

INTERNATIONAL FINANCE DISCUSSION PAPERS

A REVIEW OF CURRENT U. S. POSITION IN PETROLEUM

by

Alex Lang

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Fuel shortages experienced this winter in some parts of the United States and a sharp increase in dependence upon oil imports underscore the seriousness of U.S. energy situation. Shortages of domestic energy resources developed only gradually, although at an accelerating rate during the past decade. They remained largely unnoticed by the general public until surfacing with alarming suddenness about a year ago. Since then, the "energy crisis" has been identified as one of the foremost economic problems confronting this nation. It has become a subject of heated public debate, prompting a spate of studies and projections by public and private institutions concerned. The following text will focus mainly on the petroleum situation, the central element in the energy problem. It will discuss some of the most important factors affecting U.S. position in petroleum, its balance of payments impact, and some of the long and short-run projections.

Trends in the energy situation

A major underlying reason for the currently experienced shortages of energy resources, especially petroleum, has been an accelerated growth of energy consumption in this country. The rate of growth of energy consumption increased from less than 3 per cent a year during 1950's to 3.5 per cent in early 1960's and then jumped to almost 5 per cent in the second half of 1960's. It slowed down to an average of

of 2.8 per cent a year during 1970 and 1971, but in 1972 regained its previous level of almost 5 per cent.

Acceleration of the energy consumption growth is to a large extent attributed to continuing high rates of growth of the demand for electricity. Electricity consumption expanded at 6.5 per cent a year between 1960 and 1965, and at 7.3 per cent between 1965 and 1970. The expansion rate, however, slowed down to 6 per cent during the past two years.^{1/} While electricity has many advantages, its production and distribution does waste almost 60 per cent of the primary energy resources utilized in its production.

Increasing inefficiency of energy utilization in this country in recent years has found reflection in the trend of increasing energy consumption per dollar of GNP. This trend emerged for the first time in 1966, reversing the previous long-run historical trend of declining ratio of energy consumption to GNP. It is not yet clear, however, if the new trend will continue into the future. It lasted only through 1970. The ratio again declined in the past two years, apparently in part due to decline in the growth rate of electricity consumption.

Changes in the relative position of different sources of energy have also contributed to the current energy problem. Regulation of natural gas prices by the Federal Power Commission, following the Supreme Court decision of 1954, stimulated tremendous growth in the use of gas, while discouraging investment in exploration for gas resources. Over the last

^{1/} U.S. Department of Commerce "Business Statistics, 1971 Biennial Edition" and Survey of Current Business February 1973.

Table 1 - Share of Principal Energy Sources in the
United States Energy Consumption
(Percentage Distribution)

	<u>Coal</u>	<u>Gas</u>	<u>Petroleum</u>	<u>Hydropower</u>	<u>Nuclear Power</u>
1960	22.7	28.5	45.0	3.7	
1961	21.8	29.2	45.2	3.7	
1962	21.5	29.8	44.8	3.8	
1963	21.1	30.1	44.5	3.6	
1964	22.0	30.5	43.7	3.7	
1965	22.3	30.2	43.5	3.8	
1966	22.1	30.8	43.2	3.7	
1967	21.0	31.3	43.5	4.0	
1968	20.5	31.7	43.8	3.8	.2
1969	19.6	32.3	43.7	4.1	.2
1970	19.1	32.6	43.9	3.9	.3
1971	17.6	33.2	44.5	4.2	.6
1972	17.2	32.3	45.5	4.1	.8

Source: U.S. Department of the Interior "United States
Energy Through the Year 2000" December 1972.

decade, gas in Texas sold for about 1/4 of the cost of equivalent oil energy, and is currently selling for only 13 per cent of the price of imported gas. In recent years, the clean-air standards set by the Environment Protection Agency have further encouraged the use of gas instead of coal as a basic industrial fuel. If the 1970 limits of permissible sulphur in coal burned by utilities are strictly applied, this would outlaw the use of much of the coal dug in the Eastern United States. As a result, the share of gas in the total energy consumed increased from 28.5 per cent in 1960 to 33.2 per cent in 1971, while the share of coal dropped from 22.7 per cent to 17.6 per cent. (Table 1).

With declining exploration for new reserves, there was a steady downward trend of gas discoveries during the past decade. Since 1968, proved gas reserves have dropped from 16 times annual production to 12 in 1972. Increasing shortages of gas and even of coal have developed in the past two years.

Increasing pressure on petroleum

Under the circumstances, the burden of meeting growing energy demand has fallen disproportionately upon petroleum. Petroleum consumption increased by 3.4 per cent in 1971 and by 9.6 per cent in 1972, compared to an average annual rate of only 2.6 per cent during the entire 1960's. (Table 2, line 4). Reversing the trend of the past decade, oil consumption thus grew faster than total energy

Table 2- U. S. Petroleum Production, Consumption, Imports and Exports
(Millions of Barrels per Year)

