilization is the area which is arousing the greatest interest. Peat and wood chips which have long been used as energy sources cannot be disregarded, but the alcohol or methane obtained by the fermentation of plant material (kelp) is very effective.

The Comprehensive New Energy Development Organ (expected to start operations in October) should direct some efforts at biomass development. If nonoil producing and developing countries can be joined in cooperative efforts to produce alcohol from biomass, a very fortunate situation will be attained.

It is also needless to say that energy conservation efforts applied to existing machinery (such as refrigerators, automobiles) is also a promising source of energy.

Finally, I mention the energy balance of the United Kingdom in the year 2025 when oil and natural gas sources will be depleted as pictured by Ray which has made a lasting impression in my mind. Should we not also have some long-term cultural asset in Japan?

?267
CSO: 4105

GOVERNMENT OFFERS INCENTIVES FOR ENERGY CONSERVATION

Loans for Solar Homes

Tokyo DENPA SHIMBUN in Japanese 15 Sep 80 p 1

[Article: "Government Offers 'Incentive Loan' for Solar System"]

[Text] As part of a promotional drive to make the solar [energy] system more widespread, the Ministry of International Trade and Industry [MITI] and the Solar System Promotion Association (Toshio Doko, chairman) have inaugurated a "loan system to promote solar system diffusion" designed to provide low-interest loans to individuals and legal persons. Beginning 1 October 1980, loan applications will be accepted at 86 banks throughout the country.

Aim To Solarize 10 Million Homes by 1995

The system was established within the JFY 1980 MITI budget for comprehensive diffusion of the solar energy system. The system will operate on a capital of 2.45 billion yen, with 2.2 billion yen from the government (special account for coal, oil, and alternative oil sources) and 250 million from nongovernmental sources.

The loans for the first year will total 10 billion yen (8 billion yen for homes and 2 billion yen for commercial enterprises). Loans will be handled by 8,390 branches representing 86 banks throughout the country, including 13 city banks, 63 local banks, 7 trust banks, and 3 long-term trust banks.

Loan conditions are: (1) a solar system that uses solar heat to provide hot water, air-conditioning, and heating; (2) a system with performance and supply capabilities, etc, certified by the Solar System Promotion Association; (3) a system whose installation and maintenance have been certified as suitable by the Solar System Promotion Association, with work to be performed by registered enterprises. Expenses will be limited to purchase price, installation fees, and other necessary costs of the loan-approved solar system, and they must not exceed the standard cost limits set by the Solar System Promotion Association.

Limit of 2 Million Yen for Home Use

For home use, the loans will be in the range of 100,000 to 2 million yen at 5.5-percent interest per annum for 5 years. For business use, generally, loans will be made up to 100 million yen at 6.5-percent interest per annum for a maximum of 10 years. Also, a system of partnership [teikei] loans will be used.

Loan applications will be first screened by the financing agency receiving the application, then reviewed and the loan amount determined by the Solar System Promotion Association, after which a notice of approval or disapproval will be given to the financing agency concerned. The loan will be provided by the financing agency upon installation of the approved solar system. Therefore, for loan applications received in October, if things proceed speedily, the solar system provided by the said loan system might be installed in mid-November.

The Solar System Promotion Association estimates that during the first year, 10,000 or as many as 20,000 homes might use the loan system. The Housing Industry Division of the MITI hopes the system will solarize 7.8 million homes by JFY 1990 and 10 million homes by JFY 1995.

To put the system into full operation, the Solar System Promotion Association will establish certification standards for equipment to be used in the subsidized solar system and establish registration procedures for qualified solar system companies. The Solar System Promotion Association plans to speed up these certification measures.

Manufacturers of solar equipment are rushing steps to submit applications to register affiliated retailers and installation companies, as well as applications to have equipment certified. They are trying to be fully prepared for equipment sales and installation work when the system starts.

Industrial Investment Promotion Incentive

Tokyo NIKKAN KYOGYO SHIMBUN in Japanese 20 Sep 80 p 1

[Article: "Business and Industry Tax Deduction Benefit for Investment"]

[Text] To promote investments by industrial circles in energy conservation facilities, the MITI has been considering an "overall energy promotion tax system" to be created as a new measure for JFY 1981, and on 19 September 1980 it set up general energy conservation facility guidelines and applicable facility standards, and also revealed the projected effect of the new tax system on the national economy. The energy conservation facility guidelines are: (1) units costing over 10 million yen apiece; (2) units not widely scattered, and therefore of potential demand by a considerable number of commercial enterprises in the future; (3) units requiring over 2 years for recovery of initial investment; (4) an energy conservation effect of over 10 percent.

There are 80 facilities, including heat converters, that meet the guidelines. The effects of the tax proposal are expected to include the elimination of income transfers to such entities as OPEC, which amount to about 4 trillion yen, and a national income (GNP) rise of about 750 billion yen through increases in civilian capital investment. Industrial circles, such as the steel industries, have made tremendous progress in energy conservation, but they are all saying: "We are approaching the limits of energy-saving investments, and to advance we need investment tax reductions and eye-opening government incentives." Therefore, industrial circles are hopefully awaiting the promotional tax system, which should have the effect of inducing 3 trillion yen in investments.

Reduction of 4 Trillion Yen in Payments to OPEC

Together with the "overall energy promotion tax system," the MITI is considering establishment of a tax system to promote investments for industrial dispersion to local districts, and it is planning to combine both tax systems into a "new energy facilities investment tax system."

The "overall energy promotion tax system" aims for the sound development of Japan's economic society in the future, despite severe energy restrictions, and intends to guarantee adequate energy resources by accelerating the promotion of investments in energy facilities and strengthening the energy base of industries. To accomplish this, there would be a triad of applicable facilities: energy-saving facilities, oil-alternate energy sources, and facilities to guarantee a stable supply of oil. Of the procurement price, 10 percent would be tax-exempt for the next 5 years, starting with the next JFY. Through this measure, investments in energy facilities would be accelerated by about 15 percent and have an investment inducement effect amounting to 3 trillion yen. According to recently projected calculations, the new system would also stop an income transfer of about 4 trillion yen to OPEC and provide a GNP increase of 750 billion yen. In effect, the anticipated increase in tax income from the increased level of nongovernmental economic activities is expected ultimately to cover approximately 80 percent of the tax deductions.

On this occasion, the energy-saving facilities which would receive tax deduction benefits have been determined, but the primary objective is not limited to the establishment of such facilities to reinforce the energy conservation set-up of industries. The distinguishing features are the inclusion of energy-conserving production facilities and the modernization of medium and small enterprise facilities. Industrial circles have progressed from detailed energy conservation management to the second phase of facility improvements, and they are now entering the third phase, which demands large-scale energy-saving facility investments requiring over 2 or 3 years for investment recovery.

Types and examples of energy-saving facilities which would receive tax deduction benefits are as follows:

Waste energy recovery and use facilities--a total of 13 facilities, including heat converters, low-calorie waste-gas burning boilers, boilers using waste heat, and apparatus to recover steam drain.

Auxiliary facilities to improve the efficiency of main facilities--a total of 10 facilities, including combustion control facilities, electric load control apparatus, adiabatic facilities, and dehumidifying ventilators for industrial furnaces.

High-efficiency production facilities--a total of 41 facilities, including energy-saving industrial furnaces, cold box mold molding machines, energy-saving molders, and continuous high-pressure steamers.

Process converter production facilities--a total of 10 facilities, including continuous annealing facilities, direct dispatch rolling facilities, energy-saving polyethylene manufacturing facilities, and for the manufacture of highly-enriched phosphoric acid.

Others--a total of six facilities, including improved, dual use, absorption-type cold and warm water equipment, as well as heat-supplying electric generators.

9134
CSO: 4105

NO MAJOR REVISION OF ENERGY SUPPLY TARGETS IN FISCAL 1990

Tokyo KYODO in English 21 Oct 80 0112 GMT 21 Oct 80 OW

[Text] Tokyo 21 Oct KYODO--The Ministry of International Trade and Industry will make no major revision of the nation's energy supply targets in fiscal 1990 as set in an interim energy supply outlook, ministry sources said Tuesday. By energy source, the supply target of atomic power for the year will be kept unchanged at 53 million kilowatts, compared with 12.7 million kilowatts in fiscal 1978. The oil import target will also remain unchanged at 63 million barrels a day in fiscal 1990 (April 1990-March 1991). However, the ministry will revise upward the steaming coal import target in fiscal 1990 to 54 million tons from the 53.5 million tons in the interim outlook, the sources said. Supply targets of liquefied natural gas (LNG) and new energy sources such as solar power and coal liquefaction will be set 45 million tons and 38.5 million kiloliters, respectively, they added. These target figures will be approved at a cabinet meeting on 7 November.

CSO: 4120

SUBSIDY PROGRAM SPURS MAKERS OF ENERGY SAVING COOLERS

Tokyo BUSINESS JAPAN in English Sep 80 pp 87-88

[Article by Tadato Onizuka, Moonlight Division, Industrial Science and Technology Agency, Ministry of International Trade and Industry]

[Text] With the international oil supply becoming more limited than ever before, the world's major oil consuming countries are making every possible effort to implement their own energy programs on the basis of agreements reached through the forum of the International Energy Agency. The agreements include general restrictions on establishing new thermal power generating plants using oil, promoting the use of coal and other fuel resources in place of oil, setting a maximum for the world's oil imports and many other international co-operation programs related to energy resources.

A country heavily dependent on imports for its fuel needs, Japan has adopted a variety of energy programs, making the most of its advanced knowledge and technologies to achieve the utmost in efficiency in the use of valuable energy resources.

The save-energy technological development plan implemented by MITI's Industrial Science and Technology Agency is one of the many official programs designed to cope with the world fuel situation. The plan covers six major R&D areas: 1) development of large-scale energy-saving technologies jointly processed by government and private interests, 2) basic research on energy saving technologies by governmental institutes, 3) subsidization to consumer product manufacturing industries to facilitate the earliest possible development of equipment featuring energy conservation, 4) establishment of energy-saving standards, 5) maximum degree of participation in international programs for minimizing energy consumption, and 6) undertaking a technological survey on software contributing to energy-saving.

This article is devoted to describing how manufacturers of room air-conditioning units have been proceeding with product improvements under the above subsidized program.

High temperature with high humidity characterizes summertime in Japan. In midsummer, the THI keeps going up, causing people to slow down in their daily activities. Sometimes there are long spells of "tropical nights" as the weatherman terms it, when the heat does not subside even after nightfall. Beaches on summer weekends are no place to beat the heat. They have been likened to a dragnet full of fish as everyone tries to find a place to cool off in the water.

Installing an air-conditioning unit has recently been recognized as being the easiest way to enjoy a comfortable summer. This has rapidly pushed up the demand for air-conditioner units over the last few years. According to an official survey on the ownership of such units, less than 1% of the households in Japan owned air conditioners 20 years ago. The record 10 years ago showed 6%. The figure reached as high as 35% in the latest survey. This data only covers equipment designed for installation in individual rooms; large units for commercial establishments and centrally-controlled household units are excluded.

In view of the housing situation and various environment factors, it is generally believed that Japan will see ever increasing demands for air-conditioning units, or "Room Air-Con" as people call them, for years to come.

The growing use of electric-powered home appliances including air conditioners has increased power consumption. For the past 10 years, nonindustrial power consumption gained by some 10%. Every summer, the limited capacity of the nation's power supply poses a serious problem as consumption, specifically by air-conditioners, goes up in line with rising temperature.

Discussions among those concerned in public and private sectors to solve the supply shortage have become an annual event, but building nuclear power plants--the best solution feasible today to increase power generating capacity--has shown little progress due to difficulties in obtaining suitable plant sites.

Under the circumstances, the government has recognized the immediate need to have home electric appliance makers develop and market product which will consume the least possible amount of energy through a subsidization formula. Applicable only to consumer products already on the market for which improvements for minimized power consumption are most required, the subsidization program helps manufacturers cover the cost of laboratory tests and trial manufacture of relevant products featuring higher energy efficiency while retaining the same functions and quality as the original models provide.

Subjects to be studied for improvement are selected according to the development theme shown by the government. Each of the selected subjects is, then, given to more than one manufacturer incorporated in Japan, after careful screening of applicants in terms of their capacity in technological expertise, administration and many other aspects of manufacturing operations. Officially appointed makers receive the necessary subsidies to carry out the development project assigned. Since more than one maker is given the same assignment, each makes the most of his technical resources to become the first to accomplish the task, hoping to leave the competition behind. This greatly helps expedite development of energy-saving equipment in Japan.

The relevant subsidization system has been implemented since 1978. It offers a number of features different from other conventional types of financial assistance officially given to technical research.

Under the new system, the government first sets a target level for energy-saving improvements on the basis of preliminary studies, extending financial support to those projects that could possibly attain the target level, whereas previously the subsidy system was extended to any project that aimed at energy-saving. There is also a difference in the procedure for screening the projects being considered for subsidization. In the conventional system, the number of projects to be subsidized is decided after considering the total amount of the available subsidy, while the new system has the number of subsidized projects already set prior to the screening, so the technological level and readiness to proceed with the project on the part of manufacturers constitute important factors when the government decides which maker will be best qualified to carry out the project.

But what characterizes the new system more strongly is the fact that more than one maker is assigned to the same development project. With the same target in mind, each maker has his competitions always in mind and tries to reach the targeted level as rapidly as possible.

Now, three years after the projects were assigned, manufacturers are expected to make public results of their efforts before the yearend. In the earlier stage, it was found extremely difficult to attain the targeted EER value of 3.60 which was 25% higher than the average value shown by products then marketed. After streneous efforts, mmanufacturers are reported to have nearly achieved the target, allowing their products to offer perhaps the world's highest energy efficiency in each category.

The project covers three types of room air-conditioners – namely, a separate type of unit with inside and outside heat exchangers, a unit equipped with an air-cooling condenser, and a type exclusively designed for use as a cooler. For all these types, the EER value must be raised to 3.60 by employing new technologies in building all sections of the unit.

First, power input must be reduced by adopting an improved compressor. Then comes the motor, the heart of the air-conditioner, which needs improvements in many aspects in order to achieve higher energy efficiency. Others include the starting operation, followed by mechanical loss caused by friction in the operating section, resistance in the air inlet and outlet sections, air inlet and outlet losses, compression efficiency resulting from such parameters as input power, rotation frequency and axial output and mechanical efficiency, as well as the type of motor itself. All these have to be thoroughly checked and improved to attain the best possible total efficiency of the motor.

The heat exchanger, mainly composed of tubes and fins, performs the heat exchange between the coolant in the tube and the air surrounding the tube. Improvements are to be made in the shape of the fins which are installed outside the tube for better transmission of the heat in the air, in addition to their thickness, length and pitches. Diameter of the heat transmission tubes which serve to improve heat transmission of the coolant and their inner construction must be studied, together with maximum reduction of draught resistance when condensation takes place on the tubes.

The blast fan, housed in the heat exchanger section, has to be designed to most effectively send cooled air out of the air-conditioning unit. Improvements in the motor section can be attained in the same manner as in the unit's main motor, while the fan section must be studied from many angles including the size in diameter, thickness, the degree of curvature and the number of blades, so that it will not only minimize the power consumption but also will display characteristics matching with the operation of the heat exchanger. Reducing operating noise must also be studied.

In the air conditioning cycle section, enhacing performance of the capillary tubes and expansion pipes is the major point of study. A new mechanism has been under development which will improve performance of these two components which contribute to reduction of pressure of the high-pressure coolant.

As mentioned before, the government has encouraged competition among designated air conditioner makers in the course of their development of products with higher energy efficiency. It was the government's expectation that these makers, after having attained the required improvements, would serve to expedite completion of products of high energy efficiency by other manufacturers.

The situation has actually developed in a slightly different direction. According to industry informants, while competition for the earliest possible achievement of the assigned project has been observed among the subsidy-recipient makers as expected, non-recipient manufacturers have also started intensive R&D programs with their own investments. Now at the stage of trial production, many are reported to have successfuly raised energy efficiency in their products to almost the target level set by the government. It must be said that the official program, originally intended for a limited number of air-conditioner manufacturers, has acted to spur on the industry as a whole.

One must note here that air-conditioning units offering the highest possible energy efficiency still remain high energy consumers, and that the efficiency value cannot be improved to an unlimited extent. According to prevailing views, it may not be possible for the EER value to go beyond the point of the currently targeted 3.60.

With Japan's climatic conditions in summer and its environment concerns to be taken into consideration, an increasing number of air-conditioning units will be used in the future. No doubt this will result in more consumption of electricity, whatever improvements have been made to reduce the electricity requirement to run each unit. Then, it becomes the consumers' responsibility to make the best use of their units in order to help ease the country's energy situation.

