SHORT-TERM FUEL OIL OUTLOOK

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SHORT-TERM FUEL OIL OUTLOOK

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Prepared by the

National Petroleum Council's
Committee on Fuels

Warren B. Davis, Chairman

FOREWORD

The Assistant Secretary of the Interior for Mineral Resources, the Honorable Hollis M. Dole, requested the National Petroleum Council on August 12, 1970, to give an appraisal of the availability of residual and other fuel oils to meet domestic demands through June 30, 1971, considering a variety of alternatives (Appendix A). The letter of request indicated that the Department of the Interior had been closely monitoring the U.S. energy market for fuel oils since the interruptions in world oil flows beginning in May 1970, and that there had been no clear indication that supplies of residual and other fuel oils, from either domestic refineries or abroad, could meet rising market requirements foreseen. In this light, the Department requested of the National Petroleum Council an appraisal of the prospects for demand and supply of distillate and residual fuel oil for the fall and winter of 1970-1971, as well as its views as to general alternatives available to the Government and possible actions which might be taken individually by various segments of the industry to alleviate the situation.

The National Petroleum Council Committee on Fuels was established under the Chairmanship of Mr. Warren B. Davis, Director, Economics, Gulf Oil Corporation, and the Co-Chairmanship of the Honorable Hollis M. Dole (Appendix B). The 22 members of the Committee were selected on the basis of their training, experience and general qualifications to deal with the matters assigned, which included petroleum industry economics, supply and distribution, production, refining, transportation and marketing.

The time permitted to organize this Committee and to prepare this report (20 days) restricted the Committee to an analysis of essentially published data available at the time the request was received and severely limited the degree to which data could be thoroughly checked and evaluated. It was impracticable to attempt detailed industrywide surveys to acquire more recent or detailed statistical data or information. Time was sufficient, however, to permit the development of a consensus as to the validity of judgments based on historical data.

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PART ONE

INTRODUCTION

The adequacy of supplies of petroleum to meet U.S. military and civilian requirements has long been a major concern of both the Federal Government and the American petroleum industry. Domestic demand for oil and gas, in conjunction with the demand for all other energy sources, is receiving increasing attention. In recent months, several factors have brought into focus the domestic fuel oil supply situation.

Residual fuel oil is utilized primarily for generation of electric power, industrial operations, space heating, and ships bunkers. In 1969 some 63 percent or 1.3 million barrels per day (MMB/D) of the total U.S. requirements for residual were imported. Of that amount only 54 thousand barrels per day (MB/D) entered the U.S. West Coast and Gulf Coast, while virtually all of the remainder entered New England, the Mid-Atlantic and Florida. Historically, competitive interplay among alternate energy sources has contributed to heavy fuel prices in the United States being substantially below the domestic refiners' cost of crude oil. Consequently the yield of residual fuel in U.S. refineries has been steadily reduced to maximize the yield of gasoline, distillates and other light products, leaving most of the requirements for heavy fuel to be met from offshore sources.

Long-term trends in the energy market have been accelerated by relatively recent occurrences at home and abroad and their overall impact is evident in the residual fuel situation in the United States.

1. There has been a disruption in offshore petroleum supplies because of abrupt cutbacks in crude oil supplies available from sources in the Middle East and North Africa. What replacement crude supplies are available must be transported around the African continent because of the continued closure of the Suez Canal. This has created a marked strain on ocean-going tanker capacities and has resulted in a worldwide transportation problem.

2. The relatively recent regulatory developments relating to the composition of fuels or the emissions from their burning, imposed as environmental conservation measures, have resulted in sudden increased demands on the petroleum industry for fuel oils because of the accumulated deficits in the availability of competing fuels:

   a. A shortage of natural gas was long predicted with a steadily declining trend in the reserves/production ratio

and an actual drop in reserves in the last 2 years. This situation is clearly a result of past Federal Power Commission policies setting unrealistically low ceiling prices that (1) dampened incentives to find gas and (2) artificially stimulated growth in demand.

b. Nuclear power plants (for electric generation) have not been completed within the time frame originally planned. For example, had all the nuclear plants planned initially for 1968, 1969 and 1970 actually been completed, then they would have displaced about 265 MB/D of fuel oil equivalent.

c. In anticipation of shifts by the electric power industry to nuclear fuel, and in recognition of the trend in air pollution regulations, the coal producers and railroads have not expanded coal production and transportation facilities fast enough to meet the increased demands of the rapidly growing electric power industry. Moreover, the new mine safety laws and wildcat strikes have further restricted coal productivity.

3. Restrictions on the sulfur content of the fuel oils themselves, imposed in a very short time frame in many instances, have resulted in temporary local supply shortages pending time-consuming and costly construction of desulfurization facilities.

As a consequence of these developments, the U.S. demand for residual fuel oil, which had experienced an average annual growth of 1.9 percent between 1959 and 1968, grew over 8 percent in 1969 and is expected to grow at an annual rate of 13 percent and 11 percent in 1970 and 1971, respectively.

The present overall energy fuel situation, therefore, is one in which the United States has continued a trend of large increases in requirements, and has in recent years increased its dependence on imported residual fuel oil. Such energy problems in the United States are further complicated by the fact that the other free-world industrial countries are likewise competing for foreign residual fuel oil supplies. Even if unlimited offshore supplies of residual were available, expected available transportation facilities would not be adequate to sustain further large increases in U.S. imports in the coming winter. This situation would be materially changed if the Suez Canal were opened. Restoration of Tapline operations would also provide meaningful relief.

The U.S. Government has indicated its concern that a shortage could possibly develop in domestic supplies of residual and other fuel oils during the fall and winter of 1970-1971. The U.S. petroleum industry shares this concern.

The NPC Committee on Fuels examined U.S. petroleum demand for the years 1968 and 1969 and forecasts of demand for 1970 and 1971, with emphasis on fuel oils, the capacities of U.S. refineries to make fuel oils, and the capacities of U.S. and foreign transportation facilities. It has examined the prospects of meeting increased U.S. energy demands with larger volumes of fuel oils manufactured in U.S. refineries, with additional fuel oil imports, and with other fuels.

Since the conditions which have created the possibility of available residual fuel oil not meeting the maximum potential requirements will continue to exist beyond the time frame of this report, the range of suggested solutions must contain longer-term considerations.

The Committee wishes to emphasize the following points:

1. Emergency actions are inherently expensive. They may require reschedulings, equipment adjustments, new construction, dislocation of personnel and equipment, expensive borrowing of capital, and many other financial and operating actions which must inevitably be reflected in the cost of doing business. Thus, economic factors always come to bear on both the industry and the consumer, with the free-enterprise system permitting the forces of competition to insure that the necessary products are provided to the consumer at the least cost.

2. The long-term stability of petroleum supplies to meet the Nation's diverse needs appears to be a policy objective of the Federal Government. To achieve this desirable goal it then becomes imperative that the Government adopt wise, firm, predictable, and consistent long-range petroleum policies.

3. Individual operators in any industry are motivated to develop their own business programs or plans not only by existing government policies and regulations at any point in time, but also by what they anticipate will be the future government policies and regulations.

Accordingly, the cause-effect relationship in national energy matters can be anticipated by government policy makers. For example, to the extent or degree that U.S. policies permit or encourage dependence on foreign petroleum supplies, the Nation will experience proportionately the vagaries of foreign petroleum sources, particularly under conditions of international tensions or emergencies.

SUMMARY AND CONCLUSIONS

RESIDUAL FUEL OIL

United States residual fuel oil demands, which averaged about 2,880 MB/D in the first quarter of 1970, are expected to increase by 260 MB/D to 3,140 MB/D in the first quarter of 1971. Estimates of demand are subject to a number of uncertainties, such as the severity of the weather, the level of industrial activity, and the amount of shifting to use of residual fuel oil in the United States in lieu of coal, gas and nuclear power. As a result, the increase in residual fuel oil demand could range from 70 MB/D to 335 MB/D. The increase forecast in the base case is 9 percent in the first quarter of 1971 as compared to the 1970 first-quarter growth of 18 percent over 1969. Under normal circumstances increased imports of the same order of size as demand increases would be expected. Because refineries supplying residual fuel oil from the Caribbean are all operating essentially at capacity and because there is little or no spare capacity in the world's tanker fleet, there is some doubt as to whether the upper range of the increased volume of residual imports can be brought in.

These forecasts of residual fuel oil demand reflect the best judgment of the Committee. With the wide range in potential requirements for residual fuel oil, the Committee cannot be sure whether an already expanded level of fuel oil supply can be increased further to meet the upper limits of demand without extraordinary action by industry and Government. A shortfall during the winter months of up to 250 MB/D is a contingency which must be recognized.

MOST PROMISING SUPPLEMENTARY ACTIONS

The most promising extraordinary action for providing supplementary residual fuel oil supplies is to run additional crude oil in U.S. refineries, shift yields on all crudes, and increase residual fuel oil yields. For the level of increases under consideration, it is possible, in effect, to convert such incremental crude oil runs to nearly 100 percent residual fuel oil. While it is technically feasible to supplement fuel oil availability by running incremental crude oil and shifting yields as outlined, the economic feasibility of providing larger quantities of fuel oil from U.S. or Canadian crude oil is a major factor with which refiners and consumers would be confronted.

The analysis of residual fuel oil supply and demand by PAD districts indicates that possible problems would be confined largely to District I, with some shortages possible in District II. Some additional problems in supplying low-sulfur fuel oil could occur.

The fuel oil supply for District I from U.S. sources is dependent upon the logistical system in Districts I and III, including Texas and Louisiana crude productive capacity, pipeline capacity, refining capacity, and U.S.-flag tanker capacity. An analysis of these components indicates that they could support a supply increase to District I, over projected levels, of about 250 MB/D of fuel oil made from increased crude production in District III, which would cover nearly all the possible shortage. Much of this additional fuel oil would be low sulfur. While it appears probable that enough coiled tonnage exists for resid movements, this is not certain. Any shortfall in presently expected offshore imports of crude or residual would aggravate the tanker shortage between U.S. Gulf and East Coast.

In District II, projected supply more or less balances demand in total if large shifts from coal to oil do not occur. Nevertheless, low-sulfur fuel oil availability may be a problem in some locations. If a problem does materialize, it should be possible to make up to 115 MB/D of additional residual fuel oil from increases in U.S. crude oil or from Canadian crude oil (which would require increased Canadian crude quotas) by utilizing spare refinery capacity and shifting yields.

Manufacturing supplementary fuel oil domestically will require physical changes in refinery facilities or operations as well as other changes in the logistics system. If this is to be accomplished in time to meet the potential problems this winter, prompt action will be required.

OTHER POSSIBLE SUPPLEMENTARY ACTIONS

The Committee considered a number of other possible alternatives which have been suggested by government, industry, consumer or other interested parties and found that none of these alternatives offers any significant prospects for easing the overall supply situation over the coming winter. These additional alternatives are nevertheless discussed in the following subparagraphs and in Part Two.

BURN UNREFINED CRUDE

While the most economic use of crude would be to process it in refinery equipment designed to utilize the lighter constituents, the feasibility of burning whole crude oil in the event of a shortage of residual was examined. The low flash point of most crude oils would make the addition of safety equipment by the user mandatory. Basically, the purpose of such equipment is to prevent the creation of a hazardous, combustible atmosphere in the vicinity of the storage and pumping equipment. It is unlikely that the conversion of any significant amount of present residual burning equipment could be accomplished before this winter. However, the use of crude as fuel could be further examined as a long-range alternate for emergencies or utility peak-shaving, even though this is basically an inefficient utilization of resources.

RELAX OR DELAY SULFUR RESTRICTIONS

The present availability of both low- and high-sulfur fuel oils is limited. Relaxation of local sulfur restrictions would afford some flexibility in meeting local demands this winter, but would not significantly ease the possible overall shortage of fuel oil. Obviously, any further tightening of local sulfur restrictions this winter would seriously compound the problem. The same is generally true for coal. However, some delays in imposing sulfur limitations until stack-gas desulfurization is practical may avoid forcing industrial or utility plants to shift from coal to oil.