	<u>Annual Average</u>		<u>1970</u>	<u>1971</u>	<u>1972^{1/}</u>
	<u>1960-64</u>	<u>1965-69</u>			
1. <u>Petroleum Production</u>	3,063	3,672	4,129	4,077	4,106
Per cent change per year	+2.1	+2.4	+4.3	-1.3	+0.5
2. <u>Petroleum Imports</u>	745	992	1,248	1,433	1,719
Per cent change per year	+5.6	+6.9	+8.0	+14.8	+19.9
Crude Petroleum Imports	403	459	523	659	799
Per cent change per year	+4.3	+3.2	+1.7	+26.0	+21.2
Petroleum Products Imports	342	533	725	744	920
Per cent change per year	+7.3	+10.6	+13.1	+6.7	+18.8
3. <u>Petroleum Exports</u>					
Per cent change per year	-1.2	-2.6	+11.9	-12.8	-5.1
4. <u>Petroleum Consumption</u>	3,801	4,652	5,238	5,418	5,939
Per cent change per year	+2.8	+2.5	+1.5	+3.4	+9.6
<hr/>					
5. Share of Imports in Petroleum Consumption	19.6%	21.3%	23.8%	26.4%	28.9%
6. Growth Rate of Total Energy Consumption	+3.5	+4.9	+3.8	+1.9	+4.9

^{1/} American Petroleum Institute estimates, The Oil and Gas Journal,
January 8, 1973.

Sources: Department of the Interior "United States Energy Through the
Year 2000" December 1972;
Department of Commerce Survey of Current Business January 1973.

demand during the past two years, increasing its share in total energy consumption from 43.9 per cent in 1970 to 45.5 per cent in 1972 (Table 1).

In recent years, however, domestic oil production has not been sufficient to meet the growing demand. Petroleum production peaked out in 1970 and has been stagnating since then (Table 2, line 1). This has been in part due to exhaustion of some existing deposits and in part to a marked decline in oil exploration. The number of exploratory wells drilled in 1971 was the lowest since 1946, and less than half the record total in 1965. Exploratory drilling increased by 8 per cent in 1972, but the number was still the second lowest in the past quarter century.^{2/} Since 1967, more oil has been produced than discovered, meaning a gradual depletion of proved reserves.

Environmental concerns have contributed in a major way to the oil problem. Not only did they bring about a virtual stagnation in the utilization of coal, the most abundant source of energy in the nation, but they also blocked construction of a number of nuclear plants that would have relieved the pressure on oil supplies. Cleaning up auto exhaust already costs, by some accounts, more than 100 million barrels a year of extra gasoline, and may cost seven times more by 1980. While helping to boost the demand for oil, the environmentalists have at the same time significantly hindered exploration and development efforts. They have blocked construction of the Alaskan pipeline and delayed lease sales of prospective tracts on the outer continental shelf.

^{2/} Oil and Gas Journal December 25, 1972

Petroleum industry profits and domestic oil prices

Petroleum industry sources claim that declining economic incentives have played a major role in constraining exploration for oil and gas, and development of production facilities in the U.S. According to the financial analysis of a group of 30 leading petroleum companies by the Chase Manhattan Bank, the claim appears to be valid.^{2a/} The analysis shows that since 1969, the companies' net earnings, rate of return on invested capital and new investments have all declined in the U.S., while sharply increasing overseas.

After continuously increasing at an average annual rate of 10.3 per cent between 1961 and 1968, the industry's net earnings from their U.S. operations declined by 6.1 per cent in 1969, by 4.0 per cent in 1970 and by another 3.3 per cent in 1971. Rapidly increasing taxes and operating costs, not offset by commensurate price increases, were the primary reasons according to the Chase Manhattan Bank. The industry's net earnings overseas, on the other hand, jumped by 59.7 per cent in 1969 alone, by 9.1 per cent in 1970 and then by another 24.8 per cent in 1971. As a result, the net earnings in the U.S. in 1971 were at the level of 6 years ago, while earnings overseas during the same period increased more than two and a half times. Although the companies' investments in fixed assets in the U.S. comprised almost 60 per cent of their world total in 1971, the proportion of net earnings in the U.S. was only 48 per cent.

The rate of return received by the companies on average invested capital in the U.S. declined by almost 3 percentage points from 12.2 per cent in 1968 to 9.3 per cent in 1971, while slightly increasing overseas. For a capital-intensive industry, such a rate of return in the U.S. seems

^{2a/} The Chase Manhattan Bank, N.A. "Financial Analysis of a Group of Petroleum Companies" 1962-1971.

to be quite low. Thus, with their operations in the U.S. becoming progressively less profitable than overseas, the petroleum companies began reducing their investments in the U.S., while sharply stepping them up overseas. Domestic investments by the industry, after increasing at an average annual rate of almost 11 per cent between 1961 and 1968, dropped by 2.2 per cent in 1969, by 1.0 per cent in 1970 and 5.6 per cent in 1971. Investment overseas at the same time increased by 54.3 per cent in 1969, 22.9 per cent in 1970 and by another 23.5 per cent in 1971, compared to an average annual rate of 13.1 per cent between 1961 and 1968.^{3/}

In previous years, the primary device to equalize the profitability and of domestic/overseas operations was the oil import quotas. In existence ever since 1959, the quotas were designed to prevent the inflow of cheaper oil imports from bringing domestic oil prices down, thus providing an incentive for domestic exploration and development efforts. The incentives, however, have been progressively eroded as prices of domestic crude oil were increasing at a slower rate than the general price level. The real price of domestic crude, derived by deflating the nominal price by the wholesale price index, declined by 3.3 per cent between 1960 and 1965, by another 3.3 per cent between 1965 and 1970, and by 2.4 per cent just during the past two years.^{3a/} The real cost of drilling, at the same time, increased by 28 per cent between 1961 and 1971.^{4/}

The first major increase of the price of domestic oil in the whole decade took place in early 1969, when it was established at \$3.21 a barrel. It was again raised in December 1971 to \$3.41 a barrel, but price controls prevented another increase until August 1972, when it was allowed to move up to \$3.51. This was still its level at the end of January 1972. As the landed price of imported oil rapidly advanced during the past two years, the differential between domestic and import prices was reduced from \$1.45 a barrel in 1969, to about \$1 a barrel in

^{3/} Ibid.