For smooth marketing of the improved models, manufacturers are urged to make them available in a price range similar to conventional models by means of mass-manufacture or other measures to reduce production cost. In the marketplace, consumers, fully aware of the many advantages provided by improved models will still avoid buying them because they are generally higher priced due to the fact that energy conserving features have pushed up manufacturing costs.

CSO: 4120

SOLAR ENERGY SAID REACHING PRACTICAL APPLICATION STAGE

Tokyo BUSINESS JAPAN in English Sep 80 pp 89-93

[Article by Taira Sunami, former technician of Sunshine Project Promotion Headquarters, Agency of Industrial Science and Technology]

[Text]

THE solar energy house, utilizing cryogenic heat, belongs within the field that is making the most rapid progress among the new methods to utilize solar energy. For example, hot water supply system using solar heat have been already commercialized with sales totaling 200,000 units valued at ¥10 billion in 1979.

It appears that houses with solar heating and cooling are now at the stage of practical application. The demand for such solar houses is showing signs of steep growth this year. Tabie 1 shows recent trends in the installation of solar systems in Japan classified by type and purpose.

By the end of 1979, 600 solar energy buildings had already been built. 200 of them are provided with solar air-cooling as well. Of these buildings, 90% are used for dwellings, almost 10% for business and the rest for public purposes. A recent trend shows wider diffusion of solar systems in such public establishments as hospitals, schools, old people's homes and day nurseries, and for business uses including offices, factories, sports

Table 1 Installation of Solar Systems Classified by Type and Purpose

a) Types (in number of units)

Item \ Year	Before 1975	1976	1977	1978	1979	Total
Hot water supply	138	197	460	977	2,421	4,193
Hot water supply and room heating	–	11	149	90	136	386
Hot water supply and air conditioning	4	5	26	45	71	151
Others	–	–	4	19	13	36
Total	142	213	639	1,131	2,641	4,766

b) Purposes (in number of units)

Purposes \ Year	Before 1975	1976	1977	1978	1979	Total
Housing units	136	200	584	940	2,316	4,176
Public establishments	3	4	11	57	61	136
Business use	3	8	41	122	251	425
Industry	–	1	3	12	13	29
Total	142	213	639	1,131	2,641	4,766

Source: Solar System Development Association

Table 2 Size and Capacity of Solar Systems

Item \ System	Hot water supply systems		Hot water supply and heating		Hot water supply, (cooling) and heating	Hot water supply and air conditioning		
	Housing units	Business establishments (company dormitories)	Housing units	Business establishments (day nurseries in cold districts)	Housing units	Housing units	Business establishments (offices and buildings)	Business establishments (old people's homes)
Heat collectors (m²)	4.0	54	20	134	13	40	334	1,146
Heat storage tanks (m³)	0.3	3.5	1.0	5.0	0.6	1.8	15	60
Room coolers	–	–	–	–	about 4500kcal/h (1.5kW)	2RT	20RT	50RT
Hot water supply, quantity	300ℓ/day (converted to 60°C)	6 tons/day (50°C)	300ℓ/day (converted to 60°C)		300ℓ/day (converted to 60°C)	300ℓ/day (converted to 60°C)		
Cooled space (m²)	–	–	30	282	28~35	45	565	1,350 (about 50 beds)
Heated space (m²)	–	–	–	–	28~35	45	565	1,350

Note: Area of heat collectors is converted to plate type. (Source: Solar System Development Association)

clubs, company dormitories, bath houses, hotels and inns. Newer ones cover areas of 1,000 square meters or more.

Promoting Solar Energy Use

Typical examples of the systems being installed at present in comparatively large numbers are those classified by size and capacity (Table 2). Twenty firms are already selling such equipment and 10 other firms are planning to do so shortly. Scores of firms, including the makers of hot water dispensers, have moved into or are planning to move into solar system manufacture.

Over 10 companies are engaged in designing, production, installation and sales of solar systems, while 6 to 7 companies are engaged in only designing and installation. A few firms are producers of solar systems only (Table 3).

The output of heat collectors last year is given in Table 4. The aggregate area comes to about 70,000 m².

The development of new products is progressing rapidly as the interest in solar energy has brought about a steep growth in production and sales.

As explained below, government and local autonomous bodies are very enthusiastic in the dissemination of solar systems. Financial organs have also begun to show keen interest. The future task will be to supply inexpensive, reliable and durable equipment and systems in large quantity and determining ways to expand the market.

The first prerequisite to wide diffusion and practical application of solar systems is to popularize them with the public. Nationwide cooperation, including both the government and private citizens, is essential to develop efficient systems featuring high energy savings and reliable performance, and to assure their widest possible utilization.

The Ministry of International Trade and Industry (MITI) is energetically promoting the program to raise the percentage of solar energy to about 1% of Japan's total energy consumption, or to an equivalent of about 6.5 million kℓ of petroleum per year. About 80% of this solar energy will be accounted for by solar systems for housing units and the remaining 20% by solar beam or solar heat power generation.

Practical Measures

Development of technology as well as huge investments in funds and personnel backed up by national consensus and a strong government policy are essential to achieve the abovementioned target.

Against this background, MITI has set up an Organization for the Comprehensive Development of New Energy and promulgated a Law for Promoting Development and Introduction of Energy Superseding Petroleum. The ministry is also drawing up a program

Table 4 Production of Solar Hot Water Supply Systems and Solar Heat Collectors (1979)

Hot water supply systems		Heat collectors			Total
Production volume (units)	Value (in ¥1 million)	Production volume (units)	Area (m²)	Value (in ¥1 million)	Value (in ¥1 million)
203,127	9,956	48,833	68,034	1,605	11,560

Source: Research & Statistics Dept., Ministry of International Trade & Industry to secure development funds.

Under the Sunshine and Moonlight Projects, the Agency of Industrial Science and Technology, which is mainly responsible for the technological side of the solar energy project, is promoting the development of durable, reliable and inexpensive solar houses as well as components and materials for light and heat collectors, heat accumulators and thermal transport systems. The technology will speedily approach the stage of practical application after feasibility tests using four model houses for the Sunshine Project and 11 for the Moonlight Project (Table 5).

MITI is mapping out positive steps for practical applications and diffusion of solar houses from the current fiscal year. The Consumer Goods Industries Bureau of the ministry is the center of this activity. These measures are briefly described in Table 6.

This program calls for the "solarization" of 8 million housing units, 6,500 buildings and 20,000 factories and plants by 1990. This target is by no means an easily attainable one. Development is not only a technical and economic proposition. Solar systems must be built on a new social structure and cover numerous aspects ranging from production to distribution.

According to one estimate, direct investments in the solar system industry will amount to ¥4.8 trillion by 1990. Aggregate demand would swell this figure to about ¥11 trillion if the effects on interrelated industries are taken into account.

At present the utilization of solar energy is mainly restricted to hot water supply, heating and cooling, but applications will gradually disseminate to agriculture, forestry, fisheries, industries and electric power generation. Development of new systems in these fields is an important task for the future in view of the vast market potential.

After the current fiscal, the Sunshine Project will take up the development of industrial solar systems. Relatively simple and economical applications, such as passive systems and heat pumps, will also be studied intensively.

A prerequisite to the sound growth of the solar industry is quality guarantee and standardization of systems and equipment, rationalization of production, and protection of consumers. The industry is now studying examination standards for materials, structures and performance of equipment and systems. Standardization of heat collectors and accumulators has already started.

Diffusion efforts, which were started in the current fiscal year with a budget of ¥5,300 million, are planned to help spread the use of solar energy. Among them are the following:

1. The government will subsidize about 1/2 of cost for the installation of solar systems in the establishments of local autonomous bodies and other public institutions related to medical care, education and welfare. A budget of ¥3 billion (¥6 billion in terms of public works) has been appropriated for this purpose.

2. Loans and interest subsidies will be provided for the installation of solar systems in housing units and business establishments. A budget of ¥2,200 million is earmarked for this purpose.

Japan is in need of new indigenous energy sources. Solar energy offers possibilities answering to just such needs. The solar energy house is the vanguard for realizing these possibilities.

CSO: 4120

WASTE HEAT RECYCLING PUMP PROMISES GREAT ENERGY SAVINGS

Tokyo BUSINESS JAPAN in English Sep 80 p 95

[Text] NEARLY 50% of the total energy consumed in the world is released as waste heat into the atmosphere, rivers and the sea. Efficient recovery and reuse of this tremendous amount of waste heat has become an important task in energy-saving measures.

For example, the iron and steel industry in Japan, which accounts for 60% of the nation's energy consumption, dumps a tremendous amount of heat into our environment. It would be a great benefit to society if this heat could be recovered and made available to other industries in the region or for household use.

Against this background, the Agency of Industrial Science & Technology mapped out "Moonlight Project," a research and development program for energy-saving technology. Since 1976 the agency has commissioned a number of civilian enterprises with the development of systems and technique for the reuse of waste heat.

Technologies and systems included in the category "heat recovery and heat exchange" include: (1) low-temperature heat pipes, (2) heat exchangers for high-temperature gas, (3) heat recovery from industrial furnaces, (4) heat recovery from high-temperature waste water by means of direct contact heat exchangers, (5) heat recovery by means of compressor-type heat pumps, (6) heat recovery by means of absorption-type heat pumps, (7) recovery of solid heat from coke by means of dry fire extinguishing process, (8) movable layer heat exchangers using corrosion-resistant heat pipes, (9) technique to generate high-pressure gas by utilizing waste heat and (10) compact and high-efficiency rotary heat exchanges.

Technologies and systems included in the category of "transport and storage of heat" include (1) transport and storage of heat by utilizing chemical energy, etc. and (2) hot water transport systems by means of a thermo-siphon.

Principal techniques have already been formulated through basic research and have entered the stage of practical research and development. The present project will come to an end in fiscal 1981. A budget of ¥1,000 million has been appropriated for the current fiscal year and ¥900 million will be demanded in the final project year.

Hitachi Shipbuilding & Engineering Co., commissioned to develop heat recovery systems by means of compressor-type heat pumps, has come out with a heat pump for recovering waste heat, while Tokyo Sanyo Electric Co., commissioned to develop heat recovery systems by means of absorption-type heat pumps, has announced a cold and hot water dispenser with an absorption heat pump and has delivered the first machine to a user.

The heat pump for recovering waste heat, developed by Hitachi Shipbuilding and delivered to Sumitomo Rubber Industries, generates boiler water of 109°C from industrial waste water of 93°C as a heat reservoir in winter. In summer the same pump is converted into a refrigerating pump through a simple rearrangement of piping, producing cold water of 7°C for room cooling systems. It is claimed that energy of about ¥30 million per year can be economized through this system.

The main body of this system is composed of four heat exchangers. It has two towers, one of them housing a regenerator and a condenser, and the other an absorber and an evaporator.

First, the hot waste water discharged from a plant is conducted to the evaporator. As the water passes through heat-conducting pipes, it evaporates the coolant (water) which forms a drop-curtain outside the pipes. The steam of the coolant is led to the absorbing unit and is absorbed by a concentrated solution of lithium bromide forming another drop-curtain outside heat-conducting pipes. High temperature, generated in the absorption process, heats the water running in the piping.

On the other hand, the cold and hot water system which Tokyo Sanyo Electric Co. delivered to Gunze Limited, a manufacturer of textile products, incorporates an absorption-type heat pump and develops a cooling capacity of 200 RT. The system cools the textile plant. Simultaneously the warm water discharged from it and industrial waste water discharged from the plant (25 – 30°C) serve as a heat reservoir for hot water supplied to the dyeing plant.

This system is based on the working principle of absorbing heat from a low-temperature heat reservoir and using it for heating water. Waste water discharged from the plant serves as the low-temperature heat reservoir. Hot water obtained in this way is used for heating in the plant or led to the hot water dispensing system.

Though fuel such as kerosene is needed to drive the thermal medium, about 40% saving of fuel can be realized compared with a conventional steam boiler.

If the temperature of warm effluent water is suitable, the system can perform both room heating and cooling according to the season, room cooling and hot water dispensing, or air-conditioning and hot water dispensing.

Main applications are (1) air-conditioning of plant areas as well as supplying hot water to production equipment, (2) pre-heating of water supplied to steam boilers, (3) booster-heating of hotspring water and (4) air-conditioning of buildings. Combination with solar heat system is also possible. ◘

CSO: 4120

[redacted]

JAPAN SAID ABLE TO PRODUCE ONLY 20 MILLION TONS OF COAL ANNUALLY

Tokyo THE JAPAN ECONOMIC JOURNAL in English 9 Sep 80 p 4

[Article by Katsuo Matsumoto, NIHON KEIZAI industrial correspondent: "Japan Can Produce Only 20 Million Tons of Coal Annually at Most"]

[Text]

"The Government had long worked out its domestic coal policy as a social issue rather than as an energy issue. But the trend has now changed as domestic coal is attracting attention of the government in terms of its energy policy," says Masao Fujimori, president of Taiheiyo Coal Mining Co.

Domestic coal thus has regained its opportunity following the recent worldwide trend of looking at coal as an important source of energy again.

The number of domestic colliers at present is 26, a substantial decrease from 622 of 1960, with the number of employees for domestic coal mining industry reduced from 231,000 to 18,000 during the past 20 years.

During this time, the top priority in the domestic coal policy was to find out the way to phase out the domestic coal mining work with only a minimal friction.

Domestic customer industries, such as steel producers, were rather reluctant to buy domestic coal which is priced some ¥5,000 to ¥8,000 per metric ton higher than imported coal.

However, domestic coal is regaining its competitiveness amid a sharp increase in crude oil prices as well as a price hike in overseas coal triggered by the recent boom in regular coal.

Lower than oil

Shunsuke Takagi, managing director of Japan Coal Association, points out that domestic coal is priced more than ¥10,000 per ton lower than crude oil. "Compared with imported price, the price difference is only ¥1,000 to ¥2,000 per ton," Takagi adds.

Shingo Ariyoshi, president of Mitsui Coal Mining Co., went so far as to say that domestic coal is priced lower than imported coal from Britain and West Germany.

In an effort to work out a new coal policy, Minister of International Trade and Industry Rokusuke Tanaka asked his governmental advisory council, Coal Mining Consultative Body, to work out the 7th coal policy on Aug. 6 for the first time since the 6th coal policy was submitted five years ago.

Tanaka took the steps as it became necessary to set out a new energy policy designed to reduce dependency on oil and restore the use of coal as an important source of energy.

The domestic coal mining industry has both hope and fear for the coming 7th coal policy to be drafted by the government, with a particular concern that domestic coal may be neglected while user industries pay more attention to overseas coal.

MITI is expected to maintain "the annual 20-million ton production level of domestic coal" in proposing its 7th coal policy. But a mere policy will not help revitalize the domestic coal industry.

Although the government advocated the annual 20-million ton production target in the previous 6th coal policy, it has never been achieved so far with the annual production level decreased to 17,660,000 ton in the fiscal 1979 — a post-war record low level. MITI estimates that the domestic coal production will be around 18 million tons per year for the fiscal 1980.

Difficult conditions

The fact remains that it is far more difficult to produce coal at home now with conditions for drilling operations worsening.

For example, the average distance between coal pits and the ground became longer from 4,057 meters in March, 1970, to 5,872 meters in March, 1979.

Labor shortage is another serious problem in the domestic coal industry. Many of the mining workers employed during 1945-1955, during which coal production was increased year after year, have retired from their work under the age limit.

Many of the mining engineers in the coal industry are 50 years in age or older, but very few engineers below 50-year old level are working for the coal mining companies.

"Many excellent mining engineers sought their career in the coal mining industry during 1945-1955, but few followed them afterward," says Chiaki Hayashi, president of Hokkaido Colliery & Steamship Co. "The mining engineering course for training young engineers at universities has disappeared," laments Hayashi.

In order to step up its coal production, the coal industry must first try to put an end to its accumulated deficit and reinforce its management.

The ordinary profit and loss of nine major coal mining companies for the fiscal 1979 was ¥720 in deficit in producing 1 ton of coal. The total deficit of these companies reached ¥11,600 million for the same fiscal year.

Soaring deficit

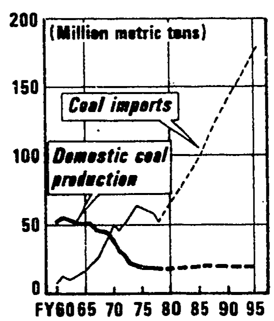
Without an increase in coal prices, the ordinary profit and loss of the nine col mining companies is estimated to suffer a deficit of ¥1,400 in producing 1 ton of coal in the fiscal 1980.

Under such circumstances, domestic coal producers have announced to raise an average of ¥1,400 per ton in coal prices, which met opposition from customer industries such as electric utilities and steel producers.