REMOVE IMPORT CONTROLS ON RESIDUAL FUEL OIL IMPORTED INTO DISTRICTS II-IV

This would not help to alleviate the possible shortage of residual fuel oil, nor would it add to total U.S. imports. It might, however, increase total fuel oil demand and probably would divert imported supply from District I, thus aggravating the shortage there.

EMBARGO COAL EXPORTS

Nearly all overseas exports of coal are low-sulfur coking coals. Because of the engineering design of existing utility boilers and the combustion characteristics of these fuels, use of these coals for steam generation poses technical problems that could adversely affect their efficient and safe utilization. Generally, existing power plants cannot utilize this type of coal without extensive and costly modifications. Therefore, an embargo on coal exports would have only minor benefit.

USE OF ALTERNATE FUELS

The present limited availability of coal, gas and nuclear energy to meet increases in the demand for their use has contributed to the increased requirements for residual fuel oil. Thus, none of the three is likely to provide short-term relief to the fuel oil supply problem.

DISTILLATE FUELS

The Committee examined the demand and expected supply of distillate fuel oil for the 1970-1971 heating season. No serious imbalance is indicated between supply and demand for distillate under anticipated operating conditions and no extraordinary measures should become necessary to meet demands resulting from normal weather conditions.

Assuming normal weather, distillate fuel demand for historic markets in the first quarter of 1971 is expected to be only about one percent higher than requirements experienced in the first quarter of 1970, which was itself colder than normal. Refinery runs are expected to increase 4 to 5 percent over a year earlier. The demand for distillate in the first quarter of 1971 could, however, be as much as 210 MB/D over the first quarter of 1970 if the weather conditions in 1971 should equal the most severe of the last decade, in which case refiners should still be able to meet demand through minor adjustments in yield patterns.

Potential increased distillate demand for electric utility peak-shaving turbine fuel and switching to distillate fuels by residual fuel users unable to obtain residual fuel supplies could add to the strain on the supply system. Occurrence of these events simultaneously with significantly colder than normal weather would cause much more difficult supply problems for both tanker transportation and refining and could, in this extreme case, shift a significant portion of the potential residual problem to distillates.

PART TWO

I. PETROLEUM SUPPLY AND DEMAND

U.S. DEMAND

The 1970 U.S. demand for all petroleum products is currently estimated at 14,861 MB/D. Of this volume, 2,557 MB/D (17.2 percent) consists of distillate fuel oil and 2,250 MB/D (15.1 percent) is residual fuel oil. Motor gasoline accounts for 5,743 MB/D, and the remainder is made up of aviation fuels, kerosene, and a large number of specialty products.

Domestic demand for oil products increased during the past 5 years, 1965 through 1969, at the rate of 5.3 percent per year. Currently this rate of increase is running at 5.1 percent. The products which are showing unexpectedly high rates of gain in the past 18 months are distillate and residual fuel oils.

While the National Petroleum Council does not make supply and demand forecasts of the type requested, there are available two published estimates which are reliable enough to be used in responding to the questions asked by the Secretary of the Interior:

1. "U.S. Supply and Demand Forecast."[1] This forecast covers the third and fourth quarters of 1970 and the year 1970, and includes detail by major product category for Districts I-IV and District V. The estimates for Districts I-IV were apportioned to individual PAD districts according to historical relationships as evidenced by U.S. Bureau of Mines data.

2. Humble Oil's forecast of U.S. supply and demand.[2] This forecast covers the period 1970-1985 in 5-year intervals, and includes details on major product categories for the United States in total only.

Quarterly 1970 and 1971 estimates for distillate and residual fuel oil in each PAD district were derived based on these forecasts and the historical relationships evidenced by Bureau of Mines data, using historical seasonal relationships.

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[1] *Oil and Gas Journal*, July 27, 1970.

[2] Presented by Mr. M. A. Wright before the House Ways and Means Committee in conjunction with the American Petroleum Institute's testimony, June 3, 1970.

The statistical data in Appendix C relating to distillate and residual fuel oil are based on the U.S. petroleum product supply and demand shown in Table 1.

TABLE 1. U.S. PETROLEUM PRODUCTS--SUPPLY AND DEMAND

	Actual (MB/D)		Estimated (MB/D)	
	1968	1969	1970	1971
Refinery Product Output	10,641	10,979	11,340	11,647
Transfers from NGL, etc.	1,517	1,603	1,679	1,784
Product Imports	1,549	1,755	2,084	2,230
Total New Supply	13,707	14,337	15,103	15,661
Stock Changes	+88	-29	+3	-173
Total Demand	13,619	14,366	15,100	15,834
Exports	226	230	239	234
Domestic Demand	13,393	14,136	14,861	15,600
NOTE:				
Crude Oil Production	9,096	9,216	9,557	9,850
Crude Oil Imports	1,291	1,408	1,303	1,518
Crude Oil Runs	10,312	10,641	10,939	11,447

WORLD CRUDE OIL SUPPLIES

Some spare crude oil producing capacity exists in various locations in the world. Its utility is affected directly by the availability of related transportation facilities. Conditions in various parts of the world can be summarized as follows:

Eastern Hemisphere. African crude oils are generally low in sulfur and closest to markets. As a result, these crudes tend to be produced at capacity and no significant spare productive capacity exists. In fact, recent government orders have reduced production of Libyan crude. A reasonable amount of spare productive capacity does exist in the Middle-East fields in the Persian Gulf area. These crudes are the furthest from the markets west of Suez.

Caribbean. Latin America has essentially no spare crude productive capacity.

Canada. Spare productive capacity does exist in western Canada. On the basis of actual performance in early 1970, spare productive capacity and pipeline capability are available to permit deliveries to the United States at rates as much as 200 MB/D above the allowed import level of 395 MB/D.

United States. The only significant spare productive capacity in the United States is in Texas and Louisiana. Unlike Canada, the United States has had no recent actual experience at producing levels higher than present producing levels. As a result, estimates of spare capacity can be made only on the basis of informed judgment.

In Texas, spare capacity exists in a limited number of fields in West Texas, East Texas, and along the Texas Gulf Coast. The total spare productive capacity[3] *available without a declaration of emergency conditions* was approximately 450 MB/D above the expected production level in August, when the allowable factor was 70 percent. In September, the spare capacity above expected levels should be about 300 MB/D. In Louisiana spare productive capacity is estimated to be 200 MB/D.

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[3]This is the spare productive capacity available *immediately* and subject to the limitations of production facilities, field gathering systems, etc. These estimates are all compatible with the data used in the recent NPC report, "Capacity of Crude Oil Gathering Systems and Deep-Water Terminals," after taking into account differences in definitions. For example, API productive capacity used in the NPC report takes no account of delivery facilities and is the volume that could be built up in 90 days.

The ability to actually realize full productive capacity is subject to the combination of adequacy of field production facilities, field gathering systems and trunk pipeline capacity. Restrictions are known to exist in various locations in each of these categories. However, quantification of these limitations is beyond the capability of the Committee.

WORLD FUEL OIL SUPPLY AND DEMAND

Total world fuel oil demand is now over 12 MMB/D and is growing at about 10 percent per year. The largest consumers are Europe (4.5 MMB/D), the Far East--primarily Japan (3.2 MMB/D), and the United States (2.2 MMB/D).

Each of the principal consuming areas has a different supply-demand pattern. Europe is principally a large importer of crude oil, but manufactures its own residual fuel. Within Europe the situation varies from country to country. While European refining capacity essentially balances consumption, Europe does both import and export limited volumes of fuel oil. Most of the European exports are low-sulfur oil to the United States.

The Far East imports about 19 percent of its fuel oil requirements and covers the remaining 81 percent by local manufactures from imported crude. The Far East is the fastest growing fuel oil market, but imported fuel oil is declining both as to percent of requirements and in absolute volume.

The United States supplies about 63 percent of its fuel oil needs from imports and 37 percent from domestic manufactures.

About 80 percent of U.S. imports in 1970 will come from the Caribbean, rising to almost 90 percent in 1971. However, indigenous Caribbean crude production is at capacity and about one-third of Caribbean fuel oil will be manufactured from Eastern Hemisphere crude.

The stringent world tanker situation discussed in section II, "Refining and Transportation," raises some question as to the ability to meet world requirements, including that of providing enough Eastern Hemisphere crude to support the indicated Caribbean fuel oil production. More particularly, it places in doubt the indicated direct movement of fuel oil from Europe to the U.S. East Coast.

II. RESIDUAL FUEL OIL

SUPPLY AND DEMAND

Figures 1 through 4 in Appendix C show the distribution of U.S. residual fuel oil demand by districts (1960-1969), the distribution of U.S. residual fuel oil supply between refinery production and imports, and the residual supply sources for Districts I and II. Tables C-1 and C-2 in Appendix C illustrate residual fuel oil demand patterns for the years 1968 through second quarter 1970, and the estimated figures for third quarter 1970 through 1971. Table C-3 shows the estimated supply-demand balance for 1970 and 1971, while Table C-4 demonstrates the effect of weather on residual fuel oil demand.

HISTORICAL DEMAND

Residual fuel oil is defined as Nos. 5 and 6 heating oils, heavy diesel, heavy industrial and Bunker C fuel oils.

After a number of years of limited growth, the demand for residual fuel oil has risen sharply during the past 18 months. Growth from 1959 through 1968 was at an average annual rate of only 1.9 percent. In 1969 demand grew over 8 percent and in the first 6 months of 1970 demand grew at an annual rate of 15 percent. This resurgence in residual fuel oil consumption has been influenced by changes that transcend just the total growth in energy requirements.

The sharp increase in residual fuel consumption beginning in 1969 primarily stems from long-term trends in the energy market being accelerated by relatively recent developments. Today's recognized critical shortage of natural gas was created by over a decade of government-regulated gas prices at low levels. These unrealistic prices reduced incentives to explore for new reserves and at the same time artificially stimulated the growth of gas consumption.

This natural gas policy had an adverse impact on the coal industry which also faced approaching competition for the utility market from nuclear power. With expansion of coal production hampered by then long-term factors, current developments such as wildcat strikes, mine safety legislation and shortage of railroad cars have limited availability of coal.

Nuclear facilities over the past 3 years have fallen far short of supplying anticipated levels of energy due to construction and licensing problems.

The consequent lack of availability of competing fuels from domestic sources has led the utility industry and general industrial consumers to turn increasingly to fuel oil.

By 1969 domestic demand for residual fuel oil had reached 1,978 MB/D. During the first quarter of 1970, the residual demand growth exploded to a rate of 18.5 percent above prior year levels and second-quarter demands continued strong. Residual fuel consumption is not unduly sensitive to severe weather; only 1.5 percentage points of the growth during the abnormally cold first quarter of 1970 were attributable to colder than normal weather.

PROJECTIONS OF RESIDUAL DEMAND

Quarterly demand levels for residual fuel oil have been projected through 1971, by district. The basis of the projections is described in section I, "Petroleum Supply and Demand." In all instances it was assumed that normal weather would prevail. The projections, which are submitted as a base case, are shown in Table 2 (page 19).

For the full year 1970, domestic demand for residual fuel oil is projected to reach 2,250 MB/D, an increase of 272 MB/D (13.7 percent) over 1969. Again, a large portion of the increase will be concentrated in District I (East Coast) and District II (Midcontinent), with these areas increasing at rates of 17.9 percent and 27.2 percent, respectively. While the District II growth rate is startling, it is on a small base and represents only 47 MB/D. District V (West Coast) shows a tendency to decline, while Districts III and IV showed little change in absolute demand.

In 1971 a further strong advance in U.S. demand is projected, with the total reaching a level of 2,500 MB/D. This represents another unusually large increment in the demand of 250 MB/D, all of which is expected to be concentrated in Districts I and II.