^{3a/} U.S. Department of Commerce "Business Statistics, 1971 Edition" and Survey of Current Business, February 1973.

^{4/} Oil and Gas Journal, December 25, 1972, p.46.

early 1972, and by the end of 1972 to 50 cents a barrel. The differential has all but disappeared since then. With a growing volume of imports, higher import prices would inevitably push domestic oil prices up, which apparently is the hope of the oil industry. The industry sources predict that domestic crude oil prices, if freed from federal restraint, would shortly rise to an average of \$3.65 per barrel.

Trade impact

With domestic oil production lagging, an increase in demand for petroleum has meant a rapid growth of imports. The volume of oil imports increased 15 per cent in 1971 and almost 20 per cent in 1972, compared to an average annual rate of less than 7 per cent during the decade of 1960's. The share of imports in oil consumption jumped to 29 per cent in 1972 from 21 per cent just a few years ago, when it was held down by oil import quotas. (Table 2, lines 2 and 5). Unlike in the past, oil is now being imported simply in order to cover the deficit, rather than because of any price advantage.

The value of oil imports (on f.o.b. basis) in 1971 was \$3.3 billion and reached \$4.3 billion in 1972. The increase in the value of petroleum imports contributed about 10 per cent to the increase of our total import bill in both 1971 and 1972, compared to only 3.6 per cent in the period between 1965 and 1970. (Table 3). After remaining virtually stable for almost a decade, oil prices in the international markets increased on average by 10 per cent in 1971 alone. After the 1971 exchange rate changes the major oil producing countries demanded an adjustment which contributed to the increase of oil prices by another 18 per cent during 1972.^{5/}

^{5/} International Monetary Fund International Financial Statistics February 1973.

Table 3 U.S. Petroleum Import Values (f.o.b.)

(Millions of Dollars)

	<u>1965</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>
1. Total Petroleum Imports	2,093	2,764	3,324	4,299
Crude Petroleum	1,142	1,283	1,704	2,383
Refined Petroleum	951	1,481	1,620	1,916
2. Share of Petroleum in Total Merchandise Imports	9.8%	6.9%	7.3%	7.7%
	<u>1965-70</u>	<u>1970-71</u>	<u>1971-72</u>	
3. Contribution of Petroleum to the Increase in Total Merchandise Imports	3.6%	10.0%	9.8%	
4. Contribution of Price Change to the Increase in Value of Petroleum Imports	-14.3%	28.5%	31.6%	

Sources: Department of Commerce "U.S. Exports and Imports Classified
by OBE End-Use Commodity Categories, 1923-68" OBE-SUP 70-01;
Department of Commerce "U.S. Foreign Trade" FT-135 and FT-410.

Thus, the larger volume of imports in 1972 added \$667 million to our oil import bill. The higher price, compared to the 1971 level, added another \$308 million, or more than 30 per cent of the total increase in the oil import bill. The additional value of oil imports, at the same time, accounted for 10 per cent of the increase in the total value of U.S. merchandise imports in 1971 and 1972. In contrast, the contribution of petroleum to the increase in total merchandise imports was only 3.6 per cent during the preceding 5 years (Table 3, lines 3 and 4). An increasing portion of the U.S. trade deficit is, therefore, the result of growing oil imports.

To determine their net impact on the U.S. balance of payments, a detailed account would have to be taken of all dollar outflows and inflows causally associated with additional oil imports. A larger volume of imports means larger shipping costs, and a larger dollar outflow when shipment is done in foreign-owned tankers. To meet the growing U.S. demand, the international oil companies step up production and exploration for oil overseas. To the extent that these efforts are financed with U.S. capital, there is an additional outflow of dollars. A portion of this outflow, however, soon returns to the U.S. in the form of payments for U.S. petroleum equipment.

A larger volume of sales and higher prices increase the oil companies' revenues, while higher tax and royalty payments to governments of the oil producing countries raise costs. Some of the companies' net earnings are remitted to the U.S. in the form of dividends, interest and "branch earnings." Another inflow of dollars results from remitted

management fees, royalties and other service charges. Finally, the oil producing countries would normally spend a portion of their added revenues on imports of U.S. goods and on investments in the U.S.

If all these financial flows could be quantified, they could be balanced against the additional cost of our oil imports. The result would then indicate a net impact of additional oil imports on the U.S. balance of payments. Unfortunately, there is not enough reliable data to permit such a quantification. For example, records indicate that in 1971 alone there was a \$1.9 billion outflow of investment capital on account of the oil industry. This, however, was more than offset by a \$3.4 billion inflow in the form of dividends and branch earnings, and a \$259 million inflow in the form of management fees, royalties, etc. The result was a net inflow of more than \$1.7 billion.^{6/}

This substantial net inflow was the outcome of all world-wide operations by the oil companies, among which the operations associated with the increased U.S. oil imports in 1971 or in preceding years were only a part. As there is no reliable way to identify that part, it would be meaningless for our purposes to balance this net inflow against the \$3.3 billion oil import bill of 1971. Attempts were made to quantify in round-about ways the financial flows directly or causally related to additional U.S. oil imports, but they proved to be very complex and not wholly satisfactory.^{7/}

^{6/} Julius Freidlin and Leonard Lupo, "U.S. Direct Investments Abroad in 1971" in the Department of Commerce, Survey of Current Business, November 1972.

