CIVIL CONSUMPTION OF PETROLEUM PRODUCTS IN THE USSR 1953-57

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CENTRAL INTELLIGENCE AGENCY

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CIVIL CONSUMPTION OF PETROLEUM PRODUCTS IN THE USSR 1953-57

Summary

The civil consumption of petroleum products* in the USSR increased steadily from 40.1 million metric tons** in 1953 to 63.8 million tons in 1957. Annual increases during this period are estimated to have averaged 12.3 percent compared with an average annual increase in the US estimated at 3.7 percent. Because the consumption of petroleum products by the military sector of the Soviet economy apparently has increased still more rapidly, the proportion of petroleum products accounted for by civil consumption in the USSR has shown a marked decline, from 86.1 percent of the total in 1953 to 81.8 percent in 1957.

Estimated civil consumption of petroleum products in the USSR, by consuming sector, during 1953-57, is summarized in Table 1*** and shown graphically in the chart, Figure 1.**** Consumption in every sector increased in each of these years. Although consumption by the chemical and coal industries remained constant, consumption by the entire industrial sector of the Soviet economy registered a substantial increase.

Consumption of petroleum products by rail transport in the USSR reached 5 million tons in 1957, or twice the level of 1953. Consumption by households also doubled during this period, sharing with rail transport the highest rate of increase in consumption by the civil economy. The consumption of diesel fuel by rail transport has been increasing steadily and is estimated at more than 6 million tons in 1965, or about one-half of such consumption by US railroads in 1956. Nevertheless, the increase in the consumption of petroleum products by rail transport may not keep pace with the planned increases in the total consumption of such products. Inland waterway, oceangoing,

* As used in this report, the term petroleum product refers to a petroleum material which serves an end use without further refining.

** Tonnages are given in metric tons throughout this report.

*** Table 1 follows on p. 2.

**** Following p. 2.

Table 1

Summary of Estimated Civil Consumption of Petroleum Products in the USSR, by Consuming Sector a/
1953-57

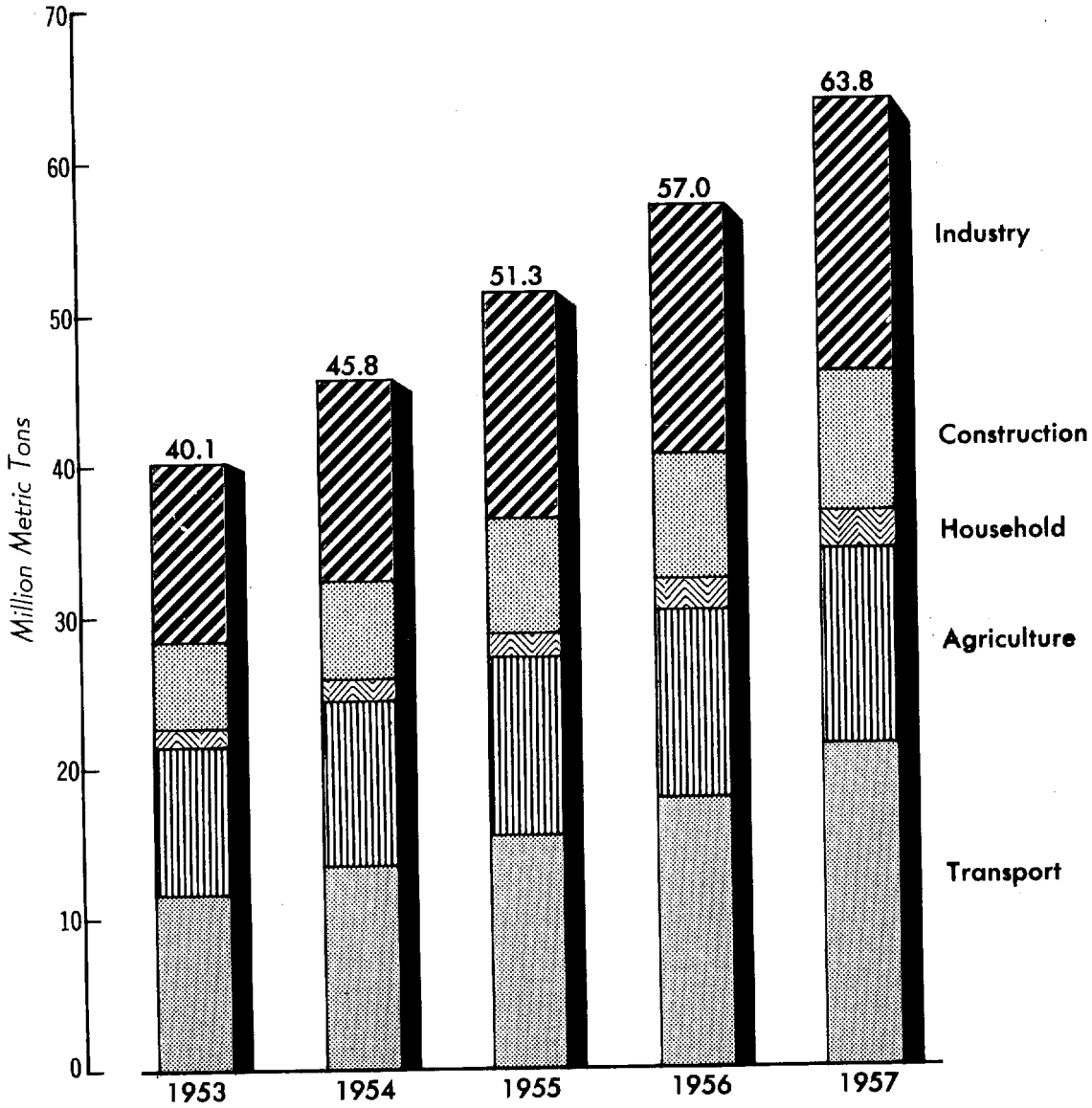
Million Metric Tons

Consuming Sector	1953	1954	1955	1956	1957
Transport					
Rail	2.5	2.7	3.0	3.8	5.0
Inland waterway	0.9	1.0	1.1	1.2	1.5
Oceangoing	0.7	0.8	1.0	1.1	1.2
Motor	6.8	8.2	9.5	10.9	12.6
Civil air	0.7	0.8	0.8	0.8	1.0
Total b/	11.7	13.5	15.4	17.9	21.4
Agriculture	9.8	10.9	11.9	12.4	12.8
Household	1.2	1.4	1.6	2.0	2.4
Construction	5.6	6.5	7.3	8.3	9.3
Industry					
Petroleum	2.7	3.0	3.6	4.3	5.0
Chemical	0.2	0.2	0.2	0.2	0.2
Coal	0.2	0.2	0.2	0.2	0.2
Steel	2.3	2.5	2.7	2.9	3.0
Electric power	5.6	6.4	6.9	7.6	8.2
Nonferrous metals and manufacturing	0.9	1.2	1.4	1.2	1.2
Total b/	11.8	13.5	15.1	16.4	17.9
Grand total b/	40.1	45.8	51.3	57.0	63.8

a. Data in this table have been compiled from Tables 6 through 10, pp. 33 through 37, below. Estimates have been rounded to the nearest hundred thousand. For a graphic representation of these data, see Figure 1, following p. 2.
b. Totals were derived from unrounded data and do not always equal the sums of the rounded components.

Figure 1

ESTIMATED CIVIL CONSUMPTION OF PETROLEUM PRODUCTS IN THE USSR BY CONSUMING SECTOR, 1953-57



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and civil air transport do not consume significant quantities of petroleum products, and no important change in this respect is anticipated.

Consumption of petroleum products by motor transport increased at an average annual rate of 17 percent to reach a total of 12.6 million tons in 1957. The gain above the level of 1953, 5.8 million tons, represented the largest absolute increase registered in any sector of the civil economy. As a result of this sharp increase, motor transport not only accounted for 20 percent of total civil consumption of petroleum products but challenged the position of agriculture as the leading civil consumer. Final figures for 1958 may show that motor transport already has replaced agriculture as the leading consumer in the civil economy. Long-range plans call for a rapid increase in the volume of freight transported by diesel trucks during the next 10 to 15 years. Nevertheless, certain limitations implicit in these plans indicate that motor gasoline will remain the primary source of power for Soviet motor transport.

Agriculture continued to be the leading civil consumer of petroleum products in the USSR, accounting for about 12.8 million tons in 1957. The relatively small increase of 3 million tons since 1953 resulted primarily from the wide-scale program of dieselization of the tractor park and the inherently lower rates of consumption of primary fuel per unit of output by diesel tractors compared with other types. At the same time, there has been a reduction in the consumption of kerosine by Soviet tractors. Available information indicates a continuation of these trends. The consumption of kerosine by tractors in 1965 is expected to be reduced to about 1.4 million tons, a decline of 64 percent from the level of 1955. Conversely, the consumption of diesel fuel by agriculture is expected to increase steadily and may reach about 23 million tons in 1965. The demand for diesel fuel will increase still more rapidly, however, in other sectors of the economy, particularly in motor transport.

The consumption of lamp and stove kerosine by the households of the USSR in 1957 is estimated to have reached 2.4 million tons, or twice the level of 1953. Inasmuch as production of kerosine is expected to increase and the demand for tractor kerosine to decline sharply, the consumption of kerosine by households may reach about 4 million tons in 1960 and about 10 million tons in 1965. Plans to increase deliveries of gas* to households, especially in urban areas,

* The term gas includes both natural gas and the gas produced from shale and the underground gasification of coal.

are not expected to have an appreciable effect on the domestic consumption of kerosine by 1965.

The consumption of petroleum products in construction in the USSR amounted to 9.3 million tons in 1957, an increase of about 66 percent since 1953. The principal products used in construction are road oils and asphalts, and continued increases in the consumption of these items are expected. In addition, construction accounted for almost 21 percent of the civil consumption of diesel fuel in 1957. The demand for other types of fuel in construction is declining, and requirements for tractor kerosine and ligroine have virtually ceased.

The consumption of petroleum products in the USSR in the generation of electric power makes the electric power industry the leading consumer of petroleum products in the entire industrial sector of the Soviet economy. In 1957 the electric power industry accounted for 46 percent of all the petroleum products consumed by the industrial sector. Although significant advances in the generation of electric power are planned, there is to be no substantial change in the generation of electric power by stations utilizing petroleum fuels. It is possible, therefore, that there will be no corresponding increase in the consumption of petroleum products by the electric power industry. In a speech at the dedication of the hydroelectric power station at Kuybyshev, Khrushchev called for an increase in the rate of construction of thermal electric power stations, but details of the program have not been announced. Implementation of such a program is certain to result in an increase in the consumption of fuel by the electric power industry, principally in the consumption of natural gas.

Throughout 1953-57 the petroleum industry ranked second only to the electric power industry as an industrial consumer of petroleum products in the USSR. Of the 5 million tons estimated to have been consumed by this industry in 1957, about 56 percent of the total represented residual fuel oil consumed in refining crude oil. About 42 percent was consumed in drilling operations and producing crude oil, which accounted for all of the gasoline, diesel fuel, lubricants, and crude oil consumed by the industry. Consumption of petroleum products in construction and repair of trunk oil and gas pipelines is insignificant. A program for the conversion of refineries and field equipment to gas has yet to be adopted nationally. The consumption of petroleum products by the petroleum industry may reach 9 million to 10 million tons in 1965.

Significant quantities of residual fuel oil are consumed by the steel industry of the USSR in firing open-hearth furnaces, soaking

pits, and reheating furnaces. The consumption of residual fuel oil for these purposes is estimated to have reached 3 million tons in 1957 compared with 2.3 million tons in 1953. The use of residual fuel oil to fire steelmaking units, however, is less frequent than the use of blast furnace and coke oven gas. A decision to increase the consumption of residual fuel oil or to convert to the use of natural gas probably will be made locally on the basis of available supplies.

Estimates of the consumption of petroleum products by the nonferrous metals and manufacturing industries of the USSR indicate a steady increase during 1953-55, followed by a decline in 1956. The apparent decline reflects the replacement of residual fuel oil as an industrial fuel by gas. The trend is toward the increased use of gas, in particular by machine-construction plants, although residual fuel oil probably will retain its present relative importance.

Estimated civil consumption of petroleum products in the USSR, by type of product, during 1953-57 is summarized in Table 2* and shown graphically in the chart, Figure 2.** Increases in the consumption of all the products except tractor kerosine occurred in each of these years. Available information indicates a continued decline in the consumption of tractor kerosine at least through 1965. Although the consumption of lamp and stove kerosine doubled between 1953 and 1957, the total consumption of kerosine declined from 5.8 million tons in 1953 to 5.4 million tons in 1957. The consumption of ligroine remained negligible.

Particularly outstanding has been the very sharp increase in the consumption of diesel fuel, which in 1957 amounted to about 16.3 million tons, or more than twice the level of 1953. During this period, diesel fuel supplanted gasoline as the major distillate.*** In the US, on the other hand, gasoline always has been the principal petroleum product. The USSR has declared its intention of introducing diesel equipment and engines into practically every phase of the civil economy, especially in transportation and in agriculture, and it is probable that diesel fuel will become increasingly more important than gasoline.

The category of residuals and other petroleum products**** continued to rank first among the petroleum products consumed by the

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* Table 2 follows on p. 6.

** Following p. 6.

*** The principal distillates are gasoline, ligroine, kerosine, and diesel fuel.

**** Including residual fuel oil, road oils, asphalts, bitumen, and bituminous tar.

Table 2

Summary of Estimated Civil Consumption of Petroleum Products in the USSR, by Type of Product a/
1953-57

Million Metric Tons

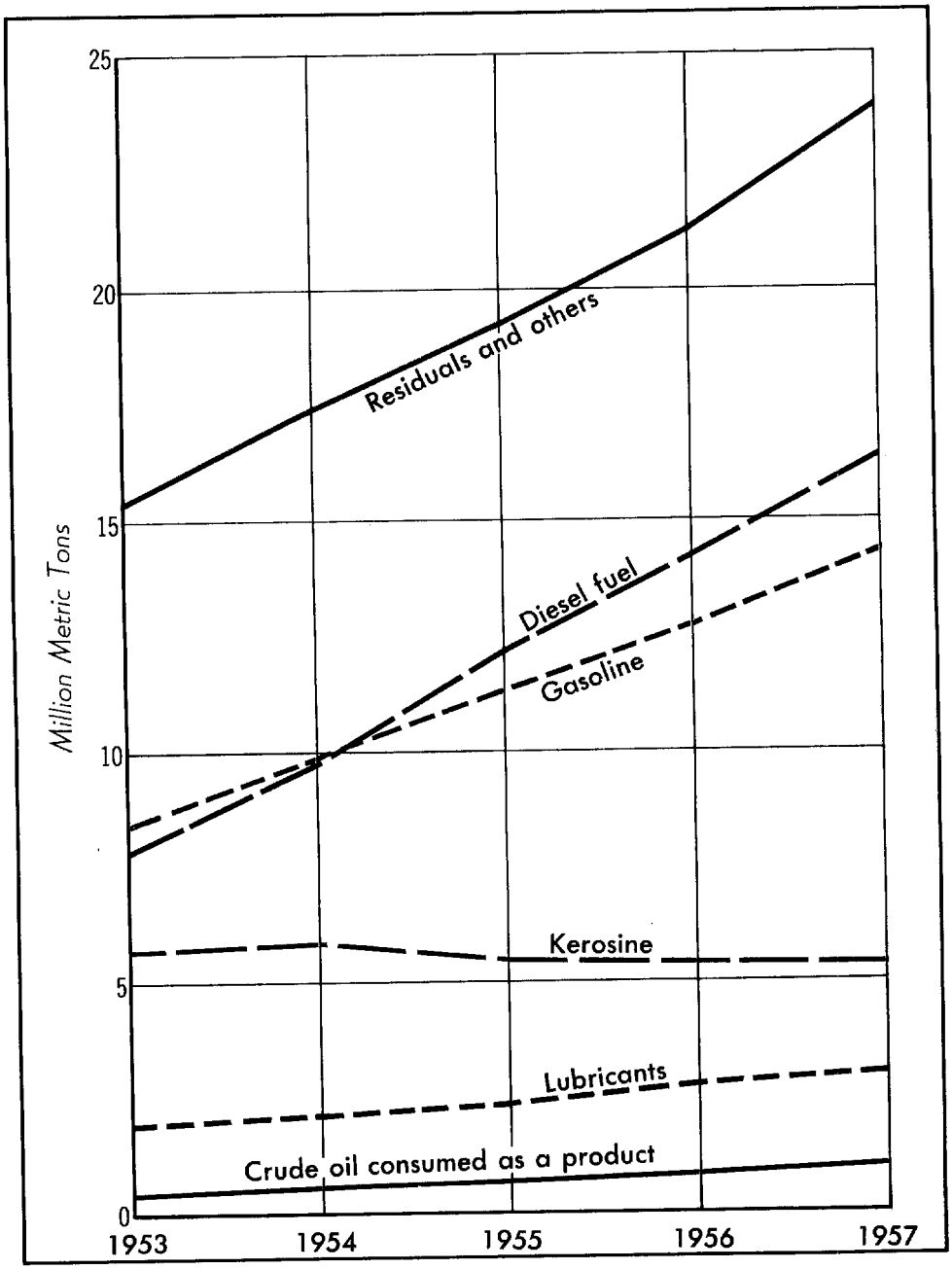
Type of Product	1953	1954	1955	1956	1957
Gasoline					
Aviation	0.7	0.8	0.8	0.8	0.9
Motor	7.8	9.1	10.4	11.8	13.4
Total b/	8.5	9.9	11.3	12.7	14.3
Kerosine					
Lamp and stove	1.2	1.4	1.6	2.0	2.4
Tractor	4.6	4.5	3.9	3.4	2.9
Total b/	5.8	5.9	5.5	5.4	5.4 c/
Diesel fuel	7.9	9.8	12.2	14.2	16.3
Lubricants	2.0	2.2	2.4	2.8	3.0
Residuals and others d/	15.4	17.4	19.2	21.2	23.8
Crude oil consumed as a product	0.5	0.6	0.7	0.8	1.0
Grand total b/	40.1	45.8	51.3	57.0	63.8

a. Data in this table have been compiled from Tables 6 through 10, pp. 33 through 37, below. Estimates have been rounded to the nearest hundred thousand. The consumption of ligroine in each of the years was negligible. For a graphic representation of these data, see Figure 2, following p. 6.
b. Totals were derived from unrounded data and do not always equal the sums of the rounded components.
c. Including jet fuel consumed by civil air transport.
d. Including residual fuel oil, road oils, asphalts, bitumen, and bituminous tar.

civil economy of the USSR. Consumption of such products in 1957 is estimated at 23.8 million tons, or more than 37 percent of the total civil consumption.

Figure 2

ESTIMATED CIVIL CONSUMPTION OF PETROLEUM PRODUCTS IN THE USSR BY MAJOR TYPE OF PRODUCT, 1953-57



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The civil consumption of petroleum products within the 12 economic regions* of the USSR during 1953-57 is summarized in Table 3** and shown graphically in the charts, Figures 3 and 4.*** Consumption has increased most rapidly in the eastern regions**** of the USSR, primarily because of the new lands program and related activities. Consumption in these regions is estimated to have increased at an average annual rate of 16 percent, amounting in 1957 to 29 million tons, or 46 percent of total civil consumption.

Of the eastern regions of the USSR, those making the most impressive gains have been Economic Regions IX (West Siberia), X (Kazakhstan and Central Asia), XI (East Siberia), and XII (the Far East). The consumption of petroleum products in these regions almost doubled in 4 years, amounting to about 15.6 million tons and representing more than one-half of the total civil consumption in the eastern regions in 1957. Meanwhile, the consumption of petroleum products in the European USSR has increased 9.6 percent annually, reaching 34.6 million tons in 1957.

Even greater than the increase in the consumption of petroleum products in the eastern regions has been the increase in production of crude oil, primarily from the highly productive oilfields in Economic Regions VI (Volga) and VIII (Urals), which was accompanied by a shift in the center of refining from Regions IV (Southeast) and V (Transcaucasus) to the eastern regions.