In 1969, 79.9 percent of U.S. demand for residual occurred in Districts I and II. In 1970 this ratio increased to 83.9 percent and in 1971 it is expected to increase further to 85.7 percent.

VARIATIONS FROM BASE CASE

Demand levels for the balance of 1970 and the year 1971 are subject to wide variation depending primarily on the extent of heavy fuel requirements in the electric utility market and the availability of coal and gas supply for the industrial boiler fuel markets.

Table 2. DOMESTIC DEMAND FOR RESIDUAL FUEL OIL BY PAD DISTRICTS, 1970-1971
(MB/D)

	District I	District II	District III	District IV	Total of I-IV	District V	Total U.S.
1970							
1Q	2129	297	95	26	2547	332	2879
2Q	1443	170	65	23	1701	206	1907
3Q	1395	180	78	22	1675	225	1900
4Q	1708	233	98	26	2065	260	2325
Year	1667	220	84	24	1995	255	2250
1971							
1Q	2345	370	103	26	2844	296	3140
2Q	1646	191	73	23	1933	205	2138
3Q	1547	195	91	22	1855	215	2070
4Q	1991	286	114	26	2417	243	2660
Year	1880	261	95	24	2260	240	2500

Levels of demand vary with the level of economic activities. Unusually mild winter weather would reduce sales of fuel oils for space heating; conversely, hot summer weather would increase demand for electric power generation. Also, the fact that we have experienced an abnormally large surge in demand during the past 18 months injects an added degree of uncertainty.

The base case was selected as being the most probable. The lowest projections included are shown as the "low projection." The "high projection" is based on demands during abnormally cold weather such as the coldest weather during the past decade. The range of projected demands is shown in Table 3.

Table 3. DOMESTIC DEMAND FOR RESIDUAL FUEL OIL BY QUARTERS, 1970-1971
(MB/D)

	Low Projection	Base Case	High Projection
1970			
1Q	2879	2879	2879
2Q	1907	1907	1907
3Q	1878	1900	1900
4Q	2298	2325	2370
Year	2225	2250	2261
1971			
1Q	2952	3140	3215
2Q	2009	2138	2138
3Q	1946	2070	2070
4Q	2500	2660	2710
Year	2350	2500	2533

APPRAISAL OF SUPPLIES

In appraising probable supplies of heavy fuel oil, the following basic assumptions were made:

1. Supply sources are U.S. refinery make, imports, and opening inventory.

2. U.S. refinery yields are estimated to be 7.2 percent

in the fourth quarter of 1970 and 8.0 percent in the first quarter of 1971. The latter is 0.5 percent higher than that of the first quarter of 1970 and implies conditions more favorable to the manufacture of residual fuel oil.

3. U.S. inventories are estimated to peak at 51 million barrels in the third quarters of 1970 and 1971.

4. Exports are estimated to be 45 MB/D in 1971.

5. Imports are estimated to be the volume required to balance supply with demand.

Estimates of imports required to meet demand (over the range of demands) are shown in Table 4.

Table 4. RESIDUAL FUEL OIL--IMPORTS REQUIREMENTS

	1970 (MB/D)		1971 (MB/D)	
	Third Quarter	Fourth Quarter	First Quarter	Second Quarter
Low range	1285	1420	2020	1235
Forecast	1325	1480	2208	1364
High range	1325	1525	2283	1364

For comparison, actual imports in corresponding quarters of 1969 and 1970 were as follows:

1969		1970	
1103	1348	1900	1403

If U.S. refinery-make should fail to increase 80 MB/D as estimated in Appendix C, that would add another 80 MB/D to these figures.

ADEQUACY OF SUPPLIES

Caribbean refineries are operating at about capacity, and the foreign-flag tanker fleet has little or no spare capacity. The low-range supply requirements are consistent with recent past experience and appear reasonable. However, the base case forecast for the first quarter of 1971 represents an increase of more than 15 percent over the corresponding quarter of 1970, when transportation was extremely tight. It is not apparent that

this level of imports is feasible. Estimates by PAD districts show that the prospective shortage is mainly in District I.

LOW-SULFUR RESIDUAL FUEL OIL

The Committee did not have at its disposal sufficient data on low-sulfur residual fuel oil (here defined as oil with sulfur content of less than 1 percent) to draw definite conclusions. It is apparent, however, that low-sulfur oil is in tight supply. It appears that about one MMB/D of the annual U.S. residual fuel oil demand is in areas requiring low-sulfur fuel. By year-end about one MMB/D of the imported supply will be low-sulfur, most of which will be in District I. While this suggests an approximate balance, several factors should be borne in mind:

1. The existence of various local sulfur restrictions makes the total supply system less flexible than in earlier years.

2. Desulfurization facilities now coming on stream in the Caribbean have not yet been in operation long enough to provide significant data on continuous output rates.

3. Virtually all of the District I imported low-sulfur fuel oil has been coming from African crude and recent cutbacks in production enforced by the Libyan Government reduce available supply. On the other hand, if, as suggested in section II, "Possible Supplementary Actions," significant increase in the domestic production of fuel oil comes about, the majority of it could be low-sulfur.

REFINING AND TRANSPORTATION

REFINING

In recent years the domestic refining industry has been installing equipment to increase the yield of gasoline, jet fuel and distillate heating oils while reducing residual production. The nationwide refining yield of residual from crude for the year 1970 is estimated to be 6.6 percent.

Economics and technology have influenced refiners to install coking facilities as they increase crude capacities. In the United States, production of coke from petroleum has grown from 17,000 tons per day in 1961 to over 38,000 tons per day at present. This tonnage of coke represents an equivalent of 940 MB/D of residual fuel.

Even with increased residual demand, the economics of making lighter fuels from residual via coking may deter refiners from shutting down cokers. Further, the contractual commitments of companies to their customers, including the aluminum industry, may preclude any significant shift in the direction of more residual and less coke.

Refiners have the option of converting a portion of their asphalt-producing capability to residual fuel. Generally, 0.8 of a barrel of asphalt when diluted with distillate will make 1.0 barrel of residual fuel. Asphalt production for 1970 is estimated to be 427 MB/D. In District I, asphalt demand is estimated to be 130 MB/D; in District II, 170 MB/D. However, asphalt also is in short supply, and diversion of asphalt would merely aggravate one problem to remedy another.

There are a number of refineries which, in the winter, either shut down or restrict throughput on distillation units generally used to make asphalts during the season. In the short time available for this study, it was not possible to ascertain the level of residual production that could be obtained from maximum off-season use of such facilities. That level is not thought to be of a magnitude sufficient to alter the conclusions of the study, but it may provide some incremental local relief.

Projected total refinery crude capacity for the United States as of December 31, 1970 is estimated to be 12,673 MB/CD. Crude runs through July 1970 are at about 89 percent of current capacity. In recent years, peak utilization of capacity for any calendar quarter has been about 95 percent of reported capacity. Table 5 lists by PAD district the announced increases in capacity going on stream in 1970, the anticipated capacity as of the end of 1970, the estimated crude runs at the end of 1970, and the estimated attainable excess crude capacity.

Table 5. DOMESTIC REFINERY CRUDE CAPACITY
(MB/D)

PAD District	Capacity[1] as of 1/1/70	Expansions[2] Complete by 12/31/70	Shutdowns Effective by 12/31/70	Net Capacity as of 12/31/70	Forecast Crude Run as of 12/31/70	Spare Capacity @ 95% Use Factor
I	1,467	6	0	1,473	1,296	100
II	3,416	246	99	3,563	3,207	180
III	4,928	324	0	5,252	4,674	325
IV	422	11	0	433	381	30
V	1,922	30	0	1,952	1,659	200
TOTAL	12,155	617	99	12,673	11,217	835

Sources: [1]*Oil & Gas Journal*, Vol. 68, No. 14, April 6, 1970, p. 116.

[2]*Hydrocarbon Processing*, "HPI Construction Report," June 1969, October 1969, February 1970.

TRANSPORTATION

The ability of the free-world transportation system to adapt to sudden changes in logistical patterns may well hold the key to whether anticipated petroleum demand in the United States can be satisfied in the months ahead. The Committee has, within the limitations of the time available, made an assessment of the various portions of the transportation system. Its findings are discussed in the sections which follow.

Domestic Pipelines

1. *Gulf to East Coast.* Petroleum raw materials and finished products are moved from the Texas-Louisiana Gulf Coast to the East Coast by both pipeline and tanker. No crude oil or heavy fuel oil is moved between these points in pipelines. Product pipelines (Colonial and Plantation) have been operating at capacity for some time and no additional space is available through these facilities.

2. *Interior to Texas-Louisiana Gulf Ports.* If additional demand for products is to be satisfied from domestic sources, it will first be necessary to move additional crude to refining centers. A survey of all principal pipelines indicates the existence of approximately 120 to 205 MB/D of space above anticipated shipment from interior Texas to Gulf ports in the fourth quarter of 1970 and 80 to 165 MB/D of available space in the first quarter of 1971. No specific data have been developed on available space in pipelines along the Texas and Louisiana coasts where some limited spare capability to move crude produced in these areas to ports is known to exist.

Several factors influence whether this available space might actually be used. First, the availability of crude for movement. Availability of additional production in interior Texas above the level forecast for September 1970 as discussed in section I indicates total pipeline space will probably be the limiting factor. It must be emphasized, however, that time has not permitted the Committee to make detailed field-by-field comparisons of productive capability with trunkline capacities and that some localized restrictions are to be expected. In that regard field gathering restrictions of up to 75 MB/D were taken into consideration in developing the foregoing pipeline space estimates. Second, the pipeline capacity availability would require a rearrangement of current operations on one major pipeline. The Sun pipeline currently moves crude northward from the Texas Gulf Coast to East Texas and thence north through other pipelines. The foregoing estimates assume that the Sun line would be reversed to move crude south out of East Texas and that the northward shipments it now supports would be replaced by

East or West Texas crude. Alternatively, this northward movement, which terminates in the upper Midwest, could be replaced with additional Canadian imports. While reversing this pipeline is physically possible, the Committee is in no position to comment on the commercial considerations involved in effecting such a change. Finally, the ability of the industry to provide sufficient crude oil to fill the available space will be dependent on the capability of field production facilities to meet requirements for handling of produced water and gas occasioned by increased oil production, as discussed elsewhere in this report.

3. *Louisiana Coast, Midcontinent and Canada to Upper Midwest.* An analysis of the upper Midwest indicates the following relationships (Table 6) for the average year 1971.

Table 6. UPPER MIDWEST: REFINERY CAPACITY AND CRUDE RUNS

	Refinery Capacity (MB/D)	Crude Runs (MB/D)
PAD District II	3650	3285
PAD District IV	430	400
West Pa. and N.Y.	100	100
	4180	3785

Operating statistics indicate that refining facilities in District II have historically been operated in a range between 86 percent and 98 percent of capacity. Actual crude runs have shown very little seasonal variation; during 1969 monthly refinery runs over the year were within ±4 percent of the yearly averages. With recent increases in refinery capacity reaching about 3,650 MB/D, forecast operating levels of 90 percent of capacity in 1970 and 1971 seem reasonable. Such levels would require 3,285 MB/D of crude runs in District II, an increase of 9 percent over 1969 or 4 percent over first half of 1970.

Refinery runs of 3,785 MB/D would result for the entire Midwest and Rocky Mountain area. Expected local crude production is 1,800 MB/D and pipeline capacity is available to move it to refineries. Allowed Canadian imports are 395 MB/D. An additional 1,570 MB/D of other domestic crude would be required to balance refinery runs. Combined total pipeline capacity into the Midwest from other domestic locations is estimated at 1,750 MB/D; however, this pipeline capacity is not all fully supported with crude production. A survey of pipeline companies indicates space is available in several of the pipelines serving the area above expected operating levels for the coming winter. Analyzing spare production and pipeline capacity estimates suggests, however,

that additional available domestic crude above expected levels would be about 50 MB/D.