^{7/} "Additional Oil Imports and the United States Balance of Payments" in "The Oil Import Question," a report by the Cabinet Task Force on Oil Import Control, Appendix H, February 1970.

Projections

There is a significant divergence of views among government and industry sources concerning the future course of development in the U.S. energy situation. Thus, a recent study prepared in the Department of the Interior^{8/} foresees a slower growth of total energy consumption than in the past 7 years, a much slower increase in petroleum consumption through 1975, and a more rapid increase after 1975. The share of petroleum in the total energy balance, it predicts, should remain virtually the same as in the past 7 years. (Table 4, entries 1 and 2).

The study also predicts a marginal decline in the domestic production of petroleum until 1975, a subsequent moderate increase in production through 1980, but then again a slow decline through 1985. It follows from these projections that oil imports should increase at approximately 13 per cent a year until 1975, reaching 2.3 billion barrels in that year. Imports should then increase to 3.9 billion barrels in 1980 and to 4.9 billion barrels in 1985. (Table 4a, entries 3 and 4). The Interior Department's study was prepared in early 1972 using data through 1971. Its short-term projections, especially for petroleum consumption and imports, were significantly at variance with the actual performance of 1972, and they are likely to be revised upward.

A comprehensive study by the National Petroleum Council^{9/}, on the other hand, predicts that the total energy consumption will continue to grow at about the same rate as in the past 7 years at least through

8/ Department of the Interior, "United States Energy Through the Year 2000" December 1972.

9/ National Petroleum Council, "U.S. Energy Outlook" December 1972.

Table 4 - Projections of Average Annual Rates of Change of U.S. Energy and Petroleum Consumption, Petroleum Production and Imports for 1972 - 1985

	(percentages)	(Negative - ()		
		<u>1972-1975</u>	<u>1976-1980</u>	<u>1981-1985</u>
1. <u>Total Energy Consumption</u>				
Actual 1965-72 Trend = 4.3				
Actual 1971-72 Average = 3.4				
Department of the Interior		3.9	3.6	4.0
National Petroleum Council		3.8-4.9	3.8-4.9	3.3-4.3
2. <u>Petroleum Consumption</u>				
Actual 1965-72 Trend = 5.1				
Actual 1971-72 Average = 6.5				
Department of the Interior		4.0	3.8	3.8
National Petroleum Council - optimistic case		4.1	2.1	0.8
National Petroleum Council - pessimistic case		6.7	5.6	3.2
3. <u>Domestic Petroleum Production</u>				
Actual 1965-72 Trend = 1.6				
Actual 1971-72 Average = (.4)				
Department of the Interior		(.5)	1.4	(.2)
National Petroleum Council - optimistic case		(2.6)	6.6	4.0
National Petroleum Council - pessimistic case		(4.1)	(1.8)	3.5
4. <u>Petroleum Import Requirements</u>				
Actual 1965-72 Trend = 9.7				
Actual 1971-72 Average = 17.3				
Department of the Interior		13.1	10.6	4.8
National Petroleum Council - optimistic case		16.7	(4.4)	(10.0)
National Petroleum Council - pessimistic case		25.0	11.4	3.1

Sources: Department of the Interior, "United States Energy Through the Year 2000" December 1972; National Petroleum Council, "U.S. Energy Outlook" December 1972; Department of Commerce Survey of Current Business, February 1973.

Table 4a. Projections of U.S. Energy and Petroleum Consumption,
Petroleum Production and Imports for 1975, 1980 and 1985

	<u>1 9 7 5</u>	<u>1 9 8 0</u>	<u>1 9 8 5</u>
1. <u>Total Energy Consumption in</u> (quadrillions of BTU's per year)			
Department of the Interior	80.3	96.0	116.6
National Petroleum Council	79.7-83.0	95.7-105.3	112.5-124.9
Actual 1971 = 68.7			
Actual 1972 = 72.1			
2. <u>Petroleum Consumption</u> (billions of barrels per year)			
Department of the Interior	6.3	7.6	9.1
National Petroleum Council			
Optimistic case	6.4	7.1	7.4
National Petroleum Council			
Pessimistic case	7.0	9.2	10.8
Actual 1971 = 5.4			
Actual 1972 = 5.9			
3. <u>Domestic Petroleum Production</u> (billions of barrels per year)			
Department of the Interior	4.0	4.3	4.2
National Petroleum Council			
Optimistic case	3.7	5.1	6.2
National Petroleum Council			
Pessimistic case	3.5	3.2	3.8
Actual 1971 = 4.1			
Actual 1972 = 4.1			
4. <u>Petroleum Import Requirements</u> (billions of barrels per year)			
Department of the Interior	2.3	3.9	4.9
National Petroleum Council			
Optimistic case	2.6	2.1	1.3
National Petroleum Council			
Pessimistic case	3.5	6.0	7.0
Actual 1971 = 1.4			
Actual 1972 = 1.7			

Sources: Same as in Table 4.