It seems likely that the coal producers yield to the pressure from the powerful coal users who will usually haggle over a price hike.

The domestic coal industry contends that the government should guarantee the purchase of coal and adequate unit prices to ensure their employees sufficient wages — should the government want to maintain the 20-million ton production level.

Japan's Production and Imports of Coal



Note: Governmental estimates for after fiscal 1985

The domestic coal producers admit, however, that they can barely produce 20 million tons of coal per year at the maximum no matter how the government puts an emphasis on domestic coal. An increasing demand for steam coal must be met by imported coal.

There is also a chance that the domestic coal industry will find a new opportunity in exploring overseas coal. Not only the domestic coal producers, but also trading and oil companies, cement producers, and electric utilities are all trying to seek a new business opportunity in overseas coal — particularly the coal in Australia.

Cooperation

The domestic coal producers, however, believe that they are the most qualified in cooperating with Australian coal mining companies with their ability for mining management and technology for drilling operations.

Among the Japanese coal mining companies that have penetrated into Australia are Mitsui Coal Mining Co. (in Drayton), Mitsubishi Coal Mining and Cement Co., (in Warkworth), Sumitomo Coal Mining Co., (Lithgow Valley), Taiheiyo Coal Mining Co., (Bird Rock), and Matsushima Kosan Co., (Sugarloaf).

Mitsui is also negotiating with China for a joint project at Si Xiong Gou colliery in the coal field of Da Tong.

However, labor shortage is posing a similar problem in the case of overseas coal mining project as well. Due to a shortage in well-experienced mining engineers, Australia is now asking Japanese coal mining companies to send their senior coal mining engineers to its country.

"We can meet such a request for the time being, but in five years it would become rather difficult because of our own shortage of senior mining engineers," says Hisaji Ishihara, director of Mitsui Coal Mining Co.

The Japanese drilling technology for coal mine is regarded as the world's top level. And yet, most of the overseas coal is extracted from an open-pit mine to which the Japanese drilling technology can not be applied.

Ishihara predicts that the

open-air mining will remain to be a major form for the overseas coal mining for the next 20 years. "After that, the underground mining will become a major type of coal mining in foreign countries," say Ishihara.

It is questionable, however, whether Japanese coal mining companies can keep up with their drilling technologies until that time.

Another problem is that the domestic coal mining industry faces a fierce competition with other domestic industries in overseas coal mining business. For all their drilling technologies, domestic colliers have a rather small capital to support their business compared with other domestic industries.

Furthermore, unlike user industries such as electric utilities and steel makers, the colliers must secure their customers for their newly extracted overseas coal.

Unless they cooperate well with the other industries, the domestic colliers may in fact fail in their overseas coal mine exploration projects.

CSO: 4120

COAL INDUSTRY REVIVED, ENTERS NEW AREA

Tokyo NIKKEI BUSINESS in Japanese 2 Jun 80 pp 36-47

[Text] New Age of Coal; Handling the "Disengagement from Oil" Which Is Emerging

Coal has rapidly come to the fore as the leading candidate in the diversification of energy sources.

Expansion in supply of nuclear energy and natural gas type oil alternative energy has taken place, and the role of coal has increased.

We are surely in a new age of coal. Coal field development, installation of port facilities and coal storages, and construction of power plants are aimed at expanding the utilization of coal, and the industrial world is making great strides.

Japan Will Be the World's Leading Importer of General Use Coal in 2000
(Trend in Import of General Use Coal) (Unit: Million Tons)

	1 1977年	2 2000年 3 ケースA	2 2000年 4 ケースB
5 日本	2	53	121
6 フランス	14	26	100
7 西独	3	20	40
8 イタリア	2	16.5	45.5
9 オランダ	1.5	19.9	34.2
10 スウェーデン	0.3	14.3	23.1
OECD	45	210	460
11 アジア(除日本)	—	60	179
12 世界	60	300	680

Note: Case A is for the situation in which coal consumption increases leisurely; Case B is for the situation when coal consumption increases sharply (from WOCOL).

Key:

1. 1977
2. 2000
3. Case A
4. Case B
5. Japan
6. France
7. West Germany
8. Italy
9. Holland
10. Sweden
11. Asia (except Japan)
12. world

Oil Unstable, Momentum Rebound to Coal

Development, import, and liquefaction of coal; design and construction of thermal power plants. In recent times, one sees articles related to "coal" appearing almost daily in the newspapers. Now the context of all these accounts nearly always refers to some return theme. They talk about "back to coal" or "return to the black diamond coal."

The facts show that where Japan imported 8.6 million tons of coal from overseas sources in 1960, this import had expanded to 64.6 million tons during the peak year of 1974, and the imports for 1979 totaled 59.4 million tons. This represents a very large increase in imports, and any idea of restoration of past practices certainly seems inappropriate.

Now, such is not the case. What is now termed "restoration" does not refer to the overall coal picture but coal for general use. Coal is classified into the two categories of raw material for steelmaking and coal for general use. As indicated by its terminology, coal for general use can be used in any application. It is used to stoke the old and nostalgic pot belly stove, steam locomotives, boilers, and similar units. The principal uses today are for power plant boiler and cement kiln (pot) use. There is also considerable use in the paper pulp area.

To Exceed 20 Million Tons After 5 Years

Now almost all of the imported coal mentioned before has been for raw material use. Coal for general use accounted for but 1.7 million tons of the 59.4 million tons that was imported in 1979 or barely 3 percent. On the other hand, if one looks at the production of coal for general use from domestic sources, its withering behavior stands out clearly. Because of the availability of cheap imported coal, the production of 43.6 million tons in 1961 dropped to 10 million tons in 1979 representing a drop to one-fourth of the previous level. There was no longer any vestige of any thought to ascend the throne of energy provider (the production of domestic raw material coal was 11.8 million tons in 1961 which dropped to 7.7 million tons in 1979, and this decrease was not as drastic).

Now, the situation has begun to change from last year starting with the reason that domestic coal is found in extremely deep layers and there are limiting factors due to cost, safety, and technology as a result of which only an annual production of the order of 12 million tons and a total of 20 million tons including raw material coal can be expected from here on. This is why there is expected to be a sharp increase in coal imports.

While the quantity may not have been very large, the 1.7 million tons of coal for general use imported in 1979 exceeded the previous year's import of 1.01 million tons by 66 percent, and this year a sharp increase on the part of the cement makers is expected to up the import to between 6-7 million tons. This is not all. This import is expected to increase to 10 million tons next year, and the long-term provisional energy demand estimates of the Comprehensive Energy Survey Board envisions import of 22 million tons in 1985, 53.5 million tons in 1990, and 80.5 million tons in 1995.

Furthermore, use of coal in other applications such as liquefaction and gasification are being planned, and it is said that the projects which presently are in the experimental stage will attain the practical stage in the 1990's, partially at least. In this manner, the trend is being reversed, and there is a picture of sudden expansion. There is, to be sure, a return to the black diamond.

There are a number of reasons which can be advanced for this activation. The first reason which can be given is the price. Put in an extreme manner, coal is cheaper than oil. That is to say, a phenomenon that is reverse to the situation in which coal was being replaced by oil has taken form. The basic factor is obviously the oil shock. At the time of the first oil shock in 1974 the price of coal for general use, both foreign and domestic, was already lower than the competitive item C oil compared on a caloric basis.

Despite this situation, except for a number of cement companies headed by the Kyosan, there was little shift at that time away from C oil. This was because of the need to finance the acquisition of new equipment as well as the recession caused by the oil shock that new equipment was out of the question. Now, the second oil shock of last year brought about a decisive difference in the price between coal and oil.

Considerably Cheaper Than C Oil

The price of oil at the present time is 5-6 yen per kilocalorie. In contrast, the cost of even the more expense of the imported coals is of the order of 2 yen. The more costly domestic coal is but 2.7 yen. There is adequate reason for the use of coal even after outlay for equipment is included. In the particular case of the cement companies, they do not need as much money for equipment to convert to coal compared to the power companies, and the time required to make this conversion in fuel is short. These companies have converted completely to coal, and this has been responsible for the sharp increase in demand.

Despite this situation, the major factor in the price structure on a long term consideration is the instability of the oil supply. The WOCOL (World Coal Study = World Coal Study Board) composed of 16 major coal producers and consumers of the world including the United States, United Kingdom, Australia, Canada, and Japan recently compiled a report "Coal--Bridge to the Future" which states that any increase in oil production from here on by OPEC (Organization of Oil Exporting Countries) cannot be anticipated, and there is greater possibility of a decrease. The daily import of oil on the part of the various countries of OECD (Organization of Economic Development) is presently 26 million barrels, and there is said to be good possibility that this figure will decrease to about 22 million barrels per day in the year 2000.

In another direction, nuclear energy which had been considered one of the leading forms of oil replacement energy has been facing antinuclear power plant movements, and it has now become not the promising source of future power as had once been anticipated. Natural gas requires tremendous outlay for transport, liquefaction, and gasification in addition to which there is a good possibility that OPEC will limit its export just as with oil. Here again, the chances are dim for any great increase. Other alternate energy sources include solar energy, hydropower, wind power, tidal power, and biomass (biological energy), but none of these is expected to make a major contribution at least in the course of this century.

Such being the situation, the one source on which major promise can be placed is coal. First of all, the total recoverable coal in the world today is estimated at about 660 billion tons. When calculated on a caloric basis, it amounts to 5 times the established oil reserves. When based on the present rate of consumption, there is enough for more than 200 years. Furthermore, 60 percent of the coal reserves is found in the four countries of the United States, Soviet Union, China, and Australia and is mainly found in leading countries and countries with stable governments. There is little chance of cartel formation similar to OPEC. These are some of the favorable conditions associated with coal.

This is why the IEA (International Energy Authority) while prohibiting new construction of oil-fired thermal power plants is asking the member countries to promote new construction of coal-fired thermal power plants. It is said that a proposal will be made at the Vienna summit to be held at the end of June to even completely ban all existing oil-fired power plants.

At the present time, no matter what stresses and strains are involved, there must be rapid conversion from oil to coal. This is what is meant when it is said that the instability in supply even more than the cost will be the major factor responsible for reactivating the use of coal when seen from a long-term viewpoint. This is particularly applicable to the electric power companies.

"Consolidated Power Age" for Fuel

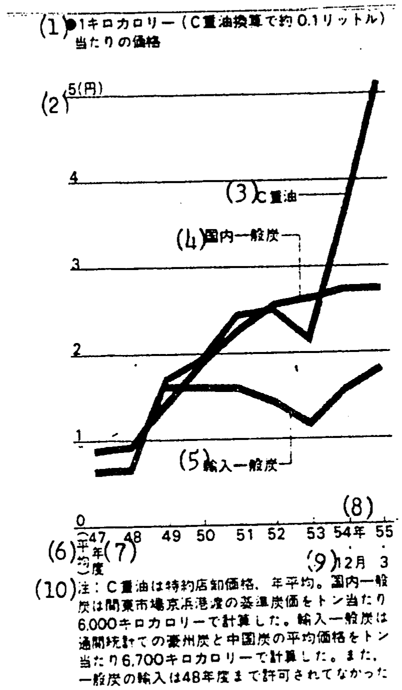
To be sure, there must be some major (international oil capital) movements involved in the background of this emphasis on conversion from oil to coal on the part of IEA and the summit. This is the movement to withdraw from the oil production sphere dominated by OPEC and to purchase or engage in capital participation in promising coal fields in the United States.Canada, Australia, and the Republic of South Africa.

In this manner, the greater the conversion from oil to coal, there is expected to be a major profit. In the particular case of Japan which by 2000 is expected to become the world's leading coal importing nation, it will be the country which will profit the most. The increasing criticism against Japan which has the highest rate of oil consumption among the leading nations can be attributed to this situation.

Even when such is the case, when one considers that the supply stability of oil will become even more uncertain in the future, the diversification of energy sources will probably be an inescapable problem as far as resources-poor Japan is concerned. Put in another way, oil which has been in the "seat of power" ever since the 1930's is seeing this power fade, and energy is presently making the transition from a "sole administration by a single party" to a "consolidated power age."

To be sure, the party out of power (alternative energy) which has the strength to replace the single party in power (oil) has not yet appeared and will probably not appear for some time, but the Mideast situation continues to be unstable. There is no telling when a "vote of no confidence" (great reduction in oil supply) on oil will take place to sink the present situation. Unless we have a diversified pipeline through a "consolidated power mode" including not only oil but coal, solar energy, natural gas, and thermal energy, Japan will not assure itself of energy. This is why there is need to put effort into all types of energy development, but the present situation is that the stock of coal is rising rapidly and is increasing its representation.

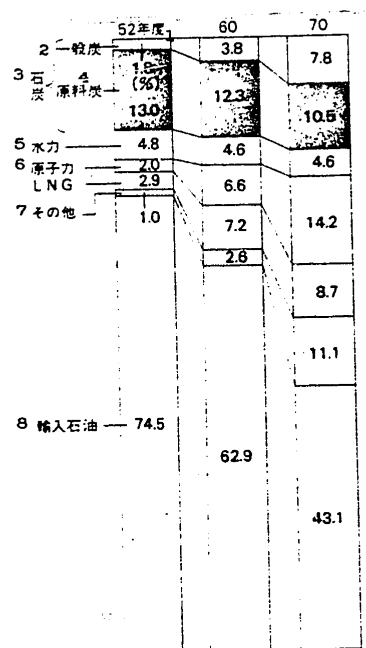
Reactivation of Coal Due to Sharp Rise in Oil Price



Key:

(1) cost per kilocalorie (about 0.1 liter as C oil)
(2) yen
(3) C oil
(4) domestic coal for general use
(5) imported coal for general use
(6) average
(7) IFY
(8) Year
(9) December
(10) Note: The average yearly wholesale prices to certain firms given for C oil. Domestic general use coal was basic price of coal at Kyohama Port which is the Kanto marketplace and was calculated on the basis of 6,000 kilocalories per ton. Imported coal for general use is the average between Australian and Chinese coal based on average of 6,700 kilocalories per ton as given by MITI statistics. The import of coal for general use was not allowed before 1973.

Expected Trends in Japan's Energy Structure



Key:
(1) JFY 1977
(2) coal for general use
(3) coal
(4) raw material cost
(5) water power
(6) nuclear power
(7) others
(8) imported oil

(9) Note: Data from "Provisional Estimated Long-Term Energy Demand and Supply" compiled by the Comprehensive Energy Survey Board was processed and used to construct this figure.

Move to Coal Field Development, Harbor and Port Installations, and Expanded Utilization

The effect of "coal reactivation" on the industrial world is greater than anticipated. Companies striving for coal assurance, cement companies, power industry troubled with siting problems, colliers, orders for harbor and port facilities, and heavy industry putting forth effort in the development of coal liquefaction technology. Warm regard for the "returned" coal.

Fuel Conversion Fever, Cement Industry Is First To Be "Ignited"

The cement industry has been the leading actor on the recent "coal fever stage." Ube Kyosan, Nihon Cement, Mitsui Mining, and Mitsubishi Mining and Cement were about the only companies which had been using coal to a limited extent before this fever. Once the curtain which introduced this fever was raised, nearly all of the remaining cement companies (20 companies) rushed in on coal producing Australia. While this was to be expected, these companies were criticized by the other industries for being responsible for "jacking up" the price of coal.

The Only Industry With "Flexible Structure" To Make Conversion to Coal

The complete switchover of the cement industry to coal was the result of the sharp increase in the price of C oil used to calcine raw material limestone to cement during the second oil shock. At the same time, this industry was in a better position to make this conversion to coal compared to the other industries. The cement industry is a "poor eating" industry which last year had used waste tires that had always posed disposal problems as fuel in an energy conservation approach. By changing the fuel to coal, the coal fines and sulfur component can be used as part of the raw material for making cement. In this manner, there were less problems due to adverse effects of conversion to coal compared to other industries, and this industry possessed "flexible structure" with respect to conversion to coal that made it unique among the various industries.

Ube Kyosan has been using coal as fuel for its cement production since 1974. This company used about 1 million tons of coal during JFY 1979. Of this total, 900,000 tons went into cement production and the remainder was used to run its own power plant. The percentage of the total energy requirements of the cement industry supplied by coal (coal conversion rate) as of April 1980 was about 65 percent, but plans indicated increasing this rate to 90-95 percent by the end of 1980. Because of this early conversion to coal, this year-end conversion rate will be highest in the world.

