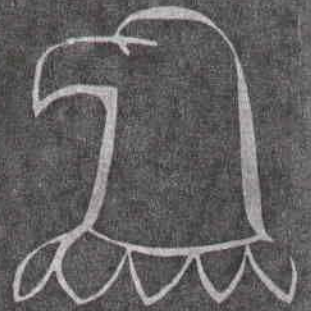


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CASE STUDY

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JAPANESE ENERGY OUTLOOK - 1970-1985 OADR

BY

William W. Clarke
Department of Commerce



FOURTEENTH SESSION

SENIOR SEMINAR IN FOREIGN POLICY

Washington, D. C.

1971 - 1972

DISCUSSION

This is an educational exercise and does not necessarily represent the viewpoint of the Senior Seminar in Foreign Policy or of the Department of State.

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TABLE OF CONTENTS

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	<u>PAGE</u>
Summary	i
Foreword	ii
Introduction	1
Energy Plans and Policies	1
Energy Demand	2
Energy Supply and Balance	5
Petroleum	8
Coal	9
Natural Gas	9
Hydroelectric Power	9
Nuclear Energy	10
Other Forms of Energy	10
Comparison with the United States	10
Selected Sources	15
Appendix	16

TABLES

1. Japanese Total Energy Consumption Projections By Consuming Sector and Type of Energy, 1970, 1975, 1985	3
2. Japanese Energy Balance, 1970, 1975, 1985	6
3. Total Energy Demand by Consuming Sector, U.S. and Japan	12
4. Primary Energy Supply by Type, U.S. and Japan	14

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SUMMARY

During the period 1970-1985, Japan will be faced with high increases in energy demand that will require a broadly coordinated domestic effort and substantial international cooperation to meet. Although the average annual growth of demand over the period will likely be 3 to 5 percent below the 13.1 percent rate of the sixties, the absolute increases in energy requirements are much larger. If expectations are realized, Japan's consumption of energy will rise from one-sixth that of the U.S. in 1970 to between one-fourth and one-third by 1985.

Contrasted to the past decade of relatively smooth, albeit unprecedented growth in the energy supply, Japanese energy planners must now contend with a variety of problems of sobering complexity. In fact, events of the past eighteen months have caused a reexamination of growth expectations for the economy, generally, and for energy, demand for which closely parallels overall growth. Projected energy demand for 1975 has been decreased about 10 percent compared with estimates for 1975 made in 1970. It is likely that 1985 projections, which are still being reevaluated, will also be lowered, probably by at least 10 percent.

The downward revisions are attributable to a variety of factors. Paramount is the realization that the expansion of the economy is unlikely to continue at the rate of the sixties. Perhaps no one event lent more clarity to this realization than the U.S. economic measures of August 1971, the so-called Nixon "shock." Another major factor is the increasing strength of the nations belonging to the Organization of Petroleum Exporting Countries. OPEC's recent price increases coupled with the realization that in the future the oil market belongs to the sellers, is a cause of much concern in Japan, where oil imports are absolutely vital and constitute 70 percent of the energy supply. A rising tide of environmental concern reflected in tougher pollution controls, heightened demand for low sulfur oil and coal, and constant conflict over power plant location is part of the reevaluation. Lastly, the domestic production of coal, the only major indigenous energy source in Japan, is declining more rapidly than envisaged.

The demand for energy in Japan will be so large and the long lead times and immense capital required to shift to other energy sources, even where possible, is so great, that over the review period the general picture will remain unchanged. In 1985 Japan will still import over 80 percent of its energy, mostly oil. However, the groundwork for a shift will have been laid in the construction of nuclear power plants. Commercialization of fast breeder reactors, toward the end of the review period, will accelerate the shift to nuclear power. Much later, perhaps around the year 2000, the advent of fusion power holds out the promise of an energy supply substantially free of imports.

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FOREWORD

In January 1970 the Interior Department requested the National Petroleum Council (NPC) to undertake a comprehensive study of the U.S. energy outlook. In July and November 1971, the Council published their initial appraisal of the U.S. outlook for 1971-1985. The NPC reports * represent a frame of reference from which the need for changes in economic conditions and government policies could be inferred and from which the probable effect of such changes could be analyzed. A third NPC report, to be released in July 1972, will cover the period 1985-2000.

The brief survey of the outlook for Japanese energy, 1970-1985, should be regarded as a tentative attempt to provide energy information for that nation using the same methodological approach as employed by the NPC for the United States. Although primary emphasis is given the Japanese outlook, greater value may possibly be found in the comparative aspects of the survey. While allowance must be made for the undefined nature of some of the information supplied by the Ministry of International Trade and Industry and others in Japan, it appears that the Japanese concepts of total energy demand, primary energy supply, and energy consuming sectors of the economy are sufficiently similar to those used in the NPC study that a creditable comparison can be effected. For comparative purposes all Japanese energy data have been converted to British Thermal Units.

* US Energy Outlook, An Initial Appraisal 1971-1985,
Volume 1, July 1971

US Energy Outlook, An Initial Appraisal 1971-1985,
Volume 2, Summaries of Task Group Reports,
November, 1971.