The shift in the centers of production and refining of crude oil may help to solve several critical problems regarding the adequate and timely supply of petroleum products to consumers. First, the centers of production have been brought closer to the centers of consumption, thus reducing significantly the distances over which petroleum products must be hauled. Second, the petroleum industry is in a better position to supply the rapidly increasing needs for petroleum products in Economic Regions IX, X, XI, and XII, where local production of crude oil is less than one-half of estimated requirements. The solution to the resulting problem of supply is the

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* The term economic region (or region) in this report refers to the economic regions defined and numbered on Map 13702 (4-55), USSR: Administrative Divisions and Economic Regions, January 1955 (see Figure 5, inside back cover).

** Table 3 follows on p. 8.

*** Following p. 8.

**** As used in this report, the term eastern regions of the USSR refers to the geographical area formed by Economic Regions VI, VIII, IX, X, XI, and XII. The remaining area is referred to as the western regions.

Table 3

Summary of Estimated Civil Consumption of Petroleum Products in the USSR, by Economic Region a/
1953-57

Million Metric Tons

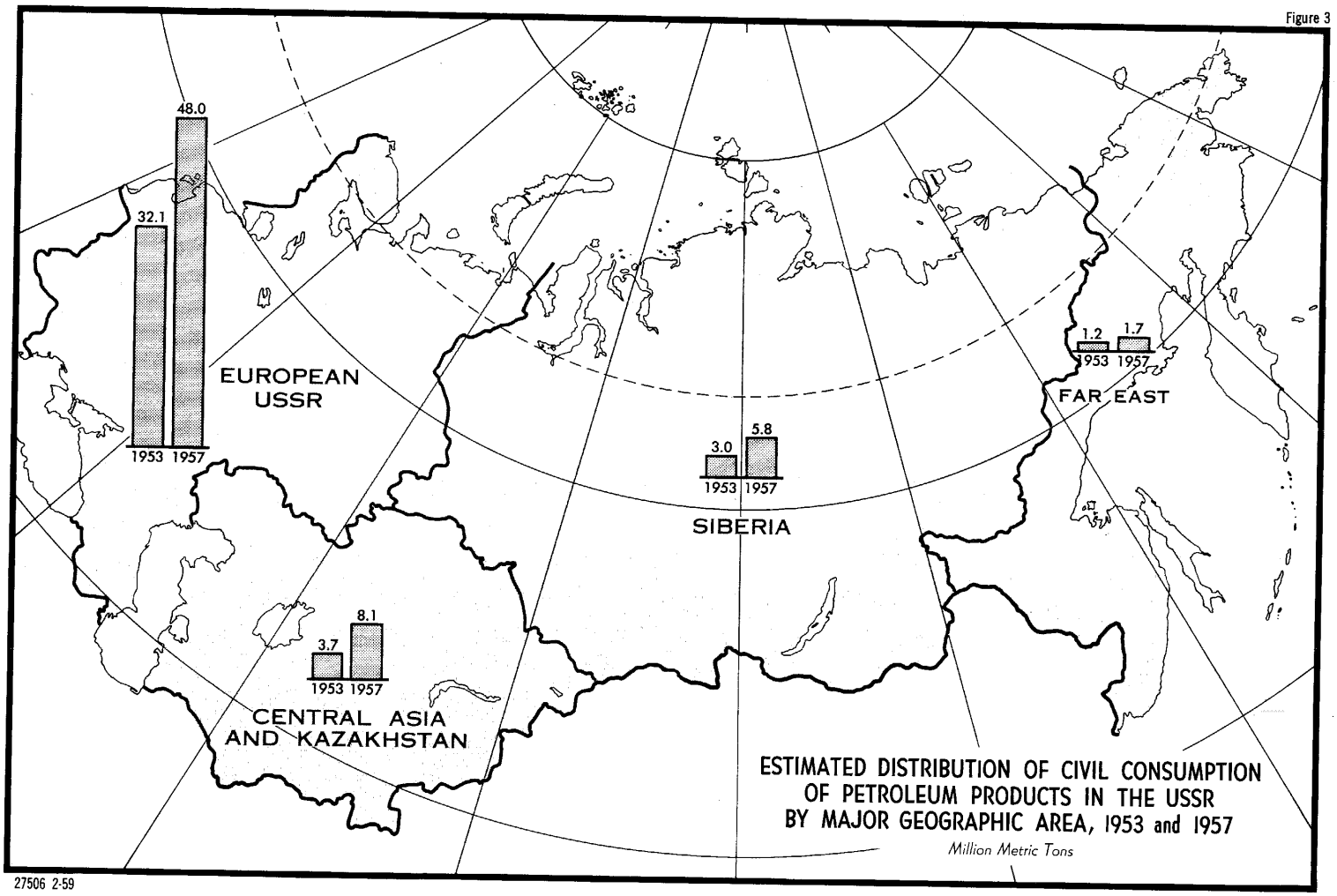
Economic Region b/	1953	1954	1955	1956	1957
I	1.8	2.0	2.2	2.5	3.1
II	1.4	1.7	1.9	2.1	2.2
III	6.6	7.4	8.1	8.6	9.2
IV	3.4	3.8	4.1	4.3	4.6
V	3.8	4.3	4.6	5.1	5.5
VI	4.0	4.6	5.5	5.8	6.5
VII	7.0	7.9	8.4	8.8	10.0
VIII	4.1	4.7	5.3	5.9	6.9
IX	2.0	2.4	2.7	3.2	3.6
X	3.7	4.5	5.7	7.1	8.1
XI	1.0	1.2	1.4	2.0	2.2
XII	1.2	1.3	1.5	1.6	1.7
Total c/	40.1	45.8	51.3	57.0	63.8

a. Data in this table have been compiled from Tables 11 through 15, pp. 49 through 53, below. For a graphic representation of these data, see Figures 3 and 4, following p. 8.
b. Economic regions are those defined on Map 13702 (4-55), USSR: Administrative Divisions and Economic Regions, January 1955.
c. Totals were derived from unrounded data and do not always equal the sums of the rounded components.

construction of an oil pipeline network which will extend ultimately to the Pacific Ocean. From the oilfields of Economic Regions VI and VIII, this network will supply the eastern regions with both crude oil and petroleum products. In connection with this project, a large-scale program for constructing and expanding refineries in the eastern regions is underway.

It is believed that the continued development of the new lands, accompanied by the expansion of industrial and transport facilities in the eastern regions of the USSR, may lead to a more equitable distribution of petroleum products for civil consumption between the eastern regions and the western regions by 1965 or possibly earlier.

Figure 3



ESTIMATED DISTRIBUTION OF CIVIL CONSUMPTION OF PETROLEUM PRODUCTS IN THE USSR BY MAJOR GEOGRAPHIC AREA, 1953 and 1957

Million Metric Tons

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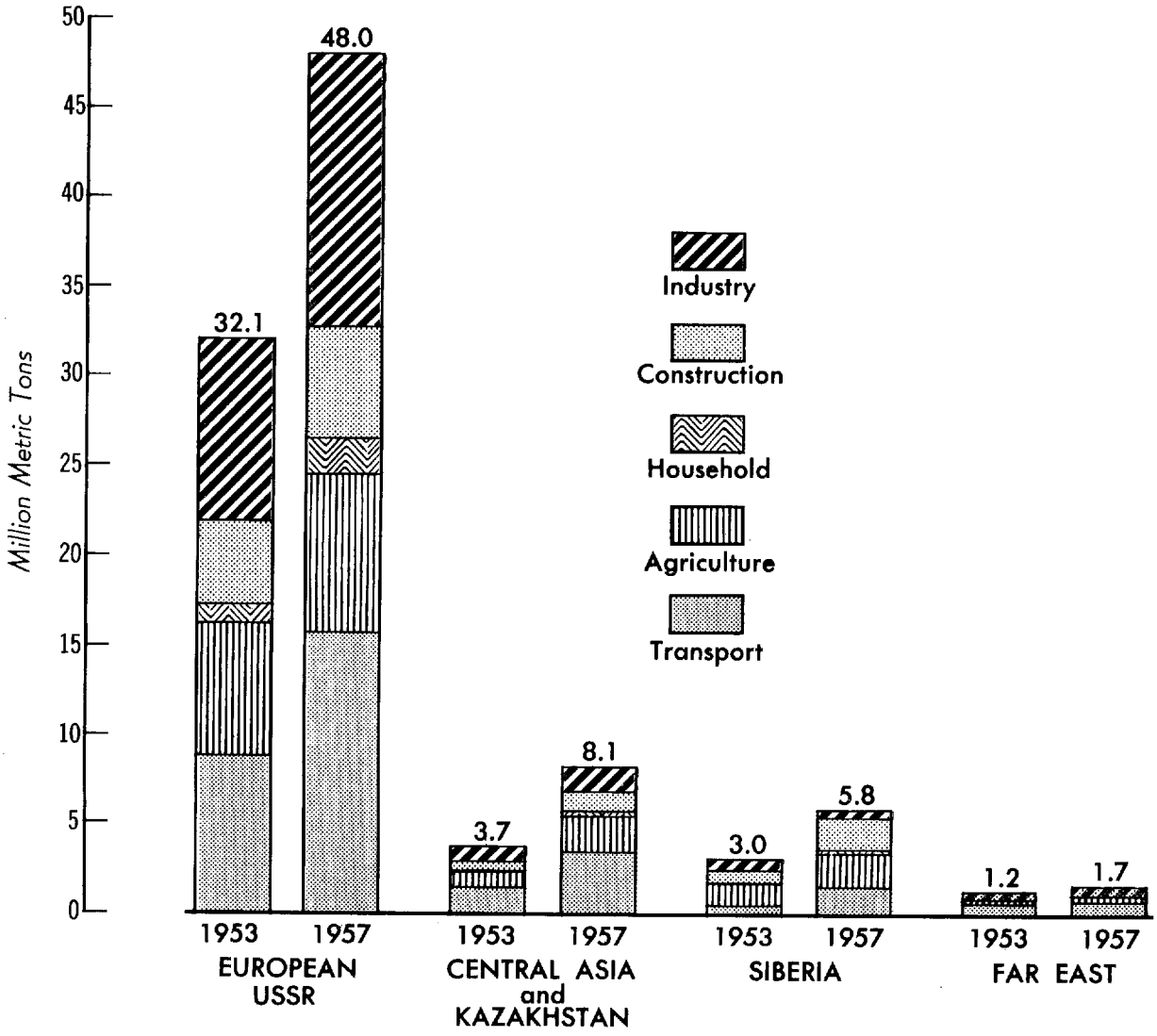
Figure 4

ESTIMATED DISTRIBUTION OF CIVIL CONSUMPTION OF PETROLEUM PRODUCTS IN THE USSR BY MAJOR GEOGRAPHIC AREA AND BY CONSUMING SECTOR 1953 and 1957



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The development of the eastern regions is reflected again in the distribution of petroleum products by consuming sector.* In 1957, civil consumption of such products by agriculture in Region X, the center of the new lands program, amounted to 2 million tons, an increase of 135 percent compared with 1953. In the field of construction, consumption in Regions VIII, IX, and X amounted to about 3.5 million tons in 1957, an increase of 166 percent compared with 1953. Industrial consumption of petroleum products is concentrated in the relatively highly developed areas of Regions III (the Ukraine), V, and VIII. These regions accounted for more than one-half of the total consumption of petroleum products by industry in 1957. Under the Seven Year Plan (1959-65), however, increased deliveries of gas to the industrial centers of the USSR, particularly in Regions III and V, may cause changes in this pattern by promoting conversion from petroleum to gas. The primary industrial consumers of gas appear to be the electric power stations, heavy metallurgical enterprises, and, to a lesser extent, plants constructing machinery. The substitution of gas in an industrial fuel for residual fuel oil at these points may serve to reduce the share of petroleum products consumed by industry in Regions III and V. Plans to supply gas to Region VIII are in a state of flux. An unusually large deposit of natural gas discovered late in 1957 near Bukhara, Uzbek SSR, in Region X may become a principal source of gas for Region VIII, but actual deliveries are unlikely before 1965.

Preliminary estimates of consumption, both civil and military, of the principal types of petroleum products in the USSR in 1965 are summarized in Table 4.** On the basis of these estimates and of the probable impact of the rapidly expanding natural gas industry on the consumption of petroleum products, increasing quantities of crude oil and petroleum products will be available for export from the USSR during the Seven Year Plan (1959-65).

Particularly significant will be the tremendous expansion of the Soviet gas industry. In terms of standard fuel units (7,000 kilocalories per kilogram -- Kcal/kg), crude oil accounted for nearly 86 percent of Soviet production of petroleum*** in 1957 but is expected to supply only 64 percent in 1965. Natural gas, however, which accounted for only about 14 percent of Soviet production of petroleum in 1957, is expected to provide nearly 36 percent of such production in 1965.

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* See Tables 11 through 15, pp. 49 through 53, below.

** Table 4 follows on p. 10.

*** As used in this report, the term petroleum includes both crude oil and natural gas.

Table 4

Estimated Total Consumption of Petroleum Products in the USSR by Major Type of Product a/
1965

Million Metric Tons

Type of Product	Amount
Gasoline	39.0
Kerosine	23.0
Diesel fuel	43.0
Lubricants	7.1
Residuals and others	75.4
Total	187.5

a. Including consumption by both the civil and military sectors of the economy.

It is estimated that in 1965 the USSR will have available for export 45 million tons of crude oil equivalent compared with a total supply estimated to be 246.5 million tons. Published trade agreements for 1965 between the USSR and other countries of the Sino-Soviet Bloc indicate a present intention to export about 20 million tons of crude oil equivalent from the USSR to the Bloc, an amount which appears to be too small to meet requirements in the other Bloc countries if their own industrial production plans are to be met. The residual, 25 million tons, will be available for export to the Free World, principally to Western Europe, unless it is diverted to meet increased intra-Bloc needs.

I. Introduction.

A. General.

This report has three objectives: (1) to estimate the total civil consumption of petroleum products in the USSR and the distribution of this consumption by economic sector and by economic region during the years 1953-57; (2) to estimate the level of consumption of selected major petroleum products in the USSR in 1965; and (3) to describe and analyze the more important trends in the consumption of petroleum products.

The major sectors of civil consumption of petroleum products discussed in this report are transport, agriculture, households, construction, and industry. The major types of petroleum products discussed are gasoline, kerosine, diesel fuel, lubricants, residual fuel oil, and road oils and asphalts. It has been possible to derive estimates of consumption only for those petroleum products considered to be of prime importance to each sector. Thus for many of the sectors, such as the chemical industry, the annual totals given must be considered minimal.

Because the primary purpose of this report has been to develop estimates of civil consumption of petroleum products in the USSR, only passing attention has been given to the military sector of the economy. Deducting estimated civil consumption, refinery losses, and stock changes from the total supply of petroleum products in the USSR, however, yields a residual that may be regarded as an estimate of military consumption of petroleum products. Such an estimate of military consumption will necessarily differ significantly from more precise estimates based on operational requirements of military equipment, largely because the errors in derivation of estimates of civil consumption are concentrated in the residual available for the military sector.

Nevertheless, to complete the probable disposition of the total supply of petroleum products in the USSR, these imprecise estimates of military consumption of petroleum in the USSR during 1953 are presented in Table 5.* Also presented in Table 5 are estimates of the total supply of petroleum products during these years as well as estimates of the quantities of petroleum products lost in handling and in transportation and of allocations to storage and state reserves.

During 1953-57, although consumption of petroleum products by the civil sector of the economy increased at the average annual

* Table 5 follows on p. 12.

Table 5

Estimated Consumption of Petroleum Products in the USSR a/
1953-57

Million Metric Tons

Item	1953	1954	1955	1956	1957
Total net supply of petroleum products b/	51.2	54.6	63.9	74.3	84.8
Losses, storage increments, and freshening of state reserves c/	4.6	4.9	5.8	5.9	6.8
Civil consumption	40.1	45.8	51.3	57.0	63.8
Military consumption d/	6.5	6.6	6.8	11.4	14.2

a. Estimates have been rounded to the nearest hundred thousand.
b. Data were compiled from Table 24, Appendix A, p. 84, below.
c. Calculated to be 9 percent of net supply during 1953-55 and 8 percent during 1956-57.
d. Residual, except 1954. The following qualifications to these estimates must be made. First, for all years except 1954, as noted below, estimates of military consumption of petroleum products were calculated simply as a residual and only to complete the picture of the total disposition of petroleum products in the USSR. Second, any errors present in the derivation of estimates for the other categories present in this table reside in the military estimate. For example, the estimates of civil consumption of petroleum products are believed to be accurate within plus or minus 10 percent, which for 1957 would yield a range of 57.4 million tons to 70.2 million tons. Thus the military estimate for this year would have a range of 7.8 million tons to 20.6 million tons. The fallacy of acceptance of these residuals as correct interpretations of the military consumption of petroleum products in the USSR is further demonstrated by the residual derived for 1954. Calculated as a residual, the military consumption of petroleum products in 1954 appears to have been 3.9 million tons. When compared with the residual estimates of 6.5 million tons in 1953 and 6.8 million tons in 1955, however, a rationale cannot be found to justify such an apparently abrupt decline in military requirements. In order that the trend for this category for 1953-57 be smoothed out, a figure of 6.6 million tons has been inserted for 1954, which represents an interpolation between the preceding and succeeding years.

rate of 12.3 percent, the proportion of the total supply of petroleum products accounted for by civil consumption in the USSR showed a marked decline, from 78 percent in 1953 to 75 percent in 1957. Thus it is apparent that military consumption of petroleum products has increased at a much faster rate during the same period of time. These apparently higher rates of growth in consumption of petroleum products by the military sector of the Soviet economy are unlikely to be maintained over a lengthy period of time. The gradual integration of missiles and atomic-powered submarines and warships into the Soviet military forces should be reflected in reduced requirements for petroleum products.

The estimates of civil consumption developed in this report are substantiated in most cases by those available in Soviet open sources: the range of error in individual years is believed to be not more than plus or minus 10 percent. Because of the complex methodology and the number of assumptions involved, derivation of ranges of error for the remaining estimates was not considered feasible.

B. Statement of Methodology.*

Most of the estimates are based on Soviet sources. In certain instances, however, the lack of information necessitated the development of data by means of subjective analysis.

With only two exceptions, estimates are given in terms of the quantities of petroleum products consumed per unit of work or per unit of output. Estimates of consumption of kerosine by households are based on state and cooperative retail sales. Estimates of the consumption of petroleum products** by the nonferrous metals and manufacturing industries in the years 1953 and 1955 represent the difference between total consumption and consumption by other consumers. Estimates of consumption in the remaining years were calculated on the basis of (1) the proportions obtaining in 1953 and 1954, (2) an index of the demand for lubricants by the manufacturing industries, and (3) information implying a decrease in consumption of residual fuel oil in 1956 and 1957.

* For further details, see the Methodology, Appendix B.

** It is believed that the only petroleum products consumed in significant quantities by the nonferrous metals and manufacturing industries of the USSR are residual fuel oil and lubricants.

II. Consumption by Consuming Sector and by Type of Product.

Estimates of civil consumption of petroleum products in the USSR, by consuming sector and by type of product, are shown for each of the years 1953-57 in Tables 6 through 10.* A description of the methodology used to derive these estimates is given in Appendix B.

A. Transport.

1. Rail.

The consumption of petroleum fuels by rail transport in the USSR is limited primarily to residual fuel oil and diesel fuel, although small amounts of oil shale mixed with coal are consumed in the Estonian SSR in Region II (West). Lubricants consumed include car axle oil, diesel lubricating oil, steam locomotive cylinder oil, and steam locomotive grease.

The consumption of petroleum products by rail transport increased to 5 million tons in 1957, or about twice the level achieved in 1953, to share with households the highest rate of increase in the consumption of petroleum products recorded by any of the consuming sectors of the civil economy. Of the individual products, diesel fuel has shown the sharpest gain since 1953, increasing by more than 270 percent to reach 0.8 million tons in 1957. The consumption of residual fuel oil, which amounted to 3.9 million tons in 1957, has shown the largest absolute increase, 1.8 million tons, since 1953. The increment in the consumption of residual fuel oil, in turn, accounted for about 75 percent of the increase in total consumption of petroleum products by rail transport during the period under study.

Most of the increase in consumption of petroleum products by rail transport was experienced in 1956 and 1957. In these years, consumption increased by 0.8 million tons and 1.2 million tons respectively compared with a total increase of only 0.5 million tons from 1953 to 1955. These increases in consumption reflect significant advances in the volume of rail transport performed by locomotives consuming petroleum fuel, particularly in Economic Regions I (the Northwest), VII (Central), and X (Kazakhstan and Central Asia).