1980, but will grow at a slower rate thereafter. The study develops four alternative situations. The most pessimistic case essentially represents the situation which would evolve if no remedial actions are taken soon and if recent trends continue. In this case, lack of positive policies, continuing disputes over environmental issues, and continuing unfavorable energy prices, would constrain growth in the production of energy resources.

Petroleum would have to carry a steadily increasing burden of meeting the growing energy demand. Yet, its domestic production would drop from 4.1 billion barrels in 1972, to 3.5 billion barrels in 1975, and then to 3.2 billion barrels in 1980. This would leave a massive deficit to be made up by oil imports. These may rise to 3.5 billion barrels in 1975, double the amount imported in 1972, and to 6 billion barrels by 1980. (See growth rates projections in Table 4).

In the most optimistic case, the National Petroleum Council foresees higher energy prices, an early resolution of environmental controversies and special incentives working together to forestall any precipitous decline in domestic oil production. Nevertheless, production would still decline to 3.7 billion barrels in 1975, but then rapidly climb to 5.1 billion barrels in 1980, and to 6.2 billion barrels by 1985. Increased production of natural gas, coal and nuclear energy, at the same time, would slow down the growth of petroleum demand through 1980, and even more so thereafter. This in turn would limit import requirements to 2.6 billion barrels in 1975, and would reduce them to 2.1 billion barrels in 1980 and to 1.3 billion barrels by 1985. (Table 4a).

Significantly, both studies come to the same fundamental conclusion that, regardless of any new policies adopted now, the United States will become heavily dependent on imports of oil by 1975. Even under the most favorable conditions, imports should reach 2.3 to 2.6 billion barrels, or 36 to 53 per cent above the 1972 level. The level of imports after 1975, however, will be to a large extent determined by new energy policies and by the energy price structure.

Not only will the volume of our oil imports rise, the prices we pay for them also are certain to rise. The future value of oil imports therefore can be expected to rise even faster than their volume. There are a number of agreements between the petroleum companies and the oil-producing countries already on the books that provide for substantial price increases in the years to come.^{10/}

In the light of recent experience, however, it would be unrealistic to expect future price increases to be limited by these agreements. Some sources, for example, believe that foreign oil prices may double by 1975 and triple by 1980 over the level at the end of 1972. If this happens, our oil import bill may climb to \$18 billion by 1975 and to \$45 billion by 1980, under the most unfavorable conditions projected by the National

^{10/} The Teheran and Tripoli agreements of 1971 contain price escalation clauses that assure progressive price increases at least through 1975. The New York agreement of 1972 on "participation" provides for an increasing portion of oil output to be turned over to the host governments, up to 51 per cent by 1982. The companies will have to buy that oil back at inflated prices. Under the Geneva agreement of 1972, the host governments will be compensated for currency rate changes. This agreement resulted in a 8.5 per cent price increase in 1972, and should raise prices by another 7 per cent after the latest dollar devaluation.

Petroleum Council. It is doubtful, however, that the cost increase will be that large. The head of the Energy Review Committee, former Commerce Secretary Peter Peterson, recently predicted that by 1980 the United States could be running a "trade deficit in energy" of \$15 billion to \$21 billion a year.^{11/} This still would represent a three to five fold increase over the 1972 level.

Future energy costs

Stark predictions of enormous import payments for energy, mainly oil, may prove to be wrong. It is generally agreed that the United States has ample resources to last for many decades at current or gradually increasing rates of consumption. In the past, the administratively controlled energy price structure was a major factor inhibiting the normal market forces from bringing new energy sources on stream. Ready availability of cheaper oil imports equally made it unprofitable to develop more expensive domestic energy resources. In a way, the United States faces today not so much an energy crisis as a shortage of cheap energy to which its population and other consumers have become accustomed.

It is a foregone conclusion, however, that the era of cheap energy is over, and that from now on the costs of energy, whether from domestic or foreign sources, will rapidly increase. Prices of imported oil and especially gas are already well above controlled domestic prices, and as the volume of imports grows they should soon begin pulling domestic

^{11/} Commerce Today, December 11, 1972.

prices up. In the longer run, considerations of national security, in addition to those of balance of payments, should set a certain limit beyond which dependence upon imports cannot be allowed to go, irrespective of relative costs.

The costs of energy supplies from the yet untapped domestic sources will be considerably above current energy costs. Most of the additional oil and gas would have to come from offshore wells sunk at significant depths, or from deposits in remote Arctic regions. Synthetic oil and gas from coal or oil shales will also cost a lot more than the natural products.

Capital requirements alone to meet domestic energy demand will be enormous in any event. The National Petroleum Council estimates that capital expenditures over the 1971-1985 period needed for development, processing and primary distribution of all fuels will range from \$215 billion to \$311 billion. An additional \$235 billion will be required for power plant construction and transmission facilities, which would bring total capital requirements to \$450-\$550 billion. This would double the current rate of capital investments in the energy field.^{12/} Domestic fuel prices would have to rise steeply to induce investments from private sources and justify supplementary government expenditures of such a magnitude. According to the National Petroleum Council, prices in constant 1970 dollars should increase by 1985: by 60 to 125 per cent for oil at the wellhead, by 80 to 250 per cent for natural gas at the wellhead, by about 30 per cent for coal at the mine, i.e. at an average annual rate for all fuels of two to nine per cent.^{13/}

^{12/} National Petroleum Council, "U.S. Energy Outlook" p. 62.