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Introduction

In his energy message of June 4, 1971, to the Congress, President Nixon outlined a broad array of fuel policy changes necessitated by the impending crisis in the U.S. caused by the increasingly rapid depletion of our remaining reserves of oil and natural gas. While the American energy problem in the period through 1985 will be very serious and its solution of vital national interest, consider the acute situation in Japan, the third largest economic power in the world today.

During the decade of the sixties (FY-59/69)*, the Japanese demand for energy increased 3.4 times (the U.S. by 1.5 times). To meet this demand the energy supply grew at an average annual rate of 13.1 percent, exceeding economic growth (real GNP) which advanced at about 11 percent. It is no wonder, therefore, that in April 1972, Premier Sato agreed with the suggestion that Japan's greatest problem for the next thirty years was energy.

In addition to this explosive demand for energy over the decade, the pattern of fuel supply underwent drastic change. Coal declined from 42 to about 23 percent of the supply while petroleum rocketed from nearly 33 to over 68 percent. Since Japan has virtually no petroleum resources, these structural shifts caused a rapid increase in the import of energy products, from about 38 percent in 1959 to just over 80 percent ten years later.

At the onset of the seventies, Japanese energy planners and policymakers were being increasingly faced with the huge logistical problem of oil imports and storage and with the rapid expansion of electric power and petroleum refining capacity required in the home islands. Their difficulties were seriously complicated by a rising tide of environmental concern in Japan and by tougher attitudes exhibited by the OPEC petroleum exporting countries, the source of most of Japan's oil. Japanese vulnerability to OPEC economic tactics, not to mention potential military interdiction of supply routes, gave pause for concern. All of these factors coupled with the U.S. economic measures taken in August 1971, the so-called Nixon "shock", as well as the mild Japanese recession, caused serious reconsideration of energy plans and policies for the period up through 1985.

Energy Plans and Policies

In February 1967, the Council for Energy collaborated with the Ministry of International Trade and Industry (MITI) in the preparation of a comprehensive long-term energy supply and demand report projecting Japanese requirements through FY-85; estimates were guided by the Economic and Social Development Plan. Also guiding the planning was the policy principle of securing a regular supply of energy at low cost within the framework of free choice and free competition, while considering that the public nature of the energy industries does not permit their completely free operation. The supply of energy, then, must be secured on the basis of independence of the Japanese energy industries and international cooperation.

* Japanese fiscal years run from April 1 to the following March 31. All Japanese energy data are related to the fiscal years. All comparisons in this report contrast Japanese fiscal year data with U.S. calendar year information.

The Council for Energy is but one of many advising the Government; in the energy field alone such advisory committees and sub-committees exist for virtually every form of fuel on both the supply and demand side. The highly regarded energy councils consist of business and industry leaders who through the Council transmit the views of the energy community to the Government.

Because of significant revisions in the Economic and Social Plan during 1970, the Council for Energy and MITI reexamined their earlier FY-75/85 projections. The new goals released in July 1970 are based generally on an average annual GNP growth in real terms of 10.6 percent through FY-75 and 8.5-9.5 percent for the period FY-76/85. While these data as of May 1972 represent the latest published overall goals for FY-75/85, it had already become apparent to Japanese planners by mid-1971 that the 1970 forecasts had been overtaken by events.

MITI and the energy councils are currently preparing new energy supply and demand forecasts for FY-75 and probably for all years FY-72/76. These will be published later in 1972. New, long range FY-80/85 projections will be made, but a good possibility exists that they will not be made public and will be used for internal government purposes only. Although the overall FY-75 energy forecast has not been released, publication of some expected electric power and petroleum products demand and targets for addition to capacity have been released.

Although growth of total energy demand in the major industrialized nations is clearly and closely related to overall economic growth as reflected by real GNP, it is necessary to apply many other factors and indicators to refine projections of demand by fuel type and consuming sector. This is done in a comprehensive manner by the Japanese authorities who construct future demand requirements by carefully examining structural and technological changes in the economy, for example, the impact of better roads on the size of the truck transport fleet and the consumption of gasoline or the decreased demand for coking coal per ton of pig iron as more and more blast furnaces operate at higher pressures. A cursory review of MITI's estimative procedures suggests that the Japanese projections of supply and demand to date are at least as sophisticated as American estimates and quite possibly more so. This sophistication may have been fostered by a longer Japanese confrontation with a critical import supply situation.

Energy Demand

The total Japanese consumption of energy by consuming sector of the economy by type of energy for FY-70/75/85 is shown in Table 1; these are July 1970 projections.* Shown in Tables 1 A/B/C in the Appendix are the comparable MITI data in physical units from which Table 1 was derived; Table 1D shows constants used by the Japanese in converting physical units to heat equivalents.

* It is important to note that Table 1 shows total energy consumption, not primary energy consumption. The latter category reflects the combined inputs of all fossil fuels for all consuming sectors, except electric power generating stations. Except for hydroelectric and nuclear power stations, electric utilities are not producers of primary energy. Total energy consumption differs from primary in that the electricity output is assigned to the residential/commercial, industrial and transportation sectors. The remaining portion of the electric utility demand, i.e. conversion, transmission, and distribution losses, is shown under the electricity conversion sector of consumption.