The increases in the consumption of diesel fuel result from the general scheme of dieselization of the railroad system. As yet, however, the consumption of diesel fuel by rail transport is

* Tables 6 through 10 follow on pp. 33 through 37.

relatively insignificant in the total civil consumption of diesel fuel, accounting for about 5 percent in 1957. Compared with the consumption of diesel fuel by US railroads, which reached more than 11.4 million tons in 1956, the consumption of diesel fuel by railroads in the USSR in 1960 has been forecast at 2.4 million tons. The demand for diesel fuel in the USSR by rail transport may reach a level of about 6 million tons by 1965, or about one-half of US consumption in 1956.

The increased consumption of residual fuel oil probably can be attributed to the apparent conversion of large numbers of steam locomotives from coal to oil in the latter half of 1955 and in 1956-57. Instead of reflecting current or anticipated shortages of coal, these conversions probably indicate a greater supply of residual fuel oil. The growing importance of rail transport as a consumer of residual fuel oil is evident in its advance to the position as the second leading civil consumer in 1956, replacing the steel industry. Rail transport accounted for about 19 percent of the civil consumption of residual fuel oil in 1956 and probably about 22 percent in 1957.

The share of rail transport in the civil consumption of petroleum products has shown only a minor advance, from slightly more than 6 percent in 1953 to about 8 percent in 1957. In spite of evidence of a continued gradual shift from solid fuels to liquid fuels, it is probable that the increase in the consumption of petroleum products by rail transport will not keep pace with the planned increases in the total consumption of such products.

2. Inland Waterway.

For the purposes of this report the consumption of petroleum products by inland waterway transport includes consumption by all of those river steamship companies formerly subordinate to the All-Union Ministry of the River Fleet and now subordinate to the Republic ministries of the river fleet; the Central Asiatic Steamship Company, recently transferred to the Ministry of the Maritime Fleet; and the Republic small river administrations. The noncommon carrier river fleets of certain mining, timber, and other industrial enterprises are not included.

Estimates have been made for residual fuel oil, diesel fuel, and lubricants. The consumption of gasoline by inland waterway transport is insignificant and has been omitted. The estimates represent the amounts of fuel and lubricants consumed in carrying freight and passengers and in performing all other functions necessary to maintain service afloat and ashore.

During 1953-56 the consumption by inland waterway transport showed a steady increase, with an average increment of 0.1 million tons in each year. In 1957, consumption increased by about 0.3 million tons, or by 25 percent, to reach 1.5 million tons. Residual fuel oil, probably reflecting an increased supply of this fuel locally, accounted for two-thirds of the increment.

At the end of World War II, inland waterway transport in the USSR consisted largely of steam vessels burning residual fuel oil, coal, or wood. Since that time an increasing emphasis has been placed on dieselization. In 1950, 19 percent of inland waterway transport was diesel-propelled; by 1960, 67-percent dieselization is planned. The effects of the planned dieselization of inland waterway transport are apparent in the period under study. Diesel fuel as a share of the total consumption of petroleum products by the fleet increased from about 19 percent in 1953 to more than 33 percent in 1957. During this period the consumption of diesel fuel increased by 170 percent, to about 0.5 million tons in 1957. Furthermore, diesel fuel accounted for about 55 percent of the increase in consumption of petroleum products by inland waterway transport during 1953-57 compared with about 45 percent attributable to residual fuel oil. Comparative gains probably will continue to be recorded, possibly through 1965.

Residual fuel oil, which accounted for about 75 percent of the total consumption of petroleum products by inland waterway transport in 1953, accounted for less than 65 percent in 1957, in spite of a concurrent estimated increase in the consumption of residual fuel oil of 36 percent, to about 1 million tons. Further declines may be expected as the result of dieselization.

Under the Sixth Five Year Plan (1956-60) the consumption of diesel fuel by the river fleet was scheduled to increase about 2.3 times and the consumption of residual fuel oil, 0.7 times. Thus by 1960, inland waterway transport may consume about 1 million tons of diesel fuel and about 1.3 million tons of residual fuel oil. Conversely, for the other types of fuel consumed by inland waterway transport, coal is to maintain approximately the level of 1955, but a significant decrease in consumption of wood is planned, to about 35 percent of the level of 1955.

The share of inland waterway transport in total civil consumption of petroleum products showed only a very slight increase, from 2.3 percent in 1953 to 2.4 percent in 1957. The significance of inland waterway transport as a consumer of petroleum products is not expected to be greatly altered in the long run.

3. Oceangoing.

Estimates of the consumption of petroleum products in the USSR by oceangoing transport include those estimates of consumption by the organizations subordinate to the Ministry of the Maritime Fleet, including all of the maritime steamship companies, and the three companies operating on the Caspian Sea. Estimates have been derived for those fuels and lubricants expended by oceangoing transport in carrying cargo and passengers and by the service fleet and shore installations in performing maintenance functions.

The consumption of petroleum products by oceangoing transport of the USSR increased to 1.2 million tons in 1957, an increase of about 60 percent over the level that was recorded in 1953. Yet as a share of the total civil consumption of petroleum products, oceangoing transport remained at a constant level of about 2 percent during 1953-57. Of the absolute increment of 450,000 tons during this period, diesel fuel accounted for about 49 percent, and residual fuel oil for about 40 percent. The consumption of diesel fuel increased at an average annual rate estimated at about 27 percent compared with approximately 8 percent for residual fuel oil.

Evidence of the apparent shift to diesel fuel is the increasing role attributed to diesel fuel in the total consumption of petroleum products by oceangoing transport. In 1953, diesel fuel accounted for slightly less than 19 percent of the petroleum fuels and lubricants consumed. By 1957 the share had grown to about 30 percent. Thus, although the trend is more pronounced in the case of inland waterway transport, there is also a definite trend toward the dieselization of the maritime fleet. Although future increases in the consumption of both diesel fuel and residual fuel oil are anticipated, it is probable that increases in the consumption of residual fuel oil will be of lesser proportions.

4. Motor.

The estimated consumption of petroleum products in the USSR by motor transport represents the consumption of petroleum products by vehicles subordinate to the Republic ministries of motor transport, as well as by those motor vehicles in agriculture and in industry. In addition, estimates of the consumption of petroleum products by privately owned automobiles and motorcycles have been included.

Of the individual sectors in the civil economy of the USSR, motor transport has shown the largest absolute increase in consumption of petroleum products since 1953 -- 5.8 million tons,

achieved at an average annual rate of 17 percent -- to reach a total of 12.6 million tons in 1957. This sharp increase served not only to raise the share of motor transport in the total civil consumption of petroleum products to 20 percent but also enabled motor transport to challenge agriculture as the leading consumer. Final figures for 1957 may show that motor transport already has replaced agriculture as the leading consumer.

Gasoline is the principal primary fuel used by motor transport. The increase in consumption of gasoline by motor transport to 11.6 million tons in 1957 represented more than 91 percent of the total increase in consumption of petroleum products by motor transport since 1953. In addition, motor transport accounted for more than 86 percent of the total civil consumption of motor gasoline in 1957. The consumption of gasoline has kept pace with the growth in the total consumption of petroleum products by motor transport. Consequently, throughout the period 1953-57 the share of gasoline in total consumption has held constant at about 92 percent.

Of the several types of gasoline-consuming vehicles within the motor vehicle park of the USSR, freight trucks account for the preponderant share of the estimated consumption of gasoline. This share ranged from more than 85 percent in 1953 to 81 percent in 1957. The slight decline resulted from slight increases in the proportions of privately owned vehicles (automobiles and motorcycles) and of motor buses, which reached 10.3 percent and 6.7 percent, respectively, in 1957. The remainder of consumption of gasoline in each year has been attributed to passenger and truck taxi.

The consumption of diesel fuel by motor transport in the USSR increased to about 170,000 tons in 1957, a gain of about 120 percent since 1953. Nevertheless, diesel fuel accounts for only about 1 percent of consumption of petroleum products by motor transport. Plans covering the next 10 to 15 years call for a rapid advance in the transport of freight by diesel-powered trucks. This rate of increase will exceed by three times that of gasoline-powered trucks. It is expected that increases in the consumption of diesel fuel will result from the implementation of this plan, although dieselization of the truck fleet will be limited primarily to those trucks with a carrying capacity of more than 4 tons. Trucks with a capacity of 4 tons will be equipped to operate on either motor gasoline or diesel fuel, depending on supplies. Trucks below 4 tons and all passenger cars will operate on motor gasoline. These plans indicate a continuation of the predominant role of motor gasoline in powering the motor vehicles.

Presently in use in the USSR are two types of motor vehicles powered by diesel fuel, freight trucks and buses. In 1953, freight trucks accounted for less than 79 percent of the diesel fuel consumed by motor transport. By 1957 this share had increased to about 88 percent.

Motor transport accounts for a considerable share of the total civil consumption of lubricants in the USSR. In 1953, motor transport accounted for about 450,000 tons of lubricants, or 22 percent of the total consumed. In 1957, consumption of lubricants increased to about 830,000 tons, or 28 percent of the total. As motor transport assumes the position of leading consumer of petroleum products, a comparable increase in the share of lubricants consumed by motor transport may be anticipated.

5. Civil Air.

These estimates include the consumption of (a) aviation gasoline by reciprocating engine aircraft of the DC-3 type (Il-14, Crate; Il-12, Coach; Li-2, Cab), (b) lubricating oil by such aircraft, and (c) jet fuel (kerosine) by the Tu-104 (Camel) and Tu-104A aircraft. The consumption of lubricating oil by jet aircraft is considered to be negligible and has not been included. Also considered negligible and not included is the consumption of petroleum products by Special Services and Polar Aviation Operations.

Civil air transport accounts for all of the civil consumption of aviation gasoline, which increased at an average annual rate of about 7 percent since 1953 to reach about 0.9 million tons in 1957.

The civil consumption of jet fuel in the USSR first became apparent in 1957, when civil air transport had in operation about 30 jet aircraft. These aircraft consumed about 150,000 tons of jet fuel, thus accounting for 15 percent of the consumption of all petroleum products by civil air transport in 1957.

The development of jet propulsion portends a significant change in the structure of consumption of aviation fuels. Soviet planners have indicated that this change will be evident particularly in the pattern of the consumption of aviation fuels by civil air transport. Although demand for aviation gasoline will increase somewhat, such gasoline will account for a smaller share of the fuels consumed by civil aviation because of a considerably higher demand for jet fuel.

The increasingly important role to be played by jet aircraft is not expected to alter significantly the minor role of civil air transport in the consumption of petroleum products in the USSR. In spite of the introduction of jet aircraft in 1957, the share of civil air transport in the consumption of petroleum products declined slightly compared with 1953. Although the increased use of aircraft will serve to reverse this trend, the share of civil air transport probably will remain at about 2 percent of the total civil consumption of petroleum products in the USSR.

B. Agriculture.

Estimates of the consumption of petroleum products by Soviet agriculture represent consumption by agricultural tractors, by combines, and by other types of agricultural machinery which use petroleum products. Estimates of the consumption of petroleum products by trucks and automobiles of the agricultural sector are included in the estimates derived for motor transport.

All tractor field work in the USSR is measured by a standard accounting unit, the soft-plowing unit, into which all work is translated. Similarly, tractor utilization is measured by the average number of soft-plowing units performed per 15-horsepower tractor unit, and fuel consumption is given in terms of the average consumption (in kilograms) per unit of tractor work for each type of work. A lack of information precluded the derivation of precise estimates of consumption according to type of tractor. Instead, an estimate was made of the proportion of the Soviet tractor park consuming diesel fuel. Evidence suggests that, for the purposes of this report, tractor kerosine may be considered the primary fuel of tractors not consuming diesel fuel. The quantities of gasoline and ligroine consumed by the agricultural tractor park are believed to be negligible, particularly in the later years under study, and have been omitted.

All of the combines in use in the USSR consume gasoline as a primary fuel. Productivity and consumption of fuel per hectare varies according to the model of the combine. In recognition of these fluctuations, use has been made of an average fuel consumption factor in terms of kilograms per hectare of area harvested, which was computed on the basis of the annual composition of the combine park, the daily productivity of each combine model, and the consumption of fuel per hectare by each model.

The consumption of petroleum products by other agricultural machinery reflects the relationship between the total amount of energy developed by tractors and combines and that developed by the other agricultural machinery.

Agriculture, the leading individual consumer during 1953-57, showed a total increase in consumption of only 3 million tons to reach 12.8 million tons in 1957. The average annual rate of increase, about 7 percent, is considerably below the estimated rate of increase of 12.3 percent in the total civil consumption of petroleum products in the USSR. Consequently, the share of agriculture in such consumption declined from more than 24 percent in 1953 to about 20 percent in 1957 and may have dropped below that of motor transport in 1958.

The relatively slower rates of increase in the consumption by agriculture result in general from the program of dieselization of the agricultural tractor park. Of the several distinct advantages that diesel tractors hold over others, probably the most important is the lower rate of consumption of primary fuel per unit of output. For the period 1953-57, it is estimated that diesel tractors consumed 10 kilograms (kg) of fuel per soft-plowing unit, as compared with an estimated consumption of more than 15 kg by nondiesel tractors. Thus, in the performance of a comparable unit of output, the use of diesel tractors would represent a saving in fuel of more than one-third.

The importance of this saving is readily apparent. In 1953, diesel tractors accounted for 53.5 percent of all soft-plowing units in the USSR. By 1957, this share had increased to 79.9 percent. If, however, the share performed by diesel tractors had remained constant throughout the period at 53.5 percent, the total primary fuel consumption by tractors in 1957 would have exceeded the amount estimated for that year by about 1 million tons, or by nearly 10 percent.

The dieselization of the agricultural tractor park has resulted in significant changes in the types of petroleum products consumed by Soviet agriculture. In 1953, consumption of tractor kerosine amounted to 4.6 million tons, or about 47 percent of all such products, and diesel fuel to 3.7 million tons, or only 38 percent of the total. By 1957, however, consumption of diesel fuel by agriculture had increased to 8.1 million tons, or more than 63 percent of all the petroleum products consumed by agriculture. At the same time, consumption of tractor kerosine declined to 2.9 million tons, accounting for less than 23 percent of the total. Available information indicates that the decline in the demand for tractor kerosine by agriculture will continue at least through 1965. By then, it has been reported that the demand will have been reduced to 37 percent of the 1955 level, thus suggesting a quantity of about 1.4 million tons.

Conversely, a continued rapid rise in the consumption of diesel fuel by Soviet agriculture is foreseen. On the basis of available evidence, the consumption of diesel fuel by agriculture

in 1965 may be estimated at about 23 million tons, or almost 3.7 times that in 1955. The fulfillment of plans for the introduction of diesel equipment into other sectors of the economy, particularly in transport, will serve to reduce the share of Soviet agriculture in the total consumption of diesel fuel in the USSR. Of the total military and civil demand for diesel fuel, the agricultural share is expected to decline from about 47.0 percent in 1955 to 38.9 percent in 1965. Meanwhile the share of transport is expected to increase from about 8.3 percent in 1955 to 24.3 percent in 1965.

In addition to diesel fuel, the agricultural sector consumes considerable quantities of gasoline and lubricants. Most of the gasoline is used by combines, the remainder being consumed by other types of agricultural machinery or as a starter fuel for diesel engines. Although the consumption of gasoline in 1957 increased to 840,000 tons, a gain of about 15 percent since 1953, there has been a decline since 1955. The consumption of gasoline by agriculture in 1957 has been estimated at 93.3 percent of the 1955 level, although the estimated number of hectares harvested by combines in 1957 represented an increase, if only minor, compared with 1955. The decrease resulted from a reduction of about 10 percent in the quantity of primary fuel consumed per hectare of area harvested in 1956 and 1957.

In each of the years 1953-57, agriculture was the leading individual consumer of lubricants. In 1953, agriculture accounted for 730,000 tons of lubricants, or 36.5 percent of civil consumption. In spite of an increase to 920,000 tons in 1957 the share of agriculture declined to 30.7 percent of civil consumption of lubricants. This decline is attributable to the dieselization of the agricultural tractor park, because diesel tractors consume a smaller proportion of lubricants than do other tractors. Further declines may be expected, possibly through 1965, but these declines should not effect the position of agriculture as the leading consumer of lubricants.

C. Households.

Estimates of the consumption of petroleum products by Soviet households have been limited to the consumption of lamp and stove kerosine. The consumption of other petroleum products, if any, is believed to be negligible and has been omitted.

Household consumption of kerosine doubled during 1953-57 to reach about 2.4 million tons. This rate of increase in consumption is equaled by only one other consuming sector, motor transport. During 1953-57 the consumption of kerosine increased at an average annual rate of 18.9 percent, or close to the rate of increase of

18.7 percent in consumption of illuminating* kerosine which was reported under the Fifth Five Year Plan (1951-55). By years, a slightly higher rate of increase in consumption was achieved in 1956 and 1957. In these years, consumption rose by an estimated 25 percent and 20 percent, respectively.

The share of households in civil consumption of kerosine increased steadily to about 44.4 percent of the total in 1957, reflecting the increased supply of kerosine for households because of the decline in the use of tractor kerosine.

There is little evidence with which to speculate on future trends in consumption of kerosine by Soviet households. These trends will be influenced to a large extent by the degree of implementation of plans to increase the delivery of electric power and gas to households. Electric power will play an important role in the more remote areas. Conversely, the delivery of gas will be increased in urban areas, particularly in the European USSR. In 1956, gas was available for domestic use to 12 million people, or 13.8 percent of the urban population of the USSR, and the number of apartments equipped to use natural gas reached 1.3 million. Delivery to rural areas was insignificant. At the end of 1958 the number of apartments using gas exceeded 1.7 million, equivalent to a population of 15.5 million. By 1965, gas is to be supplied to 42 million people, and the total number of apartments furnished with gas-burning stoves and hot water heaters is to rise to 6.7 million. In addition, it has been reported that in 1965 about 13 million people in rural areas will be using gas, chiefly liquefied petroleum gas (LPG). Thus, according to preliminary calculations as reported in Soviet source materials, in 1965 a total of 55 million people will be using gas in some form.

It is probable that kerosine will be replaced in certain areas as a household fuel by gas. It is also probable that gas will replace other household fuels such as coal and fuelwood. The consumption of lamp and stove kerosine per capita in the USSR in 1956 averaged 10 kg, representing an increase of 35 percent above the pre-World War II high of 7.4 kg per capita in 1940,** which in itself represented only a very small increase over the consumption of 6.5 kg of kerosine per capita in 1913. In consideration of the

* In Soviet sources, mention is made of only two types of kerosine These types are tractor kerosine and illuminating kerosine. It is probable that illuminating kerosine, in addition to its primary purpose, is used as a fuel for stoves.

** The slow rate of increase in consumption of kerosine for domestic purposes before World War II can be attributed to (1) the extremely high rates of increase in the demand for kerosine by the tractor park. and (2) a reduction in production of crude oil at the Groznyy fields. Both factors have led to a reduction in the quantities of kerosine available to households.

estimated increase in production of kerosine,* however, accompanied by a sharp decline in the demand for tractor kerosine, it is believed that the consumption of kerosine by households will continue to increase at the rate exhibited during 1950-57. This rate of increase -- about 19 percent annually -- probably will be continued through 1960 and possibly through 1965. The consumption of kerosine by households then would reach about 4 million tons in 1960 and about 10 million tons in 1965.

D. Construction.

Estimates of the consumption of petroleum products by construction in the USSR include consumption by the construction equipment park and by the construction materials industry. Also included are estimates of consumption of road oils and asphalts, because all of the production of these items in the USSR is believed to be used in construction.

The consumption of petroleum products in construction increased to 9.3 million tons in 1957, a gain of about 66 percent above the level of 1953. The increase in consumption has been comparable to that in the total civil consumption of petroleum products, and as a consequence the share of construction in such consumption has remained constant at about 14 percent. Construction was the third leading civil consumer of petroleum products during 1954-57 and probably will retain this position.