The 395 MB/D of Canadian imports included in an earlier table is the current allowed level. During early 1970 actual imports rates were at a substantially higher level. It has been estimated that, should the need arise, pipeline capacity would be available to handle as much as 200 MB/D of additional Canadian imports above the allowed level of 395 MB/D.

As the foregoing indicates, Midwest demand is satisfied by local refinery runs, Canadian product imports and product shipments from the Midcontinent and Gulf Coast by pipeline and up-river barge traffic. Time has not permitted making a material balance for the area.

Domestic Flag Tankers

Energy supply and demand forecast indicates a balanced condition will exist in District V; accordingly, the following discussion focuses on Districts I-IV.

The total U.S.-flag tanker fleet represents only about 5 percent of the free-world tanker fleet--less than 500 T-2 equivalents out of a 10,000 T-2 equivalent fleet.

Table 7 presents a tonnage balance of the domestic fleet by quarters through 1971. Following is a line-by-line discussion of this table:

"Total Fleet" includes all U.S.-flag vessels with coastwise trading privileges and was derived from an actual ship count. New building completions and scrapping have been included.

"MSTS" vessels trade throughout the world, are generally on long-term charter, and are not considered available for commercial trade.

"West Coast and Intercoastal" vessels have been deducted because they are not pertinent to East Coast situations. The potential of shifting vessels from West to East is of negligible practical significance in the context of the current problem.

"Trading Overseas" derives from an actual ship count taken in August 1970. The figure is carried through the balance for analytical purposes only. In normal practice the domestic fleet is balanced against U.S. needs by taking vessels in or out of this type

Table 7. U.S.-FLAG TANKER BALANCE
(T-2 Equivalents)

	1970	1971			
	Fourth Quarter	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Total Fleet	455	462	470	474	474
MSTS	80	80	80	80	80
West Coast and Intercoastal	68	70	70	70	70
Trading Overseas (Incl. ore/grain)	58	58	58	58	58
Net Available for Gulf-East Coast[1]	249	254	262	266	266
Estimated Requirements - Gulf-East Coast	248	264	244	233	250
Long/(Short)	1	(10)	18	33	16
Potentially Available from Trading Offshore	20	40	40	40	40

[1] Does not allow for normal laid-up and out-of-service (2 to 4 percent).

of service, which includes ore and grain trade. The number of vessels which, because of their current location and charter terms, could be returned to U.S. coastwise trade ranges from an estimated 20 T-2 equivalents through the fourth quarter of 1970 to a maximum of 40. As these ships become available, however, they will return to foreign out-charter unless fixed for coastal trade, emphasizing the importance of industry anticipating whether or not they will be required in coastwise trade.

"Net Available" is the difference between "Total Fleet" and the total available. The basic capacity of the available Gulf-East Coast fleet (250 T-2's) is approximately 2 MMB/D.

"Estimated Requirements" are based on an informal survey of industry.

"Long/(Short)" is the resulting balance before any adjustment.

The data suggest that some additional tonnage will be brought into domestic service to meet normal requirements in the first quarter of 1971. Present plans appear to include some above-normal crude movements to offset anticipated reduced imports; however, the exact amount of these shifts cannot be ascertained. The U.S.-flag tanker fleet could be further expanded to move approximately 150 to 250 MB/D of additional crude or product from the Gulf to the East Coast over and above that currently anticipated, by chartering for coastwise service those ships that come off overseas charters. Ships which do become available, if not chartered into coastal service, will return to overseas trade; accordingly, if added movements to cover shortfalls in heavy fuel oil or distillate are to be made, arrangements for tankers will have to anticipate such a shift. Much of the additional movements from District III to District I will be made in the form of heavy fuel oil and this may require coiling of additional tankers.

World Tanker Fleet

Table 8 reflects the disposition of the free-world tanker fleet, excluding U.S.-flag vessels, as of June 30, 1970, and probable shifts during the pre-winter period. This assessment presumes that the unusually high tanker rates in the range of Worldscale 250 (as compared to long-term minimum rates of Worldscale 50) and above will prevail over this period, thus providing the incentive for independent tanker owners to place more of their vessels in oil service.

Table 8. FREE-WORLD TANKER FLEET

		T-2 Equivalents	
		7/1/70	Potential Change by 11/1/70
Total Fleet 7/1/70		9530	
Not in Oil			
Ore/Coal	420		150
Grain	65		25
Specialties	165		25
Out of Service	605	(1255)	155
Effective Oil Fleet-7/1		8275	
New Building to 11/1		380	
Return from Other Service		355	
Effective Oil Fleet-11/1		9010	

Of the total world fleet of 9,530 T-2 equivalents, 1,255 were not in active oil service on July 1, 1970. By November 1, high tanker rates could be expected to attract 355 of these vessels back to oil trade; after taking into account new buildings, the resulting oil fleet would be 9,010 T-2's.

Events in the Eastern Hemisphere have substantially strained the world transportation system over the past few months. The closing of Tapline in May 1970 imposed an immediate increased demand on the world tanker fleet of 250 T-2's. Similarly, the cutbacks in Libyan production have increased tanker requirements approximately 50 T-2's for each 100 MB/D reduction in production, or over 300 T-2's at this writing. Normal growth in demand since summer would require an addition of over 400 T-2's. Accordingly, these events have used up more than the available flexibility in the worldwide tanker fleet. The peak winter requirement could be 10,000 T-2's or higher. This implies a tanker shortfall and raises the possibility that Europe might be forced to rely on emergency inventories to meet its requirements. The physical repair and opening of Tapline could be achieved with relative ease if the political objections could be overcome; this would ease somewhat the tanker situation. The single most significant improvement would come from opening the Suez Canal. This would require 3 or 4 months once approval were obtained and would effectively increase the world fleet by almost 10 percent.

Significant spare crude oil producing capacity exists in the world today. However, as discussed elsewhere, production of petroleum raw materials is, for all practical purposes, at

capacity in all areas of the world except North America and the Persian Gulf area of the Middle East.

Potential fuel oil supply problems in the United States involve refining capacity and marine transportation. The degree to which District III can supply sufficient fuel oils to the East Coast this winter, excluding waiver of the Jones Act, hinges on availability of U.S.-flag tankers. While it appears probable that enough coiled tonnage exists for residual fuel oil movements, this is not certain. In addition, any shortfall in presently expected offshore imports of crude or residual would aggravate the U.S.-flag tanker shortage between the U.S. Gulf and East Coast.

Ship requirements from the Persian Gulf to New York are almost 5 times the requirement from the U.S. Gulf to New York. Any shifts in supply patterns which substitute the U.S. Gulf for the Persian Gulf will thus tend to alleviate world transportation problems.

POSSIBLE SUPPLEMENTARY ACTIONS

INCREASE U.S. REFINERY RUNS, SHIFT YIELDS, DEFER SHUTDOWNS

As outlined in section II, "Refining and Transportation," it is estimated that U.S. refinery crude runs could be increased by 835 MB/D. This used 95 percent of reported capacity as an attainable capacity and 90 percent as estimated planned runs. With these assumptions, the capability for crude increases by district is shown in Table 9:

Table 9. CAPABILITY FOR INCREASED REFINERY CRUDE RUNS

District I	-	100 MB/D
II	-	180 MB/D
III	-	325 MB/D
IV	-	30 MB/D
V	-	200 MB/D

In considering the use of this crude, normal product yields by district would result as shown in Table 10 (page 34).

By adjustment of refinery yields some part of the indicated volume of potential increased crude runs could be processed with virtually all of it recoverable as residual. The potential for residual is affected by the adequacy of blending and shipping facilities and marketing outlets, and by the economic circumstances of individual refiners.

These programs for increasing residual require some lead time. Individual refineries may be limited by plant considerations other than primary stilling capacity. The time frame of this study prevented detailed examination of these constraints, but it is our opinion that with prompt action limitations in refinery systems can be overcome before this winter.

The present distribution systems can be utilized to move the additional residual to consumers using liquid fuels. Equipment and facility changes may be required for customers changing from solid to liquid fuel. The additional residual volume in some locations may press existing barge, motor, and rail transport capabilities.

In District II, the need for additional residual is probably concentrated in 6 states--Wisconsin, Michigan, Illinois, Indiana, Ohio and Missouri. It is estimated that the additional crude run for residual production would be 115 MB/D rather than the 180 MB/D reported for the entire district.

Table 10. NORMAL PRODUCT YIELDS BY PAD DISTRICTS

	District I		District II		District III		District IV		District V	
	%	MB/D	%	MB/D	%	MB/D	%	MB/D	%	MB/D
Gasoline	52.8	52.8	55.8	97.7	51.5	167.4	51.9	15.6	46.6	93.2
Light Distillate	6.8	6.8	8.1	14.2	14.8	48.1	7.5	2.3	14.8	79.6
Distillate Fuel Oil	28.6	28.6	21.5	37.6	23.2	75.4	24.4	7.3	12.7	25.4
Road Asphalt	6.2	6.2	4.9	8.6	2.0	6.5	7.1	2.1	3.4	6.8
Coke	2.8	2.8	2.7	4.7	2.3	7.5	2.1	0.6	3.5	7.0
Residual	8.8	8.8	5.2	9.1	3.5	11.4	7.2	2.2	16.9	33.8

In Districts I and III, some degree of conservatism to cover uncertainty would be in order. Applying a 70-percent factor would give 70 MB/D in District I and 230 MB/D in District III.

In addition to the additional heating oils that can be made from increased crude running, some change in refinery yields can be made. Analysis of the gasoline-distillate shift potential in a typical refinery that cokes all of its residual indicates that the total heating distillate yield could vary from a minimum of 15 percent to a maximum of 40 percent of the refinery input. This would take full advantage of flexibility in cutting end points and cracked naphthas, reformer feed, and virgin distillate, and in varying cat-cracker conversion level. The range is much less for refineries that make residual fuel oil, because of seasonal shift from asphalt and consequent use of distillate for residual fuel blending.

Typically, refiners in the northern states minimize shutdowns during the winter months. Faced with the pressures for running crude up to 95 percent of reported maximum capacity, refiners in all sectors would operate to defer shutdowns until the peak demand period was past.

INCREASE IMPORTS OF CANADIAN CRUDE

One possibility for making additional residual fuel oil available in the upper Midwest of the United States is to relax or remove the quotas on Canadian crude oil as necessary to meet the demands of refineries in District II. During February and March of 1970, just before restrictions were placed on the importation of Canadian crude, the movements of crude oil and unfinished products into Districts I-IV averaged about 580 MB/D. This is 185 MB/D in excess of the presently permitted rate of importation into this area. There is available in District II spare refining capacity of 115 MB/D. Therefore, it should be possible not only to utilize available U.S. crude, but also to count on moving additional Canadian crude into this area, and, by shifting yield patterns, to produce an additional 115 MB/D of low-sulfur fuel oil.

BURN UNREFINED CRUDE

Technical Factors

Burning of unrefined crude would require consideration of the following factors:

1. Adequate crude would have to be available from U.S. sources or the Oil Import Administration would have to permit additional crude oil imports for direct burning purposes.

2. Sufficient transportation capacity would be needed to move crude oil from refineries to which it is normally delivered into areas where it is to be burned.

3. Conversion capability would probably be limited to large utility systems with staff possessing sophisticated fuel-handling skills.

4. Conversions would have to be completed and in operation within the next 6 months in order to have any impact on the fuel supply situation through the coming winter.

5. Relaxation of local fire safety code restrictions may be necessary.

An examination of the situation indicates that:

1. Utilities not now capable of burning residual fuel oil would be forced to construct floating-roof storage tanks for crude oil and to install explosionproof pumping and other facilities. Estimated completion time for such new facilities is a minimum of 12 months. Crude oil, therefore, cannot be considered as a practical alternative at such generating stations through the third quarter of 1971.