TABLE 1
Japanese Total Energy Consumption Projections By Consuming Sector
And Type of Energy
FY-1970/1975/1985

Trillions of BTU's

<u>Consuming Sector</u> <u>Energy Type</u>	<u>Residential- Commercial</u>	<u>Industry</u>	<u>Transportation</u>	<u>Non-Energy Uses a/</u>	<u>Electricity Conversion</u>	<u>Total b/</u>
Electricity						
1970	700.3	1,875	92.8	9.8	181.1	2,859
1975	1,115	3,115	146.8	11.9	239.5	4,643
1985	2,710-2,845	6,444-7,226	619.0	27.8-31.7	766.3-789.6	10,507- 11,511
Coal/Coke c/						
1970	166.4	859.1	45.2	-	25.9	1,097
1975	146.8	1,278	4.0	4.0	15.9	1,448
1985	146.8	2,519-2,770	4.0	7.9	15.9	2,694-2,944
Petroleum						
1970	988.3	2,373	1,313	1,411	478.5	6,564
1975	1,595	3,690	2,063	2,159	373.0	9,880
1985	3,170-3,484	8,332-9,388	3,599-3,916	4,642-5,111	769.7-872.9	20,514- 22,772
Natural Gas d/						
1970	162.1	445.4	1.0	54.0	89.5	752.6
1975	305.5	880.9	-	51.6	190.5	1,428
1985	706.3-742.0	1,984-2,190	-	194.4	432.5-472.2	3,317-3,599
TOTALS						
1970	2,017	5,553	1,452	1,475	775.5	11,273
1975	3,162	8,964	2,214	2,226	833.2	17,400
1985	6,734-7,217	19,280- 21,570	4,221-4,539	4,873-5,345	1,924-2,151	37,053- 40,826

a/ Includes energy consumed by agriculture, fishing, and forestry.

b/ Totals do not always add due to rounding

c/ Includes charcoal, firewood, briquettes and lignite.

d/ Includes coke oven gas, blast furnace gas, town gas, and liquified natural gas.

In contrast to the decade of the sixties, which registered an increase in total energy consumption of 3.4 times, Table 1 shows a decline in the rate of advance in the seventies. During the period FY-70/75, demand is expected to increase at a rate that would yield a rise over the decade of about 3.1 times. Using FY-85 and interpolating for 1980 yields an increase for the decade of about 2.5 times. Clearly the planners in 1970 saw that the type of advance registered in the sixties would not repeat. Moreover, reevaluations of the projections in Table 1, currently under way at MITI, will almost certainly result in a still lower rate of advance for the seventies. However, the energy supply effort necessary to sustain an increase of even 2.0 to 2.5 times is very large and will strain Japanese resources to the utmost.

One indicator of the extent of the downward revision in the long range expected total energy consumption is the annual report for petroleum prepared by MITI and endorsed by the Petroleum Council at the end of each fiscal year. The report issued in March 1972 is contrasted below with the July 1970 forecasts. It shows downward revisions running from 5 to 11 percent in the demand for petroleum.

TOTAL ENERGY DEMAND - PETROLEUM
(millions of kiloliters)

<u>Fiscal Year</u>	<u>1970 Projection</u>	<u>1972 Projection</u>
1971	219.1	209.9 (est. actual)
1972	248.9	230.0
1973	280.0	254.6
1974	311.7	280.1
1975	343.3	303.3
1976	n.a.	326.6

It is interesting to note that in February 1967 the estimated demand for petroleum for FY-75 was 262 million kiloliters. By 1975 this estimate had been raised to 343 million kiloliters only to be dropped to 303 million kiloliters by 1972.

Another indicator of change from the July 1970 long range planning may be found in the electric power demand projections released in April 1972. These are shown below.

TOTAL ENERGY DEMAND - ELECTRIC POWER
(billions of kilowatt-hours)

<u>Fiscal Year</u>	<u>1970 Projection</u>	<u>1972 Projection</u>
1970	313.4	319.7 (actual)
1971	n.a.	345.6 (est. actual)
1972	n.a.	379
1973	n.a.	418
1975	508.7	500
1980	n.a.	788

From the above data it appears that total electric power demand in 1975 will fall slightly short of projections made in 1970. Actually, projections made in 1971 (not shown) were even higher than the 1972 projections. According to the Central Electricity Council release of April 1972, the average annual growth in total electric power demand during the balance of the decade will be about 9.4% well under the 12.4% of the sixties.

MITI authorities have stated that total energy consumption projections for FY-75 will be reduced approximately 10 percent compared to the July 1970 estimates. Officials said that 1985 projections will also be lowered, but would not state by what amount, although it seems probable that the revised estimates will also be at least 10 percent below those of 1970.

These reductions have been caused primarily by four events. The first, a slow-down in the economic rate of growth generally, does not reflect the immediate Japanese recession as much as the longer range thinking that the growth of the sixties cannot be maintained. Another reason is that domestic coal production is declining substantially faster than envisaged. A third cause is OPEC, the rise in price for crude and the sober realization of other difficulties ahead. Last are the environmental causes, nuclear and thermal power plant location and safety, the heavy demand for low sulfur oil and coal, and the other pollution control requirements.