Road oils and asphalts have accounted for most of the petroleum products used in Soviet construction, averaging about 60 percent during 1953-57. In addition, these products accounted for more than half the total increase in consumption of petroleum products in construction during those years. The consumption of road oils and asphalts increased from about 3.5 million tons in 1953 to about 5.5 million tons in 1957. On the basis of available information the consumption of road oils and asphalts may reach 10 million tons in 1965.

Together with diesel fuel, road oils and asphalts accounted for about 95 percent of the total consumption of petroleum products in Soviet construction during each of the years 1953-57. The quantity of diesel fuel so consumed in 1957 reached about 3.4 million tons, an increase of about 90 percent compared with 1953 and more than five times the quantity so consumed in 1950. In 1957, construction accounted for 20.9 percent of the total civil consumption of diesel fuel, declining slightly from the level of 22.8 percent registered in 1953. The consumption of diesel fuel probably will continue to grow at the average annual rate of increase of 17.2 percent which was exhibited during 1953-57. Continuation of this rate of increase would indicate the consumption of approximately 5.5 million tons of diesel fuel in construction in 1960.

* It has been estimated that production of kerosine in 1965 will be 2.4 times that in 1955.

During 1953-57 the consumption of tractor kerosine and ligroine in construction virtually ceased. The consumption of kerosine reached negligible proportions in 1956. The consumption of ligroine reached negligible proportions in 1954, and the need for this type of tractor fuel apparently was obviated in 1955.

The apparent need for gasoline in Soviet construction also is declining. It is estimated that since World War II such consumption reached a peak of 270,000 tons in 1954. The consumption of gasoline in 1957 is estimated at about 81 percent of the 1954 level. Further declines probably will be recorded as gasoline is supplanted by diesel fuel and electric power.

E. Industry.

1. Petroleum.

The petroleum industry in the USSR consumes a variety of petroleum products in its crude oil drilling and producing operations in the refining of crude oil, and in the construction and repair of trunk* oil and gas pipelines.** Among these products are gasoline, diesel fuel, lubricants, residual fuel oil, bitumen, bituminous tar, and ligroine. The petroleum industry also consumes as a petroleum product about 1 percent of the indigenous production of crude oil.

Of the individual branches of Soviet industry, the petroleum industry held second place behind the electric power industry as an industrial consumer of petroleum products during 1953-57. The share of the petroleum industry in total civil consumption of petroleum products advanced from about 7 percent in 1953 to about 8 percent in 1957.

The rate of increase in consumption of petroleum products by the Soviet petroleum industry has approximated the increase in production of crude oil. It has been estimated that, during 1953-57, about 5 kg of petroleum products were needed to drill for, to produce, and to refine 1 ton of crude oil.

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* That pipeline in a system of pipelines which performs the central delivery.

** Although responsibility for the construction of crude oil, petroleum product, and gas pipelines was transferred from the Ministry of the Petroleum Industry, USSR, to the Main Administration for the Gas Industry, attached to the Council of Ministers, USSR (Glavnoye Upravleniye Gazovoy Promyshlennosti pri Sovete Ministrov SSSR -- Glavgaz, USSR) in July 1957, for the purposes of this study, the consumption of petroleum products in the construction and repair of trunk pipelines during the whole of 1957 is attributed to the petroleum industry.

Inasmuch as production of crude oil increased by more than 85 percent over that in 1953, the consumption of petroleum products by the petroleum industry in 1957 is estimated at 5 million tons. The principal item consumed was residual fuel oil, which accounted for more than 60 percent of the total in each year. Crude oil accounted for nearly 20 percent annually and diesel fuel for about 12 percent. The remainder is attributed to gasoline, lubricants, bitumen, bituminous tar, and ligroine.

The consumption of the individual petroleum products by the petroleum industry is peculiar to the type of operation performed. Crude oil drilling and producing operations account for all of the consumption of gasoline, diesel fuel, lubricants, crude oil, and about 9 percent of the annual consumption of residual fuel oil. All of the remaining residual fuel oil is consumed by the crude oil refineries. In 1957 the crude oil drilling and producing operations accounted for about 42 percent of total consumption by the petroleum industry, and the consumption of residual fuel oil in the process of refining of the crude oil reached about 56 percent of the total for all petroleum products, with the remainder directed to the pipeline construction program. The pipeline construction program in 1957 consumed only 66,000 tons of bitumen and bituminous tar and negligible amounts of ligroine, accounting for about 1 percent of all petroleum products consumed by the petroleum industry.

An analysis of available information indicates that a reduction in the consumption of petroleum products in terms of production of 1 ton of crude oil is to be expected. Probably most of this reduction will occur during the process of refining, inasmuch as a number of crude oil refineries are scheduled to convert from the burning of residual fuel oil to the burning of natural gas. For example, it has been reported that most of the Baku refineries have already converted to gas. Wider use of available resources of gas in the field by the petroleum industry is also contemplated.* It is also probable, however, that the effect of the planned conversions will not be readily apparent for several years. As late as 1956, none of the field equipment of the industry had been converted to gas as yet. Therefore, with production planned at about 140 million tons of crude oil in 1960, the consumption of petroleum products by the petroleum industry in that year may be estimated at 7 million tons. Production of crude oil in 1965 is scheduled to reach 240 million tons. The consumption of petroleum products by the industry in 1965 may range between 9 million and 10 million tons.

* According to the plan for 1957 the consumption of gas by the oil and gas industries of the USSR was to reach 22.1 percent of the total civil consumption of gas.

2. Chemical.

The chemical industry of the USSR uses petroleum products in process heating in the manufacture of soda ash and caustic soda and as a raw material in production of synthetic rubber, tires, and carbon black.

Residual fuel oil is used in certain chemical plants in the calcination of sodium bicarbonate to produce soda ash and to raise the steam required in production of caustic soda. Rubrax, a petroleum alkaline bitumen, is used as a softening agent in production of tires and rubber technical articles. Green oil, a heavy distillate oil, finds application in production of certain types of carbon blacks produced by burning liquid hydrocarbons in the presence of an insufficient amount of air.

The quantities of petroleum products consumed by the chemical industry are negligible. By 1957 there had been an increase of 20 percent compared with 1953, but the total amount so consumed was only 240,000 tons.

In each of the years 1953-57, residual fuel oil accounted for approximately 50 to 55 percent of the petroleum products consumed by the chemical industry, followed by green oil, which accounted for about 35 to 40 percent. Rubrax accounted for the remainder.

Next to the coal industry the chemical industry is the smallest civil consumer of petroleum products in the USSR. The share of the chemical industry in the total civil consumption of petroleum products declined from about 0.5 percent in 1953 to less than 0.4 percent in 1957. With the anticipated development of a large petrochemical industry, the chemical industry is expected to consume much larger quantities of petroleum products. It is unlikely, however, that these quantities will be sufficient to make the industry a significant consumer of petroleum products.

3. Coal.

The coal industry is the smallest civil consumer of petroleum products in the USSR. The consumption of such products by the industry increased from 170,000 tons in 1953 to 230,000 tons in 1957.

The consumption of petroleum products by the coal industry is limited to those amounts of diesel fuel consumed in the flotation process, to lubricants consumed by surface and underground mining equipment, and to fuel and lubricants expended by the motor vehicle park of the industry. The estimates involving motor vehicles are included in the estimates derived for motor transport.*

* II, A, 4, p. 18, above.

The quantities of diesel fuel consumed in the flotation process are insignificant, ranging from 25,000 tons in 1953 to 47,000 tons in 1957. Lubricants consumed by the wide variety of mining equipment -- among which are included tunneling combines, drills, excavators, and conveyors -- accounted for about 80 percent of the petroleum products consumed in each year. Lubricants also accounted for two-thirds of the increment in the consumption of such products by the coal industry during 1953-57. The consumption of lubricants by the industry in 1957 is estimated at 180,000 tons.

Like the chemical industry, the coal industry has accounted for a decreasing share of the civil consumption of petroleum products since 1953. Although it is doubtful that these declines will continue indefinitely, there is little evidence to indicate the likelihood of any substantial relative increase in the consumption of petroleum products by the coal industry.

4. Steel.

It is believed that the steel industry of the USSR consumes substantial quantities of residual fuel oil, lubricants, motor gasoline, and diesel fuel. Except for residual fuel oil, these products are used in the performance of transport services and therefore are included in those estimates derived for motor transport.*

The major use of residual fuel oil in the steel industry is for firing open-hearth furnaces, soaking pits, and reheating furnaces. The consumption of residual fuel oil for these purposes has risen from about 2.3 million tons in 1953 to about 3 million tons in 1957. During these years, however, the share of the steel industry in the total consumption of residual fuel oil declined from 19.5 percent of the total in 1953 to about 16.6 percent in 1957. Similarly, the share of the industry in the total civil consumption of petroleum products declined from about 6 percent in 1953 to slightly less than 5 percent in 1957.

The use of residual fuel oil to fire steelmaking units in the USSR is decidedly secondary to the use of blast furnace and coke oven gas, and this situation is not likely to change greatly within the next few years. The planned conversion of a number of open-hearth furnaces to natural gas will serve to offset, at least in part, any increased use of residual fuel oil. It is probable that the conversion to natural gas or the increased use of residual fuel oil will occur only on a regional basis and will be dictated by considerations of supply.

* II, A, 4, p. 18, above.

5. Electric Power.

Significant quantities of gasoline, diesel fuel, and residual fuel oil are consumed in the USSR in the generation of electric power. Residual fuel oil probably constitutes virtually the entire supply of petroleum fuels consumed by the thermal electric power stations under the authority of the Ministry of Electric Power Stations, USSR. These plants usually have a capacity of 6 megawatts or more. Diesel fuel and other internal combustion engine fuels are used only in installations with a relatively small capacity which are not under the Ministry of Electric Power Stations.

Soviet consumption of petroleum products in the generation of electric power increased from about 5.6 million tons in 1953 to about 8.2 million tons in 1957, an average annual gain of 10 percent. These totals place the electric power industry as the leading consumer of petroleum products in the industrial sector. In each of the years 1953-57, the electric power industry accounted for about 46 percent of the total consumption of petroleum products by the industrial sector.

Consumption of petroleum products by the electric power industry represented about 13 percent of total civil consumption in 1957.

In relation to other consumers of petroleum products in the civil economy, the electric power industry holds fourth place and is expected to remain in this position.

The electric power industry is a major consumer of residual fuel oil in the USSR. In each of the years 1953-57, approximately 30 percent of the civil consumption of residual fuel oil has been in the generation of electric power. At the same time the consumption of this product by the electric power industry increased from about 3.7 million tons in 1953 to about 5.4 million tons in 1957, accounting for about two-thirds of all the petroleum products consumed by the industry.

Considerable quantities of diesel fuel are also consumed by the electric power industry in the USSR. These quantities ranged from about 1.5 million tons in 1953 to about 2.3 million tons in 1957, representing about 19 percent and 14 percent, respectively, of the civil consumption of diesel fuel. This rather sharp decline may be attributed to the more rapid increases in the consumption of diesel fuel by other sectors of the economy.

Gasoline is of relatively minor importance of the electric power industry of the USSR. In 1957, consumption amounted to about 490,000 tons, a gain of 32 percent compared with 1953. Nevertheless, gasoline represented less than 6 percent of the petroleum products consumed in 1957 by the industry.

The consumption of lubricants by the electric power industry of the USSR is negligible. The estimates, which have been based on analogy with US practice, amount to only 1,000 tons in each of the years 1953-57.

Significant increases in Soviet production of electric power are expected. At present, goals are believed to be as follows: 1960, 300 billion kilowatt-hours (kwh); 1965, 500 billion kwh; and 1972, 900 billion kwh. Relative increases in the consumption of petroleum products by the electric power industry are unlikely, because the amount of electric power to be generated by stations using petroleum products is not to change substantially. Production of electric power by stations using residual fuel oil in 1972 probably will amount to about 9 billion kwh compared with 8.8 billion kwh generated by such stations in 1955. The generation of electric power by stations using other petroleum products is scheduled to increase from 6.5 billion kwh in 1955 to about 9 billion kwh in 1972, but because of probable reductions in the consumption of fuel per unit of output, significant increases in the consumption of these fuels by the industry are not anticipated. Details for implementing Khrushchev's speech at the dedication of the Kuybyshev hydroelectric power station, in which he called for a speed-up in the construction of thermal electric power stations, have not been announced. The implementation of this program will require an increase in the consumption of fuel by the electric power industry. Much of this increase probably will be provided by natural gas and residual fuel oil.

It is believed that the consumption of petroleum products by the electric power industry in the USSR in 1965 may be double the levels that have been estimated for 1957.

6. Nonferrous Metals and Manufacturing.

There is little information to indicate the volume of petroleum products consumed by either the nonferrous metals or manufacturing industries in the USSR. For certain phases of the Soviet economy in which practices are comparable to those in the USSR, fairly reliable estimates of the consumption of petroleum products can be derived by analogy. With regard to the nonferrous metals industry,

however, the absence of estimates of Soviet production of the individual metals precludes such a comparison. Conversely, for the manufacturing industries, usable data on the consumption of petroleum products by comparable US industries are not available.

It is believed that the only petroleum products consumed in any significant quantity by the manufacturing industries of the USSR are lubricants and residual fuel oil. Although the nonferrous metals industry of the USSR probably consumes quantities of several petroleum products in the performance of various operations, such as the exploitation of mining equipment, the principal share would be consumed in transportation. Estimates of consumption in transportation are included by definition in those estimates for motor transport.* Therefore, the only estimates of consumption that have been derived for the manufacturing and nonferrous metals industries are those involving lubricants and residual fuel.

These estimates for lubricants and residual fuel indicate that consumption of petroleum products by the nonferrous metals and manufacturing industries in the USSR increased from 900,000 tons in 1953 to a maximum of 1.4 million tons in 1955 but declined to 1.2 million tons in 1956. In the absence of data to the contrary, it is assumed that consumption in 1957 remained at the level of 1956. Such levels of consumption represented insignificant portions of the total civil consumption of petroleum products, averaging about 2 percent in each year.

The apparent decline in the consumption of petroleum products in the USSR reflects the replacement of residual fuel oil as an industrial fuel by gas. Estimated consumption of residual fuel oil had increased from 700,000 tons in 1953 to 1.2 million tons in 1955 but declined sharply to 900,000 tons in 1956. Although further declines of 25 percent are unlikely, the use of gas is increasing, especially in the manufacturing industries. In information supplied to the Economic Commission for Europe, the USSR indicated plans for a sharp increase in the allocation of gas to machine-construction plants. In 1960 the consumption of gas in machine construction is scheduled to reach 6.1 billion cubic meters, or nearly 12 times the level of 1956, and to account for about 10 percent of total consumption of gas.

The consumption of lubricants by the nonferrous metals and manufacturing industries of the USSR has increased from 200,000 tons in 1953 to 300,000 tons in 1957, accounting for an average of 10 percent of annual civil consumption. It has been reported that by 1965 the consumption of lubricants by the entire industrial sector will account for 53.3 percent of the total consumption of lubricants in the USSR. Perhaps as much as one-half of this quantity may be directed to the nonferrous metals and manufacturing industries.**

* See II, A, 4, p. 18, above.

** Text continued on p. 39.

Table 6

Estimated Civil Consumption of Petroleum Products in the USSR
by Consuming Sector and by Type of Product a/
1953

Thousand Metric Tons

Type of Product	Transport								Industry							Total b/
	Rail	Inland Waterway	Ocean-going	Motor	Civil Air	Agriculture	Household	Construction	Petroleum	Chemical	Coal	Steel	Electric Power	Nonferrous Metals and Manufacturing		
Gasoline																
Aviation	0	0	0	0	680	0	0	0	0	0	0	0	0	0		680
Motor	0	0	0	6,300	0	730	0	260	95	0	0	N.A.	370	c/		7,800
Total b/	0	0	0	6,300	680	730	0	260	95	0	0	N.A.	370	c/		8,500
Ligroine	0	0	0	0	0	c/	0	4	d/	0	0	0	0	0		4
Kerosine																
Lamp and stove	0	0	0	0	0	0	1,200	0	0	0	0	0	0	0		1,200
Tractor	0	0	0	0	0	4,600	0	8	0	0	0	0	0	c/		4,600
Total b/	0	0	0	0	0	4,600	1,200	8	0	0	0	0	0	c/		5,800
Diesel fuel	220	180	140	76	0	3,700	0	1,800	310	0	25	N.A.	1,500	c/		7,900
Lubricants	200	60	75	450	4	730	0	96	50	N.A.	140	N.A.	1	200		2,000
Residuals and others																
Residual fuel oil	2,100	700	530	0	0	0	0	0	1,700	99	0	2,300	3,700	700		11,800
Road oils and asphalts	0	0	0	0	0	0	0	3,500	0	0	0	0	0	0		3,500
Bitumen and bituminous tar	0	0	0	0	0	0	0	0	22	0	0	0	0	0		22
Rubrax	0	0	0	0	0	0	0	0	0	14	0	0	0	0		14
Green oil	0	0	0	0	0	0	0	0	0	85	0	0	0	0		85
Total b/	2,100	700	530	0	0	0	0	3,500	1,700	200	0	2,300	3,700	700		15,400
Crude oil consumed as a product	0	0	0	0	0	0	0	0	530	0	0	0	0	0		530
Grand total b/	2,300	940	750	6,800	690	9,800	1,200	5,600	2,700	200	170	2,300	5,600	900		40,100

a. Estimates of less than 10,000 are expressed in 1 significant digit; those of 10,000 through 9.9 million, in 2 significant digits; and those of 10 million or more, in 3 significant digits.
b. Totals were derived from unrounded data and do not always equal the sums of the rounded components.
c. Unknown.
d. Negligible.

Table 7

Estimated Civil Consumption of Petroleum Products in the USSR
by Consuming Sector and by Type of Product a/
1954

Thousand Metric Tons

Type of Product	Transport					Industry									
	Rail	Inland Waterway	Ocean-going	Motor	Civil Air	Agri-culture	House-hold	Construc-tion	Petro-leum	Chemical	Coal	Steel	Electric Power	Nonferrous Metals and Manufacturing	Total b/
Gasoline															
Aviation	0	0	0	0	770	0	0	0	0	0	0	0	0	0	770
Motor	0	0	0	7,600	0	780	0	270	110	0	0	N.A.	400	c/	9,100
Total b/	0	0	0	7,600	770	780	0	270	110	0	0	N.A.	400	c/	9,900
Ligroine	0	0	0	0	0	c/	0	d/	d/	0	0	0	0	0	d/
Kerosine															
Lamp and stove	0	0	0	0	0	0	1,400	0	0	0	0	0	0	0	1,400
Tractor	0	0	0	0	0	4,500	0	6	0	0	0	0	0	c/	4,500
Total b/	0	0	0	0	0	4,500	1,400	6	0	0	0	0	0	c/	5,900
Diesel fuel	280	230	170	96	0	4,800	0	2,100	350	0	31	N.A.	1,700	c/	9,800
Lubricants	200	64	85	540	5	810	0	110	57	N.A.	150	N.A.	1	200	2,200
Residuals and others															
Residual fuel oil	2,200	720	580	0	0	0	0	0	1,900	110	0	2,500	4,300	1,000	13,300
Road oils and asphalts	0	0	0	0	0	0	0	4,000	0	0	0	0	0	0	4,000
Bitumen and bituminous tar	0	0	0	0	0	0	0	0	23	0	0	0	0	0	23
Rubrax	0	0	0	0	0	0	0	0	0	15	0	0	0	0	15
Green oil	0	0	0	0	0	0	0	0	0	85	0	0	0	0	85
Total b/	2,200	720	580	0	0	0	0	4,000	1,900	210	0	2,500	4,300	1,000	17,400
Crude oil consumed as a product	0	0	0	0	0	0	0	0	590	0	0	0	0	0	590
Grand total b/	2,700	1,000	840	8,200	770	10,900	1,400	6,500	3,000	210	180	2,500	6,400	1,200	45,800

a. Estimates of less than 10,000 are expressed in 1 significant digit; those of 10,000 through 9.9 million, in 2 significant digits; and those of 10 million or more, in 3 significant digits.
b. Totals were derived from unrounded data and do not always equal the sums of the rounded components.
c. Unknown.
d. Negligible.