2. Generating stations now capable of burning residual fuel do have fixed-roof storage tanks and oil pumping systems already on site. Under normal conditions, utilities evaluating crude oil would prefer to convert to floating-roof tank storage and install different type pumps to handle crude oil. The change-over could require as much as 12 months. Under emergency fuel supply conditions, however, it may be possible to modify existing oil-storage and pumping facilities in 3 to 4 months. To have any impact on the fuel situation this coming winter, such emergency conversion programs must be begun within the next 2 months. Very few utility systems are seriously considering the move at the moment, so the impact of crude oil as an alternative to residual fuel is likely to be quite limited during the period under study.

Generally speaking, existing residual-burning systems cannot safely store and deliver to burner tips an unstabilized crude because of the low flash point. A 1967 report[4] of the Schubu Electric Power Co., Nagoya, Japan, outlines the precautions taken to burn crude oil in large boilers. In addition to floating-roof tankage, the report mentions the use of double

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[4]"Crude Oil Fuels to 375 Megawatt Units in Japan," *Electrical World,* December 25, 1967.

mechanical seals in pumps, explosionproof electrical equipment, either all welded pipelines or with grounded flanges, outdoor placement of pumps, and combustible-gas detectors as some of the features found to be necessary. At least one U.S. public utility is known to have experimented with the burning of crude, with generally similar results.

The alternate solution for major users to burning unrefined crude is having the crude stabilized at about 150°F flash point. This would eliminate the need for floating-roof tankage and reduce the amount of change required in the preheat and pumping systems. At present, only refiners with crude distillation capacity are clearly in a position to do this. The installation of additional capacity would require heaters and towers and could not be accomplished before the 1971-1972 heating season.

Refiners who processed more crude oil would go further than simple flashing. They would process crude to produce finished residual fuel oil.

3. Certain utilities now using distillate in small gas turbine generators are also investigating the possibility of switching these units to crude oil if necessary. Investigations indicate that such changes are feasible over the coming winter period, but the volume of distillate being used in small gas-turbine generators is not significant in relation to the total national energy problem.

Outlook

On balance, direct consumption of unrefined crude oil seems to offer very limited possibilities as an alternate source of energy through the third quarter of 1971.

Consumers who convert to burn crude will have to justify expenditures in terms of long-range expectations or the value of flexibility. Furthermore, burning of crude is fundamentally a less efficient use of resources.

RELAX OR DELAY SULFUR RESTRICTIONS FOR FUELS

Many city and county governments have recently passed laws limiting the sulfur content of any fuel burned in particular areas. While these laws are matters of local rather than Federal control, they can affect the availability of residual fuel oil in the areas concerned. The Committee, therefore, believed it appropriate to consider what effect the relaxation of such local laws might have.

For the United States as a whole, and for District I in particular, the critical factors affecting low-sulfur fuel oil

are foreign residual fuel oil supply and tankers to move it. Therefore, relaxation of local sulfur restrictions does not appear to offer much relief to any overall fuel oil shortage that may develop.

The Committee did not have adequate time to obtain and analyze detailed information on low-sulfur fuel requirements and supply. Nevertheless, it generally agreed that in many local areas there is a critical supply problem. Relaxation of local sulfur restrictions would gain flexibility. Some communities may need to delay the effective dates of restrictions to avert local shortages of low-sulfur fuel. In the case of coal, delays in imposing sulfur limitations until some of the more promising air pollution control devices are perfected may avoid forcing industrial or utility plants to shift from coal to oil.

OBTAIN WAIVER UNDER THE JONES ACT

The Merchant Marine Act of 1920, more commonly referred to as the Jones Act, precludes non-U.S. ships from trading between U.S. ports. Authority to waive this restriction in the interest of national security is vested in the Secretary of the Treasury.

Both foreign-flag tankers and U.S.-flag tankers are in extremely short supply and if the current situation continues to prevail there is little prospect of easing in the near future. Since some observers have referred to the possible waiver of Jones Act restrictions as a temporary expedient to permit use of foreign-flag tankers in U.S. coastal service, the Committee considered this possibility and concluded that, at most, some apparent flexibility might result, but that such a waiver would offer little if any prospect of meaningful relief.

REMOVE IMPORT CONTROLS ON RESIDUAL TO PAD DISTRICTS II-IV

Oil import regulations permit marketers of residual fuel oil in District I to import enough residual fuel oil to replace any sales they make, the only restriction being that it must be used as a fuel and not processed in a refinery. In contrast, in Districts II-IV, only those companies that imported residual fuel oil in 1957 may import it, with the volume of their imports limited to the volume they imported in 1957. Therefore, the Committee analyzed the possible effect on the supply and distribution of residual fuel oil if District I rules were to be applied.

The most serious problem with residual fuel oil supply adequacy is in District I. Removing import controls in Districts II-IV will not increase the supply in District I and would probably reduce it. Foreign residual fuel oil supplies

and foreign-flag tankers to transport foreign residual fuel oil are both limited. There is no reason to expect that removing import controls in Districts II-IV will increase total U.S. imports. If total U.S. imports remain constant and more residual fuel oil is imported into District II, these supplies probably will be diverted from District I, and the principal problem will be aggravated.

GRANT BONUS CRUDE QUOTAS FOR MAKING LOW-SULFUR RESIDUAL FUEL OIL IN PAD DISTRICTS I-IV

Section 3(e) of "The Proclamation of the President on Oil Import Controls" authorizes the Secretary of the Interior to grant crude oil quotas to persons who make low-sulfur residual fuel oil. Section 11(a) of *Oil Import Regulation 1* provides one barrel of crude oil quota to a District V refiner who makes one barrel of residual fuel oil with sulfur content of 0.5 percent or less and delivers it to a customer who needs it to comply with a local law. There is no such provision for Districts I-IV. At the present time the world petroleum supply situation has depressed the value of import quotas so that extending a District V type of provision to Districts I-IV would offer little incentive to the refiner. Accordingly, to be effective, such an extension of the District V program would also have to provide that the import quota awarded would be valid for more than the normal one-year term in order for the recipient to have some opportunity to use them profitably. This type of program would be extremely complex and would present major problems in administration. Each refiner would react differently to such a change in the program and some refiners might receive windfall quota without increasing available residual supply. Any incentive system would also have to be carefully examined to insure that it neither reduced the supply of other products (for example, asphalt), nor unduly distorted the normal economics of refining.

USE OF ALTERNATE FUELS

Natural Gas

The interstate natural gas pipelines cannot be relied upon to relieve a deficiency in the supply of other fuels during the remainder of 1970 and the first three quarters of 1971. Indeed, this segment of the national energy industry is currently experiencing the initial phases of a gas supply shortage which will, even according to the most optimistic appraisals, continue for several years, probably for the foreseeable future. This year numerous public announcements have been made by interstate pipeline companies that no new customers can be accommodated and that added sales to existing customers must be limited.

In a report issued in September of 1969 by the Federal Power Commission's Bureau of Natural Gas, *A Staff Report on Natural Gas Supply and Demand*, data summarized from American Gas Association sources clearly indicate the declining supply position of this industry as shown by the decline of the Reserve-to-Production ratio for the 48 contiguous United States from 18.2 in 1964 to 14.6 in 1968. Additional information from the American Gas Association indicates the R/P ratio for 1969 to be approximately 13.0, whereas a ratio of 13.7 had been projected. A ratio of 12.8 projected for 1970 compared to the actual of 13.0 for 1969 signals almost a one-year acceleration of the decline in supply in just one year of elapsed time. In 1968, the first year in which production exceeded reserves added, the U.S. natural gas production was 19.3 trillion cubic feet and the reserves added were only 12.0 trillion. The situation further worsened in 1969, when production increased to 20.7 trillion and reserves added declined to 8.5 trillion.

The Federal Power Commission's report concludes that the natural gas supply-demand relationship supports the need for an immediate major program to speed up the exploration and development of the domestic natural gas resource base. The report further recognizes that even with a greatly accelerated exploration program no single producing area has sufficient potential for development of new reserves required to halt the decline in the R/P ratio.

Supplemental sources such as gasification of coal, liquefied natural gas imports, and Alaskan and Canadian imports are all mentioned by the Commission report as expected to play a future role in the gas supply picture. However, except for certain possible increased imports from Canada, no significant immediate support from these areas can be expected during the coming year. Significant results will lag by several years behind even the most emphatic efforts to support the weakening supply of the natural gas industry. Of course, localized and intermittent exceptions to the general situation are always possible but are impossible to predict and will not, in any event, be of significance in alleviating the overall supply position.

In addition, a salient fact concerning the natural gas pipelines themselves should be recognized. These transmission systems usually operate at virtually 100 percent of their capability during the winter heating season. Many of the gas pipeline systems include storage facilities near their terminus which are used to supplement pipeline capacity in meeting the heavy winter loads. It is normal practice to begin replacing the exhausted storage inventories as soon as the winter demands abate. This means that a surplus capacity within the overall

system cannot be restored until the third quarter of 1971, too late to be of primary interest during the period to which this report is addressed.

Coal

1. Demand for bituminous coal during the calendar year will be 580 million tons, based upon the most recent projection by the National Coal Association's Economics Committee, and 603 million tons during the calendar year 1971. (The N.C.A. forecast was adjusted slightly in order to reflect more recent developments.) Production of bituminous for the period January to July 1970 was 328 million tons, according to the U.S. Bureau of Mines, or 6 percent over the comparable period of 1969. During the first 7 months of 1970 average weekly production was about 11.3 million tons, compared to 10.7 million in the same period of 1969. Assuming a continuation of the same weekly rate for the remainder of the year, production in 1970 will be about 571 million tons, or about 10 million tons below projected demand.

Coal inventories of certain consumers are at critically low levels, as in the much-publicized problem of T.V.A. However, although stockpiles are below normal operating levels throughout the industry, the most recent monthly fuel consumption and fuel inventory reports filed by electric utilities with the Federal Power Commission and recent surveys of electric utilities stocks by the Office of Emergency Preparedness indicate that the critically low level of coal inventories at T.V.A. and certain other utility plants is not the rule.

Problems dealing with brownouts, voltage reductions, load shedding, and service curtailments have not been primarily attributable to fuel shortages. Equipment failures and surges in peak demand have been the major factors, particularly in the East. The current tight supply of bituminous coal is due to four major factors, and unless solutions are forthcoming soon they will continue to adversely affect consumers and suppliers of coal and other energy sources. They are listed below, though not necessarily in order of importance since their individual impact varies throughout the country.

a. A shortage of coal transportation, especially railroad cars.

For various reasons, the coal-carrying capacity of the American railroad industry has not kept pace with demand for coal.

b. Unauthorized work stoppages.

During 1969, as much as 20 million tons of bituminous coal were lost because of wildcat strikes in the industry. The situation is not much improved in 1970.

c. The 1969 Federal Coal Mine Health and Safety Act.

d. Air pollution regulations and fuel quality standards.

Because of the above factors, it is not expected that the coal supply can be significantly increased in the next few months, even though there are many mines that could be produced at higher rates. Hence, relaxation of air quality control requirements, while possibly affording some flexibility locally, would have little overall favorable impact this winter on easing the problem of shortage of coal. Nevertheless, some delays in imposing sulfur limitations until stack-gas desulfurization is practical may avoid forcing industrial or utility plants to shift from coal to oil.

2. A program for encouraging development of bituminous coal capacity will have a minimal impact, if any, on increased supplies of bituminous coal which could alleviate energy shortages next winter. A period of from 3 to 5 years is required to develop a large underground coal mine, and from 2 to 3 years to develop a large surface operation.

A tabulation in December 1969, of the construction of new mines and major expansions of existing mines in the United States for the period 1969 to 1973 (as published in McGraw-Hill's *Keystone Coal Buyers Manual*), showed that the bituminous industry has proposed or under construction new capacity in 63 mines amounting to about 140 million tons. This is equivalent to 25 percent of the total bituminous coal production in 1969. This indicates that, if the program is carried out, the coal supply situation should be eased in the long term.

It is estimated that 100 MB/D of the current residual fuel demand occurs at electric generating plants that had been using coal. If the coal-handling facilities at these plants have not been dismantled and are still in good repair, they could be converted to coal in not more than 6 to 8 weeks under emergency conditions. However, the projected supply of coal, as discussed above, will not permit such a reconversion in fuel supply, even if the coal-handling equipment remains at the plants and is in usable condition.