^{13/} Ibid., p.7.

It is generally known that both the supply and demand for various types of fuel are quite sensitive to price movements, i.e. are price elastic, when substitutes are available. Little is known, however, about the nature of the relationship between the total energy consumption in the society and changes in the general level of energy prices. Most projections of future energy consumption explicitly assume a continuation of the historical relationship between energy demand and growth rates of GNP and population, but they implicitly assume that the total energy demand is virtually price inelastic. This last assumption, however, has never been tested, as the relative price of energy to U.S. consumers has been declining in this century, although at decreasing rates especially in the past two decades.^{14/} In this respect, the coming era of steeply rising energy prices may prove to be unique.

If real prices of energy begin to rise (which has not happened yet), there is a possibility that the total consumption of energy would decline. Higher costs would tend to reduce energy waste. Fuel intensive activities and goods would give way to those that are less energy intensive. Not only does the demand for energy resources depend upon GNP growth, but the GNP growth rate apparently can be affected by significant changes in the real cost of energy. Higher energy costs may reduce the

^{14/} The relative price of energy, as measured by the index of fuels and power prices deflated by the index of wholesale prices for all commodities, declined at an average annual rate of 0.9 per cent between 1949 and 1959, and 0.6 per cent between 1959 and 1969. The relative price of energy increased by 1 per cent in 1970 and by more than 4 per cent in 1971, but then again declined by 0.6 per cent between December 1971 and December 1972. It further dropped by 1.1 per cent by the end of January 1973. See: Department of Commerce, "1971 Business Statistics" and Survey of Current Business, February 1973.

GNP growth rate and thus reduce the growth rate of energy consumption. The experience of 1966-1970 when the ratio of energy consumption to GNP was rising quite possibly will not be repeated again. Future rates of growth of total energy consumption, therefore, may turn out to be even lower than those projected in the lowest projection by the National Petroleum Council. (Table 4, entry 1).

Higher petroleum and gas prices will stimulate demand for and production of alternative fuel resources. Already there is a perceptible increase in demand for coal, and its production increased by 7 per cent in 1972. Higher prices have also brought a number of unconventional sources of energy closer to the edge of economic feasibility. It was reported that shale oil and synthetic oil from coal would become economically attractive at about \$4-\$4.50 a barrel.^{15/} This is not very far from the recently quoted landed cost of imported petroleum of \$3.57 per barrel. Shale oil production is expected to commence in 1975 and reach 365 million barrels per year by 1985.

Thus, with a slower growth of energy demand coupled with increased consumption of coal and synthetic fuels, the pressure on petroleum should be closer to the level projected by the Department of the Interior than to the most pessimistic level projected by the National Petroleum Council. (Table 4, entry 2). By the end of this decade Alaska's North Slope is expected to add some 730 million barrels a year, which should to a large degree offset any possible decline in oil production in the lower 48 states. Together with new oil supplies from offshore

15/ The Journal of Commerce, December 20, 1972.

deposits, this should keep oil import requirements in the intermediate future, between 1975 and 1985, at manageable levels. A well-known petroleum consultant, Walter Levy, for example, believes that U.S. import requirements in the early 1980's might be about 3 billion barrels a year.^{16/} This would be a midway between the figure projected by the Department of the Interior and the lowest projection by the National Petroleum Council.

If Dr. Levy's projection is correct, as may well be the case, our import bill for oil alone should rise by the early 1980's to about \$15 billion if import prices double over their present level. However imperfect, the solution of the energy problem in the intermediate future should provide enough time for commercial development of radically new sources of energy, such as the breeder reactor, nuclear fusion, solar and geothermal power. These should provide an increasing portion of total energy supplies in the longer run after 1985.

A critical period ahead

The most critical situation in energy and oil in particular will probably be in the next 4 to 5 years. There is no way to effect on short notice a significant change in the patterns of energy consumption or a major increase of domestic oil and gas production. It would take at

16/ Petroleum Press Service, January 1973, p. 6.

least 5 years and a vast capital investment to bring on stream substantial new sources of fossil fuels. It may take even longer, much higher fuel prices and new legislation to bring about any significant slow down in the growth of energy consumption, and a substitution of coal for gas and oil on a broad scale. Meanwhile, there seems to be no alternative to increasing imports of oil and in the near future of liquefied natural gas.

There is little doubt that petroleum imports will rise sharply in 1973. An industry source, the Independent Petroleum Association of America, forecasts a 6.2 per cent increase in oil demand in 1973, and at the same time a drop in domestic production by 2.1 per cent, meaning a 24.4 per cent increase in imports.^{17/} Such an increase would bring the volume of oil imports in 1973 to more than 2.1 billion barrels. With the nation's economy expected to expand at an above-average rate this year and petroleum stocks currently at the lowest level since World War II, this projection is likely to prove correct. International oil prices, at the same time, are expected to rise in 1973 at least by 10 per cent over the 1972 level. In this case our oil import bill for 1973 may rise to \$5.8 billion, exceeding the 1972 import bill by \$1.5 billion.

17/ Petroleum Press Service, January 1973, p. 35.