The cement industry giant Nihon Cement was also on the early side having converted in 1977. It is aiming for 55 percent by October 1980 and 81 percent by March 1981, and it is pushing reconstruction at its five plants spread over the country. This conversion will require capital expenditure of about 6 billion yen in JFY 1980, but there is the feeling that "even though the prices of C oil and coal remain at their present levels, we will have some return as the result of this change" (according to President Tamotsu Harashima of Nihon Cement). The coal consumption for JFY 1980 is expected to be 1.3-1.4 million tons of which domestic sources will provide about 20 percent and the rest will come mainly from Australia.

In addition, Mitsubishi Mining and Cement is planning to increase its conversion rate of about 20 percent as of March 1980 to more than 70 percent as of the end of March 1981 and plans to invest some 5-6 billion yen in this direction. This move will be accompanied by an annual consumption of more than 1 million tons at the end of March 1981. Onoda Cement and Chichibu Cement also have conversion plans, and the present situation is that there is no cement company which does not have plans for plant conversion.

[redacted]

The electric power industry comes next to the cement industry in its eagerness to convert to coal. Although the electric power industry depends on coal for not more than 4 percent of its primary energy at the present time, it is obvious even from the conversion plans of IEA that conversion to coal will be promoted.

Be that as it may, there is an overwhelming number of problems associated with modifying existing oil-fired power plants to coal. The major problems are the space required for the installation of pollution prevention equipment and the assurance of space for coal storage. Furthermore, the power plants cannot be stopped for this conversion. The problem of just how to provide power during the course of modification is a problem which remains. The Shimonoseki No 1 Power Plant of Chugoku Electric (175,000 KW output) is an example of an oil-fired plant which was converted to coal, but this is a rare case.

The Electric Power Industry Is Active in Coal-Fired Power Plant Construction

This is the reason the electric power industry has no choice but to take the direction of conversion to coal through the construction of new coal-fired thermal power plants. Looking at the new design plans planned up to 1985, 10 plants at 7 sites (5.675 million KW total output) are envisioned. The Sento Koshin plant of Hokkaido Electric (350,000 KW output) is expected to go on stream this fall, the Matsushima No 1 of the Electric Power Development Company (500,000 KW output) in January 1981, and the No 2 Plant of the same company (same output) is expected to initiate operation in July of next year.

In addition, preparations are under way for construction of the Sunagawa No 4 of Hokkaido Electric (125,000 KW output), Takehara No 3 of the Electric Power Development Company (700,000 KW), the (Motsurai) No 8 Plant of Tokiwa Cooperative (600,000 KW output), and the No 9 Plant of the same cooperative (600,000 KW). All of these plants were designed some time ago, and selection of the site as well as resolution of the environmental problems have been given considerable time to arrive at today's status. In present conditions 10 years will be required before a coal-fired thermal power plant starts operation even though site selection proceeds in orderly manner.

Tokyo Electric has just started explaining its plans to site anew a coal-fired thermal power plant on the remains of the Mito bombing range in Ibaraki Prefecture. This company also hopes to construct two other plants, but these are still in the stage of selection of possible sites. Kwansai Electric and Chubu Electric both of whom serve large power consumption districts cannot help but construct coal-fired power plants, but they have not as yet revealed any specific plans.

There Are Also Plans for Paper Pulp and Synthetic Fibers

There also are movements toward conversion to coal in the paper and pulp industries, which include plans to convert from C oil to coal in order to fire their boilers. The reason for this conversion is once again the price differential. The coal consumed by the entire industry during 1978 was 43,000 tons which doubled in 1979 to 86,000 tons. The reason for this rapid doubling in consumption was the renewed use of old coal-fired boilers which had been lying idle at these plant sites, and there was no new boiler construction. It is estimated that the amount of coal consumed during 1980 will be close to 200,000 tons. Here again, conversion from the oil-fired boilers accounts for the major change, and it is said that it will be only from the latter half of 1980 that new construction of coal-fired boilers will be initiated.

There is a strong feeling in this industry that there is no other way than to go to coal to supply its energy needs if the price of C oil ever goes over the present level. An estimate of future demand for coal based on this line of thought is "600,000 to 1.2 million tons up to 1985 and 3 million to 4 million tons by 1990" (Japan Paper Makers Association).

The movement to coal conversion in the industrial world is "presently centered in the electric power, cement, and paper and pulp industries" (department head Shingyo Ono, Coal Plans Department, Resources and Energy Bureau). Plans in this direction are under way in the synthetic fiber and alloy industries, and the movement is expected to extend to a wide range of industries although the quantities involved may not be very high.

Take One's Turn at Assurance of Volume

Companies Which Develop Their Own Power

"Control price increases and assure volume." This is the slogan adopted at the end of January of this year by the nine electric power companies and the Electric Power Development Company when they jointly financed the establishment of the "Coal Resources Development Company" (abbreviated JCD, main office in Tokyo, President Hideo Yokota, capitalization 2.5 million yen). The cement industry increased its outlay for coal by 70-80 percent in the course of just 1 year of coal fever, but this was a result of scattered buying on the part of the individual cement companies.

This is why the aim of this new organization is to unitize the outlet to suppress any disorderly price increases and to acquire coal development rights in coal producing countries such as Australia to assure the coal supply. JDC plans to supply about one-third of the coal used by its 10-member power companies with coal mined by its own development program by 1985. This production is planned to be increased to the point of supplying one-half of the cooperative's needs by 1995.

Nissho Iwai Leads This Year in Coal for General Use

While the move to go to a single procurement window can also be seen in the cement industry, it is the integrated companies which are surveying and developing mines mainly in Australia. Even though the power companies ventured out in development through the medium of JDC or cement companies such as Ube Kyosan participated in development, they would not have been able to realize their goals without the intervention of these integrated companies. Where the power companies and cement companies are very inexperienced in the area of coal acquisition, the integrated companies have long experience in the development and purchase of raw material coal and abundant information gathering power.

Furthermore, demand can only increase in the future, and coal assurance is just at its beginning stage. Such being the case, these integrated companies cannot help but enter the picture. By acquiring rights to favorable mines as quickly as possible ahead of other companies, it will be possible to guarantee greater volume of coal to parties such as the power companies. By acquiring rights to promising mines, stable profit in line with the outlay can be realized.

As far as raw-material coal is concerned, the volume handled by Mitsubishi and Mitsui make up more than half of the domestic demand (about 60 million tons annually). Assigning Mitsubishi the role of grand champion and Mitsui the runner-up, the other companies are of the junior grade, and coal for general use is presently in a state of rivalry between local groups. Looking at just this year's records, Nissho Iwai which has ties with Ube Kyosan expects to handle 1.7-1.8 million tons placing it at the top of the integrated companies.

Still the Top Competitor Is 'the Majors'

"Naturally Mitsui and Mitsubishi eventually will fill the grand champion and runner-up roles, but the situation here unlike that of raw material coal is such that other integrated companies can rise to the levels of junior champion or third-ranking member" (Nissho Iwai), and spirits are high within these companies. In addition to other companies, these integrated companies face another competitor known as the Majors. It is said that the Majors already has taken over more than half of the principal coal mines of the United States and Canada, 40 percent of Australia's, and 70 percent of South Africa's, and its holdings are an order of magnitude above those of Japan's which is still at the "gnawing stage."

This is why these integrated companies frequently look to "coexistence rather than competition" so that they can acquire rights to part of the mines which the Majors has already taken over and promote joint operation. On the other hand, the term joint operation may sound nice but it also entails the possibility that the project may wind up with the operation being a subcontract to the Majors if not run properly. "Self-development is still important" is the feeling, and the present situation is that both joint operation and self-development are being pursued.

There is also increasing movement to set out on overseas coal development using the arsenal of domestically developed technology as weapons in this development, and there are many cases in which the integrated companies are entering into joint operations with domestic coal companies which developed the technologies. Mitsui and Company with Mitsui Mining, Mitsubishi Corporation and Mitsubishi Mining and Cement, and Sumitomo Corporation and Sumitomo Coal Mining type intra-group combinations are the general case. In addition, there is also a considerable number of combinations such as Matsushima Kyosan and Nichimen Jigyo, Taiheiyo Bussan and Mitsui and Company, and Ito and Company.

In any event, it is inevitable that fierce competition will continue from here between these integrated companies, and the following situations lie in the background of the present movements. (1) Because of small rate of growth, no great expansions in domestic business can be expected; (2) the influential makers have acquired their own trade capabilities; and (3) glamor industries such as electronics and fashion require a very fine business network and marketing which is very difficult to handle on the part of integrated industries.

On the other hand, the energy area is made to order for these integrated companies who possess the capabilities of overseas development and information acquisition. There is no way of stopping these companies from entering the areas of DD oil and coal. This is the reason the competition between the different companies is becoming more fierce.

Example of Development of Australian Coal Mines by Japanese Industry

	Project (name of mine)	Japanese Investment Rate (percent)	Type of Coal	Targeted Production (10,000 t/yr)
New South Wales	Drayton	Total Mitsui Mining and Mitsui and Co 5	(1)	300
	Basrock	Taiheiyo Kyosan Group 49	(2)	200
	Mount Arther	Electrical Power Development Co 15	(2)	500
	Mount Sugar Loaf	Total Matsushima Mining and Nichimen Jitsugyo 25	(1)	100
	Yulan	Mitsubishi Inc. 40	(1)	500
	Easterlygo	Mitsubishi Kasei, Marubeni 4.6 each	(1)	70
	Warkwas	Mitsubishi, Inc. 11, Mitsubishi Mining and Cement 4	(1)	300
	Moswelbrook	Marubeni has 14.99 in new mining company	(2)	200
	Newlands	Itochu and various power companies	(2)	300
Queensland	Blairsol	Electric Power Development Co	(2)	1,000
	Milmelan	Mitsubishi Inc. 6.25	(2)	500

Note: Compiled on data from the Japan Energy Economics Laboratory Survey

Key: (1) general, raw material coal (2) coal for general use

Upgrading Image Through Processing

Promote Liquefaction and Gasification Plans

The energy revolution of the 1966 period did not come about simply from the price factor. One of the reasons was that coal is a solid which makes it more difficult to handle than a liquid. Oil is a liquid making it possible for transport through pipes, and its volume can be readily controlled with valves. In contrast, coal is inconvenient to handle starting from mining, transport, storage, and utilization, and these steps also entail considerable cost. Furthermore, roughly 12-13 percent by weight of ash remains after its use whose disposal becomes necessary.

In order to make considerable use of this "old wife" with low cost but some disadvantageous conditions, some makeup must be applied. There is need to alter the coal which is not as palatable as oil to some form of "processed food" which is more appetizing. Coal liquefaction, coal gasification, and COM (coal and oil mixture) plans are "techniques" to alter the coal which in the raw is not usable to the average household to a form which is easy to use.

These Processes Will Become Practical With the Sunshine Program in the 1990's

In plain language coal liquefaction means the decomposition of coal to remove the ash component and recover an oil equivalent to fuel oil. The three Sunshine projects use bituminous coal as raw material. The "solvolysis liquefaction method" which dissolves and liquefies coal at room temperature is being taken up by the Electric Power Development Company and Mitsubishi Heavy Industries while the "direct hydrogenation liquefaction method" in which coal is subjected to high temperature and pressure in the presence of a catalyst and hydrogenated and decomposed to produce a liquid oil is being undertaken by the Electric Power Development Company and Mitsui Shipbuilding and Engineering. There is also a third process called the "solvent treatment liquefaction" method in which coal under medium pressure is partially liquefied, and this is used to liquefy the rest of the coal which the Electric Power Development Company, Sumitomo Light Metal Industries, and Sumitomo Coal Mining are promoting. The future schedule is as shown in the following figure, and it is expected that practical use will be after 1990.

Where the projects under the Sunshine Program involve domestic coal and domestic technology for the liquefaction, there are also a number of international liquefaction schemes. There are the joint Japanese-American-German SRCH method, the joint Japanese-American EDC method, the Comminic method, and the SRCI method developed by the Mitsubishi group which are being expanded internationally. The SRCH method was developed by capital and technological cooperation on the part of three countries. Participation on the part of Japanese industry has finally been decided, and a joint internationally funded company will soon be formed with Gulf of the United States and Rule Cole of West Germany. A demonstration plant of 6,000 ton/day coal treatment capacity is planned for construction in the United States.

In another direction, the Comminic method to be employed by the three companies of Kobe Steel, Mitsubishi Chemical Industries, and Nissho Iwai will use peat from the province of Victoria in Australia. Unlike bituminous coal, this material is lower in quality which often runs the danger of being discarded, and this is the feature of this method. The basic technology was developed by February 1979, and construction of a plant to handle the equivalent of 50 tons/day coal was initiated in 1980. This peat from the province of Victoria is planned to be used by the Mitsui group for use with the SCRI method, and rivalry between these two groups has surfaced. This is an indication that coal fever has extended down to these low quality material.

Gasification of coal involves methods for the production of low calorie gas to be used in power generation and methods to produce high calorie gas for use as city gas. Both types are being promoted under the Sunshine Plan for eventual practical use. The low calorie gas to be produced by the method contracted to the Coal Technology Laboratory is to be used for electric power generation, and a plant capable of processing 40 tons/day of coal is expected to be completed by September 1980. In addition, design for a 1,000 ton/day demonstration plant will be started in the very near future. In another direction, considerably more time will be required to develop a high calorie gasification process, and this process is expected to attain the practical state in the 1995 era.

COM Activated Faster But Rise in Oil Price Has Effect

Where gasification and liquefaction will require more than 10 years to attain the stage of practicality, the COM method which involves a mixture of fuel oil and finely powdered coal requires much less time to achieve the practical stage. The fluidization of coal by this method to form a "rice gruel" is presently being researched by the Electric Power Development Company and Sumitomo Metal Industries. The Electric Power Development Company has been importing COM technology from GM in the United States since 1976, and this company is presently in the state of application development. The basic pilot plant experiments were completed by the end of 1979, and plans are under way to start COM blowing in experiments at the Takehara Thermal Power Plant.

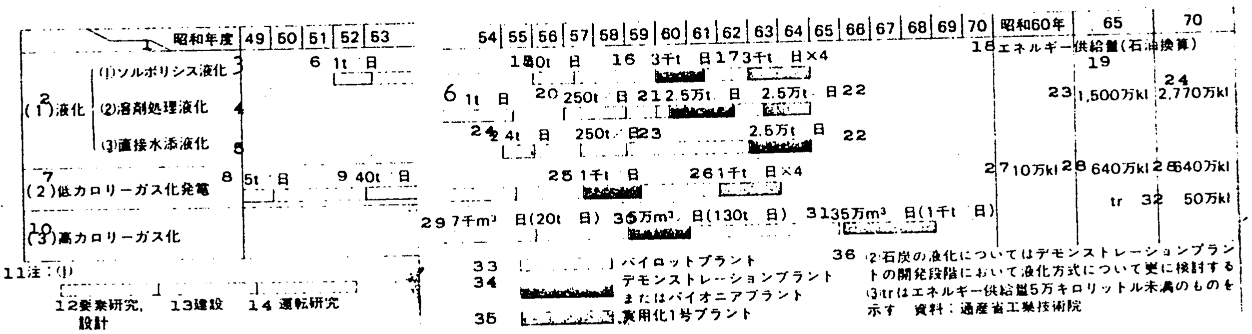
In another direction, Sumitomo Metals intends to utilize COM as blast furnace fuel, and plans are to start blowing in experiments at the No 2 blast furnace of Kashima Steel Plant in August. In this manner, the COM method is not very far from practical use, but this method requires fuel oil as one of the starting materials. In other words, a major drawback is the ready influence this method comes under the price of crude oil. "Rice Gruel" is not a solid food nor a soup which, plus this being a mode not removed from oil, seems to have lowered the possibility of wide use of this method.

Good Look at the Spinoff Effect

One Trillion Yen Required for 10 Million Tons

Ever since the Coal Resources Development Group (JCD) was established at the end of January of this year, many of the key people of various industries dropped in to visit this establishment. This list included the nine integrated companies as expected along with marine transport, construction, shipbuilding, industrial

It Will Be the Era of 1995 When Liquefactions and Gasifications Under the Sunshine Plan Become Practical



Key:

1. year of Showa
2. liquefaction
3. solvolysis liquefaction
4. solvent treatment liquefaction
5. direct hydrogenation liquefaction
6. 1t/day
7. low calorie gasification power generation
8. 5t/day
9. 40 t/day
10. high calorie gasification
11. Note
12. element analysis, design
13. construction
14. operational research
15. 40 t/day
16. 3,000 t/day
17. 3,000 t/day x 4
18. amount of energy supplied
19. oil equivalent
20. 250 t/day
21. 25,000 t/day
22. 25,000 t/day
23. 15 million kl
24. 27.7 million kl

24a 2.4 5/day

25. 1,000 t/day
26. 1,000 t/day x 4
27. 100,000 kl
28. 6.4 million kl
29. 7,000 m^3/day (20t/day)
30. 50,000 m^3/day (130 t/day)
31. 350,000 m^3/day (1,000 t/day)
32. 500,000 kl
33. pilot plant
34. demonstration plant or pioneer plant
35. practical plant No 1
36. Where coal liquefaction 2) is concerned, further studies on the liquefaction mode will be made at the demonstration plant development stage. 3) tr indicates that the energy supply quantity of 500,000 kl is not quite reached.
Source of material: Agency of Industrial Science and Technology, Ministry of International Trade and Industry.

machinery, and even insurance companies. "Boy, was I surprised" laughed President Yokota. This was an indication that he himself had underrated his own company.