3. An embargo on American bituminous coal exports is being advanced widely as a major solution to indigenous coal supply problems. This approach may offer temporary relief in some areas; however, there are severely limiting technical and economic factors.

There has not been a sudden increase in coal exports that has greatly affected domestic coal supply. Between 1964 and 1969 annual bituminous coal production in the United States increased 69 million tons, or 14 percent. During this same period annual overseas exports increased 5.6 million tons, or 8 percent of the increase in total production over this 5-year period. In both 1964 and 1969, overseas exports accounted for only 7 percent of the total bituminous output.

Five years ago, the Atomic Energy Commission, certain electric utilities, and electric equipment manufacturers were highly optimistic as to the possibilities for utilizing nuclear power as the principal utility fuel. The coal industry reacted by committing production from existing and new mines for the life of the reserves to U.S. and Canadian utility and steel companies, and overseas steel producers. Within the past several years many coal mines were built specifically to serve overseas customers. The coal industry, therefore, is faced with honoring these commitments. Furthermore, coal exports have been encouraged for their contribution to the U.S. balance of payments. Currently, overseas exports contribute annually almost 0.75 billion dollars to this country's trade balance.

Certain technical constraints also exist. In 1969 about 98 percent of overseas exports were metallurgical grade and about 40 percent were low-volatile coal. Since nearly all exported coal is of metallurgical grade, it is, by definition, also low in sulfur. A report prepared for and published by the National Coal Policy Conference points out that the problems involved in the use of low-sulfur coal in existing electric power plants are significant.

Use of such coal could cause higher costs over and above the higher cost of the low-sulfur coal itself, and impair the reliability of electric service. Most large utility and industrial boiler furnaces are not designed to burn low-volatile coal. Therefore, problems associated with ignition loss would occur, with resultant erratic combustion and the hazard of severe explosions, which would damage not only the furnace but also the power plant.

Atomic Energy

Nuclear power plants have been plagued by construction delays, court suits, and other licensing delays. Original plans had anticipated 12,600 megawatts of nuclear generating capacity on the line by mid-winter of 1970. At full operation they would have contributed the energy equivalent of nearly 490 MB/D of oil toward the generation of electric power. We now estimate that only the nuclear contribution shown in Table 11 can be considered definite for the period in question.

Table 11. NUCLEAR POWER PLANTS - ENERGY CONTRIBUTION
(4Q 1970 - 1Q 1971)

PAD District	Plants	Megawatts Capacity	Oil Equivalent (MB/D)
I	9	4,149	160
II	4	1,144	45
III	-	-	-
IV	-	-	-
V	2	480	20
Total	15	5,773	225

In addition, three other plants in District II are ready to go into operation but face court action and licensing problems that make them doubtful starters at least through mid-winter. If these conditions could be cleared up they could provide the energy equivalent of 60 MB/D of oil to the Midwest power pool.

Other than the plants mentioned, there is no possibility that nuclear energy will provide any help toward solving an energy shortage during the period through the third quarter of 1971.

III. DISTILLATE FUEL OIL

DEMAND

HISTORIC DEMAND

Distillate fuel oil is defined as Nos. 1, 2, and 4 heating oils, diesel oil, and industrial distillates. The demand for this product is influenced by normal growth, by the availability of competing fuels (particularly coal and natural gas), and by the severity of the weather in any given heating season. About 52.4 percent of distillate is currently being consumed in District I (East Coast), and another 29.4 percent is consumed in District II (Midcontinent).

During the past 5 years (1965 through 1969), the average annual growth rate for distillate demand has been 3.8 percent. In 1969 demand for distillate in the United States reached a level of 2,470 MB/D, an increase of 3.1 percent over 1968. During the first and second quarters of 1970, a marked demand increase has occurred in Districts I and II. This rise in demand is attributable to colder than normal weather, to the limited supplies of natural gas and coal which are available, and to the use of No. 2 fuel by industrial and utility users for peak-shaving purposes.

Tables C-5 and C-6 in Appendix C show the distribution of U.S. distillate demand by districts, 1968 through 1970, and the estimated figures, Third Quarter 1970 through 1971. Table C-7 illustrates the estimated supply and demand balance for 1970-1971, and Table C-8 demonstrates the effect of weather on distillate demand.

DEMAND PROJECTIONS

Distillate demands projected as described in Section I are shown in Table 12.

Table 12. DOMESTIC DEMAND FOR DISTILLATE FUEL BY PAD DISTRICT
(MB/D)

	District I	District II	District III	District IV	Total of I-IV	District V	Total U.S.
1970							
1Q	2090	998	146	69	3303	250	3553
2Q	996	622	178	72	1868	215	2083
3Q	767	530	180	68	1545	207	1752
4Q	1515	860	164	70	2609	247	2856
Year	1342	752	167	70	2331	230	2561
1971							
1Q	2096	1002	170	70	3338	255	3593
2Q	1040	652	140	73	1905	218	2123
3Q	802	550	180	69	1601	211	1812
4Q	1580	900	165	71	2716	252	2968
Year	1380	775	164	71	2390	234	2624

For the full year 1970 domestic demand for distillate fuel oil is expected to reach a level of 2,561 MB/D, an increase of 91 MB/D or 3.7 percent over 1969. In 1971 a further increase of 2.5 percent is projected in U.S. demand, with Districts I and II increasing 2.8 percent and 3.2 percent, respectively.

In 1969, 80.6 percent of U.S. demand for distillate occurred in Districts I and II. In 1970 this ratio increased to 81.7 percent and in 1971 it is expected to increase further to 82.2 percent.

ESTIMATED EFFECT OF COLDER WEATHER

The chief factor which might increase demand for distillate fuel is the weather. The coldest weather in the past 10 years occurred in the 1962-1963 heating season, when average degree days exceeded the normal by 5.4 percent. If that severe a winter were to recur, an additional 110 MB/D and 170 MB/D of distillate would be consumed during the fourth quarter of 1970 and the first quarter of 1971, respectively. On an area basis we would expect 63 percent of this increase to be distributed to District I and 37 percent to District II.

SUPPLY

APPRAISAL OF SUPPLIES

In appraising probable supplies of distillate the following basic assumptions were made:

1. Refinery yields will follow the normal seasonal patterns of recent years.

2. Stocks will follow their normal seasonal pattern of recent years.

3. U.S. refinery make will supply all requirements in excess of imports.

Total U.S. distillate supply, including No. 2 fuel oil, diesel oil and No. 4 fuel oil, was 2,466 MB/D in 1969 and was in balance with demand. Total supplies of 2,585 MB/D in 1970 and 2,617 MB/D in 1971 will be required to balance demand. The maximum supply required under normal weather conditions is in the first quarter of 1971 and would be 2,840 MB/D.

The maximum demand in the first quarter of 1971, assuming weather as cold as the coldest of the past decade, would be 3,010 MB/D.

ADEQUACY OF SUPPLIES

For the 1970-1971 heating season, if U.S. distillate supplies from domestic refineries and imports follow trends of the past 2 years, normal demands should be met without any extraordinary measures. If the 1970-1971 heating season should be very cold (comparable to the 1962-1963 season), supplies would be tight, but a shift in yield pattern to 24 percent and some stock drawdown over normal would provide adequate supplies. By comparison, normal yields have averaged about 22 percent year-round and were 23.5 percent in the first quarter of 1970.

No account has been taken of the possibility that all the installed, distillate-fired, peak-shaving capacity would be used on a regular-service basis. This amounts to about 500 MB/D. Such an unusual occurrence would create a serious distillate supply problem.

APPENDIXES

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

COPY

August 12, 1970

Dear Mr. Brockett:

Since the interruptions in world oil flows beginning in May of this year, the Department of the Interior has been closely monitoring the United States energy market for fuel oils. There has been no clear indication that supplies of residual and other fuel oils, from either domestic refineries or abroad, can meet rising market requirements foreseen.

Part of our concern arises from an apparent failure of inventories to rise seasonally as they have in the past. Adding to our concern is the increasing frequency with which we are being contacted by consumers who claim to be unable to purchase the quantities and qualities of fuel oil which they need.

A number of unusual circumstances, including dislocations of world petroleum flows, shortages of alternative fuels, delays in nuclear power plant construction, and the requirement of environmental improvement, have contributed to the current tight supply situation in residual and other fuel oil. These circumstances make it difficult to predict levels of either demand or supply for the forthcoming fall and winter. Nonetheless, an early and valid appraisal of these prospects is imperative in view of the lead times which will be needed for whatever corrective or ameliorative actions the situation may require.

I therefore request the National Petroleum Council to provide, at the earliest possible date, quarterly estimates of distillate and residual fuel oil requirements for PAD Districts I, II-IV, and District V, through June 30, 1971, under an assumption of normal weather conditions, and also with estimates of demand variations which may arise under various conditions of colder than normal weather.

I request an appraisal of supplies and production which will probably be available to meet these demands in such districts, giving full consideration to time lag, physical, environmental, and general economic constraints which are likely to limit such supplies and production. Further, a detailed look at crude supplies on the Gulf Coast and the ability of that area to respond in crude production is needed.

If projected supplies and crude production appear inadequate for any reason to meet demands in full under any weather circumstances, what alternative courses are available to the Government to bring supply and demand into balance with a minimum disruption of the United States economy?

In addition, I would like an appraisal of the adequacy of overall petroleum supplies in the upper Mid West, under assumptions of normal and various degrees of colder than normal weather, using various assumptions as to levels of supply of domestic petroleum, Canadian and other imports into that area, and the ability of domestic production in the Gulf Coast and elsewhere to respond to the foreseeable demand with the present transportation facilities.

There are, you realize, definite legal limitations on the scope of the Council's activities, and needless to say, the Council is not being asked either by inference or directly, to devise or implement a program of concerted action within the industry. Neither am I asking you to develop a policy for the Government. I request only your views as to general alternatives available to the Government and possible actions which may be taken individually by various segments of the industry to alleviate the situation as you view it.

Your careful consideration of these questions will be appreciated. We request that your study be submitted on or before September 1, 1970.