Fifteen year projections of total energy consumption are hazardous, particularly at a time when some basis rethinking of the economy is transpiring. In the U.S. during the sixties, every energy forecast for 1970 was understated. Even the 1968 forecast for 1970 was 6.5 percent low. Despite our experience, Japanese planners are lowering their earlier projections. Only time will tell whether they have miscalculated demand in the residential/commercial and transportation sectors of consumption as was the case in the U.S.

Energy Supply and Balance

The Japanese energy balance and the supply of primary energy* to consumers from both indigenous and imported sources is shown in Table 2. The projections are those published in July 1970. The information contained in Table 2 is also shown pictorially in Figure 1.

* The primary energy consumption, defined earlier, is the same as the primary energy supply.

TABLE 2

JAPANESE ENERGY BALANCE
(Trillions of BTU's)

	FY-1970	FY-1975	FY-1985
Total Energy Consumption <u>a/</u>	12,319	18,665	39,588-43,394
Primary Energy Supply-Domestic			
Petroleum	33.6	31.7	234.1
Natural Gas	106.2	115.1	420.6
Coal <u>b/</u>	1,060	968.2	948.4
Hydroelectric Power <u>c/</u>	778.5	841.2	980.1-1,008
Nuclear Power <u>d/</u>	44.5	404.7	3,952
Total Domestic Supply	<u>2,023</u>	<u>2,361</u>	<u>6,535-6,563</u>
Primary Energy Supply - Imports			
Petroleum	8,687	13,590	26,590-29,710
Natural Gas <u>e/</u>	51.5	178.6	547.6
Coal	<u>1,559</u>	<u>2,536</u>	<u>5,912-6,575</u>
Total Imports	<u>10,297</u>	<u>16,304</u>	<u>33,050-36,830</u>
Total Primary Energy Supply <u>f/</u>	<u>12,320</u>	<u>18,665</u>	<u>39,585-43,393</u>

a/ The difference between these consumption figures and the slightly lower demand data from Table 1 is caused by allocations to export, stock-pile buildup, and other minor adjustments. The only significant exports of energy products from Japan are jet fuel for commercial aircraft and fuel oil (bunkers) for ships. Stockpiles are being increased.

b/ Includes lignite, charcoal, and firewood.

c/ May include "pumped" storage hydropower units. If true, pumping losses should be subtracted out.

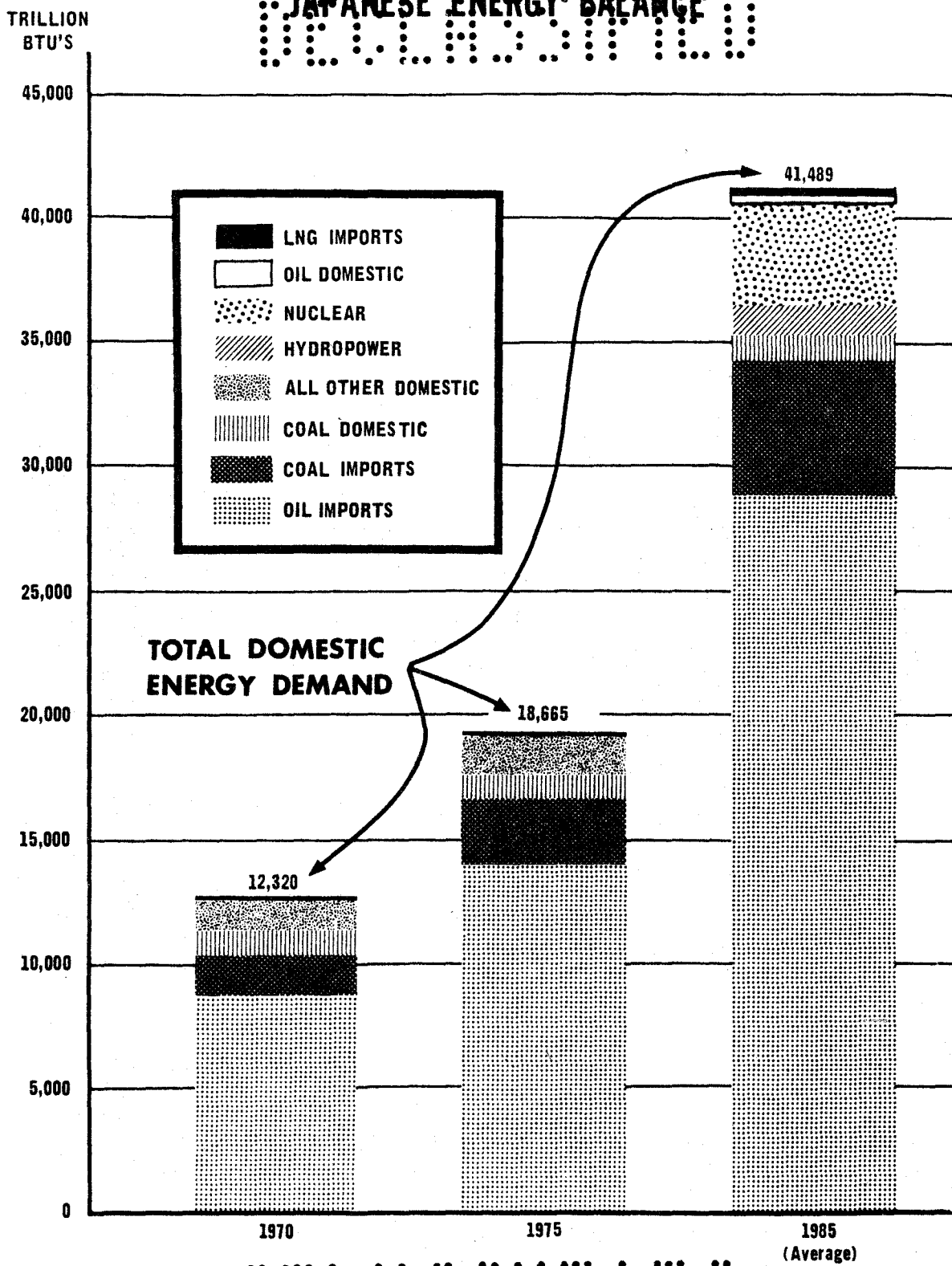
d/ In Japan nuclear energy is considered semi-indigenous even if the enriched uranium is imported.