Table 8

Estimated Civil Consumption of Petroleum Products in the USSR
by Consuming Sector and by Type of Product a/
1955

Thousand Metric Tons

Type of Product	Transport					Industry									Total b/
	Rail	Inland Waterway	Ocean-going	Motor	Civil Air	Agriculture	Household	Construction	Petroleum	Chemical	Coal	Steel	Electric Power	Nonferrous Metals and Manufacturing	
Gasoline															
Aviation	0	0	0	0	830	0	0	0	0	0	0	0	0	0	830
Motor	0	0	0	8,700	0	900	0	260	130	0	0	N.A.	430	c/	10,400
Total b/	0	0	0	8,700	830	900	0	260	130	0	0	N.A.	430	c/	11,300
Ligroine	0	0	0	0	0	c/	0	0	d/	0	0	0	0	0	d/
Kerosine															
Lamp and stove	0	0	0	0	0	0	1,600	0	0	0	0	0	0	0	1,600
Tractor	0	0	0	0	0	3,900	0	4	0	0	0	0	0	c/	3,900
Total b/	0	0	0	0	0	3,900	1,600	4	0	0	0	0	0	c/	5,500
Diesel fuel	460	300	240	110	0	6,300	0	2,400	420	0	36	N.A.	1,900	c/	12,200
Lubricants	230	68	100	620	5	870	0	130	68	N.A.	160	N.A.	1	200	2,400
Residuals and others															
Residual fuel oil	2,400	750	630	0	0	0	0	0	2,300	110	0	2,700	4,600	1,200	14,600
Road oils and asphalts	0	0	0	0	0	0	0	4,500	0	0	0	0	0	0	4,500
Bitumen and bituminous tar	0	0	0	0	0	0	0	0	42	0	0	0	0	0	42
Rubrax	0	0	0	0	0	0	0	0	0	17	0	0	0	0	17
Green oil	0	0	0	0	0	0	0	0	0	85	0	0	0	0	85
Total b/	2,400	750	630	0	0	0	0	4,500	2,300	220	0	2,700	4,600	1,200	19,200
Crude oil consumed as a product	0	0	0	0	0	0	0	0	710	0	0	0	0	0	710
Grand total b/	3,000	1,100	970	9,500	830	11,900	1,600	7,300	3,600	220	200	2,700	6,900	1,400	51,300

a. Estimates of less than 10,000 are expressed in 1 significant digit; those of 10,000 through 9.9 million, in 2 significant digits; and those of 10 million or more, in 3 significant digits.
b. Totals were derived from unrounded data and do not always equal the sums of the rounded components.
c. Unknown.
d. Negligible.

Table 9

Estimated Civil Consumption of Petroleum Products in the USSR by Consuming Sector and by Type of Product a/
1956

Thousand Metric Tons

Type of Product	Transport								Industry						
	Rail	Inland Waterway	Ocean-going	Motor	Civil Air	Agri-culture	House-hold	Construc-tion	Petro-leum	Chemical	Coal	Steel	Electric Power	Nonferrous Metals and Manufacturing	Total b/
Gasoline															
Aviation	0	0	0	0	840	0	0	0	0	0	0	0	0	0	840
Motor	0	0	0	10,100	0	890	0	250	150	0	0	N.A.	460	c/	11,800
Total b/	0	0	0	10,100	840	890	0	250	150	0	0	N.A.	460	c/	12,700
Ligroine	0	0	0	0	0	c/	0	0	d/	0	0	0	0	0	d/
Kerosine															
Lamp and stove	0	0	0	0	0	0	2,000	0	0	0	0	0	0	0	2,000
Tractor	0	0	0	0	0	3,400	0	0	0	0	0	0	0	c/	3,400
Total b/	0	0	0	0	0	3,400	2,000	0	0	0	0	0	0	c/	5,400
Diesel fuel	580	370	300	140	0	7,200	0	2,900	500	0	41	N.A.	2,100	c/	14,200
Lubricants	240	72	120	720	5	900	0	150	80	N.A.	170	N.A.	1	300	2,800
Residuals and others															
Residual fuel oil	3,000	750	690	0	0	0	0	0	2,700	120	0	2,900	5,000	900	16,000
Road oils and asphalts	0	0	0	0	0	0	0	5,000	0	0	0	0	0	0	5,000
Bitumen and bituminous tar	0	0	0	0	0	0	0	0	47	0	0	0	0	0	47
Rubrax	0	0	0	0	0	0	0	0	0	19	0	0	0	0	19
Green oil	0	0	0	0	0	0	0	0	0	85	0	0	0	0	85
Total b/	3,000	750	690	0	0	0	0	5,000	2,700	230	0	2,900	5,000	900	21,200
Crude oil consumed as a product	0	0	0	0	0	0	0	0	840	0	0	0	0	0	840
Grand total b/	3,800	1,200	1,100	10,900	840	12,400	2,000	8,300	4,300	230	210	2,900	7,600	1,200	57,000

a. Estimates of less than 10,000 are expressed in 1 significant digit; those of 10,000 through 9.9 million, in 2 significant digits; and those of 10 million or more; in 3 significant digits.
b. Totals were derived from unrounded data and do not always equal the sums of the rounded components.
c. Unknown.
d. Negligible.

Table 10

Estimated Consumption of Petroleum Products in the USSR
by Consuming Sector and by Type of Product a/
1957

Thousand Metric Tons

	Transport					Industry									
Type of Product	Rail	Inland Waterway	Ocean-going	Motor	Civil Air	Agriculture	Household	Construction	Petroleum	Chemical	Coal	Steel	Electric Power	Nonferrous Metals and Manufacturing	Total b/
Gasoline															
Aviation	0	0	0	0	890	0	0	0	0	0	0	0	0	0	890
Motor	0	0	0	11,600	0	840	0	220	180	0	0	N.A.	490	c/	13,400
Total b/	0	0	0	11,600	890	840	0	220	180	0	0	N.A.	490	c/	14,300
Ligroine	0	0	0	0	0	c/	0	0	d/	0	0	0	0	0	d/
Kerosine															
Lamp and stove	0	0	0	0	0	0	2,400	0	0	0	0	0	0	0	2,400
Tractor	0	0	0	0	0	2,900	0	0	0	0	0	0	0	c/	2,900
Jet fuel	0	0	0	0	150	0	0	0	0	0	0	0	0	0	150
Total b/	0	0	0	0	150	2,900	2,400	0	0	0	0	0	0	c/	5,400
Diesel fuel	820	490	360	170	0	8,100	0	3,400	590	0	47	N.A.	2,300	c/	16,300
Lubricants	260	79	120	830	5	920	0	170	94	N.A.	180	N.A.	1	300	3,000
Residuals and others															
Residual fuel oil	3,900	950	710	0	0	0	0	0	3,100	130	0	3,000	5,400	900	18,100
Road oils and asphalts	0	0	0	0	0	0	0	5,500	0	0	0	0	0	0	5,500
Bitumen and bituminous tar	0	0	0	0	0	0	0	0	66	0	0	0	0	0	66
Rubrax	0	0	0	0	0	0	0	0	0	21	0	0	0	0	21
Green oil	0	0	0	0	0	0	0	0	0	85	0	0	0	0	85
Total b/	3,900	950	710	0	0	0	0	5,500	3,200	240	0	3,000	5,400	900	23,800
Crude oil consumed as a product	0	0	0	0	0	0	0	0	980	0	0	0	0	0	980
Grand total b/	5,000	1,500	1,200	12,600	1,000	12,800	2,400	9,300	5,000	240	230	3,000	8,200	1,200	63,800

a. Estimates of less than 10,000 are expressed in 1 significant digit; those of 10,000 through 9.9 million, in 2 significant digits; and those of 10 million or more, in 3 significant digits.
b. Totals were derived from unrounded data and do not always equal the sums of the rounded components.
c. Unknown.
d. Negligible.

III. Regional Distribution of Consumption.

Tables 11 through 15* show the distribution of the civil consumption of petroleum products in the USSR, by economic region and by consuming sector, for the years 1953-57. Data for each year are shown in a separate table. A description of the methodology used to effect the distribution is given in Appendix B.

A. General.

In each of the years 1953-57, Economic Region VII (Central) -- which embraces Moscow and the surrounding industrial complex -- has accounted for the largest share of total civil consumption. In this region, which has almost 22 percent of the population of the USSR but less than 6 percent of total land area, the consumption of petroleum products has increased from about 7 million tons in 1953 to about 10 million tons in 1957. In terms of the total civil consumption of petroleum products, however, the share of Region VII declined slightly during these years, from 17.5 percent to 15.7 percent. The relative decline results from the emergence of the eastern regions (VI, VIII, IX, X, XI, and XII) as important consumers of petroleum products.**

The leading consumers in Economic Region VII are agriculture, motor transport, and construction, which have accounted for between 65 and 70 percent of the total consumption in the region in each year. During 1953-55, agriculture was the leading consumer, followed by motor transport. In 1956, however, a slight decline in consumption by agriculture enabled motor transport to assume the leading position. It appears that the consumption of petroleum products in Region VII by agriculture has levelled off, temporarily at least, at between 2.3 million and 2.4 million tons. At the same time, continued increases will establish motor transport as the leading consumer. Construction has ranked third in each year and has shown a tendency to level off at 1.4 million to 1.5 million tons.

The highest average annual increase in consumption of petroleum products, 22 percent, was achieved in Economic Regions X (Kazakhstan and Central Asia) and XI (East Siberia). In addition, Region X showed the largest absolute increase in consumption of any economic region, from 3.7 million tons in 1953 to 8.1 million tons in 1957. Meanwhile, the share of Region X in civil consumption increased from 9.2 percent of the total in 1953 to 12.7 percent in

* Tables 11 through 15 follow on pp. 49 through 53.

** For further discussion of this trend, see III, D, p. 76, below.

1957. The rapid increase in consumption of petroleum products in Region X resulted from the implementation of the new lands program. Consumption by agriculture in Region X reached 2 million tons in 1957, increasing about 135 percent since 1953. Transportation services and construction in Region X also were increased to support the new lands program, and in certain instances the increase in consumption of petroleum products by these sectors has surpassed that of agriculture. For example, consumption by motor transport reached 1.7 million tons in 1957, a gain of 139 percent since 1953, while consumption in construction reached 1.1 million tons, a gain of 206 percent.

The consumption of petroleum products in construction in the USSR increased even more rapidly in Economic Region XI. Since 1953, consumption in construction has accounted for more than one-half of the increase in this region. As consumption in Region XI increased from 1 million tons in 1953 to 2.2 million tons in 1957, a gain of 120 percent, consumption in construction increased from 190,000 tons to 820,000 tons, a gain of more than 331 percent. Thus construction, which had ranked third in 1953, became the leading civil consumer in the region in 1957. Agriculture, which had been the leading civil consumer through 1956, dropped to second place in 1957, with consumption declining by nearly 25 percent to 550,000 tons. Consumption by motor transport in Region XI, which ranks third in importance, has made slight but steady advances. The 430,000 tons consumed by motor transport in 1957 accounted for about 20 percent of the total consumption of petroleum products in the region.

In 1956, Economic Region XII (the Far East) accounted for the smallest share of total civil consumption of petroleum products in the USSR, supplanting Region XI. Civil consumption in Region XII in 1956 represented only 2.8 percent of the total and declined to less than 2.7 percent in 1957 in spite of a slight absolute increase. Only minor increases by any of the consuming sectors within the region have been evident. The most rapid gains have been made by motor transport, followed closely by construction. Compared with an average annual increase in consumption of 9.1 percent for the region as a whole, consumption by motor transport increased annually by about 13.9 percent to reach about 320,000 tons in 1957. Consumption in construction increased 12.1 percent annually to 300,000 tons in 1957. Oceangoing transport, however, has remained the leading consumer in Region XII.

Most of the consumption of petroleum products by oceangoing transport has taken place in Region XII, but more rapid increases in such consumption have occurred in Economic Region V (Transcaucasus), indicating that by 1959 most of the consumption by oceangoing transport

probably will occur in Region V. This apparent regional shift lowered the share of oceangoing transport in the total consumption in Region XII to 27.6 percent in 1957 compared with 30.8 percent in 1953, in spite of an increase in consumption from 370,000 tons in 1953 to 470,000 tons in 1957.

Throughout the period 1953-57, most of the consumption of petroleum products by motor transport, agriculture, and construction occurred in Economic Region VII.* In every case Economic Region III (South) ranked second, only slightly behind Region VII. The impressive increase in consumption in Region X, which resulted from the new lands program, brought this region into third place in 1957. It is believed that these regions are firmly established as the leading regional consumers of petroleum products. The position of Region X, however, will depend at least in part upon the continued success of the new lands in producing agricultural commodities.

B. By Consuming Sector.

1. Transport.

a. Rail.

The consumption of petroleum fuels and lubricants by rail transport is concentrated principally in four economic regions -- IV (Southeast), V (Transcaucasus), VI (Volga), and X (Kazakhstan and Central Asia) -- which accounted for more than 72 percent of all such consumption in 1957. Of these four, Region X has consistently consumed the largest share and also shown the highest rate of increase. In Region X, consumption of petroleum products by railroads increased to about 1.6 million tons in 1957, a gain of almost 130 percent since 1953, and accounted for approximately one-third of the total consumption by rail transport. Much of this increase may be attributed to an increase of about 280 percent in the quantities of diesel fuel consumed by rail transport, which in turn resulted from the scarcity and poor quality of water for coal-burning and oil-burning locomotives in Region X. The highest rate of increase in consumption by rail transport, however, was a gain of 154 percent recorded by Region VII. The overwhelming share of this increase was achieved in 1957, when consumption increased by 350,000 tons to reach 610,000 tons. Of the increase, residual fuel oil accounted for 270,000 tons.

* In 1957, however, consumption in construction in Region VIII (Urals) equaled that in Region VII.

b. Inland Waterway.

Significant consumption of petroleum products by inland waterway transport is limited to Economic Regions VI (Volga) and VII (Central), with a minor amount in Region I (North and Northwest). Region VI includes most of the navigable length of the Volga River and also a portion of the Don River. Within Region VII is found, among other major rivers, the Oka, the Dnieper, the Don, and a portion of the Volga. Most of the freight transported on the rivers by vessels consuming petroleum fuel is moved in Regions VI and VII, and thus these regions account for most of the consumption of petroleum products by inland waterway transport. The share of these regions has been estimated at 85 percent of the total 940,000 tons consumed by inland waterway transport in 1953, but declined to 75 percent in the total 1.5 million tons so consumed in 1957 because of increased consumption in Region I.

c. Oceangoing.

The consumption of petroleum products by oceangoing transport in the USSR is limited to Economic Region I (Northwest and North), V (Transcaucasus), and XII (the Far East). Arctic and Baltic operations have been considered as being serviced from Region I; Black Sea and Caspian Sea operations, from Region V; and Pacific Ocean operations, from Region XII. In Region XII, which accounted for 49.3 percent of all such consumption in 1953 and 39.2 percent in 1957, oceangoing transport is the principal consumer. The relative decline in such consumption in Region XII has resulted from more rapid increases in the consumption of both diesel fuel and residual fuel oil by oceangoing transport in Region V. It is probable that by 1959 Region V will have replaced Region XII as the principal consumer of petroleum products for oceangoing transport. Nevertheless, oceangoing transport should continue for some time to be the principal consumer in the civil economy of Region XII.

d. Motor.

Consumption of petroleum products by motor transport is centered in Economic Regions III (South) and VII (Central) and, increasingly, in Economic Region X (Kazakhstan and Central Asia). Throughout the period 1953-57, these three regions accounted for more than one-half of the annual consumption by motor transport. The sharpest rate of increase was shown in Region X, where consumption by motor transport in 1957 reached 1.7 million tons, a gain of 139 percent compared with 1953, as a result of the new lands program.*

* See III, A, p. 39, above.

Continued success of the new lands program may support a trend toward the increased consumption of petroleum products by motor transport in Region X.

In the remaining economic regions, measurable changes in the relative importance of consumption of petroleum products by motor transport are not expected.

e. Civil Air.

The estimates given in Tables 11 through 15* represent the regional distribution of consumption by aircraft with reciprocating engines and by jet aircraft. The regional distribution of petroleum products consumed by aircraft using reciprocating engines in civil air transport has been based upon a pattern derived for 1955, and thus it was not possible to show changes in consumption by regions from year to year. The largest share -- about one-fourth -- of annual consumption took place in Region VII (Central), reflecting the heavy flight traffic in and out of Moscow. Other significant consumption is in Regions III (South), VI (Volga), VIII (Urals), IX (West Siberia), and X (Kazakhstan and Central Asia), and the share of each of these regions in the annual total averages about 11 percent.

The consumption of jet fuel by civil air is apparent only for 1957. Schedules for that year showed jet aircraft operating into Moscow, Tashkent, Tbilisi, Irkutsk, Omsk, and Novosibirsk. The regional distribution of these operations is believed to have been as follows: Region V (Transcaucasus), 5 percent; Region VII, 42 percent; Region IX, 17 percent; Region X, 24 percent; and Region XI (East Siberia), 12 percent. Available information on the consumption of petroleum products both by jet aircraft and by aircraft using reciprocating engines indicates an approximately equal distribution between the eastern and western regions of the USSR.

2. Agriculture.

As previously indicated,** the principal influence upon the regional distribution of consumption of petroleum products by Soviet agriculture has been the new lands program. The increased need for petroleum products resulting from this program has been particularly evident in Economic Region X (Kazakhstan and Central Asia), and to a lesser degree, in Economic Region IX (West Siberia). As the result of sharp increases the share of Region X in total consumption of petroleum products by Soviet agriculture increased

* Pp. 49 through 53, below.
** See III, A, p. 39, above.

from 8.7 percent in 1953 to 15.6 percent in 1957. Significant increases, although not so sharp, were recorded by agriculture in Region IX. Consumption in this region is estimated at 1.2 million tons in 1957, an increase of 50 percent over 1953.

In spite of these sharp increases in Economic Regions IX and X, most of the consumption of petroleum products by agriculture continued to take place in Regions III (South) and VII (Central). In 1953 the consumption in these two regions is estimated at 4.1 million tons, or almost 42 percent of total consumption by agriculture. By 1957, however, consumption in these regions had increased only to 4.7 million tons, and the share of these regions in the total consumption by agriculture had dropped to less than 37 percent.

Increased consumption in Regions IX and X, coupled with relatively stable consumption in Regions III and VII, has effected a shift to greater emphasis upon the eastern regions (VI, VIII, IX, X, XI, and XII) in the consumption of petroleum products by agriculture. Compared with less than 40 percent in 1953, the eastern regions furnished almost 46 percent of the total for 1957. Should this trend continue as the result of further successes with the new lands program, the eastern regions may account for as much as one-half of annual consumption of petroleum products by agriculture in 1960.

3. Households.

The distribution by economic region of the quantities of kerosine consumed by Soviet households has been estimated on the basis of (a) reported retail sales of kerosine in the various union republics in 1955 and (b) the distribution of population in the RSFSR. A close relationship was shown between the distribution of sales of kerosine and population among the republics, suggesting that distributing sales of kerosine on the basis of total population within the RSFSR provided a reasonably accurate approach. It is believed that probable changes in the percentage for any region between 1953 and 1955 or between 1955 and 1957 would be within the margin of error of the 1955 percentage for the region.

Consumption of kerosine by Soviet households is concentrated in Economic Regions III (South) and VII (Central) which account for 21 percent and 22 percent, respectively, of all such consumption. The share of the third ranking region, Region X (Kazakhstan and Central Asia) is about one-half of that of Region VII.

Much publicity has been given to plans for significant increases in the delivery of gas to Soviet households. Most of these deliveries will be to major cities such as Moscow, Leningrad, Stalingrad, Kiev, and Baku. In the rural areas, where the use of kerosine prevails, deliveries of gas are insignificant and will not be increased substantially much before 1965. It is believed that increased deliveries of gas to the more densely populated regions, in particular Regions III and VII, will lead to a more equal distribution of consumption of kerosine among the 12 economic regions of the USSR.

4. Construction.

Construction in the underdeveloped areas of Economic Regions IX (West Siberia), X (Kazakhstan and Central Asia), and XI (East Siberia), added to a continued high rate of expansion in Region VIII (Urals), served to alter radically the pattern of regional distribution of petroleum products consumed for this purpose during 1953-57. In 1953 the eastern regions accounted for about 38 percent of all consumption in construction, and by 1957 their share had risen to more than 57 percent. By contrast, consumption in construction in the more fully developed Regions III (South) and VII (Central), which amounted to 2.3 million tons, or more than 41 percent of the total so consumed in 1953, increased only slightly to reach 2.6 million tons in 1957, representing less than 28 percent of all such consumption.