Sincerely yours,

/S/ HOLLIS M. DOLE

Assistant Secretary of the Interior

Mr. E. D. Brockett
Chairman
National Petroleum Council
1625 K Street, N. W.
Washington, D. C. 20006

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American Oil Company

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Assistant Manager
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Manager, Pipeline Planning
Shell Oil Company

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Marine Transportation Department
Mobil Oil Corporation

SECRETARY

Vincent M. Brown
Executive Director
National Petroleum Council

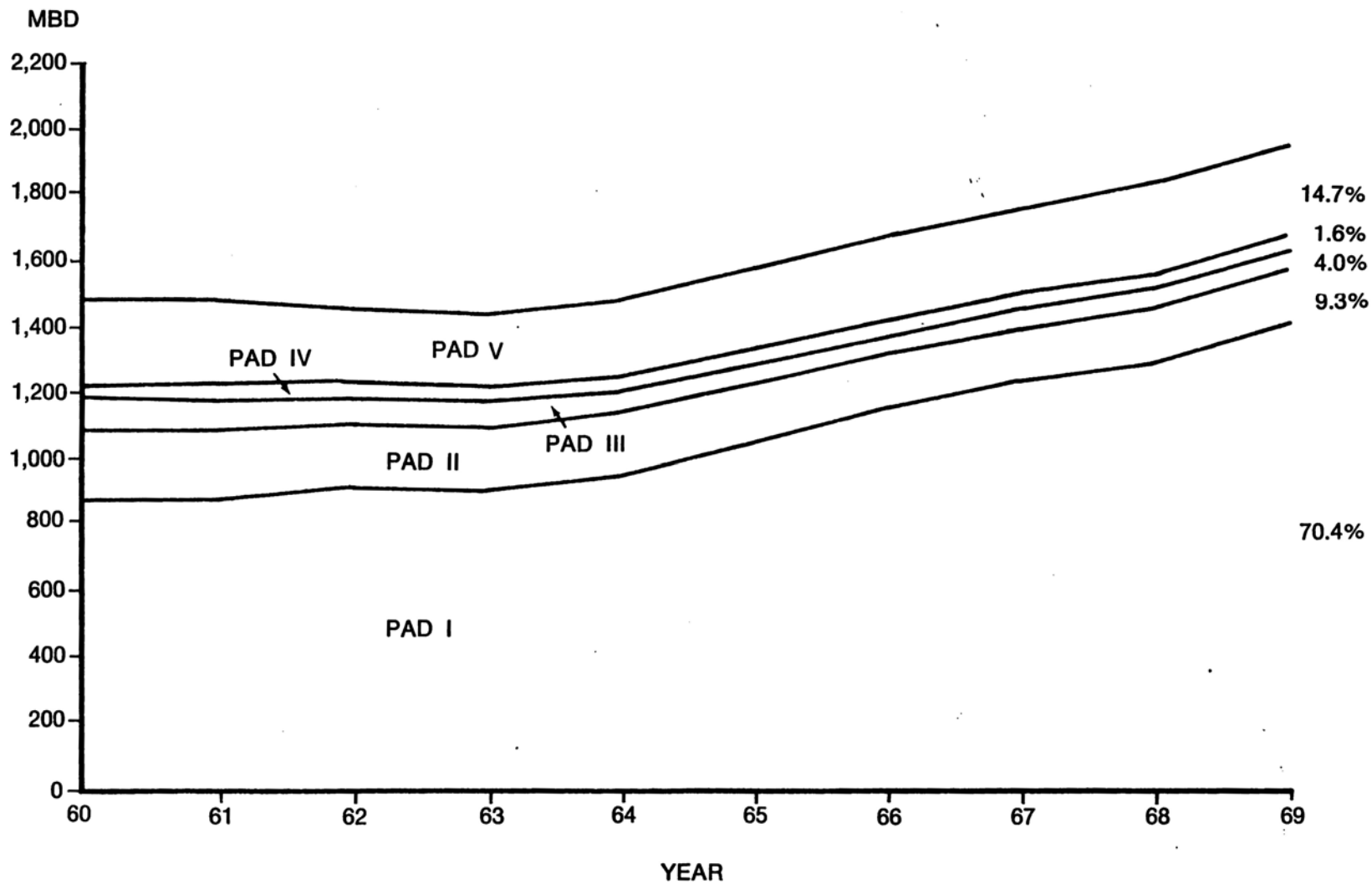

FIGURE C – 1. Total U. S. Residual Fuel Demand

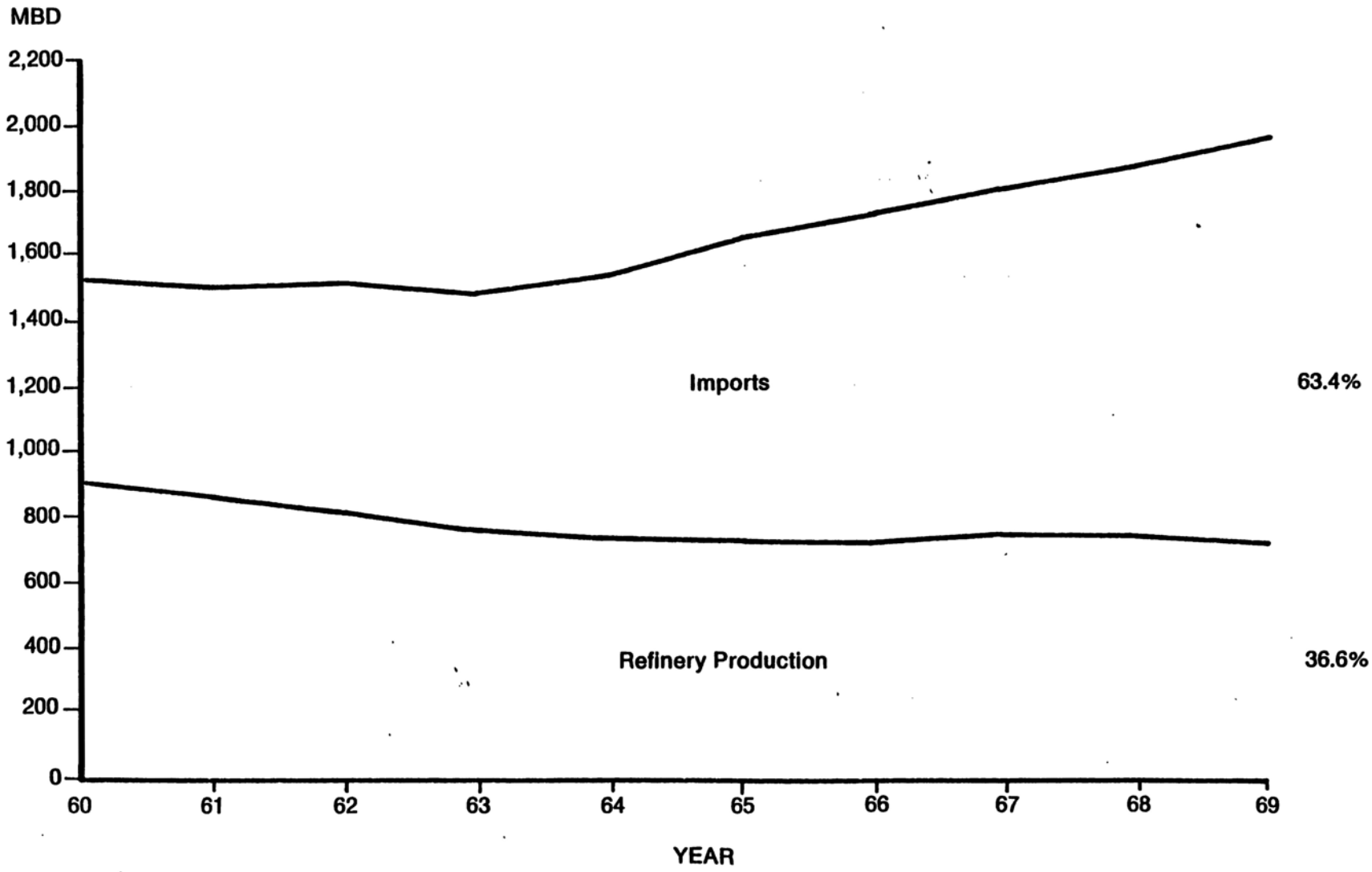

FIGURE C – 2. Total U. S. Residual Fuel Supply

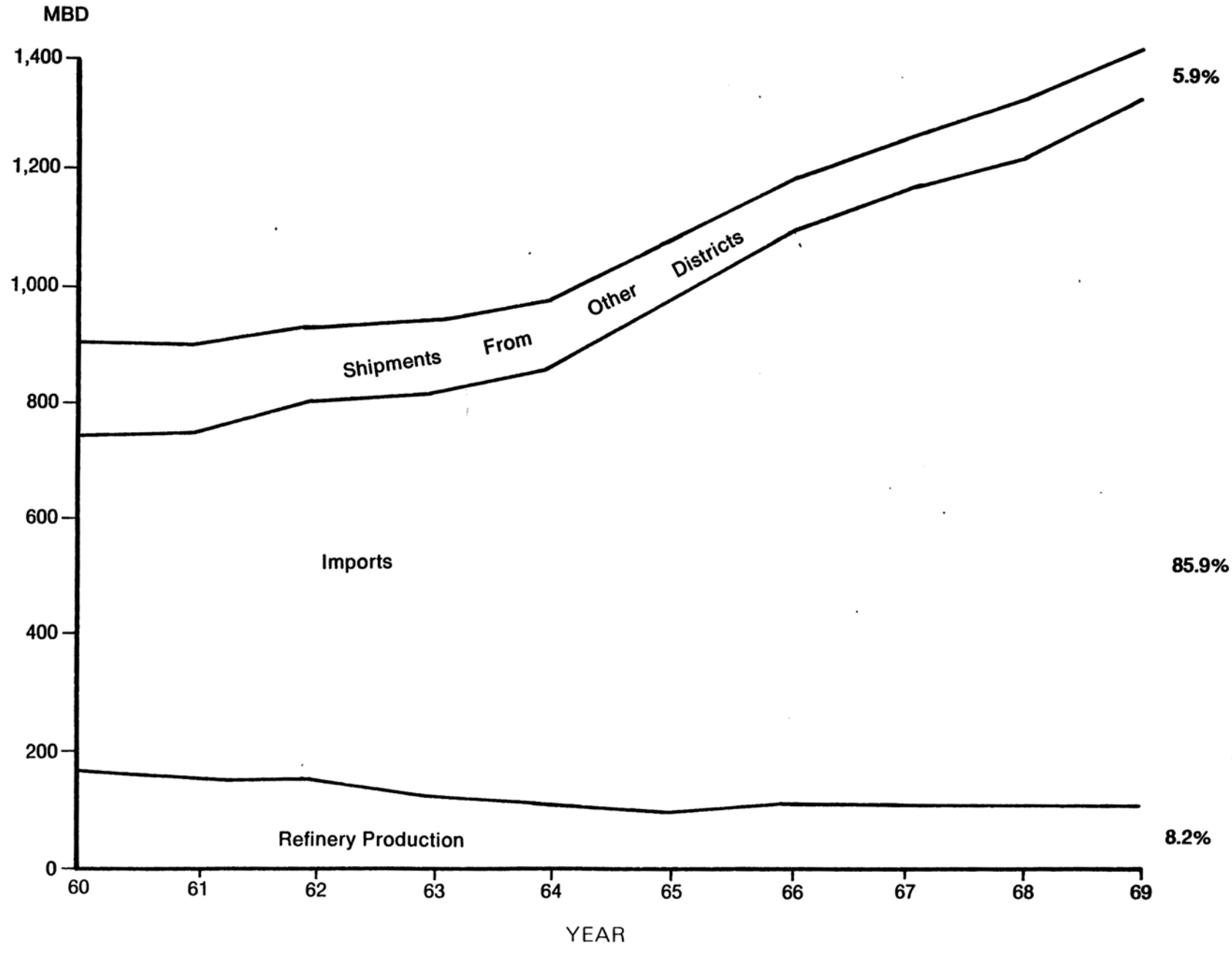

FIGURE C — 3. Pad District I Residual Fuel Supply-Demand

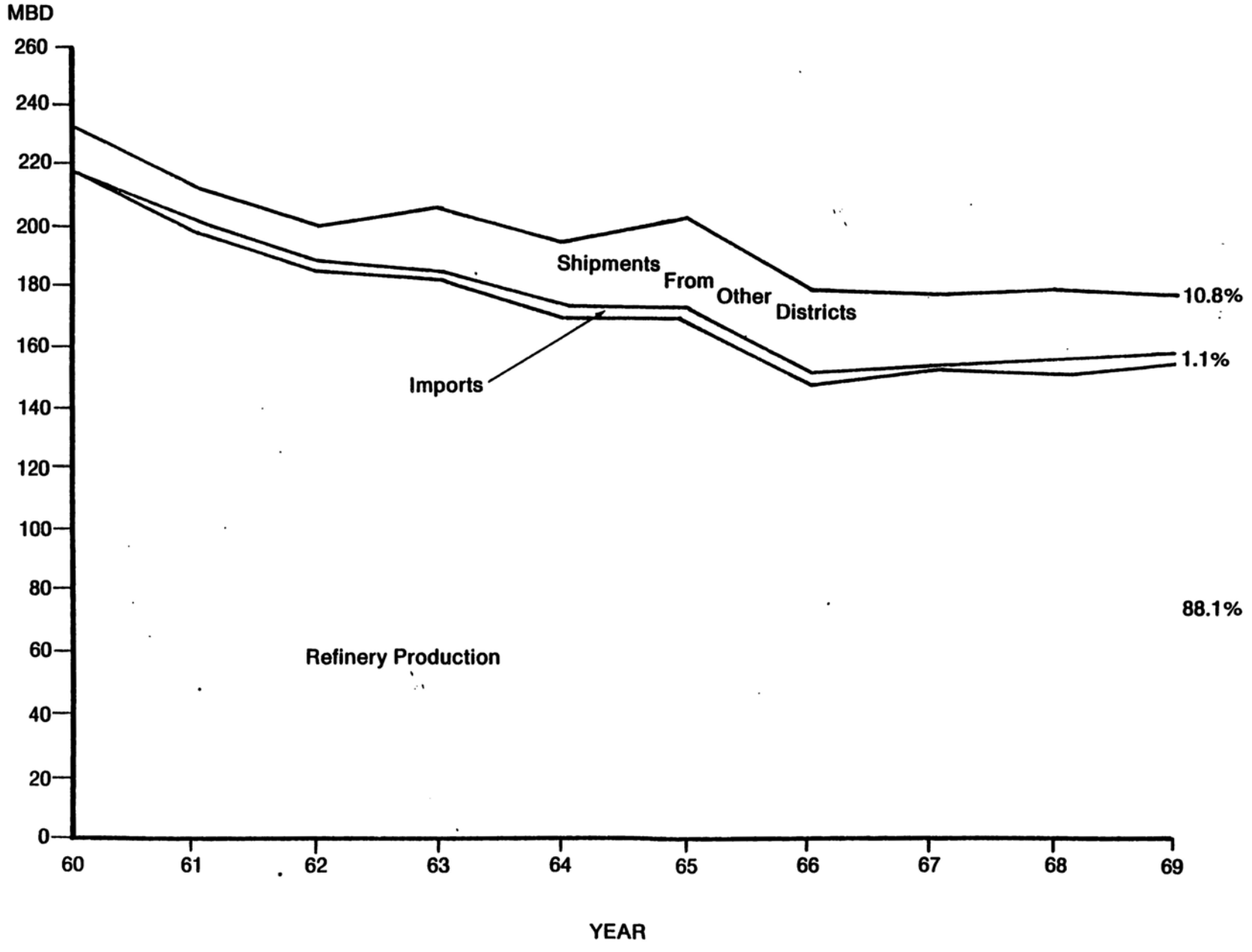

FIGURE C – 4. Pad District II Residual Fuel Supply-Demand

Table C-1. DOMESTIC DEMAND FOR RESIDUAL FUEL BY PAD DISTRICTS, 1968-1971
(MB/D)

1968	District I	District II	District III	District IV	Total of I-IV	District V	Total U.S.
1Q	1649	264	74	34	2021	306	2327
2Q	1100	112	65	28	1305	250	1555
3Q	1034	100	62	27	1223	273	1496
4Q	1328	191	81	34	1634	293	1927
Year	1277	167	70	31	1545	281	1826
1969							
1Q	1705	242	83	43	2073	356	2429
2Q	1252	116	78	33	1479	256	1735
3Q	1213	121	75	32	1441	236	1677
4Q	1485	197	93	29	1804	275	2079
Year	1413	169	82	34	1698	280	1978
1970							
1Q	2129	297	95	26	2547	332	2879
2Q	1443	170	65	23	1701	206	1907
3Q*	1395	180	78	22	1675	225	1900
4Q*	1708	233	98	26	2065	260	2325
Year	1667	220	84	24	1995	255	2250
1971							
1Q*	2345	370	103	26	2844	296	3140
2Q*	1646	191	73	23	1933	205	2138
3Q*	1547	195	91	22	1855	215	2070
4Q*	1991	286	114	26	2417	243	2660
Year*	1882	261	95	24	2262	240	2500

*Assuming normal weather

Table C-2. DOMESTIC DEMAND FOR RESIDUAL FUEL BY PAD DISTRICTS, 1969-1971
(Percentage Change from Previous Year)

1969	District I	District II	District III	District IV	Total of I-IV	District V	Total U.S.
1Q	3.4	-8.3	12.2	26.5	2.6	16.3	4.4
2Q	13.8	3.6	20.0	17.9	13.2	2.4	11.5
3Q	17.3	21.0	21.0	18.5	17.8	-13.6	12.1
4Q	11.8	3.1	14.8	14.7	10.4	- 6.2	7.9
Year	10.6	1.8	16.4	12.9	9.9	-	8.4
1970							
1Q	24.9	22.7	14.5	-39.5	22.9	- 6.8	18.5
2Q	15.3	46.6	-16.7	-30.3	15.0	-19.5	9.9
3Q	15.0	48.8	4.0	-31.2	16.2	- 4.7	13.3
4Q	15.0	18.3	5.4	-10.3	14.5	- 5.5	11.8
Year	17.9	27.2	9.0	-18.6	17.5	- 9.3	13.7
1971							
1Q	10.1	24.6	8.4	-	11.7	-10.8	9.1
2Q	14.1	12.4	12.3	-	13.6	- 0.5	12.1
3Q	10.9	8.3	16.7	-	10.7	- 4.4	8.9
4Q	16.6	22.7	16.3	-	17.0	- 6.5	14.4
Year	12.9	18.2	11.8	-	13.3	- 5.9	11.1

Table C-3. U.S. RESIDUAL FUEL OIL SUPPLY AND DEMAND, 1970-1971
(MB/D)

	1970 Quarters					1971 Quarters				
	1	2	3	4	Yr.	1	2	3	4	Yr.
Crude Runs	10,825	10,620	11,134	11,167	10,937	11,266	11,294	11,660	11,566	11,448
% Yield	7.5	5.7	6.0	7.2	6.6	8.0	7.7	6.5	7.3	7.4
Refinery Make	817	606	665	809	724	897	873	762	849	845
Imports	1900	1403	1325	1480	1525	2208	1364	1395	1790	1689
Transfers	13	13	12	11	12	12	12	12	12	12
Total Supply	2730	2022	2002	2300	2262	3117	2249	2169	2651	2546
Stock Change	-201	+64	+52	-73	-39	-68	+66	+54	-54	-
Total Demand	2931	1958	1950	2373	2301	3185	2183	2115	2705	2546
Exports	52	51	50	48	51	45	45	45	45	46
U.S. Demand	2879	1907	1900	2325	2250	3140	2138	2070	2660	2500
Closing Stocks MM BBLS	40.3	46.1	50.7	46.1	-	40.0	46.0	51.0	46.0	-

Table C-4. ABNORMAL DEMAND FOR RESIDUAL FUEL

	Fourth Quarter 1970 (MB/D)	First Quarter 1971 (MB/D)
District I	40	67
District II	5	8
	45	75