e/ Liquefied natural gas (LNG) only.

f/ May not add due to rounding errors.

FIGURE 1

JAPANESE ENERGY BALANCE



Source - Table 2

The great reliance of Japan on imported supplies of energy is indicated below.

JAPANESE PRIMARY ENERGY SUPPLY,
INDIGENOUS VS. IMPORTED SOURCES

<u>Fiscal Year</u>	<u>Indigenous</u>	<u>Imported</u>
1956	73.6%	26.4%
1960	55.8	44.2
1965	33.8	66.2
1970	16.5	83.5
1975	12.6	87.4
1985	15.2-16.5%	83.5-84.8%

Petroleum

Petroleum has become the life blood of Japan and literally all of it must be imported. According to the 1970 projections, petroleum is to constitute 70.4 percent of the primary energy supply in FY-70, 73 percent in FY-75, and around 67 percent in FY-85. Japan is currently the largest importer of oil in the world receiving about 95 percent of its supply of about 3.6 million barrels per day in FY-71 from the OPEC countries.

It is this great dependency on OPEC nations coupled with the OPEC induced price rises of 1971 that has been the recent cause of great concern in Japanese energy circles. Authorities are taking a variety of steps to meliorate future adverse actions by OPEC members. MITI envisages an over-all Japanese/OPEC economic cooperation agreement facilitating the direct import of crude in exchange for Japanese capital and technology. Such an agreement would intentionally bypass the international major oil companies which currently handle about 80 percent of Japan's crude oil imports.

Another step being undertaken includes a greatly enhanced exploration effort which, if completely successful, would aid in meeting the ambitious 1980 target of securing 30 percent of Japan's oil from sources owned or developed with Japanese capital; control currently is at the 20 percent level. During the seventies up to \$3 billion is to be spent in exploration. Additionally, the Japanese will buy concessions where they can.

For some years Japan and the Soviet Union have discussed the development of a Siberian pipeline bringing Tyumen crude to Japan. Recently, discussions became more serious, but it now appears that an agreement may be tied to a political settlement returning certain of the Kurile Islands to Japan. If the go-ahead were given in 1973, it would still be 1980 before any oil deliveries began.

As a hedge against interruptions in the supply of OPEC crude, MITI is taking steps to build up the existing stocks of 20 days of crude and 25 days of petroleum products to a 60 day total by 1975. Even a 60 day supply is recognized as low, but the cost of facilities and availability of land for storage will seriously inhibit building of a larger reserve.

The strain placed on securing the requisite crude imports over the next fifteen years without interruption will be great. For Japan imported petroleum is the only energy product that is sufficiently flexible to make up deficiencies elsewhere in the primary energy supply, although coal imports could be increased some. While the decline in oil demand recently projected for FY-71 amounts to 11 percent, it seems likely that oil imports will have to be stepped up if the domestic coal industry continues to perform as poorly as is likely in FY-71/72. Even now the demand for imported low sulfur crude to meet pollution controls can not be met.

Coal

The production of coal, the most important domestically produced energy source in Japan, has been declining sharply in recent years. The share of coal in the primary energy supply has dropped from 45 percent in 1955 to about 21.2 percent in 1970. Projections for FY-75/85 indicate a further decline to 18.8 and 17.4 percent, respectively. Domestically produced coal will constitute only 5 and 2 percent of the primary energy supply in FY-75/85.

Of even more immediate concern is the fact that the rate of decline is becoming more rapid than envisaged. The July 1970 forecast called for a production of 38 million metric tons in FY-75, but recently MITI stated that FY-72 production would only reach 27 million tons. The government has taken a number of measures to bolster the sagging domestic coal industry. Subsidies are provided by allocating to coal about 83 percent of the petroleum tariff, in FY-71 about \$360 million. But because of the greater attractiveness of oil from the cost and pollution aspects and because the productivity of the Japanese coal miner (30-60 tons/mo.) versus the productivity of overseas sources (200-300 tons/mo.), domestic coal output continues to decline.