Conversely, in Regions VIII (Urals), IX, and X, the major centers of consumption in the eastern regions, the consumption of petroleum products in construction increased from 1.3 million tons in 1953 to 3.5 million tons in 1957, a gain of about 166 percent. In 1957, construction was the largest civil consumer in Region XI and also in Region VIII, where it had shared this position with the petroleum industry in 1956.

The consumption of petroleum products in construction seems to have become relatively stable at about 1.2 million tons in Region III and 1.3 million tons in Region VII. The continuation of this trend as part of the shift to the eastern regions will depend largely on the successful exploitation of the new lands and on the allocation of capital investments to develop industrial enterprises.

5. Industry.

It is not possible to ascertain any meaningful pattern of the regional distribution by individual years of the quantities

of petroleum products consumed by the industrial sector of the Soviet economy. For certain industries a regional pattern has been derived for one year and has been held constant for the other years because of a lack of information. Thus, only a general analysis based on a single year can be made. Of the period 1953-57, basic information is most complete for 1955, and the subsequent analysis of regional distribution is based on data for that year.

In essence the regional distribution of consumption of petroleum products by all industries except the nonferrous metals and manufacturing industries has been effected in accordance with the regional distribution of production (or of the capacity to produce) of the major commodity of that branch. In the complete absence of information concerning the regional distribution of petroleum products consumed by the nonferrous metals and manufacturing industries, the pattern for the regional consumption of lubricants and residual fuel oil is analogous to that described by all other consuming sectors of the civil economy.

The consumption of petroleum products by the chemical and steel industries appears to be concentrated in Economic Regions III (South), VII (Central), and VIII (Urals). In these regions is consumed an estimated three-quarters of the annual total for the chemical industry and two-thirds of the annual total for the steel industry. Consumption of petroleum products by the coal industry is centered in Regions III and IX (West Siberia) and by the electric power industry in Regions III, V (Transcaucasus), and VIII. In each case about one-half of the total consumption of petroleum products by the industry takes place in these regions. The estimated regional distribution of petroleum products consumed by the nonferrous metals and manufacturing industries indicates some degree of concentration in Regions V and VI (Volga) but also a nearly equal apportionment in the heavier populated areas, with only insignificant shares in the relatively underdeveloped regions, Ib (North), IX, XI (East Siberia), and XII (Far East).

Information concerning the petroleum industry is sufficient to develop an annual regional pattern of consumption. This pattern reflects the well-publicized shift in the center of production of crude oil from Economic Region V to the eastern regions of the USSR (VI, VIII, IX, X, XI, and XII), particularly to Regions VI and VIII. Production of crude oil in the eastern regions has increased from about 29 million tons, or 45 percent of the total, in 1953 to about 67 million tons in 1957, or 76 percent of the total. Of the crude oil produced in the eastern regions, Regions VI and VIII provided about 76 percent in 1953 and about 90 percent in 1957. As a result of this shift in production the consumption of petroleum products by

the petroleum industry in the eastern regions has increased from about 45 percent of the total consumed by the industry in 1953 to more than 64 percent in 1957. In 1953, Regions VI and VIII accounted for about 79 percent of the petroleum products consumed by the petroleum industry in the eastern regions. By 1957, this figure had increased to about 87 percent.

In 1955, more than 41 percent of all industrial consumption of petroleum products in the USSR took place in the eastern regions, and this proportion compares quite closely with the estimated 43 percent consumed in the eastern regions by the civil economy as a whole. Yet -- except in Region III, where the comparison is exact -- the regional distribution of industrial consumption of petroleum products differs from the regional distribution of total civil consumption. Region V, for example, accounted for 18.7 percent of the industrial consumption of petroleum products, but less than half that proportion of total civil consumption. Region VII, on the other hand, accounted for only 9.3 percent of industrial consumption but nearly twice that proportion of total civil consumption.

It is apparent that consumption by industry in the less developed areas of Regions IX, X (Kazakhstan and Central Asia), XI, and XII, which embrace the entire land area east of the Urals, has not kept pace with the consumption in these areas by the other sectors of the civil economy. In 1955, Regions IX, X, XI, and XII accounted for about 12 percent of the consumption of petroleum products by all industries but more than 18 percent of the total consumed by other sectors of the civil economy. The estimates which are given in Tables 11 through 15* point up the concentration of industrial consumption of petroleum products in the relatively highly developed areas of Regions III, V, and VIII. More than one-half of the industrial consumption of such products in 1955 took place in Region V and, to a lesser extent, in Regions III and VIII.

During the Seven Year Plan (1959-65), measurable changes in this pattern may take place. These changes will reflect efforts to supply gas in increasing quantities to the industrial centers of the USSR. The industrial enterprises of the Ukrainian USSR in Region III, particularly those located in the Donbas, are to be supplied with gas from the nearby deposits in Khar'kovskaya Oblast and in Krasnodarskiy and Stavropol'skiy Krays. Production of gas in these areas in 1965 may reach to 40 percent of the planned national goal of about 150 billion cubic meters for that year. The primary consumers of gas in these areas appear to be the electric power stations and heavy metallurgical enterprises, and the substitution of gas as an industrial

* P. 49 through 53, below.

fuel for residual fuel oil may serve to reduce the relative consumption of petroleum products by industry in the Ukrainian SSR.

In Region V, exploitation of the vast Karadag deposits of gas in Azerbaydzhan SSR will significantly alter the fuel balance of the republic and also will influence the fuel balance of the Armenian SSR and the Georgian SSR through the construction of a major transmission gas pipeline to transport Karadag gas from Azerbaydzhan to these republics. According to preliminary calculations, the increased supply of gas in Azerbaydzhan SSR will serve to reduce the consumption of residual fuel oil from 2.34 million tons in 1956 to about 700,000 tons in 1960. By 1960, gas will provide more than 90 percent of the supply (in units of standard fuel*) of fuel in Azerbaydzhan SSR compared with only 40 percent in 1956. Inasmuch as most of the gas is to be delivered to such major consumers of petroleum products as crude oil refineries, electric power stations, and machine-construction plants, industrial consumption of petroleum products in Region V probably will decline.

At present, plans for supplying gas to the industrial enterprises in Region VIII appear to be in a state of flux. According to the original directives of the Sixth Five Year Plan (1956-60) the points of origin of gas for the Urals were to be Shkapovo in Bashkirskaya ASSR and Berezovo on the northern reaches of the Ob' River. Gas pipelines from these points were to terminate in Magnitogorsk and in Sverdlovsk. Since the publication of these plans, discovery of an unusually large natural gas deposit near Bukhara in Uzbek SSR in Region X probably has caused the re-examination of these earlier directives. It is planned tentatively to construct a gas pipeline from the Bukhara deposits through the Kustanayskaya and Aktyubinskaya Oblasts of Kazakh SSR, also in Region X, which probably will tie in with the gas pipeline between Shkapovo and Magnitogorsk and may continue on to Sverdlovsk. The problems inherent in the construction of this pipeline would be considerable. The length of the pipeline would be about 2,000 kilometers (km) at a minimum, exceeding by 50 percent the longest gas pipeline previously built in the USSR. In addition, the pipeline would pass through 650 km of desert wasteland and then 1,000 km further through sparsely settled areas of Kazakh SSR. Neither the probability of construction of this pipeline nor the effects of the increased supply of gas on industrial consumption of petroleum products in Region VIII can be ascertained at this time. Because only about 25 percent of the planned production of gas in the USSR in 1965 is to be consumed in the eastern regions and because it is doubtful that gas from Bukhara could be delivered to Region VIII before 1965, it is believed that industrial consumption of petroleum products in Region VIII will remain relatively stable during the 1960's.**

* Measured in terms of 7,000 Kcal/kg.

** Text continued on p. 54.

Table 11

Estimated Distribution of Civil Consumption of Petroleum Products in the USSR by Economic Region and by Consuming Sector a/
1953

Thousand Metric Tons

Consuming Sector	Economic Region b/												Total c/
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Transport													
Rail	16	6	29	450	400	450	240	180	25	700	15	5	2,500
Inland waterway	38	6	12	2	1	480	320	28	18	9	23	4	940
Oceangoing	170	0	0	0	210	0	0	0	0	0	0	370	750
Motor	490	400	1,200	340	290	370	1,600	600	430	710	250	190	6,800
Civil air	11	14	76	34	21	76	160	79	62	90	41	21	690
Total c/	720	430	1,300	830	920	1,400	2,300	890	540	1,500	330	590	11,700
Agriculture	330	390	2,000	860	160	870	2,100	800	800	850	390	200	9,800
Household	61	65	240	64	100	58	250	90	68	130	37	25	1,200
Construction	360	280	1,100	310	320	450	1,200	640	300	360	190	190	5,600
Industry													
Petroleum	18	0	46	450	810	520	100	440	0	210	0	50	2,700
Chemical	2	0	55	22	9	1	45	46	19	0	0	0	200
Coal	5	d/	68	17	1	d/	14	16	20	12	10	7	170
Steel	140	0	810	120	150	200	330	390	34	71	11	36	2,300
Electric power	120	200	840	660	1,200	440	590	710	210	480	72	63	5,600
Nonferrous metals and manufacturing	33	11	120	98	150	120	92	110	24	93	11	29	900
Total c/	320	210	1,900	1,400	2,300	1,300	1,200	1,700	310	870	100	180	11,900
Grand total c/	1,800	1,400	6,600	3,400	3,800	4,000	7,000	4,100	2,000	3,700	1,000	1,200	40,100

a. Estimates of less than 10,000 are expressed in 1 significant digit; those of 10,000 through 9.9 million, in 2 significant digits; and those of 10 million or more, in 3 significant digits.
b. The economic regions are those defined on Map 13702 (4-55), USSR: Administrative Divisions and Economic Regions, January 1955.
c. Totals are derived from unrounded data and do not always equal the sums of the rounded components.
d. Negligible.

Table 12

Estimated Distribution of Civil Consumption of Petroleum Products in the USSR by Economic Region and by Consuming Sector a/
1954

Thousand Metric Tons

Consuming Sector	Economic Region b/												Total c/
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Transport													
Rail	17	6	31	510	400	520	140	130	18	890	18	6	2,700
Inland waterway	45	6	16	3	1	510	340	31	21	10	26	4	1,000
Oceangoing	200	0	0	0	240	0	0	0	0	0	0	400	840
Motor	580	500	1,500	390	340	430	1,800	710	510	910	290	220	8,200
Civil air	12	15	85	39	23	85	190	89	70	100	46	23	770
Total c/	850	530	1,600	940	1,000	1,500	2,500	960	620	1,900	380	650	13,500
Agriculture	340	490	2,000	940	190	930	2,400	900	960	1,100	450	220	10,900
Household	74	78	290	77	120	70	300	110	83	160	45	30	1,400
Construction	400	320	1,300	330	320	580	1,300	710	360	390	230	230	6,500
Industry													
Petroleum	18	0	54	480	860	640	110	540	0	230	0	55	3,000
Chemical	2	0	60	22	9	1	46	48	19	0	0	0	210
Coal	6	d/	73	18	1	d/	15	17	22	13	11	7	180
Steel	140	0	910	130	150	210	350	410	36	76	12	39	2,500
Electric power	140	220	960	760	1,400	500	660	820	230	540	81	72	6,400
Nonferrous metals and manufacturing	42	12	160	140	220	170	120	150	28	120	12	39	1,200
Total c/	350	230	2,200	1,600	2,600	1,500	1,300	2,000	340	980	120	210	13,500
Grand total c/	2,000	1,700	7,400	3,800	4,300	4,600	7,900	4,700	2,400	4,500	1,200	1,300	45,800

a. Estimates of less than 10,000 are expressed in 1 significant digit; those of 10,000 through 9.9 million, in 2 significant digits; and those of 10 million or more, in 3 significant digits.
b. The economic regions are those defined on Map 13702 (4-55), USSR: Administrative Divisions and Economic Regions, January 1955.
c. Totals are derived from unrounded data and do not always equal the sums of the rounded components.
d. Negligible.

Table 13

Estimated Distribution of Civil Consumption of Petroleum Products in the USSR by Economic Region and by Consuming Sector a/
1955

Thousand Metric Tons

Consuming Sector	Economic Region b/												
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total c/
Transport													
Rail	18	7	34	570	450	580	90	87	27	1,100	21	6	3,000
Inland waterway	44	5	18	3	1	570	380	33	19	10	26	6	1,100
Oceangoing	230	0	0	0	310	0	0	0	0	0	0	430	970
Motor	650	600	1,700	440	380	490	2,100	800	580	1,100	330	250	9,500
Civil air	12	17	92	42	25	91	200	96	75	110	50	25	830
Total c/	950	630	1,800	1,100	1,200	1,700	2,800	1,000	700	2,300	430	720	15,400
Agriculture	370	530	2,100	990	180	980	2,400	930	1,100	1,500	520	230	11,900
Household	80	89	330	87	140	97	350	120	94	180	51	35	1,600
Construction	470	360	1,300	360	320	750	1,500	780	450	550	280	240	7,300
Industry													
Petroleum	18	0	44	440	820	1,000	94	870	0	250	0	49	3,600
Chemical	3	0	66	22	9	1	47	49	19	0	0	0	220
Coal	6	d/	79	20	1	d/	16	19	24	14	12	8	200
Steel	160	0	1,000	140	190	220	380	440	39	80	13	43	2,700
Electric power	150	250	1,000	810	1,500	540	730	890	250	590	89	79	6,900
Nonferrous metals and manufacturing	48	13	180	160	260	200	130	180	30	140	12	45	1,400
Total c/	380	260	2,400	1,600	2,800	2,000	1,400	2,400	360	1,100	130	220	15,000
Grand total c/	2,200	1,900	8,100	4,100	4,600	5,500	8,400	5,300	2,700	5,700	1,400	1,500	51,300

a. Estimates of less than 10,000 are expressed in 1 significant digit; those of 10,000 through 9.9 million, in 2 significant digits; and those of 10 million or more, in 3 significant digits.
b. The economic regions are those defined on Map 13702 (4-55), USSR: Administrative Divisions and Economic Regions, January 1955.
c. Totals are derived from unrounded data and do not always equal the sums of the rounded components.
d. Negligible.

Table 14

Estimated Distribution of Civil Consumption of Petroleum Products in the USSR by Economic Region and by Consuming Sector a/
1956

Thousand Metric Tons

Consuming Sector	Economic Region b/ I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total c/
Transport													
Rail	120	7	36	630	560	650	260	47	28	1,400	25	6	3,800
Inland waterway	59	6	20	5	1	580	390	43	26	15	33	8	1,200
Oceangoing	260	0	0	0	390	0	0	0	0	0	0	460	1,100
Motor	720	700	2,000	500	410	560	2,400	920	650	1,500	370	280	10,900
Civil air	13	17	93	42	25	93	200	97	76	110	50	25	840
Total c/	1,200	730	2,100	1,200	1,400	1,900	3,200	1,100	780	3,000	480	780	17,800
Agriculture	360	680	2,200	960	210	920	2,300	880	1,100	1,900	720	250	12,400
Household	100	110	390	110	170	96	420	150	110	220	62	42	2,000
Construction	470	270	1,300	360	330	700	1,400	1,100	730	860	580	270	8,300
Industry													
Petroleum	20	0	55	500	900	1,200	110	1,100	39	280	0	57	4,300
Chemical	3	0	71	22	10	1	48	54	19	0	0	0	230
Coal	6	d/	86	21	1	d/	17	20	26	15	13	9	210
Steel	170	0	1,100	140	220	240	390	470	42	80	14	48	2,900
Electric power	160	270	1,100	890	1,600	590	800	970	280	650	98	86	7,600
Nonferrous metals and manufacturing	45	16	160	130	200	160	130	150	34	120	16	41	1,200
Total c/	400	290	2,600	1,700	2,900	2,200	1,500	2,800	440	1,100	140	240	16,400
Grand total c/	2,500	2,100	8,600	4,300	5,100	5,800	8,800	5,900	3,200	7,100	2,000	1,600	57,000

a. Estimates of less than 10,000 are expressed in 1 significant digit; those of 10,000 through 9.9 million, in 2 significant digits; and those of 10 million or more, in 3 significant digits.
b. The economic regions are those defined on Map 13702 (4-55), USSR: Administrative Divisions and Economic Regions, January 1955.
c. Totals are derived from unrounded data and do not always equal the sums of the rounded components.
d. Negligible.

Table 15

Estimated Distribution of Civil Consumption of Petroleum Products in the USSR by Economic Region and by Consuming Sector a/
1957

Thousand Metric Tons

Consuming Sector	Economic Region b/												
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total c/
Transport													
Rail	420	9	39	680	600	740	610	200	29	1,600	27	6	5,000
Inland waterway	100	11	38	10	1	680	450	76	44	24	59	14	1,500
Oceangoing	280	0	0	0	440	0	0	0	0	0	0	470	1,200
Motor	830	810	2,300	580	470	640	2,700	1,100	750	1,700	430	320	12,600
Civil air	13	18	98	45	34	98	280	100	110	150	71	27	1,000
Total c/	1,600	850	2,500	1,300	1,500	2,200	4,000	1,500	930	3,500	590	840	21,300
Agriculture	380	700	2,300	950	200	940	2,400	910	1,200	2,000	550	240	12,800
Household	120	130	470	130	200	120	500	180	140	270	74	50	2,400
Construction	490	230	1,200	360	310	760	1,400	1,400	960	1,100	820	300	9,300
Industry													
Petroleum	30	0	66	560	1,000	1,500	120	1,300	45	310	0	65	5,000
Chemical	3	0	79	22	10	1	49	57	19	0	0	0	240
Coal	7	d/	92	23	1	d/	18	22	28	16	14	9	230
Steel	180	0	1,100	150	260	250	400	480	43	83	15	51	3,000
Electric power	180	290	1,200	960	1,800	640	870	1,000	300	700	110	93	8,200
Nonferrous metals and manufacturing	45	16	160	130	200	160	130	150	34	120	16	41	1,200
Total c/	440	310	2,700	1,800	3,300	2,600	1,600	3,000	470	1,200	160	260	17,900
Grand total c/	3,100	2,200	9,200	4,600	5,500	6,500	10,000	6,900	3,600	8,100	2,200	1,700	63,800

a. Estimates of less than 10,000 are expressed in 1 significant digit; those of 10,000 through 9.9 million, in 2 significant digits; and those of 10 million or more, in 3 significant digits.
b. The economic regions are those defined on Map 13702 (4-55), USSR: Administrative Divisions and Economic Regions, January 1955.
c. Totals are derived from unrounded data and do not always equal the sums of the rounded components.
d. Negligible.

C. By Major Type of Product.

Tables 16 through 21* show the estimated distribution of civil consumption of the major types of petroleum products in the USSR, by economic region and by consuming sector, for the years 1953-57. These major products are gasoline, kerosine, diesel fuel, lubricants, residual fuel oil, and road oils and asphalts. Although road oils and asphalts were consumed only in construction, the volume of such consumption is of major proportions, exceeding that of lubricants in each year and that of kerosine in 1957.

1. Gasoline.**

Because in the USSR gasoline is consumed primarily by motor transport, the pattern of regional distribution is in essence an extension of the pattern of consumption of gasoline by motor transport.

In 1953, civil consumption of gasoline in Economic Regions III (South) and VII (Central) accounted for 3.4 million tons, or 40 percent of the total. In 1957, civil consumption of gasoline in these two regions accounted for about 5.4 million tons, or 37.8 percent of the total. Of the individual regions, Region VII has consistently received the largest share, with consumption of gasoline increasing from 1.9 million tons in 1953 to 3 million in 1957. The highest rate of increase, 120 percent, took place in Region X as the result of the development of motor transport in support of the new lands program.

In contrast to the apparent general shift in consumption of petroleum products to the eastern regions of the USSR, there has been no perceptible change in the regional distribution of gasoline. Both in 1953 and in 1957 the eastern regions accounted for about 40 percent of the total consumption of gasoline.