NOTE: The maximum effect of abnormally cold weather on demand for space-heating purposes, based on the experience of the past decade, would approximate only 30 MB/D on an annual basis. Since the increase in demand would occur during the fourth quarter of 1970 and the first quarter of 1971, it would add 60 MB/D to the winter requirements. This would approximate proportionately about 45 MB/D in the fourth quarter of 1970 and 75 MB/D in the first quarter of 1971. District I would account for 90 percent of the increased requirements.

Table C-5. DOMESTIC DEMAND FOR DISTILLATE FUEL BY PAD DISTRICTS, 1968-1971
(MB/D)

1968	District I	District II	District III	District IV	Total of I-IV	District V	Total U.S.
1Q	2015	924	162	66	3167	238	3405
2Q	872	543	131	64	1610	222	1832
3Q	685	488	177	71	1421	205	1626
4Q	1426	791	161	83	2461	240	2701
Year	1250	687	157	71	2165	226	2391
1969							
1Q	1939	931	201	75	3146	261	3407
2Q	943	583	139	73	1738	210	1948
3Q	732	513	201	67	1513	214	1727
4Q	1484	836	162	70	2552	244	2796
Year	1275	716	176	71	2238	232	2470
1970							
1Q	2090	998	146	69	3303	250	3553
2Q	996	622	178	72	1868	215	2083
3Q*	767	530	180	68	1545	207	1752
4Q*	1515	860	164	70	2609	247	2856
Year	1342	752	167	70	2331	230	2561
1971							
1Q*	2096	1002	170	70	3338	255	3593
2Q*	1040	652	140	73	1905	218	2123
3Q*	802	550	180	69	1601	211	1812
4Q*	1580	900	165	71	2716	252	2968
Year*	1380	775	164	71	2390	234	2624

*Assuming normal weather

Table C-6. DOMESTIC DEMAND FOR DISTILLATE FUEL BY PAD DISTRICTS, 1969-1971
(Percentage Change from Previous Year)

	District I	District II	District III	District IV	Total of I-IV	District V	Total U.S.
1969							
1Q	-3.8	0.8	24.1	13.6	-0.7	9.7	0.5
2Q	8.1	7.4	6.1	14.1	8.0	-5.4	6.3
3Q	6.9	5.1	13.6	- 5.6	6.5	4.4	6.2
4Q	4.1	5.7	0.6	-15.7	3.7	1.7	3.5
Year	1.8	4.4	12.1	1.4	3.2	2.2	3.1
1970							
1Q	7.8	7.2	-27.4	- 8.0	5.0	-4.2	4.3
2Q	5.6	6.7	28.1	- 1.4	7.5	2.4	6.9
3Q	4.8	3.3	-10.5	1.5	2.1	-3.3	1.4
4Q	2.1	2.9	1.2	-	2.2	1.2	2.1
Year	5.3	5.0	- 5.1	- 2.8	4.3	-0.4	3.9
1971							
1Q	0.3	0.4	16.4	1.4	1.1	2.0	1.1
2Q	4.4	4.8	-21.4	1.4	2.0	1.4	1.9
3Q	4.6	3.8	-	1.5	3.6	1.9	3.4
4Q	4.3	4.7	0.6	1.4	4.1	2.0	3.9
Year	2.8	3.2	- 1.8	1.4	2.5	1.7	2.5

Table C-7. U.S. DISTILLATE FUEL SUPPLY AND DEMAND, 1970-1971
(MB/D)

	1970 Quarters					1971 Quarters				
	1	2	3	4	Yr.	1	2	3	4	Yr.
Crude Runs	10,825	10,620	11,134	11,167	10,937	11,266	11,294	11,660	11,566	11,448
% Yield	23.5	22.0	21.4	21.7	22.1	23.0	21.0	20.4	21.2	21.2
Refinery Make	2541	2332	2380	2439	2423	2594	2370	2375	2449	2447
Imports	222	108	130	165	156	240	124	134	174	168
Transfers	6	6	6	6	6	6	6	6	6	6
Total Supply	2769	2446	2516	2610	2585	2840	2500	2515	2629	2621
Stock Change	-786	+359	+760	-250	+20	-750	+374	+700	-336	-5
Total Demand	3555	2087	1756	2860	2565	3596	2126	1815	2965	2626
Exports	2	4	4	4	4	3	3	3	3	3
U.S. Demand	3553	2083	1752	2856	2561	3593	2123	1812	2962	2623
Closing Stocks MM BBLS	101.0	133.7	203.6	180.6	-	113.1	147.1	211.5	180.6	

Table C-8. ABNORMAL DEMAND FOR DISTILLATE FUEL

	Fourth Quarter 1970 (MB/D)	First Quarter 1971 (MB/D)
District I	70	105
District II	40	65
	110	170

NOTE: The chief factor in possible increased demand for distillate fuel is the weather.

The coldest winter in the past decade occurred in the 1962-1963 heating season, when degree days exceeded the normal by 5.4 percent. It is estimated that a recurrence of such weather would add about 70 MB/D annually to U.S. distillate fuel oil demand. Since the amount of heating oil stored in the second and third quarters is determined according to normal-weather demands, the increase in winter-quarter demands due to abnormally cold weather would approximate 140 MB/D. While the excess degree days would probably occur in the first quarter, a normal spread of excess requirements in Districts I and II would be an additional 110 MB/D in the fourth quarter and 170 MB/D in the first quarter. This increase, proportioned by districts and quarters, is shown in the above table.