Oil import requirements will probably grow at a more moderate rate in 1974 and subsequent years. Pressure on oil supplies can be eased somewhat within a year or two by eliminating the most obvious energy wastes and by speeding up substitution of coal for oil and gas, provided fuel prices are allowed to rise and strict pollution control regulations are relaxed. In 1971, more than 18 per cent of all petroleum and 7 per cent of all natural gas consumed in this country were used to fuel power plants. A large portion of this oil and gas apparently can be saved for other uses. Close to 84 per cent of all power plants, it is being reported, can switch from gas and oil to coal with only minor modifications.^{18/}

With proper incentives, it may be also possible to stabilize the domestic production of oil and gas in a year or two. Industry sources are quick to point out that the main producing fields in the U.S.A. have already been opened up to the point where no spare production capacity is left. This may be so. But, the capacity they refer to is apparently the "proved reserves" of oil and gas. Undoubtedly, there are other fields that almost certainly contain oil and gas, although their existence is not "proved" because wells have not been drilled yet. Their owners are obviously waiting for the wellhead price of oil to rise, as they are certain it shortly will, before they drill. With landed cost of some foreign crudes currently quoted on the East Coast almost 40¢ per barrel above comparable domestic crudes, they can wait without fear of losing the market to imports.

18/ Oil and Gas Journal, October 16, 1972, p. 75.

Even if domestic oil production stabilizes in the next year or two and pressure on oil imports eases, this would not necessarily prevent the cost of oil imports from continuing to rise sharply at least for another 4 to 5 years. Apart from the expected rise in the price of foreign crudes, there are also rising freight costs and shortages of refining capacity in the U. S. that will be pushing import costs up.

Shipping costs

Freight costs already add importantly to the costs of imports and to the balance of payments outflow. Thus, when in 1971 our payments for oil imports on f.o.b. basis were about \$3.3 billion, associated transport payments were between \$500 - \$600 million, or about 18 per cent of the total landed costs. There are several factors at work that are expected to raise transport payments sharply in the years to come.

One is a major shift in geographical distribution of our oil imports. So far, close to 80 per cent of our oil imports was obtained in the Western Hemisphere. (Table 5). Crude production in the Western Hemisphere, however, has been stagnating in recent years. A 16.5 per cent rise in Canada in 1972 was all but offset by a sharp drop in Venezuelan output, which was mainly due to the diminishing competitiveness of Venezuelan oil. Exports from Venezuela are expected to decline gradually in the coming years, while exports from Canada are going to be restricted

Table 5 - Sources of U. S. Petroleum Imports

Percent of Total Value

	<u>1965</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>
Canada	13.6	25.4	24.5	25.8
Latin America & Caribbean	69.1	55.1	54.3	45.4
Africa	2.4	3.5	5.0	11.4
Middle East	13.7	4.5	9.7	9.8
Southeast Asia	.6	2.0	2.5	3.2
Western Europe	.3	4.4	3.6	3.7
Eastern Europe		.3		.4
Japan	.2	.1	.1	.2
Australia & Oceania			.1	.1

Source: Department of Commerce "U.S. Foreign Trade, Highlights of Exports and Imports" FT990.

by new export quotas. This means that more than the entire increase in our imports would have to come from much more distant sources in Africa and the Middle East. It presently costs about \$1.36 per barrel to ship crude from the Persian Gulf to the U. S. East Coast and about 60¢ per barrel to ship it from the Mediterranean,^{19/} compared to only 25¢ a barrel from Venezuela.

Rising freight rates will also add to our shipping costs. Freight rates have been rising since mid-1972, and at a faster rate than the price of oil itself. For example, from November 1972 to the end of January 1973 Persian Gulf crudes increased in price 15¢ a barrel, while tanker rates from the same area to U. S. ports jumped by 80¢ a barrel.^{20/} Freight rates are expected to continue rising at an accelerated rate as the volume of our imports grows.

Apparently there is already a shortage of medium-sized tankers that U. S. ports can handle, as most of the recent tanker construction was in the super tanker category. Tanker requirements are expected to increase roughly 2-1/2 times by 1980 over the 1971 level.^{21/} Lack of deep-water port facilities will cost the U. S. dearly. Moving oil in medium-size tankers costs at least 50 per cent more than in ships five times their size. Development of deep water terminals on the East Coast and the Gulf of Mexico has been effectively blocked by the environmentalists.

^{19/} Oil and Gas Journal, February 26, 1973, p. 19.

^{20/} Ibid.

^{21/} Sun Oil Co. "15th Annual Tanker Survey" December 1972.

Port construction, even if started now on a large scale, would not make much difference until 5 - 6 years from now. Meanwhile, we may even run into difficulties procuring necessary imports if supply conditions are tight. Our competitors, especially Japan with its 7 deepwater ports, would be enjoying a major cost advantage over us.

Shortage of refining capacity

Another important factor aggravating the petroleum situation is the shortage of refining capacity in the U. S. The last time a new refinery was completed in this country was in 1969, and not a single new refinery is currently under construction. Existing refineries are already running close to their maximum capacity. The demand for refining services, at the same time, is growing more than proportionately to the demand for oil products. A more intensive refining is required to produce sulphur free fuels and lead-less gasoline.

Industry sources blame the lack of refinery construction on the uncertainty of future supplies of imported crudes. Refineries are usually built to process particular types of crude oil, and until long-term supply arrangements are secured new investments that may run into hundreds of millions of dollars would not be committed. Some U. S. refineries already experience difficulties in obtaining imports of needed types of crude. Industry sources also point out that in recent years the industry has been denied convenient coastal sites for new refineries. It is possible, and probably cheaper, to expand existing inland refineries.