On the basis of a link relative obtained from a Soviet source, it can be estimated that the civil consumption of motor gasoline in the USSR may reach 30 million tons by 1965. Of this quantity, probably 18 million to 19 million tons will be consumed in the European USSR and the remaining 11 million to 12 million tons in the eastern regions. Although data are not sufficient to allow speculation concerning the amount of aviation gasoline to be consumed in 1965, it is probable that the proportion of aviation gasoline

* Tables 16 through 21 follow on pp. 60 through 75.
** Data include those amounts of aviation gasoline consumed by civil air transport.

consumed in the western regions will be higher than the proportion of motor gasoline. On the basis of a given regional distribution of all petroleum fuels in the USSR in 1965, the share of the eastern regions in the total consumption of motor gasoline will not change significantly from that in 1957.

2. Kerosine.

The category kerosine includes illuminating kerosine consumed by households, tractor kerosine, and those quantities of kerosine consumed as a jet fuel by civil air transport in 1957.

Kerosine is the only major petroleum product the consumption of which apparently has declined in the USSR since 1953. This decline, which averaged about 1.8 percent annually, resulted from the wide-scale replacement of kerosine-burning tractors by more efficient diesel tractors in virtually all phases of the civil economy. The resultant decline in requirements for tractor kerosine more than offset the apparent doubling of consumption of illuminating kerosine and the additional quantities of kerosine required by the introduction of jet aircraft. The estimated consumption of kerosine declined from a peak of 5.9 million tons in 1954 to 5.4 million tons in 1957, a reduction of about 8.5 percent.

The sharpest absolute declines took place in Economic Regions VII (Central) and VIII (Urals), where the consumption of kerosine declined from a peak of 2.4 million tons in 1954 to 1.8 million tons in 1957. The consumption of tractor kerosine declined from 1.4 million to 1 million tons in Region VII and from 430,000 tons to negligible quantities in Region VIII, but a portion of these declines were offset by increases in the consumption of illuminating kerosine totaling 270,000 tons.

Further reductions in the consumption of tractor kerosine in the USSR are anticipated. It has been estimated that the consumption of tractor kerosine in 1965 will decline to about 1.4 million tons, or only 37 percent of the level in 1955.* Of this quantity, about 30 percent is expected to be consumed in the eastern regions, and thus the pattern of regional consumption of tractor kerosine in 1957 would be continued. The consumption of tractor kerosine in the eastern regions in 1957 reached slightly more than 30.4 percent of the total, a significant decline from the 37.6 percent estimated for 1953 and from the 36.8 percent estimated for 1955. Thus it would appear that the pattern of regional distribution of the tractor kerosine consumed in the USSR is to remain stable at least through 1965.

* See II, B, p. 21, above.

Two other factors also serve to indicate that the pattern of regional distribution of civil consumption of kerosine in the USSR in 1965 will not differ significantly from that in 1957, when the eastern regions accounted for 33 percent of the total. First, the regional distribution of illuminating kerosine is expected to remain relatively stable. Second, a Soviet source indicates that the pattern prevailing in 1957 will continue in 1965 in the regional distribution of "other fuels," which are believed to include aviation gasoline, illuminating kerosine, and jet fuel.

3. Diesel Fuel.

The rates of increase estimated for the civil consumption of diesel fuel in the USSR during 1953-57 far exceeded those of any other major petroleum product. Civil consumption of diesel fuel increased at an average annual rate estimated at 19.8 percent, reaching 16.3 million tons in 1957. The second highest rate of increase, 12 percent, was estimated for road oils and asphalts.

Agriculture not only continued as the leading civil consumer of diesel fuel in the USSR but increased its share from 3.7 million tons, or about 47 percent of the total, in 1953 to 8.1 million tons, or almost 50 percent, in 1957.

The influence of agriculture on civil consumption of diesel fuel is particularly evident in Economic Regions III (South), VII (Central), and X (Kazakhstan and Central Asia), which together account for more than one-half of the total. In 1957, agriculture accounted for almost two-thirds of the estimated civil consumption of diesel fuel in Economic Region III, a larger share than in any other economic region. In Region VII, agriculture accounted for about one-half of the civil consumption of diesel fuel in 1957. The largest absolute gains in the consumption of diesel fuel by agriculture, however, were shown in Region X, where the new lands program served to increase consumption from 530,000 tons in 1953 to 1.7 million tons in 1957. Inasmuch as total civil consumption of diesel fuel in Region X increased from 1 million tons in 1953 to 2.9 million tons in 1957, agriculture was responsible for more than 60 percent of the increment. If comparable increases continued throughout 1959, Region X probably exceeded Region III in the consumption of diesel fuel by agriculture.

The sharpest relative increase, however, occurred in Region XI (East Siberia), where consumption of diesel fuel in 1957 represented an increase estimated at 315 percent compared with 1953. Most of this increase resulted from new construction and, to a lesser degree, from the impact of the new lands program on requirements for

diesel fuel. Since 1953 the consumption of diesel fuel in construction in Region XI has increased by about 400 percent; consumption by agriculture, by 900 percent; and consumption by transport, by more than 500 percent.

Steady gains in the consumption of diesel fuel have been achieved in the eastern regions of the USSR, which accounted for 42 percent of the total in 1953 and 51 percent in 1957. Available information does not imply any change in this pattern, at least through 1965.

4. Lubricants.

The estimated distribution by economic region of the civil consumption of lubricants in the USSR parallels closely the patterns of the major primary fuels, gasoline, kerosine, and diesel fuel. Again, civil consumption was concentrated in Economic Regions III (South), VII (Central), and X (Kazakhstan and Central Asia), which together accounted for about 46 percent of the total civil consumption of lubricants. In 1957 the consumption of approximately one-half million tons of lubricants both in Region III and also in Region VII represented an increase of about 34 percent above the level of 1953 in each region. The highest rate of increase, slightly more than 100 percent, occurred in Region X as a result of expansion of agriculture, transport, and construction.

The estimates shown in Table 19* indicate that the share of the eastern regions in the civil consumption of lubricants reached a peak in 1956 of about 44 percent of the total and maintained the same level throughout the year 1957. Available information indicates relative reductions in the consumption of lubricants in the eastern regions through 1965. In 1965 the consumption of lubricants in the eastern regions is expected to account for only 40 percent of the total lubricants consumed in the USSR in that year. The principal reason for this decline probably will be the relative increase in consumption of lubricants by industry to 53.3 percent of the total in 1965.** The total consumption of lubricants in the USSR in 1965 may range between 7 million and 8 million tons, of which 3 million tons may be consumed in the eastern regions.

5. Residual Fuel Oil.

The USSR consumes more residual fuel oil than any other type of petroleum product. Civil consumption of residual fuel oil

* P. 67, below.
** See II, E, 6, p. 31, above.

increased from 11.8 million tons in 1953 to 18.1 million tons in 1957, a gain of about 53 percent.

The principal consumers of residual fuel oil in the USSR are the railroads and the petroleum, steel, and electric power industries. Although consumption of residual fuel oil by these four sectors varies in the different economic regions, the total civil consumption of residual fuel oil in most of the economic regions is relatively stable. In most of the regions, civil consumption of residual fuel oil averaged between 9 to 15 percent. Civil consumption of residual fuel oil in Region V (Transcaucasus) has averaged about 21 percent of the total for the USSR, the largest share of any region, because of the relatively high concentration of electric power stations burning residual fuel oil. Region V also has shown the highest absolute increase in consumption, 1.2 million tons, of which the electric power industry accounted for one-half. Most of the remainder is attributable to increased consumption by transport and by the petroleum industry. The highest relative gains, however, took place in Region VIII (Urals). Civil consumption of residual fuel oil in Region VIII in 1957 represented a gain of about 67 percent over 1953, largely because of expansion of the petroleum industry. In the same period, Region X (Kazakhstan and Central Asia) showed an increase of 64 percent in such consumption, almost wholly as the result of an unusually sharp increase in the consumption by rail transport.

The relative share of the eastern regions in the total civil consumption of residual fuel oil in the USSR also has remained substantially unchanged during 1953-57 at 41 to 43 percent. In certain sectors, such as the petroleum industry, emphasis on the eastern regions in the consumption of residual fuel oil had been apparent, but these trends have been offset by comparable increases in consumption in the European USSR by other sectors, notably the electric power industry.

It can be estimated that in 1965 the quantity of residual fuel oil produced from the refining of natural and synthetic crude oils in the USSR may reach to 67 million tons. Because of the rapid development of the gas industry and the trend toward the substitution of gas for residual fuel oil, there may be a sizable surplus of residual fuel oil in the USSR by 1965. In all probability this surplus will be directed primarily to meet the growing needs for residual fuel oil in the countries of Northern Europe.

6. Road Oils and Asphalts.

Construction has accounted for all the consumption of road oils and asphalts in the USSR. The consumption of road oils and

asphalts has increased since 1953 at an average annual rate estimated at 12 percent, reaching 5.5 million tons in 1957 and representing about 60 percent of all the petroleum products consumed in construction.

As in the case of all petroleum products, emphasis on the eastern regions in the consumption of road oils and asphalts has been particularly evident in recent years. In 1953 the consumption in the eastern regions represented about 38 percent of the total and advances were slow through 1955, when the share of the eastern regions amounted to about 42 percent of the total. In 1956 and 1957, however, consumption in the eastern regions increased at a considerably higher rate than in the European USSR, and the share of the eastern regions in 1957 has been estimated at more than 57 percent of the total. Impressive gains in the consumption of road oils and asphalts have been made in Regions VIII (Urals), IX (West Siberia), and X (Kazakhstan and Central Asia), whereas in Regions III (South) and VII (Central), where requirements for road oils and asphalts are more established, consumption has been relatively stabilized.

The level of technology which has been achieved in the USSR in the construction and operation of crude oil refineries is approaching that of the US. Thus, it may be calculated that, with an estimated refinery charge of 200 million tons in 1965, the yield of road oils and asphalts in the USSR may approach 5 percent, or 10 million tons. In the absence of conflicting data the distribution between the eastern regions and the western regions of this amount may parallel that for petroleum products as a whole.*

* Text continued on p. 76.

Table 16

Estimated Distribution of Civil Consumption of Gasoline in the USSR by Economic Region and by Consuming Sector a/*
1953-57

Thousand Metric Tons

Year	Consuming Sector	Economic Region b/ I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total c/
1953	Transport													
	Motor	450	370	1,100	310	270	340	1,400	550	400	650	230	170	6,300
	Civil air	10	14	75	34	20	75	160	78	61	89	41	20	680
	Total c/	460	380	1,200	340	290	420	1,600	630	460	740	270	190	7,000
	Agriculture	15	32	130	65	11	75	160	75	76	48	28	8	730
	Construction	16	13	51	14	15	21	54	30	14	17	9	9	260
	Industry													
	Petroleum d/	1	0	1	13	28	21	1	18	0	9	0	1	95
	Electric power	12	31	89	22	17	20	77	24	22	45	12	5	370
	Total c/	13	31	90	35	45	41	78	42	22	54	12	6	460
	Grand total c/	510	460	1,500	460	360	550	1,900	780	570	860	320	220	8,500
1954	Transport													
	Motor	540	460	1,400	360	310	400	1,700	650	470	840	260	200	7,600
	Civil air	12	15	85	38	23	85	180	88	69	100	46	23	770
	Total c/	550	480	1,500	400	330	480	1,900	740	540	940	310	220	8,400
	Agriculture	16	34	120	67	9	82	180	85	96	54	33	9	780
	Construction	17	13	52	14	13	24	56	29	15	17	9	9	270
	Industry													
	Petroleum d/	1	0	1	13	27	29	1	23	0	10	0	2	110
	Electric power	13	34	95	23	18	21	82	25	23	49	12	5	400
	Total c/	14	34	96	36	45	50	83	48	23	59	12	7	510
	Grand total c/	600	560	1,700	520	400	640	2,200	900	670	1,100	360	250	9,900

* Footnotes for Table 16 follow on p. 62.

Table 16

Estimated Distribution of Civil Consumption of Gasoline in the USSR by Economic Region and by Consuming Sector a/ 1953-57 (Continued)

Thousand Metric Tons

Year	Consuming Sector	Economic Region b/ I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total c/
1955	Transport													
	Motor	600	560	1,600	410	350	450	1,900	740	530	1,000	300	230	8,700
	Civil air	12	17	91	42	25	91	200	95	75	110	50	25	830
	Total c/	610	580	1,700	450	380	540	2,100	840	600	1,100	350	260	9,500
	Agriculture	15	43	120	71	12	89	170	93	110	130	37	10	900
	Construction	15	12	48	12	11	26	53	28	16	19	10	9	260
	Industry													
	Petroleum d/	1	0	1	12	27	43	1	29	0	10	0	2	130
	Electric power	14	36	100	25	19	23	88	27	25	52	13	5	430
	Total c/	15	36	100	37	46	66	89	56	25	62	13	7	560
	Grand total c/	660	670	1,900	570	440	720	2,400	1,000	760	1,400	410	280	11,300
1956	Transport													
	Motor	660	650	1,800	470	380	510	2,200	850	600	1,400	340	260	10,100
	Civil air	12	17	92	42	25	92	200	96	75	110	50	25	840
	Total c/	670	670	1,900	510	400	600	2,400	950	680	1,500	390	280	10,900
	Agriculture	13	44	110	64	11	83	160	85	110	170	39	10	890
	Construction	14	8	38	11	10	21	42	33	22	25	17	8	250
	Industry													
	Petroleum d/	1	0	1	13	28	55	1	38	0	11	0	2	150
	Electric power	15	39	110	27	21	24	94	29	27	56	14	6	460
	Total c/	16	39	110	40	49	79	95	67	27	67	14	8	610
	Grand total c/	720	750	2,200	620	470	790	2,700	1,100	830	1,700	460	310	12,700

Table 16

Estimated Distribution of Civil Consumption of Gasoline in the USSR by Economic Region and by Consuming Sector a/
1953-57
(Continued)

Thousand Metric Tons

Year	Consuming Sector	Economic Region b/ I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total c/
1957	Transport													
	Motor	760	750	2,100	540	440	590	2,500	1,000	690	1,600	390	300	11,600
	Civil air	13	18	98	44	27	98	210	100	80	120	53	27	890
	Total c/	770	770	2,200	580	470	690	2,700	1,100	770	1,700	440	330	12,500
	Agriculture	13	41	100	59	10	77	150	80	110	170	28	10	840
	Construction	12	5	29	9	7	18	34	32	23	27	19	7	220
	Industry													
	Petroleum d/	2	0	2	13	29	68	1	47	0	12	0	2	180
	Electric power	16	41	120	28	22	26	100	31	28	59	15	6	490
	Total c/	18	41	120	41	51	94	100	78	28	71	15	8	670
	Grand total c/	820	850	2,400	690	530	880	3,000	1,300	930	1,900	510	350	14,300

a. Estimates of less than 10,000 are expressed in 1 significant digit; those of 10,000 through 9.9 million, in 2 significant digits; and those of 10 million or more, in 3 significant digits.
b. Economic regions are those defined on Map 13702 (4-55), USSR: Administrative Divisions and Economic Regions, January 1955.
c. Totals are derived from unrounded data and do not always equal the sums of the rounded components.
d. Data exclude those insignificant quantities consumed in the construction and repair of the trunk pipeline.

Table 17

Estimated Distribution of Civil Consumption of Kerosine in the USSR by Economic Region and by Consuming Sector a/ 1953-57

Thousand Metric Tons

Year	Consuming Sector	Economic Region b/ I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total c/
1953	Agriculture	280	200	390	460	82	460	1,400	420	150	210	320	170	4,600
	Households	61	65	240	64	100	58	250	90	68	130	37	25	1,200
	Total c/	340	260	620	520	180	510	1,700	510	220	340	350	200	5,800
1954	Agriculture	280	250	170	460	95	450	1,600	430	130	33	370	190	4,500
	Households	74	78	290	77	120	70	300	110	83	160	45	30	1,400
	Total c/	360	320	460	540	220	520	1,900	540	210	190	410	220	5,900
1955	Agriculture	300	260	58	480	50	460	1,300	250	76	40	420	190	3,900
	Households	80	89	330	87	140	79	350	120	94	180	51	35	1,600
	Total c/	380	350	380	570	190	540	1,600	370	170	220	470	230	5,500
1956	Agriculture	300	340	50	420	63	300	1,100	21	27	25	510	210	3,400
	Households	100	110	390	110	170	96	420	150	110	220	62	42	2,000
	Total c/	400	450	440	530	230	390	1,600	170	140	250	570	250	5,400
1957	Civil air transport d/	0	0	0	0	7	0	62	0	25	35	18	0	150
	Agriculture	320	330	43	300	4	250	1,000	16	21	36	370	190	2,900
	Households	120	130	470	130	200	120	500	180	140	270	74	50	2,400
	Total c/	440	460	520	430	210	370	1,600	200	180	340	460	250	5,400

a. Data exclude the insignificant amounts consumed in construction. Estimates of less than 10,000 are expressed in 1 significant digit; those of 10,000 or more, in 2 significant digits.
b. Economic regions are those defined on Map 13702 (4-55), USSR: Administrative Divisions and Economic Regions, January 1955.
c. Totals are derived from unrounded data and do not always equal the sums of the rounded components.
d. Jet fuel.

Table 18

Estimated Distribution of Civil Consumption of Diesel Fuel in the USSR by Economic Region and by Consuming Sector a/*
1953-57

Thousand Metric Tons

Year	Consuming Sector	Economic Region b/ I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total c/
1953	Transport													
	Rail	0	0	0	46	0	39	0	9	0	130	0	0	220
	Inland waterway	9	1	3	1	d/	87	59	6	4	2	5	1	180
	Oceangoing	32	0	0	0	39	0	0	0	0	0	0	70	140
	Motor	5	5	13	4	3	4	17	7	5	8	3	2	76
	Total c/	46	6	16	50	42	130	76	22	9	140	8	73	620
	Agriculture	9	130	1,300	270	59	270	340	250	520	530	11	6	3,700
	Construction	110	84	340	96	98	140	360	200	93	110	60	60	1,800
	Industry													
	Petroleum	3	0	2	42	94	72	4	60	0	31	0	5	310
	Coal	1	0	10	3	d/	0	2	2	3	2	2	1	25
	Electric power	49	130	360	87	68	79	310	95	87	180	47	19	1,500
	Total c/	53	130	370	130	160	150	320	160	90	210	49	25	1,800
	Grand total c/	220	340	2,100	550	360	690	1,100	630	710	1,000	130	160	7,900
1954	Transport													
	Rail	0	0	0	50	0	53	0	10	0	170	3	0	280
	Inland waterway	17	2	6	1	d/	98	66	12	8	4	10	2	230
	Oceangoing	41	0	0	0	49	0	0	0	0	0	0	83	170
	Motor	7	6	17	5	4	5	21	8	6	10	3	3	96
	Total c/	65	8	22	56	53	160	87	30	14	180	16	87	780
	Agriculture	12	170	1,600	340	69	330	390	320	670	900	15	8	4,800
	Construction	130	110	410	110	110	190	440	230	120	130	74	74	2,100

* Footnotes for Table 18 follow on p. 66.