On the other hand, it is only natural that the industrial world take a serious look at JCD which is spearheading coal development for use in power production. This is because the spinoff effect resulting from expanded coal supply is very great. Even a rough calculation will show that, assuming increased coal supply to 10 million tons/year, this will require 25 colliers of the 50,000 ton class or 15 colliers of the 80,000 ton class. These ships will cost about 250 million yen. Assuming all this coal is used in power generation, they will fire four coal-fired power plants of the 1 million KW class. These power plants will require about 700 billion yen for their construction.

In addition, there will be need for construction of facilities for coal shipment and unloading harbors along with the cranes, belt conveyers, and bulldozers for the operation while coal mining equipment, railroad facilities, and various pollution prevention equipment are indispensable items. In other words, any number of need effects are created at every stage of the coal chain which covers "from the mining of coal to the disposal of the ashes," and an increase in annual production of 10 million tons will give birth to a one trillion yen industry at the very least.

According to the long-term outlook, the demand is expected to increase to about 50 million tons by 1990, and a simple calculation indicates that a 5-6 trillion industry would be created. When this possibility is considered, one cannot fault these different companies for their great interest in this direction.

Special Trucks, Special Ships, and Relay Businesses

There are already some indications of new needs arising from this spinoff effect. There is activation of movements to initiate new businesses looking to expand import of overseas coal. For example, Nippon Sharyo Seizo and Kawasaki Heavy Industries received at the start of this year an order from Chichibu Cement for a total of 250 special coal trucks. The plant which Chichibu Cement plans to convert its kilns from oil to coal is located in Saitama Prefecture which will require railway transport from the Tokyo Bay area. This order totals 2.5 billion yen between these two companies, and a part of the order is expected to be delivered this September.

Along the lines of special colliers, Mitsubishi Heavy Industries launched the 70,000 ton ship (Saikai Maru) in May of this year, and this ship is owned by Nippon Yusen. This collier is designated to supply the Matsushima and Takehara coal-fired power plants of the Electric Power Development Corporation. The construction of special colliers has just started and the number of ships constructed is expected to increase from here on. The number of inquiries including those from abroad on possible ship construction is to be noted.

In another direction Nippon Kokan this March established a new company "M K Coal Center" (headquarters in Tokyo) aimed at serving as intermediary for imported coal for general use. "We want to use coal, but there is no relay base (coal center), and we have no way to turn." Taking into account the many potential customers of this type, this company set up a coal center at its Fukuyama steel making plant. This steel making plant has a raw material coal yard which can store 7 million tons of raw material coal over a year, but it still has room to spare which it will utilize to handle 1-1.5 million tons of coal for general use. The customers include Nihon Cement and Chugoku Electric, but it intends to increase this business gradually to include not only small sales but even to enter into its own import of coal for general use.

The Large Heavy Industries Are Getting Ready Discretely

These trends are appearing in various other forms, but this does not mean that the coal related industries are expecting a large increase in demand in a short time. In fact, it is more often the case that preparations are being made in a discrete manner. This picture applies particularly to the case of large heavy industries such as Mitsubishi Heavy Industries and Ishikawajima-Harima Heavy Industries. These large industries not only handle orders in vast sums for coal-fired thermal power plant equipment and special ships but also produce construction equipment, loading equipment, and pollution prevention equipment much of which is used in coal related operations.

This is why these companies are in a position to profit most handsomely from an expanded coal industry, but this is also the reason they are the most discrete. This is because this large demand will fall by the wayside should the construction of coal-fired thermal power plants be delayed or suspended by siting problems or local citizen protests. Initiating production based on hasty conclusions arrived at as the result of the wide number of items which have to be considered can lead to a major blunder. At the same time, it is said that the present picture is that power plant construction is delayed from the original plans. This discreteness cannot be faulted.

To the Establishment of a Coal Chain

It is necessary to establish at an early date a coal chain which extends from overseas coal mines to domestic customers.

We must not become embroiled with any type of coal just to achieve this end. There is need for decisive investment based on new concepts.

"Coal chain." Just as the characters imply, this refers to a chain involving coal. It means the coal flow through a system from coal mine development to the customer. While small quantities are of no concern, there will be trouble should any part of this chain be broken when large quantities of the order of several ten thousand tons of coal are to be handled in a reliable manner. We will dissect this long chain and discuss the problems associated with the assurance of a stable coal supply.

First, we look at coal mine development. There is presently an Australian boom. There is good possibility that the Australian laborers will strike frequently. Even after the outlay of capital which is so sorely needed, the outlay will be meaningless unless the most important coal is not available. There is need, first of all, to diversify the supply sources.

Such being the case, China, Canada, and the United States come to mind. Minister Sasaki of the Ministry of International Trade and Industry whom we interviewed said he had informed the Chinese that Japan will be ready in JFY 1985 to accept 10 million tons of coal import in return for a yen loan. On the other hand, people involved with the situation say, "this is half talk. It would be great if we can take in 5 million tons." There are promising coal fields, but the transport facilities have not kept pace.

Such being the case with China, what about Canada, and the United States. If coal is to be imported from the United States, new development of coal fields in the western section of that country is necessary. The same can be said for Canada. "On the other hand, we as customers will always be in a bind if we act from a state of complete void. It may be better to purchase about half of our needs from the United States even at a higher price and then deal with other countries." (Director Koichiro Ejiri of Mitsui and Company.) There are some who think this way. Reliance on an Australian dominated view will not be practical particularly where resources are concerned. Furthermore, this country should make several propositions to these coal producing countries and maintain an overall overproduction air in order to enhance negotiating power. On the other hand, will the resources-rich countries accept such an approach? There is need for some skillful manipulations.

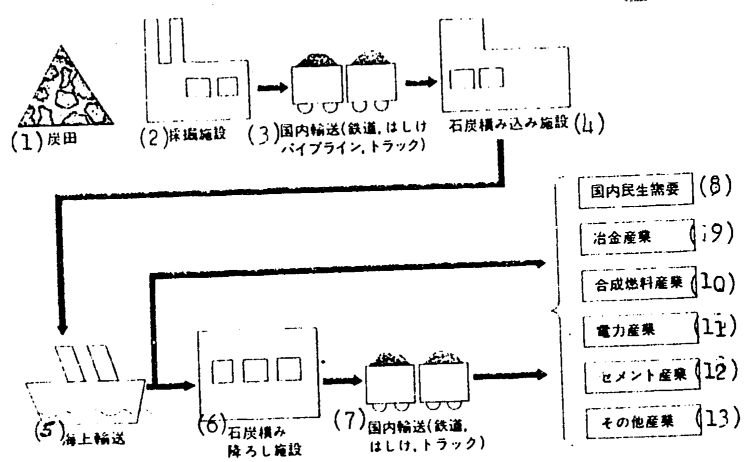
Speed Coal Center Installation

Even after coal field development has been achieved by one means or other, the chain is still very long from the inland area of the foreign country to Japan. Taking the case of Australia, the distance from the coal field to the harbor facilities is short compared to the distances involved in Canada and the United States. Even then there are doubts raised such as "the present railroads are made for raw material coal. How can they haul the tremendous volume of coal for general use?" (Steel maker head) This from the leading steel industry.

There are these impediments even in existing coal fields. Now there is need to develop new coal fields and construct railroad and port facilities. If an existing harbor is to be used, loading capacity has to be increased and harbors have to be dredged and widened. Even when the reliance is on Canada or the United States, these installations have to be present. France has a special coal loading port on the eastern shore of the United States. "Even when we invest in these harbors and railroads, there is the possibility that the coal can be exported to countries other than Japan" (head of coal development of a certain conglomerate). Such narrow thinking has to be discarded. There may be need to be cognizant that the infrastructure is a public asset and to forego a part of the profit while shipping out and cooperate in promoting these facilities.

It is only after these efforts that the coal can finally be removed from the producing country. Fortunately the assurance and construction of colliers does

There Are Problems Needing Resolution at Every Stage of the Coal Chain From Overseas Coal Mines to Domestic Customers



Key:
(1) coal mine
(2) mining facility
(3) in-country transport (railroad, barges, pipelines, trucks)
(4) coal stockpiling facility
(5) ocean transport
(6) coal loading and unloading facilities
(7) domestic transport (railroad, barges, trucks)
(8) private domestic demand
(9) metal industry
(10) synthetic fiber industry
(11) electric power industry
(12) cement industry
(13) other industries

not seem to involve too many problems. On the other hand, problems arise when this coal is about to be landed in Japan's ports. At the present time, the harbors which can directly dock colliers can at best handle ships up to 40,000 to 50,000 tons. Because of this inadequate situation in harbor facilities, there was a recent case in the North Kyushu sector in which the coal from a 30,000 ton collier was unloaded using a fleet of 128 barges.

Should coal import become a reality in the future, these coal carrying ships will become larger and larger. There will be need for coal centers at which 100,000 ton class ships can berth directly. There is a concept now to create 3 coal centers over the entire country each with the capacity to handle 4-5 million tons. Even if this plan should materialize directly, there will soon be a state of inadequate capacity if one takes the increase in demand into account. There is need for this country which is not a coal producing country but a coal consuming country to speed up the installation of its infrastructure.

Once the coal is landed, it is delivered to the customers, and the coal chain is roughly completed. Now the customers are not without their problems in the use of this coal. There are some physical problems such as the assurance of coal storage sites and the inconvenience in handling of coal. "The hands become dirtied, and the inside of a plant becomes considerably soiled. We were able to have the union agree to working under this situation, but we will have to make real changes in future labor contracts" (President Tamotsu Harashima of Nippon Cement). This is the internal situation today.

Now, the greater problem related to the use of coal is whether the local residents will readily assent to its use. There are many power plants and factories which are located in densely populated regions. "In our case, the people who live around our plant daily check the color of the smoke emitted from our stacks. Should the smoke leaving the stacks assume a different color, our telephone switchboard is swamped with protests" (chemical fiber plant). There are companies such as these who have resigned themselves in having to heed the local residents to this extent.

How To Overcome a Weak Base

Now, the electric power companies should not have to put up with this. "We are perfecting our pollution prevention facilities, and we are using coal which has been expensive to use from the past. Surely, there should not be an allergic reaction as much as nuclear energy" (Tokyo Electric). While such statements can be heard, considerable time is required to win the assent of the local people. Assuming that everything goes as scheduled, it will require 10 years before the power plant actually goes into operation. When we consider Japan's energy picture which is worsening by the day, this is too long a time. The coal which had been finally brought in from overseas mines cannot be used so readily at this final point.

The above is the part that shows of the coal chain. The actual situation is that part of the chain which is concealed. When coal is consumed at the rate of several ten million tons, there is always left behind several million tons of coal ash. There is no definitive idea just how to handle this ash. Coal liquefaction is not burdened with this problem of ash, but it is inevitable that the discussion of just where a coal liquefaction plant is to be located is an important subject in dealings between this country and a coal producing country. It would be desirable to locate this plant in the coal producing country from the standpoint of transportation costs, but there are criticisms to this approach in the vein that "is Japan going to leave the coal producing country in a state of pollution?" Assuming that this liquefaction is performed within the coal producing country, will a country such as Australia which is lacking in oil readily give up this liquefied coal. The actual situation is that the federal government will take over the liquefied coal even in the plans of the Comminic group.

Coal is saddled with the many problems which were discussed in this paper. One of the Japanese members participating in WOCOL activities said, "the predictions of WOCOL and Japan's provisional estimates with regard to oil are too optimistic.

It is very possible that even twice the quantity of coal will be needed in the year 2000." What would happen should this prediction materialize? "If the WOCOL prediction is not realized, Japan's GNP will surely fall" (Director Hidso Inaba of the Industrial Laboratory). In this manner, Japan's economy will suffer a damaging blow should the negative prediction given above come into fruition.

As the recession following the oil shock has finally been overcome, the Japanese people have finally come to realize that "there is no prosperity." There is no substitute for oil other than coal at the present time. Even this coal is associated with the very weak function which was discussed above. Unless we accurately understand the role that coal can play and earnestly consider just how to assign manpower, technology, and capital to most efficiently assure this source of energy, the time may be too late.

(Shogo Imoto, Tamaki Sato)

Plan To Diversify Sources of Coal for General Use and Look for "Polyphagous Energy" Power Generation

A major problem for the future is just how to assure the supply of this so necessary coal. Domestic coal is limited to an annual production of 20 million tons of which general use coal can be expanded to little more than 50 percent. This is why the "long-term energy demand and supply estimate" has targeted 22 million tons in JFY 1985 and 53.5 million tons in 1990 of general purpose coal to be assured from foreign sources.

It is thought that the countries exporting coal for general use include Australia, China, United States, and Canada, and it is desirable that this import be made from as many different sources as possible. Furthermore, it may be wise to draw up long-term contracts with countries such as China and Australia which conceivably can deal with countries other than Japan as well. Although China is the coal producing country closest to Japan, depending solely on this country would be risky.

The 22 million tons of coal for general use to be imported in 1985 will be used mainly to fill the needs of the cement companies and several power plants, and this distribution has already been decided. Where the 1990 distribution is concerned, there seems to be some overlapping in the foreign coal which the conglomerates talk about. The role of these integrated companies should stop at their service as agents in the import transactions and stay completely out of the price establishment. Put in more common terms, they should be like the cormorants of Nagara River.

Looking at the way this coal is used, the steel, cement, and electric power industries can use coal in its solid form. Transport equipment will have to rely on oil if not on electric power. In addition, the petrochemical industry which uses oil as raw material cannot readily convert to coal. Such being the case, electric power generation is the only area where we can expect a conversion to coal. While the comparison may not be too exact, one wonders whether there is no other course than to feed an animal which can subsist on a variety of foods a variety of foods.

2267
CSO: 4105

NEW COAL UTILIZATION TECHNOLOGY--FLUIDIZED BED BOILER, GASIFICATION

Tokyo HITACHI HYORON in Japanese Vol 62 Apr 80 pp 75-80

[Article by Mizuho Hirato,* Tokio Masui,** Shin Kawada,*** and Hiroshi Terada****]

[Text] At present a boiler that burns powdered coal is used in electric power generation with coal as fuel. A cleaner, more economical new electric power generation technique is being examined and its development is being sought on a national scale. Of many projects in this field, we will concentrate on the current status of fluidized bed boiler and coal gasification technologies that are being developed by Hitachi Group associate firms. The Fluidized Bed Boiler Project has completed its basic test stage and a construction of a 20t/h pilot plant is to be attempted in 1980. Construction of a 200t/h demonstration plant is also scheduled and the practical utilization phase is nearing. Coal Gasification is a medium to long-range development project. At this time, construction of a 7,000N·m^3/d capacity pilot plant centering around a hybrid gasification furnace is under way. This facility uses coal and crude oil as raw materials.

1. Preface

It is expected that thermal power generation which uses coal as fuel will employ the traditional powdered coal stoked boiler format. However, a cleaner, more efficient, new form of thermal power generation method is being researched and developed. For example, in Japan coal gasification, electric power generation is already under way as a national project within the framework of the Sunshine Program. There are others being pursued as large-scale projects.

*Professor of Engineering, Hitachi, Ltd. Research Laboratory
**Electromechanical Operations Headquarters, Hitachi, Ltd.
***Babcock-Hitachi, Inc.
****Babcock-Hitachi, Inc. Kure Research Laboratory

Japan is fully engaged in developing a new coal utilization technology. Research developments are also being pursued in other developed nations (such as the United States, England and West Germany) as national projects at tremendous cost. Moreover, at the IEA (International Energy Agency which includes Japan) level, there is a move to raise the efficiency level of research developments in this field by means of international cooperation. There is even an actual instance of cooperative research.[1] Several avenues are possible in considering new coal utilization technology from the perspective of electric power generation; and these are being researched and developed. One way to determine the relative importance of these projects is to compare the respective electric power generation efficiency level and the projected time frame for commercialization. The data is given in Table 1. Atomspheric pressure, fluidized bed boiler (hereafter referred to as fluidized bed boiler) is a relatively short-term development item, whereas the rest are middle to long-range development objectives.