Imports of coking coal are projected to continually increase owing principally to the demand of the steel industry. Australia and the U.S. supplied about 85 percent of the 45.2 million metric tons imported in FY-70. In 1970 these imports were projected to rise to about 81.3 and 188 to 209 million tons by FY-75/85, respectively.

Natural Gas

The production of natural gas in Japan will continue to be an insignificant factor in the primary energy supply. Until the recent advent of liquified natural gas (LNG) technology and subsequent commercialization, Japan had no possibility of increasing the supply of this highly desirable form of energy. The imported LNG is gasified and used primarily for firing thermal power stations.

With the first imports of LNG from Alaska in 1969, plans have proceeded for increasing foreign sources of LNG. Major projects are planned or underway in Brunei, Abu Dhabi, Australia, and Iran. By 1975 natural gas derived from LNG should surpass domestic production. Nevertheless, the share of all natural gas in the primary energy supply will be only 1.6 percent in FY-75 and 2.2 to 2.5 percent in FY-85.

Hydroelectric Power

Japan's rivers are short and of modest flow, hence, the potential for hydropower development is not great. While increases in capacity are projected over the next fifteen years, the share of hydropower in the overall primary energy supply is destined to decline from 6.3 percent in FY-70 to 4.5 percent in FY-75 and to 2.2 to 2.5 percent in FY-85.

Although "pumped" storage hydroelectric capacity is expected to increase, such power does not represent primary energy.

Nuclear Power

Nuclear power development represents the only hope for the Japanese for significantly diminishing their dependence on oil imports. Given the huge investments and long lead times required for nuclear power plant development, fifteen years is too short a span for appreciable inroads to be made on petroleum. And still Japan would be dependent on uranium imports. Moreover, environmental problems may cause still further delay. The end of the period under review may see the advent of the first commercial fast breeder reactors followed by a rapid upsurge in dependence by Japan on nuclear power. In the still more distant future fusion power offers Japan the chance of eventually becoming largely self-sufficient in their supply of primary energy.

Nuclear power from Japan's four atomic power plants will represent less than one percent of the primary energy supply in FY-1972. By FY-75/85, however, the nuclear power share may be expected to climb to 2.2 and 9.1 to 10 percent, respectively. It is expected that technological improvements and scale of plant will reduce nuclear power costs to below those of thermal plants by 1980.

Since 1967 Japan has markedly increased its plans to rely on nuclear power. In 1967 construction of nuclear generating capacity was projected to reach 30-40,000 MWe by the end of FY-85. By 1971, this target had been boosted to 60,000 MWe which is now probably on the low side. Indicative of this is the more recent change of April 1972 calling for 35,000 MWe by the end of FY-80; this figure had been at 32,000 MWe and as recently as March 1971 the target was 27,000 MWe.

Environmental concern, and uranium enrichment facilities, in that order, represent the two greatest problems currently facing the expansion of nuclear power in Japan.

Other Forms of Energy

The fact that the projected primary energy supply over the next fifteen years shows no contribution from newer forms of energy does not indicate a lack of Japanese interest, but only the inability to commercialize such developments on a sufficiently large scale in the relatively short time frame.

While Japan has no indigenous reserves of oil shales or tar sands, they do have the capital to invest in the U.S. or Canadian development of synthetic fuels from such sources. In Japan, too, coal gasification could be developed, but with steadily falling production and poor coal reserves a major program seems unlikely. Geothermal projects are under development in Japan.

Comparison With the United States

A comparison of U.S. and Japanese total projected consumption of energy shows the Japanese gaining relatively on the U.S. over the fifteen year period of the survey as follows.

Total Projected Consumption of Energy U.S. and Japan

Trillions of BTU's

<u>Year</u>	<u>U.S.</u>	<u>Japan</u>	<u>Japan % of U.S.</u>
1970	67,827	11,273	16.6
1975	83,481	17,400	20.9
1985	124,942	57,053.40,826	29.7 - 32.7

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The improved position of Japan vis-a-vis the U.S. is to be expected given their growth rate projections through 1985. The NPC study projection shows average annual energy demand growth rates of 4.2 percent or somewhat less than half those of Japan. If projected Japanese demand is deflated by 10 percent as indicated in the Energy Demand section, consumption will still be approximately 26.7 to 29.4 percent of the U.S. in 1985; very broadly, U.S. demand was 6 times Japan's in 1970 declining to between 3 and 4 times by 1985. A more detailed comparison showing projected demand by consuming sector is shown in Table 3.