In most cases, however, this solution is not feasible for the lack of logistics of moving imported crude inland from the coast. Finally, it would appear that the refinery profits, squeezed by rising costs of crude, rising operating costs including those of pollution control, and domestic price control, are insufficient to justify major new investments.

The oil industry intends to increase its investments in refineries in 1973 by 56 per cent over the 1972 level. Most of these investments, however, will be used to eliminate bottlenecks remaining in the existing refineries, rather than to construct new ones. These outlays should increase the capacity of existing refineries enough to meet the normal demand in 1973 and 1974. But, unless a major construction program gets underway in 1973, severe shortages of refining capacity would develop in 1975 - 1976. It has been suggested that to meet the growing demand in the second half of this decade, at least 5 large refineries would have to be built every year from now on. Unless this happens, imports of refined products, which are more costly, will have to be relied upon more heavily.

With virtually no spare capacity left in the U.S., domestic shortages of some refined products can develop any time when there is a sudden increase in demand. This has already happened, in the 1972-73 cold season. The demand for fuel-oil, more than 70 per cent of which is normally met by imports, jumped 9 per cent above the anticipated level, but additional imports could not be easily procured. A slight excess

capacity presently exists in Europe and elsewhere, but it is not sufficient to meet the volume or the product mix of our growing import requirements. All major oil-consuming nations seek to freeze further expansion of refining capacity and to increase imports of refined products. Some products are already in tight supply in the international oil market. The danger of supply shortages will continue to increase until major export refineries are completed some 4 - 5 years from now in the Caribbean area and in Canada.

The share of refined products in the total volume of petroleum imports increased from 46 per cent in 1960 - 1964 to 58 per cent in 1970 (Table 2, entry 2). This was mainly the result of a growing division of labor between domestic and offshore refineries, with domestic refineries specializing in production of higher valued products, and offshore refineries producing largely cheaper fuel-oils. The share of products in the total oil imports, however, declined in the past two years to 53.5 per cent in 1972. As the spare refining capacity is all but exhausted by now, crude imports should increase from now on at a slower rate. Thus, an increasing proportion of our oil imports should hereafter be in the form of refined products. This would further increase our oil import bill, especially so as products' prices are expected to increase more than proportionately to prices of crude oil.

Conclusions

The complex energy problem, various aspects of which have been discussed in the preceding study, represents a fundamental, real change in the U.S. position in petroleum and other fossil fuels. It is not a temporary crisis caused solely by some bureaucratic mistake in Washington, or by a profit maximizing effort on the part of the petroleum industry, or even by the environmentalist movement, as some spokesmen occasionally imply. The nature of the problem is much more basic. It lies in the significant depletion of the easily accessible, rich and therefore relatively cheap fossil fuels, especially natural gas and petroleum.

The nation still has vast potential reserves of desired fossil fuels, but their extraction and distribution are likely to be much more difficult and expensive than in the past. The current petroleum and natural gas supply problem represents an end of the era of seemingly inexhaustible supplies of desired fuels available at continuously declining real costs, and a beginning of an era of unpredictable fuel supplies at steadily rising costs, with an as yet unknown impact upon the economy and the standards of living in this country.

The energy problem itself has two time dimensions. In the short run, during the next 4-5 years, a tight supply situation in some fuels seems to be unavoidable despite steeply rising prices. To a large extent this will be due to a number of already existing bottlenecks, such as shortages of domestic production facilities, shortages of refining capacity and of deep water ports. In this respect, things will probably

get worse before getting any better. The oil import bill should be close to \$6 billion in 1973, almost double the level just two years ago, and it may reach \$8 billion or more by 1975-1976. Balance of payments outflows due to the rising shipping costs and refining capacity shortages will most probably rise, but by how much remains a question.

In the longer run beyond 1975, if some of the present bottle-necks are eliminated, if strict pollution control regulations are relaxed, and if new energy policies are promulgated, there should be a gradual lessening of pressure on petroleum and natural gas supplies. The pressure on oil imports should also decrease, and the oil import bill would grow at a slower rate to about \$13 billion by the end of the decade. The price of this solution would be a doubling of the rate of capital investments in the energy field, and much higher costs of energy to consumers. This solution, however, should give the nation enough time to develop some radically new sources of energy that should increasingly take over the burden of meeting the growing energy demand after 1985.

Rising costs of energy are likely to have a far reaching effect on the economy, involving occasional dislocations and eventually important structural changes. Marginal industries, especially those with energy intensive processes are most likely to be severely affected. Mining and metal industries, some of which are already experiencing declining production and are losing their market to imports, may lose much of their remaining competitiveness. In a few years, these effects of the rising energy costs may have an even greater adverse impact on our balance of

payments than the energy problem itself. The impact, of course, would to a large extent depend upon how timely and orderly the necessary adjustments in the economy are introduced.

The study has focused largely on the domestic petroleum situation in the U.S., touching only slightly on the international aspects of the problem. But it is clear that the U.S. emergence from virtual self-sufficiency in energy resources into a rapidly growing dependence upon imports will radically change the international petroleum situation.

The impact of U.S. demand on prices and availability of fuels to other countries will be a matter of concern throughout the world. The question of how we solve our energy problem is important to Americans and to residents of both developed and developing countries abroad.