Hitachi Group associate firms are actively involved in technological development through independent, cooperative and consignment research. In this paper, we will discuss the development status and history of two of these research development topics: fluidized bed boiler and coal gasification. Aside from these two noted above, new coal utilization technology encompasses an extensive field--liquefication, COM (coal-oil-mixture), storage, transportation, effective utilization of ash and so forth. But these will not be dealt with in this paper.

2. Fluidized Bed Boiler

Fluidized bed boiler refers to a boiler that uses fluidized bed combustion technology. As a coal stoked boiler for thermal power generation, it has the following advantages:

(1) It is suitable for wide range of coal types.

(2) It can use low grade coal and crude fuel materials.

(3) Desulfurization inside the furnace is possible; and there is no need for desulfurization exhaust system.

(4) Because of low temperature combustion the amount of NO_x (Nitrogen Oxides) released is relatively small.

(5) Heat transmission rate in the bed is high and a compact design is possible.

Since Japan relies on overseas sources for its coal supplies, the fact that (1) there is relatively little limitation as to the type of coal used, and (2) diverse kinds of fuel may be employed, are great attractions.

---

[1] For example, pressure principle, fluidized bed boiler development project in which England, United States and West Germany are the participants.

Table 1. Comparison of Efficiency Levels of New Electric Power Generation Methods Using Coal and Their Projected Time Frame for Commercialization

(Atomspheric pressure, fluidized bed boiler is slated to be developed within a few years. Items 3, 4 and 5 are middle and long-range goals; and their utilization time projection is thought to be within a similar time frame.)

No.	Electric Power Generation Method	Efficiency Rate (Percent)	Anticipated Time Frame for Utilization (year)
1.	Traditional model, powdered coal stoked boiler (desulfurization, exhaust, denitrification attachment)	33-35	--
2.	Atomspheric pressure fluidized bed boiler	35-37	1980-1985
3.	Pressure model fluidized bed boiler	38-42	1985-1990
4.	Electric power generation via coal gasification	39-43	1985-1990
5.	Fuel storage	43-47	after 1990
6.	MHD (magnetohydrodynamic) power generation	45-48	after 1995

Because of the above noted advantages, Babcock-Hitachi Inc. began development as an independent research project in 1973. In 1975 it built a 500 mm square fluidized bed boiler pilot plant at the company plant and has been testing it. Beginning in 1978, the project received aid from the Ministry of International Trade and Industry (MITI) Agency of Natural Resources and Energy and the Coal Technology Research Foundation; and the company has been conducting research development in cooperation with the said foundation and three other boiler manufacturers.[1] During 1978, development of requisite technology in the form of a pilot plant was effected, and a 500 MW fluidized bed boiler feasibility study was made. In 1979, detailed design for a 20t/h evaporation volume pilot plant was initiated and it is currently being worked on. Following this phase, a construction of a 20t/h boiler, 200 t/h demonstration plant is expected. On the other hand, with regard to small and medium capacity boiler and low grade coal stoked boiler, independent research using a 550 mm square pilot plant and the like is being continued, and we are at a point where design for practical machine is now feasible.

[2]Ishikawajima Harima Heavy Industries Co, Ltd, Kawasaki Heavy Industries, Ltd. and Mitsubishi Heavy Industries, Ltd.

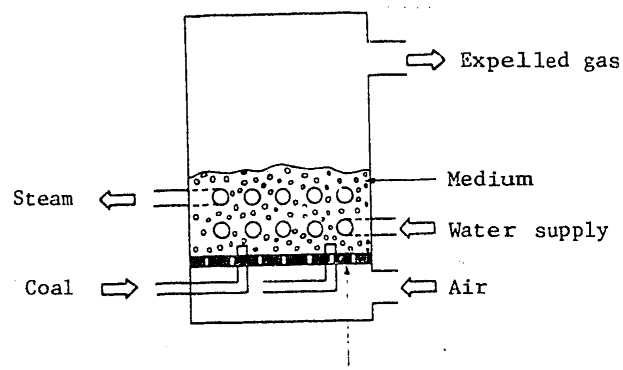


Figure 1. Principle of Fluidized Bed Combustion

Particles (medium) on the porous board are blown upward by means of air from below and they are in the state of great agitation. This situation is termed fluidized bed. Medium is heated to a high temperature and fuel is thrown into the medium and combustion takes place.

2.1 Principle of Fluidized Bed Boiler

Fluidized bed stoking (Figure 1) refers to a method of combustion whereby a medium such as sand is placed on a porous board and air is passed through the holes on the board, thereby fluidizing the medium. Then, fuel is introduced to effect combustion. Along with fluidized bed combustion there are fixed bed combustion(Figure 2) and free floating combustion (Figure 3). From the perspective of combustion method, in the fixed bed situation the fuel is stationary and air travels above it. Thus the relative velocity of air and fuel is great. Moreover, as the length of time the fuel is inside the boiler is long, combustion efficiency is high. Therefore, the height of the furnace can be low, or else, the fuel particles may be large. Among coal stoked boilers, the traditionally much used stoker combustion boiler fits this format. The disadvantage of stoker combustion is that combustion rate per unit area is not great.

And as capacity grows, the surface area becomes larger and space factor gets worse. In order to compensate for this fault, the floating combustion method powdered coal stoked boiler was created, and it constitutes the boiler mainstream today. Under the floating combustion method, air and fuel are introduced into the burner at the same time. Thus relative velocity is practically zero. Consequently, there is a need to make coal granules as small as possible. At the same time, in order to allow for sufficient retention time, the furnace must be very large. It is necessary to sufficiently lower the gas temperature before the contact/heat transfer phase--to a point lower than the coal's ash content melting point--in order to prevent ash fusion at a heat transfer phase. This factor contributes to a need for a larger furnace

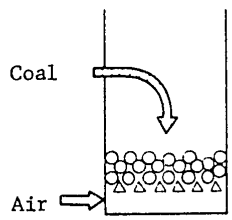


Figure 2. Fixed Bed Combustion

Air circulatory speed is low and the particles are almost always stationary
(stoker combustion boiler)

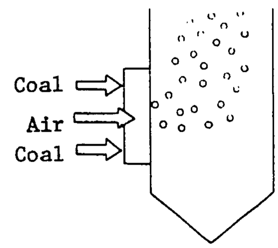


Figure 3. Floating Combustion

Fuel is pulverized and while being transported along with air, combustion is elicited
(powdered coal stoked boiler)

capacity. A search for a new combustion method to replace the powdered coal combustion boiler led to fluidized bed boiler. In fluidized bed combustion, the fuel is thrown into a fluidized medium. As a result, relative velocity with air is great and since combustion efficiency is high, combustion can be achieved at a lower temperature (850-950°C). Medium's temperature distribution is stable and low, so there is no danger of ash being fused and fixed; and heat transfer coefficient within the bed at heat transfer phase is great. Aside from these advantages, in terms of environmental protection, if limestone or another desulfurization agent is used as a medium in the furnace, it absorbs the sulfer in the coal within the furnace and desulfurization can be effected without the expensive exhaust system. Because the method employs low temperature combustion, NO_x generation can be curtailed. From the standpoint of coal quality, as the method is relatively unaffected by the characteristics of different types of coal--exothermic volume, moisture content, fusion temperature of ash and so on--a wide variety of coal may be used. Aside from coal, crude oil and gas may also be employed in combination as well. This method can also use substitute fuels expected to be developed and used together in the future--for example, oil and carbide recovered from pyrolysis of urban waste. When we consider today and tomorrow's fuel picture and the need for environmental safety precautions, this is a boiler that has great affinity with the needs of our era. Fluidized bed combustion itself had been used in incinerators from early on. It was used to dispose of difficult to burn substances, impossible to handle in a conventional furnace or wastes containing low melting point compounds. Examples of this kind of furnace are incinerators used in disposition of general and industrial waste matter, sewage dirt and ash generated by EP (Electrostatic Precipitator) in crude oil combustion electric power generation. The fact that it is used in the incinerators that handle hard to burn substances is an indication that the fluidized bed combustion is a superior combustion method.

2.2 General Design for 500 MW Coal Combustion Fluidized Bed Boiler

As a result of basic tests with a 550 mm square pilot plant, characteristics pertaining to combustion and heat transfer, friction, dirt from heat transmission phase and desulfurization have been determined. Based on this basic data, a 500 MW coal combustion fluidized bed boiler was designed and economic comparison with traditional heatpowered units (powdered coal combustion boilers) was conducted in 1978 as one item for cooperative research with the aforementioned Coal Technology Research Foundation. The particulars about the said design are detailed in Table 2. The results of economic comparison are presented in Table 3. Figure 4 is a side view of the boiler. As indicated in Table 3, there is little difference in terms of price of the boiler main body; but there is the advantage of dispensing with the exhaust, denitration, desulfurization system; and this contributes significantly to decreasing the electric power generation cost. Moreover, it was revealed that even if the only factor was elimination of exhaust, denitration system, that would be advantage enough.

Table 2. Conceptual Design Particulars for 500 MW Fluidized Bed Boiler

Steam requisites used for powdered coal stoked, thermal power generating boiler was used here as well.

Items	Particulars
Largest continuous steam volume	1,640t/h
Superheater exit opening steam requisites	
Steam pressure	Gauge pressure 255 kg/cm^2
Steam temperature	543°C
Water supply temperature	286.6°C
Reheater steam requisites	
Entrance steam pressure	Gauge pressure 45.2 kg/cm^2
Entrance steam temperature	301.5°C
Exit steam pressure	Gauge pressure 43.3 kg/cm^2
Exit steam temperature	541°C
Reheated steam flow volume	1,323t/h
Air temperature	
Outside air	20°C
Entrance of push-in ventilator	40°C
Coal supply method	Air current conveyed Loaded from below

Table 3. Economic Comparison of 500 MW Fluidized Bed Boiler

Economic comparison of traditional model powdered coal combustion boiler and fluidized bed boiler was made in reference to 500MW x 2 coal combustion thermal energy generation. The fact that the exhaust/desulfurization system can be eliminated contributes to the decreased cost of power generation.

Items	Comparison	
1. Building Cost (500MW x 2)	Traditional thermal power (powdered coal combustion boiler)	Fluidized Bed Boiler
(1) Land	base	0
(2) Building	base	0
(3) Structure	base	0
(4) Machinery	base	+1,700
(a) steam generating facility	(powdered coal)	(+2,500)
(b) turbin generator	(powdered coal)	(0)
(c) tank, dust collect	(powdered coal)	(- 800)
(d) main electric and transformer equipment	(powdered coal)	(0)
(e) coal unloading and transportation equipment	(powdered coal)	(0)
(f) ash processing system	(powdered coal)	(0)
(g) other	(powdered coal)	(0)
(5) Total cost	base	+ 170
SUBTOTAL	base	+1,870
(6) Exhaust/desulfurization system	base	-14,000
(7) Exhaust/denitration system	base	-10,000
TOTAL	base	-22,130
2. Power generating cost	100%	78.1%

Note: Unit (1 million yen)

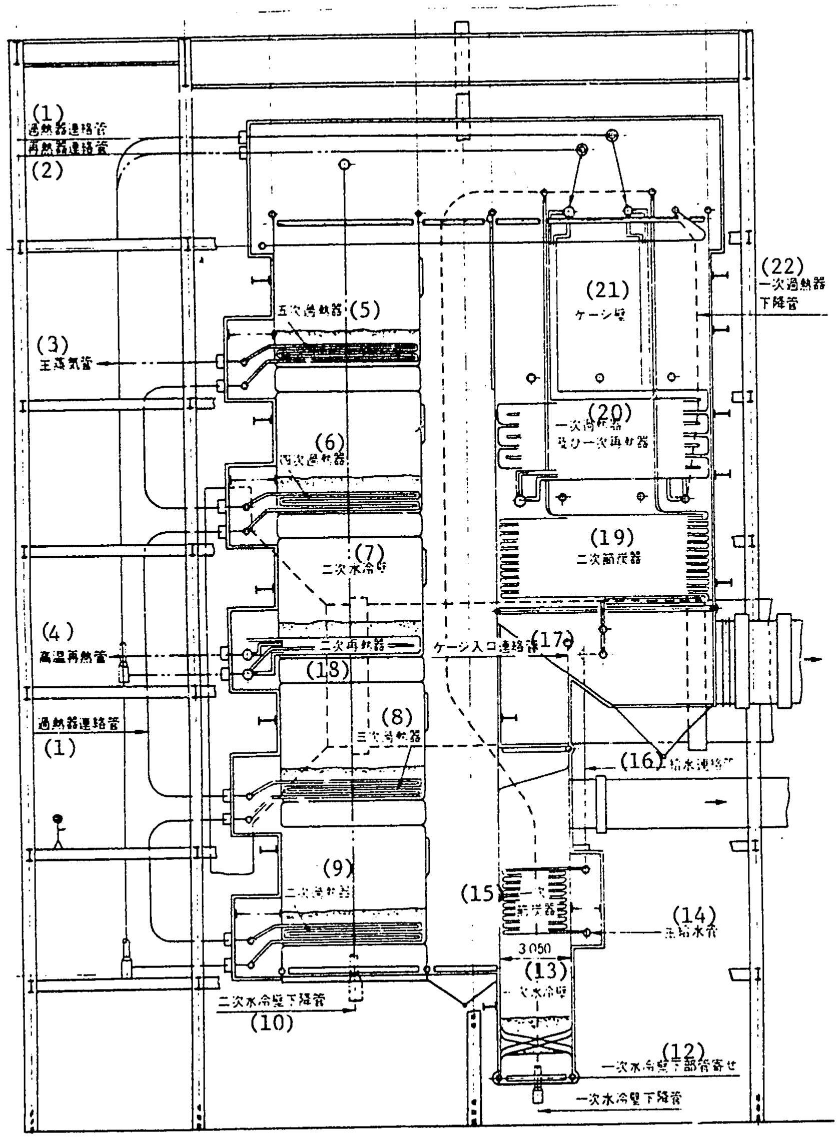


Figure 4. Conceptual Design for 500MW Fluidized Bed Boiler--Side View

This is a conceptual design for a 500MW ultimate fluidized bed boiler. Fluidized bed is stacked in five layers.

Key to Figure 4:

(1) Superheater connecting duct
(2) Reheater connecting duct
(3) Main steam duct
(4) High-temperature reheating duct
(5) Fifth stage superheater
(6) Fourth stage superheater
(7) Second stage water-cooled wall
(8) Third stage superheater
(9) Second stage superheater
(10) Second stage water-cooled wall, downward duct
(11) First stage water-cooled wall, downward duct
(12) First stage water-cooled wall, lower duct clencher
(13) First stage water-cooled wall
(14) Main water supply duct
(15) First stage coal saver unit
(16) Water supply connecting duct
(17) Cage entrance connecting duct
(18) Second stage reheater
(19) Second stage coal saver unit
(20) First stage superheater and first stage reheater
(21) Cage wall
(22) First stage superheater, downward duct

2.3 20t/h Pilot Plant Design

The conceptual design and economic calculation detailed in the preceding section verified the merit of the fluidized bed boiler. As further proof, a pilot plant with steam energy capacity of 20t/h is being designed. This pilot plant seeks to establish that the large fluidized bed boiler for electric power generation would contribute to (1) better environmental protection, (2) decreased waste matter, (3) better control, (4) increased reliability, and (5) better adaptability to coal varieties. Detailed design is to be completed in 1979 and it is to be built in 1980 with a view to begin testing it in 1981. The project is receiving aid money from MITI Agency of Natural Resources and Energy and Coal Technology Research Foundation. Designing the pilot plant has been a joint project involving Babcock-Hitachi, Inc. and Kawasaki Heavy Industries, Ltd. Table 4 details the design particulars and Figure 5 outlines the concepts behind the pilot plant's main body. After completion of this pilot plant, a construction of 200t/h class demonstration plant is scheduled.

2.4 Commercial Fluidized Bed Boiler

As stated above, development of a large fluidized bed boiler for electrical power generation is a large-scale operation and development is being pursued as a segment of a national project. However, Babcock-Hitachi Inc is also engaged in parallel development for commercial use at the same time, and construction of an operable model has begun already. Figure 6 represents conceptual design for 150t/h commercial thermal power generating fluidized bed boiler.

Table 4. 20t/h Fluidized Boiler Pilot Plant Design Particulars

Steam temperature of 540°C--a standard for a large volume thermal energy--was used. It is a plan which proves the advantages of the fluidized bed boiler.