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TABLE 3

Total Energy Demand by Consuming Sector

U.S. and Japan

1970, 1975, 1985

Year	Trillions of BTU's				
	<u>Residential - Commercial</u>	<u>Industry</u>	<u>Transportation</u>	<u>Non-Energy Uses</u>	<u>Electricity Conversion</u>
<u>1970</u>					
U.S.	15,761	20,056	16,313	4,058	11,639
Japan	2,017	5,553	1,452	1,475	776
Japan % of U.S.	12.8	27.7	8.9	36.3	6.7
<u>1975</u>					
U.S.	18,827	23,193	19,948	5,279	16,234
Japan	3,162	8,964	2,214	2,226	833
Japan % of U.S.	16.8	38.8	11.1	42.2	5.1
<u>1985</u>					
U.S.	26,598	30,921	28,331	8,930	30,162
Japan	6,734-7,217	19,280-21,570	4,221-4,539	4,873-5,345	1,924-2,151
Japan % of U.S.	25.4-27.2	62.4-69.7	14.9-16.0	54.6-59.8	6.4-7.1

A comparison of U.S. and Japanese consumption data in Table 3 reveals several interesting points. Note that the consumption of energy relative to the U.S. by the Japanese industry and non-energy sectors substantially exceeds the overall ratio for all three benchmark years. This is believed to reflect the relatively greater Japanese emphasis on industry, generally, and on petrochemicals; the large consumer of energy products for non-energy purposes. It is not hard to envisage why 100 million people in an area the size of California require much less energy relative to the U.S. for transportation purposes. Given the nature of the Japanese home, it is also possible to see that the Japanese residential/commercial sector currently consumes less energy relative to the U.S. However, one wonders, based on recent U.S. experience, whether MITI and other planning authorities are making adequate allowance for the dynamics of the Japanese people over a fifteen year period.

Another comparison shown as Table 4 reveals the degree of dependence for each form of energy as well as the dependence on imports for each form of energy.

TABLE 4

Primary Energy Supply by Type

Primary Energy Type	U.S.			JAPAN		
	1970	1975	1985	1970	1975	1985
Petroleum	42.0	46.2	43.6	70.6	73.2	67.8-69.1
Percent Imported	(22.0)	(40.7)	(56.6)	(99.6)	(99.8)	(99.9)
Coal <u>a/</u>	19.3	19.6	18.6	21.2	18.8	17.4
Percent Imported	(0)	(0)	(0)	(59.5)	(72.3)	(86.4-87.5)
Natural Gas	34.4	27.0	17.8	1.3	1.6	2.2-2.5
Percent Imported	(4.1)	(7.2)	(28.3)	(32.7)	(61.0)	(56.6)
Hydroelectric Power	3.9	3.4	2.5	6.3	4.5	2.2-2.5
Nuclear Power	0.4	4.0	17.3	0.4	2.2	9.1-10.0
Other	0.0	0.1	0.4	n.a.	n.a.	n.a.
Total Energy <u>b/</u>	100.0	100.3	100.2	99.8	100.3	-
Percent Imported	12.4	20.7	29.7	83.5	87.4	83.5-84.8

a/ All types

b/ Does not total 100.0 because of rounding.

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APPENDIX

TABLE 1 (A)

Japanese Total Energy Consumption By Consuming Sector and Type of Energy
FY-1970

Consuming Sector Energy Type	Physical Units						Total
	Residential- Commercial	Industry	Transportation	Non-Energy Uses b/	Electricity Conversion		
Electricity (mill. kwh.)	72,034	192,907	9,549	1,013	18,627	294,130	c/
Coal (thou. m.t.)	2,413	3,063	682	-	1,277	7,435	
Coke (thou. m.t.)	103	42,674	11	-	92	42,880	
Lignite, Briquettes and Charcoal(thou. m.t.)	2,052	61	1,300	-	4	3,417	
Firewood a/ (thou. cu.m.)	9,499	-	-	-	-	9,499	
Natural Gas (mill. cu.m.)	1	402	25	1,395	319	2,142	
Coke Oven Gas (mill. cu.m.)	-	8,498	-	-	1,192	9,690	
Blast Furnace Gas (mill. cu.m.)	-	78,369	-	-	11,354	89,723	
Town Gas (mill.cu.m.)	4,085	486	-	-	522	5,093	
Crude Oil (thou.kl.)	-	-	-	602	-	602	
Refinery Gas (mill.cu.m.)	-	-	-	-	3,381	3,381	
Gasoline(thou.kl.)	-	-	20,592	422	-	21,014	
Naphtha(thou.kl.)	-	-	-	26,041	-	26,041	
Jet Fuel(thou.kl.)	350	-	851	-	-	1,201	
Kerosene(thou.kl.)	10,496	2,826	935	1,578	-	15,835	
Gas Oil (thou.kl.)	2,420	1,171	7,934	478	-	12,003	
Heavy Fuel Oil (thou. kl.)	9,165	55,365	4,823	4,596	5,265	79,214	
LPG(thou. m.t.)	3,294	1,164	1,430	527	72	6,487	
Other Petroleum Products (thou.kl.)	-	-	-	6,239	-	6,239	

a/ Stack gases. b/ Includes energy consumed by agriculture, fishing, and forestry. c/ Losses and adjustments would bring total demand to 313,000 million kwh.