No.	Items	Particulars
1.	Volume of steam generated	20t/h
2.	Steam pressure	Gauge pressure 60kg/cm^2
3.	Steam temperature	540°C
4.	Coal's exothermic volume (planned coal)	
	Dry coal, high grade	7,100 kcal/kg
	Wet coal, high grade	6,603 kcal/kg
5.	Coal supply method	Spreader and air transport
6.	Ventilation method	Balanced ventilation

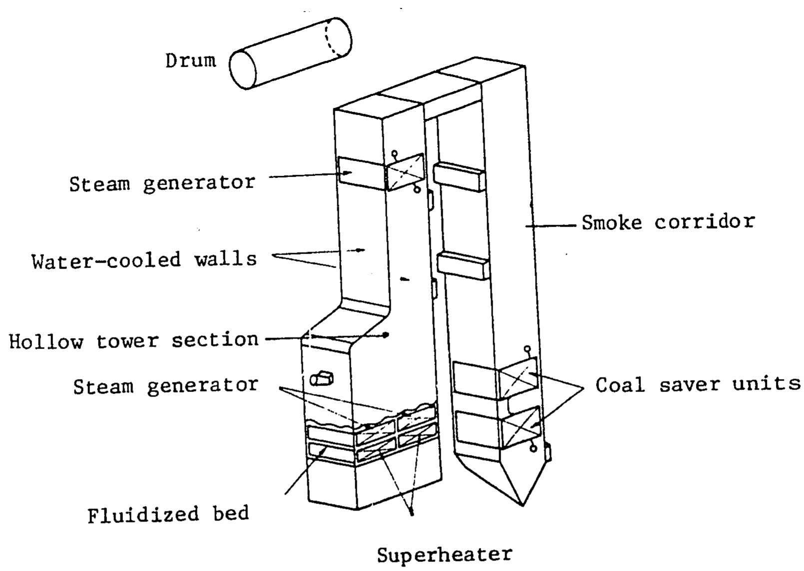


Figure 5. Conceptual Design for 20t/h Fluidized Bed Boiler Pilot Plant Main Body

The design allows for adjustment of the height of the hollow tower section.

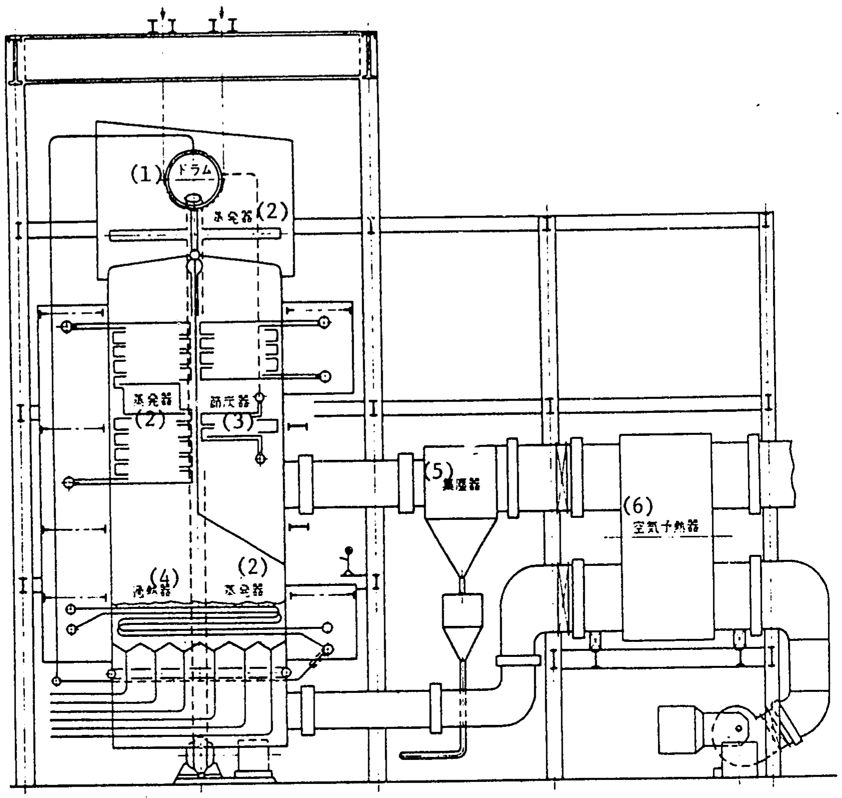


Figure 6. 150t/h Fluidized Bed Boiler

Superheater's heat transformer facet is located within the fluidized bed.

Key:
(1) Drum
(2) Steam generator
(3) Coal saver
(4) Superheater
(5) Dust gathering apparatus
(6) Air preheater

2.5 Overseas Development Status

Finally, we will discuss fluidized bed boiler development in various foreign countries. The development of the boiler in question began in England by the NCB--National Coal Board--in 1963. The board has already completed development of a smoke duct boiler and a general commercial use model. Currently, they are at a popularization stage. The board is also pursuing development of a pressure model fluidized bed boiler. This is an IEA backed international cooperative project with the United States and West Germany participating in the joint research. At present, an 85 MW·th pilot plant is under construction in England with a plan to start testing in March 1980. However, it is believed that actual utilization of pressure model fluidized bed boiler plant will not be realized until quite far in the future. Because of the petroleum situation in eastern Canada and the United States and because it can use the highly sulfurous coal produced in that region, speedy development is sought. Since 1977 PER (Pope, Evans and Robbins) and FW (Foster Wheeler) companies have been given a commission by DOE (Department of Energy), and they are conducting operating research at the West Virginia, Rivesville's Mononghahela Power Plant using a 30 MW fluidized bed boiler. Recently, a 20 MW-200MW fluidized bed boiler development plan was announced. It will be a cooperative project involving DOE-EPRI (Electrical Power Research Institute)-TVA (Tennessee Valley Authority)-B and W Company (Babcock and Wilcox Company). According to this plan, a 20 MW pilot plant is to be constructed and operating research conducted by 1981 at TVA's Shawnee Power Station. Thereafter the project will move on to construction of a 200 MW practical plant by 1987. Aside from these there is rapidly growing interest in fluidized bed boiler in the United States and Canada in the form of improving the existing stoker combustion boilers and creating a new steam boiler. As one theme for international cooperation in coal utilization technology, IEA has selected fluidized bed boiler and an agreement has been signed by the governments or government authorized agencies of nine countries--including Japan. The gist of this agreement is this: Each participating state is to construct a practical scale pilot plant on its own and the information obtained by operating these plants is to be shared. Japan's target is the aforementioned 20t/h pilot plant. The participating countries are scheduled to construct the plants during the 1980-81 period.

3. Coal Gasification

Along with liquefication, coal gasification is one of the major items in coal conversion/utilization technology. Under the heading of the Sunshine Plan, Japan is pursuing its development. Under consignment from MITI Agency of Industrial Science and Technology's Sunshine Plan, the Hitachi Group companies developed a high-pressure fluidized bed gasification furnace. They have been engaged in development of processing and outfitting phase since 1974. In 1979 they were commissioned by the Electric Power Development Company to construct a 7,000 $N \cdot m^3/d$ (gas volume)--methane gas conversion--pilot plant based on their past accomplishments noted above. Currently, they are at the production of machinery and tools stage. This plant is to be completed in 1981 and will immediately be used for operational research.

3.1 High Pressure Fluidized Gasification Furnace

The gasification furnace developed by Hitachi, Ltd. was called a "hybrid" unit. Coal and crude oil are mixed to form a slurry and this is supplied to the furnace to be gasified by means of pyrolysis and partial combustion, then refined further; and ultimately, clean gas is manufactured. Figure 7 demonstrates this process by a flow-chart. Its characteristics are: (1) Since

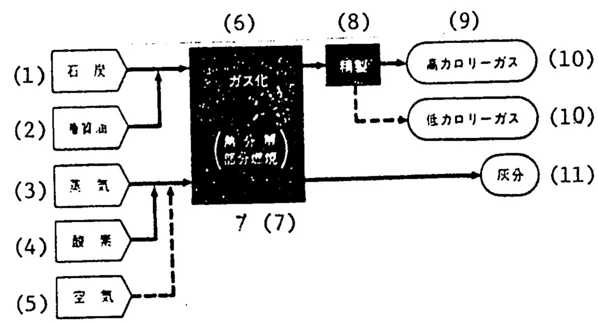


Figure 7. Coal Gasification Process

For high calorie gas, oxygen is used as a gasification agent. In the case of low calorie gas, air is used; but there is no difference between the two in terms of gasification principle.

Key:
(1) Coal
(2) Crude oil
(3) Steam
(4) Oxygen
(5) Air
(6) Gasification
(7) Pyrolysis
Partial combustion
(8) Refining
(9) High calorie gas
(10) Low calorie gas
(11) Ash content

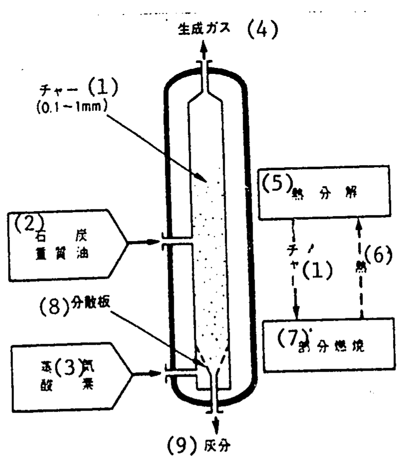


Figure 8. Hitachi High-Pressure Fluidized Gasification Furnace

It is a single tower fluidized bed furnace with a simple structure

Key:
(1) Char
(2) Coal
Crude oil
(3) Steam
Oxygen
(4) Produced gas
(5) Pyrolysis
(6) Heat
(7) Partial combustion
(8) Distribution board
(9) Ash content

high-pressure, fluidized bed furnace is employed, large volume, highly efficient treatment is possible; and (2) since the raw material is in the form of a slurry, continuous supply of raw material and enlargement of coal types employed can be had. Figure 8 details the structure of gasification furnace's main elements. The gasification furnace under discussion is a single tower fluidized bed furnace and the structure is simple and high pressurization can easily be achieved. Heat transmission speed is also high. The raw material slurry is supplied at about mid section--in relation to the height of the gasification furnace--and after pyrolysis, it is gasified. Heat necessary for pyrolysis is provided by partial combustion of char (carbonized substance) created in the lower portion of the furnace by pyrolysis.

And char itself circulates within the tower and becomes additional heat source. Steam and oxygen (air) which are gasification agents are supplied through the distribution board at the bottom of the furnace. Clinkers are the most troublesome aspect of coal gasification process. In order to prevent its formation, jet flow, turntable-shaped distribution board was used. Hydrolysis--being developed as a consignment project under MITI Agency of Industrial Science and Technology's Sunshine Plan--will be used to supply the raw materials. Gasification of coal alone is possible also.

3.2 Coal Gasification Electric Power Generating System

Figure 9 is a flow chart of a coal gasification electric power generation system. Gasification electric power generation system attempts to attain an overall efficiency greater than the traditional thermoelectric power generation by increasing the gas turbine capacity and pairing it with steam turbine. This is why expediting development of a high-temperature, high efficiency gas turbine is desired. Moreover, it is desirable to conduct desulfurization and dust removal in a high temperature environment in the gasification plant. The solution to this problem, however, is slated as a future development theme.

4. Conclusion

Development of a new coal utilization technology is of utmost importance in view of the anticipated worsening petroleum supply situation. The fluidized bed boiler discussed in this paper is, we believe, a relatively short range objective and coal gasification power generation is a middle to long-range goal. Having completed the construction of a practical utilization level pilot plants, both of these projects are about to enter a testing stage. It is the intention of Hitachi Group companies to wrestle with the development of new coal utilization technology in earnest, regardless of whether the format of the project is consigned research or an independent endeavor.

Lastly, we thank the MITI Agency of Industrial Science and Technology, Coal Division, Charccal Section and Coal Technology Research Foundation for permission to publish this paper.

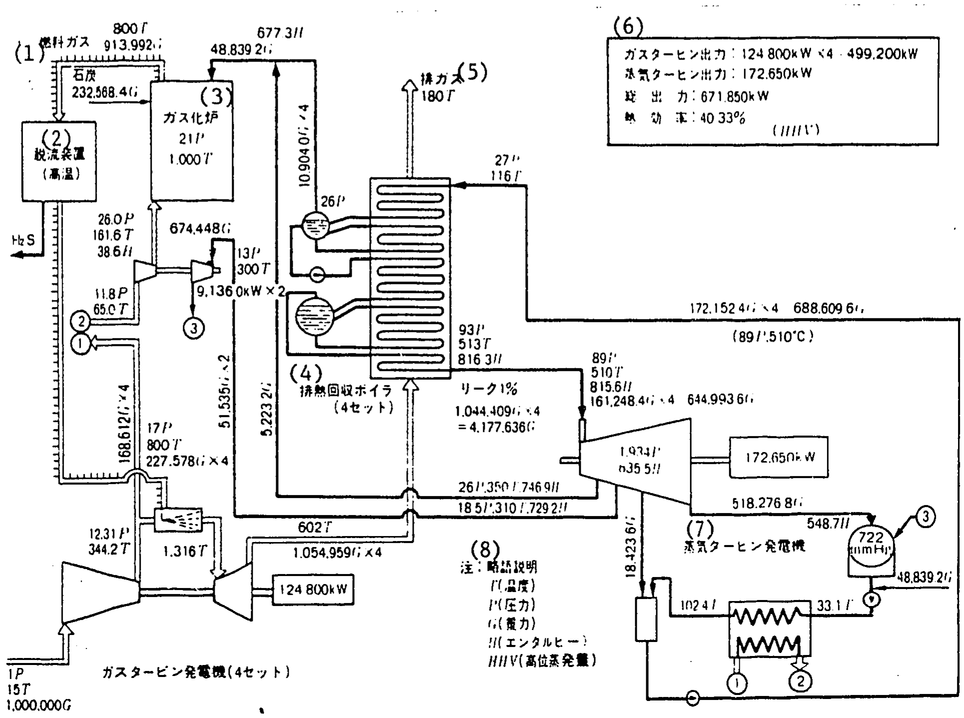


Figure 9. Flow Chart of Coal Gasification Electric Power Generation System

It is an example of combining high-temperature gas turbine and high-temperature desulfurization facility.

Key:

(1) Fuel gas
(2) Desulfurization facility (high temperature)
(3) Gasification furnace
(4) Exothermal recovery boiler
(5) Expelled gas
(6) Gas turbine output
    Steam turbine output
    Total power output
    Heat efficiency
(7) Steam turbine electric power generator
(8) Note: Explanation of abbreviations
    T (temperature)
    P (pressure)
    G (gravity)
    H (enthalpy)
    HHV (high evaporation volume)

REFERENCE

1. Yu Guan [3768 6306] et al, "Development of Coal Stoked Fluidized Combustion Boiler Electric Power Generation Technology," Proceedings of Coal Utilization Technology Research Conference, Coal Technology Research Foundation (August 1979)

11460
CSO: 8129/0067

ITALIAN PAPER LOOKS AT JAPAN'S NUCLEAR POWER PROGRAM

Rome NOTIZIARIO COMITATO NAZIONALE PER L'ENERGIA NUCLEARE in Italian Jun 80 pp 39-43

[Article by Paola Fiorentini: "Japan's Energy Problem"]

[Excerpts] Nuclear Program

Japan's nuclear power program, instituted in the 1960's and reviewed every 5 years as a rule, has been revised more than once since September 1978, when a program was adopted that took account of the worldwide situation that had developed in the years immediately following the first oil crisis and of the ever-rising opposition to nuclear energy. This program called for a nuclear electric power installed capacity of 33,000 megawatts [MW] by 1985 and 60,000 MW by 1990.

Subsequently, about mid-1979, the Agency for Natural Resources and Energy revised these objectives to 28,000 MW of installed nuclear power capacity by 1985 and 54,000 MW by 1990. The most recent White Book on nuclear energy, published at the end of 1979 and based on the report published in August 1979 by the Demand and Supply Subcommittee of the Consultative Committee for Energy, projects an installed nuclear energy capacity of 30,000 MW by 1985, 53,000 megawatts (electric)[MW(E)] by 1990, 78,000 MW(E) by 1995 and 100,000 MW(E) by 2000.

At the end of 1979,[5] there were 21 nuclear power plants in operation producing a total of 14,952 MW and 7 units under construction with a total capacity of 5,839 MW. (Table III, Figures 2-8).

The plants are all equipped with LWR's [light water reactor] except for the Tokai Mura one which is equipped with a GCR [gas-cooled reactor]. In 1979, the Atomic Energy Commission vetoed the importation of CANDU reactors, which however were preferred by the MITI [Industrial Science and Technology Agency]. Recently, the negative attitude toward the CANDU system appears to be subsiding.

Since March 1979, the Fugen prototype reactor, with a capacity of 165 MW(E), moderated by heavy water and cooled by light water, and with characteristics similar to those of the Cirene one, has been in commercial operation at Tsuruga.