APPENDIX

TABLE 1 (B)

Japanese Total Energy Consumption Projections By Consuming Sector And Type of Energy

Physical Units

FY-1975

Consuming Sector Energy Type	Residential- Commercial	Industry	Transportation	Non-Energy Uses b/	Electricity Conversion	Total
Electricity (bill.kwh)	114.5	320.4	14.9	1.4	26.2	477.4 <u>c/</u>
Coal (mill.m.t.)	2.0	3.2	0.2	-	1.0	6.4
Coke (mill.m.t.)	-	68.2	-	-	-	68.2
Lignite, Briquetts, and Charcoal(mill.m.t.)	1.5	0.1	-	0.3	-	1.9
Firewood a/(mill.cu.m.)	10.0	-	-	-	-	10.0
Natural Gas(bill.cu.m.)	0.1	0.3	-	1.3	0.3	2.0
Coke Oven Gas (bill.cu.m.)	-	20.7	-	-	2.6	23.3
Blast Furnace Gas (bill. cu.m.)	-	144.2	-	-	26.8	171.0
Town Gas(bill.cu.m.)	7.6	0.5	-	-	1.1	9.2
Crude Oil(mill.kl.)	-	-	-	1.0	-	1.0
Refinery Gas(bill.cu.m.)	-	-	-	-	2.7	2.7
Gasoline(mill.kl.)	-	-	32.3	0.9	-	33.2
Naphtha(mill.kl.)	-	-	-	43.0	-	43.0
Jet Fuel (mill.kl.)	0.4	-	1.6	-	-	2.0
Kerosene(mill.kl.)	16.5	3.0	1.2	3.0	-	23.7
Gas Oil (mill.kl.)	4.8	1.6	12.5	0.7	-	19.6
Heavy Fuel Oil (mill.k.)	15.0	87.5	7.9	5.5	4.0	119.9
LPG (mill.m.t.)	4.8	1.9	2.1	1.6	-	10.4
Other Petroleum Products (mill.kl.)	-	-	-	-	6.2	6.2

a/ Stack gases

b/ Includes energy consumed by agriculture, fishing, and forestry.

c/ Losses and adjustments would bring total demand to 508,700 million kwh.

APPENDIX
TABLE 1 (C)

Japanese Total Energy Consumption Projections By Consuming Sector and Type of Energy

FY-1985

Physical Units

Consuming Sector Energy Type	Residential- Commercial	Industry	Transportation	Non-Energy Uses b/	Electricity Conversion	Total
Electricity(bill.kwh)	278.7-292.5	663.0-743.5	63.7	29-32	72.5-81.1	1,081-1,184
Coal(mill.m.t.)	2.0	2.5-2.6	0.2	-	1.0	5.7-5.8
Coke(mill.m.t.)	-	148.4-164.1	-	-	-	148.4-164.1
Lignite,Briquettes and Charcoal (mill.m.t.)	1.5	0.1	-	0.5	-	1.6
Firewood a/ (mill. cu.m.)	10.0	-	-	-	-	10.0
Natural Gas(bill.cu.m.)	0.2	-	-	3.7	0.5	4.4
Coke Oven Gas (bill. cu.m.)	-	45.4-49.8	-	-	5.7-6.4	51.1-56.2
Blast Furnace Gas (bill. cu.m.)	-	344.0-382.0	-	-	63.9-71.0	407.9-455.0
Town Gas (bill.cu.m.)	17.6-18.5	0.7	-	-	2.6-2.7	20.9-21.9
LNG(mill. m.t.)	-	-	-	1.0	-	1.0
Crude Oil (mill.kl.)	-	-	-	1.6	-	1.6
Gasoline and Naphtha(mill.kl.)	-	-	50.2-54.8	101.9-113.3	-	152.1-168.1
Kerosene(mill.kl.)	41.9-45.4	10.8-11.5	24.9-27.0	7.2-8.1	-	84.8-92.0
Heavy Fuel Oil (mill.kl.)	33.4-36.1	195.2-220.5	17.7-19.5	8.4	8.3-9.3	263.0-293.8
Other Petroleum Products(mill.kl.)	14.0-17.1	10.5-12.0	9.5-10.0	15.8-17.1	3.8-4.4	54.6-60.6

a/ Stack gases

b/ Includes energy consumed by agriculture, fishing and forestry.

APPENDIX

TABLE 1 (D)

Calorific Content of Various Categories of Energy

		1 kilocalorie = 3.968 British Thermal Units
Electricity	2,450 k. cal./kwh	
Coal		
Indigenous	5,340 k. cal./kg	
Imported	7,700 k. cal./kg	
Coke	6,800 k. cal./kg	
Lignite	4,200 k. cal./kg	
Briquettes	5,400 k. cal./kg	
Charcoal	7,000 k. cal./kg	
Firewood	1,540 k. cal./cu.m.	
Natural Gas	9,800 k. cal./cu.m.	
Coke Oven Gas	4,800 k. cal./cu.m.	
Blast Furnace Gas	800 k. cal./cu.m.	
Town Gas	10,000 k. cal./cu.m.	
LNG	13,300 k. cal./kg	
Crude Oil	9,400 k. cal./l	
Refinery Gas	20,000 k. cal./cu.m.	
Gasoline	8,600 k. cal./l	
Naphtha	8,600 k. cal./l	
Jet Fuel	8,900 k. cal./l	
Kerosene	8,900 k. cal./l	
Gas Oil	9,200 k. cal./l	
Heavy Fuel Oil	9,900 k. cal./l	
Other Petroleum Products	9,400 k. cal./l	
LPG	12,000 k. cal./kg	