Currently under study is a project for a 600-MW(E) heavy-water reactor of an advanced type.

The first experimental fast reactor, the 75-megawatt (thermal) [MW(Th)] Yoyo one installed at Oarai, became critical in 1977, whereas the Monjoy, the 300-MW(E) LMFBR [liquid metal fast breeder reactor] prototype, the construction of which is to begin in 1981 for completion by 1987, is already at an advanced planning stage.

Authorization to begin construction of this plant was only issued in the Spring of 1980 by the Atomic Energy Commission and the Nuclear Safety Commission. It had been repeatedly delayed owing not only to safety considerations but also to economic ones having to do mainly with the apportionment of expenses between the government and the electrical companies.

The decision to proceed with the development and building of fast breeder reactor plants appears to have been borne out by the results of the final meeting of the INFCE [International Conference for Nuclear Fuel Cycle Evaluation] held in Vienna at the end of February 1980.

A study and research program is in progress on high-temperature gas-cooled reactors that could be used as sources of heat for steelmaking purposes: The first experimental prototype could be completed by 1990.

Concurrently with this decision to proceed with the building of the Monjoy, the Atomic Energy Commission and the Nuclear Safety Commission reconfirmed their intention to proceed with the development of the related program.

Fifteen Japanese steel enterprises will participate as a consortium in this program, the cost of which is estimated at $55 million. The steel industry, which consumes almost 18 percent of the nation's energy production, must in fact resort to the use of nuclear energy, which is considered the only alternative energy source capable of enabling the adaptation of current furnaces to a productive process that will result in a substantial reduction of current energy consumption.

To insure the supply of fuel it will need for the operation of its nuclear power plants, Japan has signed agreements and is participating in research and development activities with governmental agencies and enterprises of numerous countries in various phases of the fuel cycle (from prospection activities to those related to the processing and disposal of wastes).

Specifically, the electrical companies have contracted with South Africa, Canada, Australia and France for the needed supplies, and with the United States and EURODIF [European Diffusion Agency] for the needed enrichment services, to carry them up to 1990.

Japan is at the same time giving maximum impetus to the development of its own national enrichment technology based on ultracentrifuging. The first pilot plant, located in Ningyo-Toge, went into operation in September 1979.

It is equipped with 1,000 Type OP-1A centrifuges, capable of producing an enrichment of 3.2 percent U-235. The 3,000 OP-1B machines (having 1 and 1/2 times the power of the Type OP-1A's) will be installed by the fall of 1980 and 3,000 Type OP-2 centrifuges by September 1981, bringing the plant's total enrichment capacity up to 75 tons per year of solid material. The program's ultimate objective is to have a commercial plant in operation by 1990.

The first pilot plant for the reprocessing of spent fuel, located at Tokai Mura and having a maximum capacity of 210 tons per year, has been in operation since September 1977 (its operation was suspended from August 1978 to November 1979 owing to problems found in recovering the nitric acid used in the fuel-reprocessing cycle). The Japanese electrical industry is now pressing its studies on the construction of a commercial-scale reprocessing plant that is to be in operation by 1990.

At the beginning of March, the government announced its decision to build the plant. It will be built and operated by the Nuclear Fuel Service Company, which was formed for the purpose, and will cost $2.8 billion.[6]

The development of nuclear fusion is being accorded major importance. Following the completion of experiments conducted with its JFT-2 and JFT-2a toroidal machines, construction was started recently, at Naka (province of Ibaraki), on a new and larger experimental machine of the Tokamak type, designated JT-60, with which the Japanese hope to achieve a plasma responding to thermonuclear conditions. The JT-60 is scheduled for completion by 1983.

Its first nuclear-propelled ship, the "Mutsu," whose sea trials had to be suspended in the Summer of 1974 owing to an accident that occurred in the reactor, is now at Sasebo (province of Nagasaki), where it was transferred in October 1979. The necessary repair work is expected to take about 3 years to complete.

TABLE III - Nuclear Power Plants in Japan as of 31 May 1980

Plant	Owner or Operator	Net Power MW(E)	Reactor	Reactor Supplier	Commercial Operation	Energy Produced to 30 Apr 1980 10^3 kWh
IN OPERATION						
Tokai 1	JAPC	159	GCR	GEC	Jul 1966	12,887
Tokai 2	JAPC	1,067	BWR	GE	Nov 1978	12,108
Tsuruga	JAPC	340	BWR	GE	Mar 1970	19,625
Shimane 1	Chugoku Electric Power	439	BWR	Hitachi	Mar 1974	17,354
Fukushima 1	Tokyo Electric Power	439	BWR	GE/Toshiba	Mar 1971	14,268
Fukushima 1-2	Tokyo Electric Power	760	BWR	GE	Jul 1974	17,440
Fukushima 1-3	Tokyo Electric Power	760	BWR	Toshiba	Mar 1976	18,766
Fukushima 1-4	Tokyo Electric Power	760	BWR	Hitachi	Oct 1978	9,171
Fukushima 1-5	Tokyo Electric Power	760	BWR	Toshiba	Apr 1978	11,781
Fukushima 1-6	Tokyo Electric Power	1,067	BWR	GE	Oct 1979	6,303
Hamaoka 1	Chubu Electric Power	516	BWR	Toshiba	Mar 1976	11,063

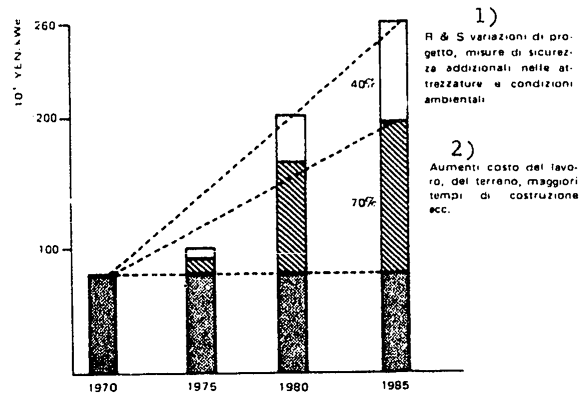
TABLE III [contd] - Nuclear Power Plants in Japan as of 31 May 1980

Plant	Owner or Operator	Net Power MW(E)	Reactor	Reactor Supplier	Commercial Operation	Energy Produced to 30 Apr 1980 10^3 kWh
IN OPERATION [contd]						
Hamaoka 2	Chubu Electric Power	814	BWR	Toshiba	Nov 1978	9,643
Mihama 1	Kansai Electric Power	320	PWR	W	Nov 1970	5,632
Mihama 2	Kansai Electric Power	470	PWR	MHI	Jul 1974	17,293
Mihama 3	Kansai Electric Power	780	PWR	MHI	Dec 1976	15,966
Takahama 1	Kansai Electric Power	780	PWR	W	Nov 1974	18,287
Takahama 2	Kansai Electric Power	780	PWR	W	Nov 1975	20,433
OHI 1	Kansai Electric Power	1,122	PWR	W	Mar 1979	6,342
OH 2	Kansai Electric Power	1,122	PWR	W	Dec 1979	7,884
Genkai 1	Kyushu Electric Power	529	PWR	MHI	Oct 1975	17,064
Ikata 1	Shikoku Electric Power	538	PWR	MHI	Sep 1977	9,774

TABLE III [contd] - Nuclear Power Plants in Japan as of 31 May 1980

Plant	Owner or Operator	Net Power MW(E)	Reactor	Reactor Supplier	Commercial Operation	Energy Produced to 30 Apr 1980 10^3 kWh
IN OPERATION [contd]						
Fugen	PNC	200	ATR	Hitachi/MHI	Mar 1979	1,420
UNDER CONSTRUCTION						
Fukushima II-1	Tokyo Electric Power	1,067	BWR	Toshiba	May 1982	--
Fukushima II-2	Tokyo Electric Power	1,067	BWR	Hitachi	Aug 1983	--
Kashiwajaki Kariwa 1	Tokyo Electric Power	1,067	BWR	Toshiba	Dec 1984	--
Genkai 2	Kyushu Electric Power	529	PWR	MHI	Mar 1981	--
Sendai 1	Kyushu Electric Power	846	PWR	MHI	Jul 1984	--
Ikata 2	Shikoku Electric Power	538	PWR	MHI	Mar 1982	--
APPROVED						
Monju	PNC	300	LMFBR	**	1987	--

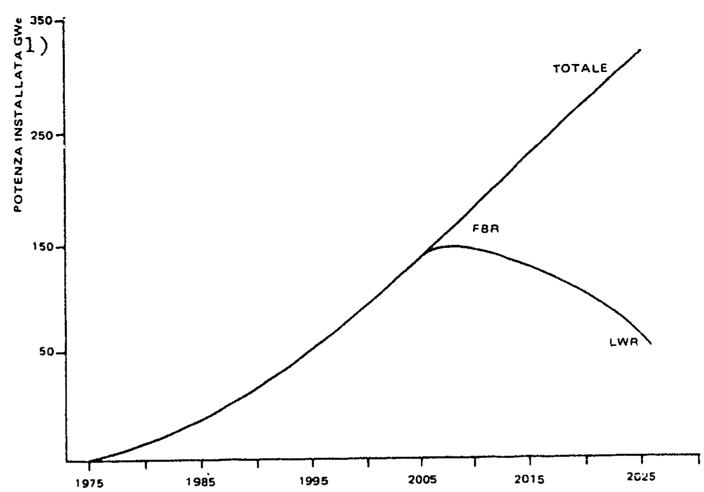
*MHI = Mitsubishi Heavy Industries
**An industrial consortium made up of PMC and 11 industries (9 electric companies, Electric Power Development Company and Japan Atom Power Company).



Key:

1. Research and development, project changes, additional safety measures to equipment and ambient conditions.
2. Increases in labor costs, land costs. construction times, etc.

Fig 2 - Unit construction costs of nuclear power plants in Japan



Key:

1. Installed capacity GW(E)

Fig 4 - Estimated growth of installed nuclear capacity in Japan

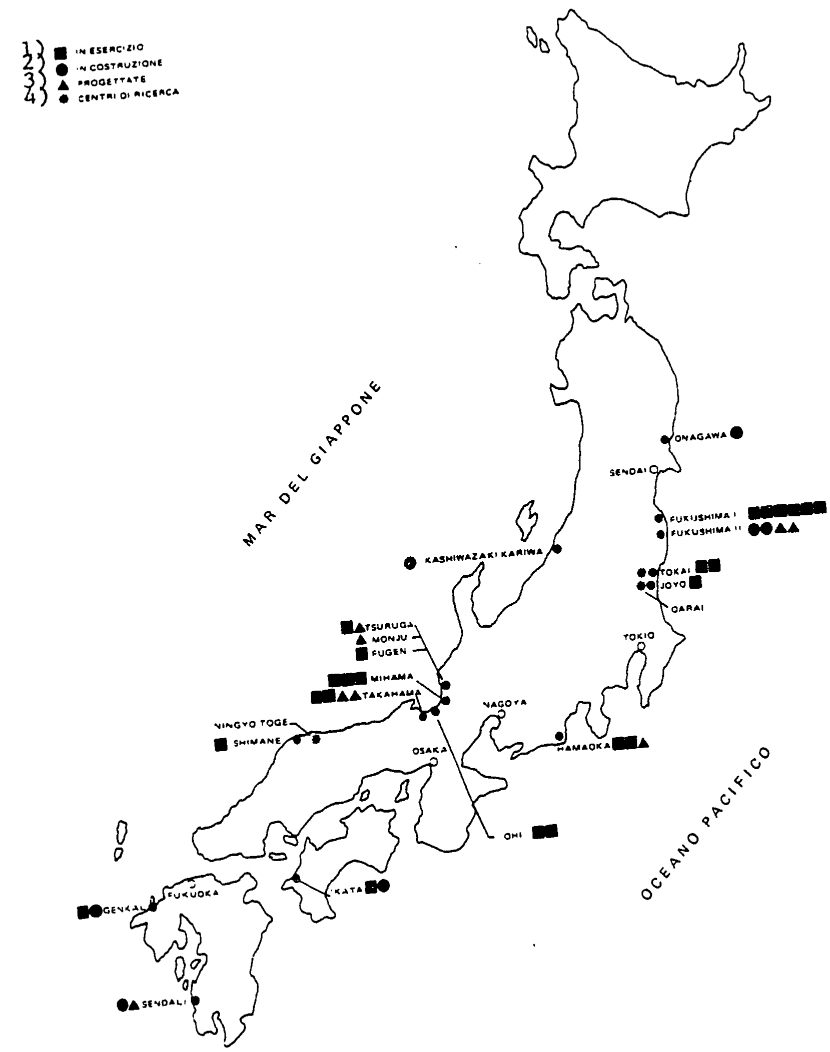
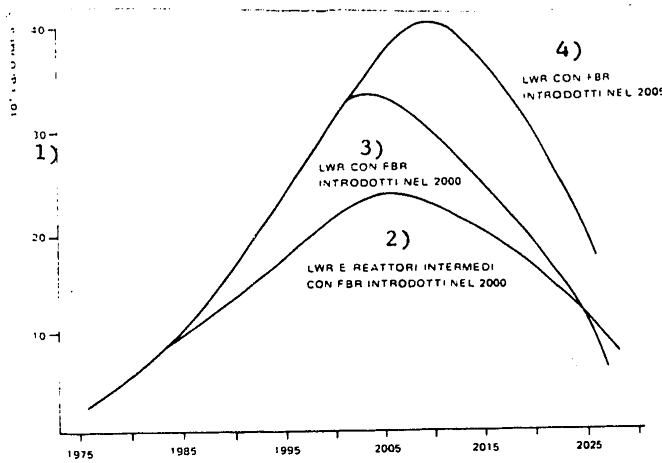


Fig 5 - Nuclear power plants installations in Japan

Key:

1. In operation
2. Under construction
3. Planned
4. Research centers



Key:

1. 10^3 tons/yr native uranium.
2. Light water reactor and intermediate reactors with fast breeder reactor installed in 2000.
3. LWR with FBR installed in 2000.
4. LWR with FBR installed in 2005.

Fig 6 - Annual native uranium requirements

Key:

1. Tons/yr spent fuel.
2. LWR and intermediate reactors with FBR installed in 2000.
3. LWR with FBR installed in 2000.
4. LWR and intermediate reactors with FBR installed in 2005.

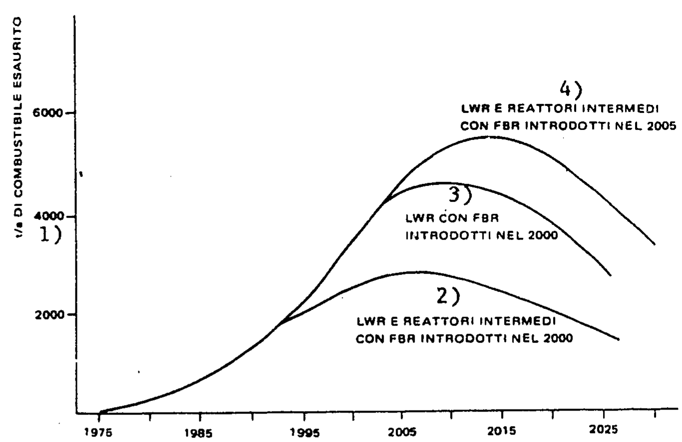


Fig 7 - Enriched uranium requirements

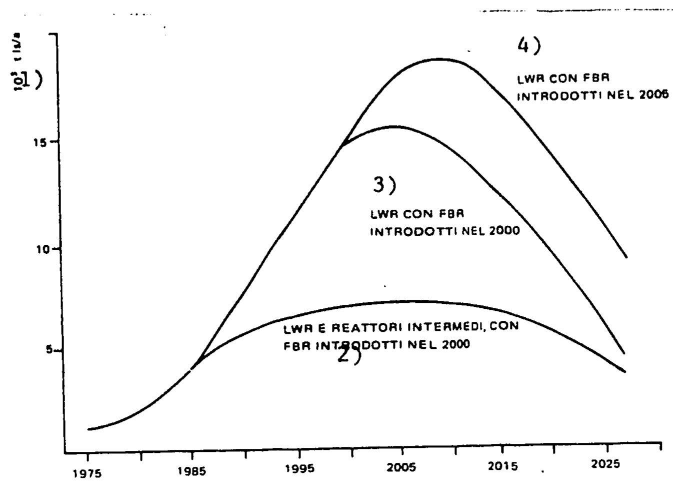


Fig 8 - LWR fuel reprocessing

Key:

1. 10^3 tons/yr solid material.
2. LWR and intermediate reactors with FBR installed in 2000.
3. LWR with FBR installed in 2000.
4. LWR with FBR installed in 2005.

9399
CSO: 3104

END