Table 18

Estimated Distribution of Civil Consumption of Diesel Fuel in the USSR by Economic Region and by Consuming Sector a/
1953-57
(Continued)

Thousand Metric Tons

Year	Consuming Sector	Economic Region b/ I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total c/
1954	Industry													
	Petroleum	3	0	2	42	91	96	4	78	0	32	0	5	350
	Coal	1	0	12	3	d/	0	2	3	4	2	2	1	31
	Electric power	55	140	400	98	77	89	350	110	98	210	53	21	1,700
	Total c/	59	140	410	140	170	180	360	190	100	240	55	27	2,100
	Grand total c/	270	430	2,400	650	400	860	1,300	760	900	1,500	160	200	9,800
1955	Transport													
	Rail	0	0	0	65	0	68	0	13	0	310	4	0	460
	Inland waterway	28	3	11	2	d/	110	77	21	12	6	17	4	300
	Oceangoing	55	0	0	0	76	0	0	0	0	0	0	100	240
	Motor	8	8	20	5	4	6	25	10	7	13	4	3	110
	Total c/	90	11	31	72	80	190	100	43	19	330	25	110	1,100
	Agriculture	17	190	1,800	360	100	350	770	520	860	1,200	23	10	6,300
	Construction	140	120	450	120	110	250	490	260	150	180	92	80	2,400
	Industry													
	Petroleum	3	0	3	39	92	140	4	98	0	34	0	6	420
	Coal	1	0	15	4	d/	0	3	3	4	3	2	1	36
	Electric power	62	160	450	110	86	100	390	120	110	230	59	24	1,900
	Total c/	66	160	470	150	180	240	400	220	110	270	61	31	2,400
	Grand total c/	320	480	2,800	710	470	1,000	1,800	1,000	1,100	2,000	200	230	12,200
1956	Transport													
	Rail	0	0	0	62	0	82	37	22	0	360	7	0	580
	Inland waterway	43	5	15	4	1	130	85	32	19	11	24	6	370
	Oceangoing	69	0	0	0	100	0	0	0	0	0	0	120	300
	Motor	9	9	25	6	5	7	30	12	8	19	5	4	140
	Total c/	120	14	39	72	110	210	150	65	27	390	36	130	1,400

Table 18

Estimated Distribution of Civil Consumption of Diesel Fuel in the USSR by Economic Region and by Consuming Sector a/
1953-57
(Continued)

Thousand Metric Tons

Year	Consuming Sector	Economic Region b/ I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total c/
1956	Agriculture	13	240	1,900	400	120	480	820	710	900	1,500	120	12	7,200
	Construction	160	93	440	130	110	240	500	390	250	300	200	96	2,900
	Industry													
	Petroleum	4	0	5	42	93	190	4	130	0	36	0	7	500
	Coal	1	0	17	4	d/	0	3	4	5	3	2	2	41
	Electric power	68	180	500	120	95	110	430	130	120	250	65	26	2,100
	Total c/	73	180	520	170	190	300	440	260	120	290	67	35	2,600
	Grand total c/	370	520	2,900	770	530	1,200	1,900	1,400	1,300	2,500	430	280	14,200
1957	Transport													
	Rail	0	1	0	71	0	120	110	25	0	490	8	0	820
	Inland waterway	64	7	23	6	1	150	100	47	27	15	36	9	490
	Oceangoing	83	0	0	0	130	0	0	0	0	0	0	140	360
	Motor	11	11	30	8	6	8	36	14	10	22	6	4	170
	Total c/	160	18	53	85	140	280	250	86	37	530	50	160	1,800
	Agriculture	21	280	2,000	520	170	550	1,100	750	980	1,700	110	28	8,100
	Construction	180	82	450	130	110	280	520	500	350	420	300	110	3,400
	Industry													
	Petroleum	6	0	6	42	96	230	5	160	0	39	0	7	590
	Coal	1	0	19	5	d/	0	4	4	6	3	3	2	47
	Electric power	75	190	540	130	100	120	470	150	130	270	72	29	2,300
	Total c/	82	190	560	180	200	350	480	310	140	310	75	38	2,900
	Grand total c/	440	570	3,100	920	620	1,500	2,300	1,600	1,500	2,900	540	330	16,300

a. Estimates of less than 10,000 are expressed in 1 significant digit; those of 10,000 through 9.9 million, in 2 significant digits; and those of 10 million or more, in 3 significant digits.
b. Economic regions are those defined on Map 13702 (4-55), USSR: Administrative Divisions and Economic Regions, January 1955.
c. Totals are derived from unrounded data and do not always equal the sums of the rounded components.
d. Negligible.

Table 19

Estimated Distribution of Civil Consumption of Lubricants in the USSR
by Economic Region and by Consuming Sector a/*
1953-57

Thousand Metric Tons

Year	Consuming Sector	Economic Region b/ I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total c/
1953	Transport													
	Rail	16	6	29	8	3	13	36	21	25	22	15	5	200
	Inland waterway	7	1	2	d/	d/	20	14	5	3	2	4	1	60
	Oceangoing	17	0	0	0	20	0	0	0	0	0	0	37	75
	Motor	32	26	82	22	19	25	100	39	29	47	16	12	450
	Total c/	72	33	110	30	43	58	150	66	57	70	35	55	790
	Agriculture	27	29	140	66	12	66	170	61	56	61	31	17	730
	Construction	6	5	19	5	5	8	20	11	5	6	3	3	96
	Industry													
	Petroleum	d/	0	d/	7	15	11	1	9	0	5	0	1	50
	Coal	4	d/	58	14	1	d/	12	14	17	10	9	6	140
	Nonferrous metals and manufacturing	12	8	34	13	8	16	37	17	15	21	9	9	200
	Total c/	16	8	92	34	24	27	50	40	32	36	18	16	390
	Grand total c/	120	75	370	140	90	160	390	180	150	170	87	91	2,000
1954	Transport													
	Rail	17	6	31	8	3	14	38	22	18	22	15	6	200
	Inland waterway	7	1	3	1	d/	22	15	5	4	2	4	1	64
	Oceangoing	20	0	0	0	24	0	0	0	0	0	0	40	85
	Motor	39	33	97	26	22	29	120	47	34	60	19	14	540
	Total c/	83	40	130	35	49	64	180	74	55	84	39	61	890
	Agriculture	27	37	140	71	14	70	190	67	67	73	36	18	810
	Construction	7	6	22	6	6	10	23	12	6	7	4	4	110

* Footnotes for Table 19 follow on p. 70.

Table 19

Estimated Distribution of Civil Consumption of Lubricants in the USSR by Economic Region and by Consuming Sector a/
1953-57
(Continued)

Thousand Metric Tons

Year	Consuming Sector	Economic Region b/ I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total c/
1954	Industry													
	Petroleum	d/	0	d/	7	15	15	1	12	0	5	0	1	57
	Coal	5	d/	61	15	1	d/	12	14	18	11	9	6	150
	Nonferrous metals and manufacturing	12	8	34	13	8	16	37	17	15	21	9	9	200
	Total c/	17	8	95	35	24	31	50	43	33	37	18	16	410
	Grand total c/	130	91	390	150	93	170	430	200	160	200	97	98	2,200
1955	Transport													
	Rail	18	7	34	9	3	15	41	24	27	24	17	6	230
	Inland waterway	8	1	3	1	d/	23	16	6	3	2	5	1	68
	Oceangoing	23	0	0	0	32	0	0	0	0	0	0	45	100
	Motor	43	40	110	29	25	32	140	53	38	74	22	17	620
	Total c/	93	47	150	39	61	71	200	83	69	100	43	68	1,000
	Agriculture	30	40	150	75	13	73	180	67	77	110	42	19	870
	Construction	7	6	23	6	6	13	26	13	8	9	5	4	130
	Industry													
	Petroleum	1	0	1	6	15	23	1	16	0	5	0	1	68
	Coal	5	d/	64	16	1	d/	13	15	19	11	10	6	160
	Nonferrous metals and manufacturing	12	8	34	13	8	16	37	17	15	21	9	9	200
	Total c/	18	8	99	35	24	39	51	48	34	37	19	16	430
	Grand total c/	150	100	420	150	100	200	450	210	190	250	110	110	2,400

Table 19

Estimated Distribution of Civil Consumption of Lubricants in the USSR
by Economic Region and by Consuming Sector a/
1953-57
(Continued)

Thousand Metric Tons

Year	Consuming Sector	Economic Region b/ I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total c/
1956	Transport													
	Rail	19	7	36	9	3	16	43	25	28	26	18	6	240
	Inland waterway	9	1	3	1	d/	24	16	6	4	2	5	1	72
	Oceangoing	27	0	0	0	40	0	0	0	0	0	0	49	120
	Motor	47	46	130	33	27	37	160	61	43	98	24	19	720
	Total c/	100	54	170	43	68	77	220	92	75	130	47	75	1,200
	Agriculture	29	52	150	72	15	67	170	59	75	130	57	20	900
	Construction	8	5	22	6	6	12	25	20	13	15	10	5	150
	Industry													
	Petroleum	1	0	1	7	15	30	1	20	0	6	0	1	80
	Coal	5	d/	69	17	1	d/	14	16	21	12	10	7	170
	Nonferrous metals and manufacturing	18	13	52	19	13	24	56	26	23	31	13	13	300
	Total c/	24	13	120	43	29	54	71	62	44	49	23	21	550
	Grand total c/	160	120	460	160	120	210	480	230	210	320	140	120	2,800
1957	Transport													
	Rail	21	8	39	9	3	17	46	26	29	28	20	7	260
	Inland waterway	9	1	4	1	d/	26	18	7	4	2	5	1	79
	Oceangoing	29	0	0	0	46	0	0	0	0	0	0	49	120
	Motor	55	54	150	38	31	42	180	73	49	110	28	21	830
	Total c/	110	62	190	49	81	86	240	110	83	140	53	79	1,300

Table 19

Estimated Distribution of Civil Consumption of Lubricants in the USSR
by Economic Region and by Consuming Sector a/
1953-57
(Continued)

Thousand Metric Tons

Year	Consuming Sector	Economic Region b/ I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total c/
1957	Agriculture	32	53	160	70	14	68	180	62	80	140	43	10	920
	Construction	9	4	22	6	6	14	26	24	17	21	15	5	170
	Industry													
	Petroleum	1	0	1	7	15	36	1	25	0	6	0	1	94
	Coal	6	d/	74	18	1	d/	15	17	22	13	11	7	180
	Nonferrous metals and manufacturing	18	13	52	19	13	24	56	26	23	31	13	13	300
	Total c/	25	13	130	44	29	60	72	68	45	50	24	21	570
	Grand total c/	180	130	500	170	130	230	520	260	230	350	140	120	3,000

a. Data exclude those insignificant quantities consumed by civil air transport and in the generation of electric power. Estimates of less than 10,000 are expressed in 1 significant digit; those of 10,000 more, in 2 significant digits.
b. Economic regions are those defined on Map 13702 (4-55), USSR: Administrative Divisions and Economic Regions, January 1955.
c. Totals are derived from unrounded data and do not always equal the sums of the rounded components.
d. Negligible.

Table 20

Estimated Distribution of Civil Consumption of Residual Fuel Oil in the USSR by Economic Region and by Consuming Sector a/*
1953-57

Thousand Metric Tons

Year	Consuming Sector	Economic Region b/ I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total c/
1953	Transport													
	Rail	0	0	0	400	400	400	200	150	0	550	0	0	2,100
	Inland waterway	23	3	7	1	a/	370	250	17	10	6	13	2	700
	Oceangoing	120	0	0	0	150	0	0	0	0	0	0	260	530
	Total c/	140	3	7	400	550	770	450	170	10	560	13	270	3,300
	Industry													
	Petroleum	8	0	40	320	520	300	89	260	0	110	0	35	1,700
	Chemical	0	0	54	0	0	0	0	45	0	0	0	0	99
	Steel	140	0	810	120	150	200	330	390	34	71	11	36	2,300
	Electric power	60	40	390	550	1,100	340	200	600	97	250	14	40	3,700
	Nonferrous metals and manufacturing	21	3	84	85	140	110	55	96	8	70	2	21	700
	Total c/	230	43	1,400	1,100	1,900	950	670	1,400	140	500	27	130	8,500
	Grand total c/	370	46	1,400	1,500	2,500	1,700	1,100	1,500	150	1,100	40	400	11,800
1954	Transport													
	Rail	0	0	0	450	400	450	100	100	0	700	0	0	2,200
	Inland waterway	20	3	7	1	a/	390	260	14	10	5	12	2	720
	Oceangoing	140	0	0	0	170	0	0	0	0	0	0	280	580
	Total c/	160	3	7	450	570	840	360	110	10	700	12	280	3,500
	Industry													
	Petroleum	9	0	46	350	580	340	98	300	0	130	0	38	1,900
	Chemical	0	0	60	0	0	0	0	46	0	0	0	0	110

* Footnotes for Table 20 follow on p. 74.

Table 20

Estimated Distribution of Civil Consumption of Residual Fuel Oil in the USSR by Economic Region and by Consuming Sector a/
1953-57
(Continued)

Thousand Metric Tons

Year	Consuming Sector	Economic Region b/ I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total c/
1954	Industry (Continued)													
	Steel	140	0	910	130	150	210	350	410	36	76	12	39	2,500
	Electric power	69	46	460	640	1,300	390	230	690	110	290	16	46	4,300
	Nonferrous metals and manufacturing	29	4	120	120	210	160	78	140	12	100	3	30	1,000
	Total c/	250	50	1,600	1,200	2,200	1,100	760	1,600	160	600	31	150	9,800
	Grand total c/	410	53	1,600	1,700	2,800	1,900	1,100	1,700	170	1,300	42	440	13,300
1955	Transport													
	Rail	0	0	0	500	450	500	50	50	0	800	0	0	2,400
	Inland waterway	8	1	3	1	d/	430	290	6	4	2	5	1	750
	Oceangoing	150	0	0	0	200	0	0	0	0	0	0	280	630
	Total c/	160	1	3	500	650	930	340	56	4	800	5	280	3,700
	Industry													
	Petroleum	8	0	35	320	530	550	80	560	0	140	0	31	2,300
	Chemical	0	0	65	0	0	0	0	48	0	0	0	0	110
	Steel	160	0	1,000	140	190	220	380	440	39	80	13	43	2,700
	Electric power	74	49	490	680	1,400	420	250	740	120	310	17	49	4,600
	Nonferrous metals and Manufacturing	35	5	140	150	250	190	93	170	15	120	3	36	1,200
	Total c/	280	54	1,700	1,300	2,400	1,400	800	2,000	170	650	33	160	10,900
	Grand total c/	430	55	1,700	1,800	3,000	2,300	1,100	2,000	180	1,500	38	440	14,600

Table 20

Estimated Distribution of Civil Consumption of Residual Fuel Oil in the USSR by Economic Region and by Consuming Sector a/
1953-57
(Continued)

Thousand Metric Tons

Year	Consuming Sector	Economic Region b/ I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total c/
1956	Transport													
	Rail	100	0	0	560	560	550	180	0	0	1,100	0	0	3,000
	Inland waterway	7	1	2	1	d/	440	290	5	3	2	4	1	750
	Oceangoing	160	0	0	0	240	0	0	0	0	0	0	290	690
	Total c/	270	1	2	560	800	990	470	5	3	1,100	4	290	4,400
	Industry													
	Petroleum	9	0	41	370	610	640	92	660	39	170	0	36	2,700
	Chemical	0	0	70	0	0	0	0	53	0	0	0	0	120
	Steel	170	0	1,100	140	220	240	390	470	42	80	14	48	2,900
	Electric power	80	54	530	740	1,500	460	270	800	130	340	18	54	5,000
	Nonferrous metals and manufacturing	26	3	110	110	190	140	70	120	11	90	2	27	900
	Total c/	280	57	1,800	1,400	2,500	1,500	820	2,100	220	680	34	160	11,600
	Grand total c/	550	58	1,800	1,900	3,300	2,500	1,300	2,100	230	1,700	39	460	16,000
1957	Transport													
	Rail	400	0	0	600	600	600	450	150	0	1,100	0	0	3,900
	Inland waterway	30	3	11	3	d/	500	330	22	13	7	17	4	950
	Oceangoing	160	0	0	0	260	0	0	0	0	0	0	280	710
	Total c/	590	3	11	600	860	1,100	780	170	13	1,100	17	280	5,600
	Industry													
	Petroleum	11	0	48	430	710	760	110	780	45	190	0	42	3,100
	Chemical	0	0	79	0	0	0	0	55	0	0	0	0	130

Table 20

Estimated Distribution of Civil Consumption of Residual Fuel Oil in the USSR by Economic Region and by Consuming Sector a/
1953-57
(Continued)

Thousand Metric Tons

Year	Consuming Sector	Economic Region b/												Total c/
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
1957	Industry (Continued)													
	Steel	180	0	1,100	150	260	250	400	480	43	83	15	51	3,000
	Electric power	87	58	580	800	1,600	490	290	870	140	360	20	58	5,400
	Nonferrous metals and manufacturing	26	3	110	110	190	140	70	120	11	90	2	27	900
	Total c/	300	61	1,900	1,500	2,800	1,600	870	2,300	240	720	37	180	12,500
	Grand total c/	900	64	2,000	2,100	3,700	2,700	1,700	2,500	250	1,800	55	460	18,100

a. Estimates of less than 10,000 are expressed in 1 significant digit; those of 10,000 through 9.9 million, in 2 significant digits; and those of 10 million or more, in 3 significant digits.
b. Economic regions are those defined on Map 13702 (4-55), USSR: Administrative Divisions and Economic Regions, January 1955.
c. Totals are derived from unrounded data and do not always equal the sums of the rounded components.

Table 21

Estimated Distribution of Civil Consumption of Road Oils and Asphalts in the USSR, by Economic Region a/
1953-57

Thousand Metric Tons

Year	Economic Region b/												Total c/
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
1953	230	180	680	190	200	280	720	400	190	220	120	120	3,500
1954	250	200	770	200	200	360	830	440	220	240	140	140	4,000
1955	300	220	830	220	200	460	910	480	280	340	170	150	4,500
1956	280	160	760	220	200	420	860	660	440	520	350	160	5,000
1957	290	140	720	210	180	450	840	800	570	680	480	180	5,500

a. Construction accounted for all consumption of road oils and asphalts in the USSR. All estimates are expressed in 2 significant digits.
b. Economic regions are those defined on Map 13702 (4-55), USSR: Administrative Divisions and Economic Regions, January 1955.
c. Totals are derived from unrounded data and do not always equal the sums of the rounded components.

D. Increased Role of Eastern Regions.

As indicated by the estimates given in Tables 16 through 21,* most increases in consumption of petroleum products have taken place in the eastern regions of the USSR (VI, VIII, IX, X, XI, and XII). Civil consumption in these regions has been estimated at 29 million tons in 1957 compared with 16 million tons in 1953. This increase represents an average annual rate of 16 percent in the eastern regions compared with 9.6 percent in the western regions. Consumption in the European USSR in 1957 has been estimated at 34.6 million tons, an increase of 10.6 million tons compared with 1953. Thus, there is an apparent shift in emphasis to the eastern regions in the civil consumption of petroleum products.

The increase in consumption of petroleum products in the eastern regions of the USSR has been accompanied by an even higher rate of increase in production of crude oil in these regions. The success of concentrated efforts to develop at a high rate the rich oilfields in Regions VI (Volga) and VIII (Urals) has enabled the eastern regions to provide a constantly larger share of national production of crude oil. As illustrated in the following tabulation, production of crude oil in the eastern regions increased from 45 percent of total Soviet production in 1953 to 76 percent in 1957.

	1953		1957	
Area	Production of Crude Oil	Consumption of Petroleum Products	Production of Crude Oil	Consumption of Petroleum Products
Western Regions	55	60	24	54
Eastern Regions	45	40	76	46
Total	100	100	100	100

Concomitant with the shift in the center of production of crude oil, although not so pronounced, has been a shift in the center of output of petroleum products in the USSR, from Region V (Caucasus) to the eastern regions, especially to Regions VI and VIII. The output of petroleum products in Regions VI and VIII increased from about 32 percent of the total in 1953 to more than 47 percent in 1957. At the same time the share produced in Region V declined from about 51 percent to less than 28 percent.

* Pp. 60 through 75, above.

On the other hand, the consumption of petroleum products in the eastern regions increased at a much slower rate than production. In 1957 the eastern regions accounted for 46 percent of the civil consumption of petroleum products in the USSR, a gain of only 15 percent compared with 1953. Moreover, although production of crude oil in the western regions had decreased from 55 percent of the total in 1953 to 24 percent in 1957, the estimated consumption of petroleum products in this area declined only from 60 percent of the total in 1953 to 54 percent in 1957. Thus it might appear that the indigenous supply of petroleum products in the western regions during 1953-57 became increasingly inadequate to meet requirements for fuels and lubricants. Such, however, was not the case; the western regions always have been deficient in fuel. The concentration of the production and refining of crude oil in Region V before World War II had necessitated extremely long and costly hauls of petroleum products to the centers of consumption.

Implicit in the shift of centers of production and refining of crude oil is the solution at least in part to these critical problems. The oilfields of Regions VI and VIII are more centrally located with respect to centers of consumption. For example, Economic Region VII (Central), which in 1957 was the largest regional consumer, is located immediately adjacent to Regions VI and VIII. Before World War II, consumers in Region VII were supplied with petroleum products delivered over a route averaging probably between 1,500 and 2,000 km. Today these hauls can be reduced possibly by one-half by shipments from Regions VI and VIII. Moreover, although the problem of supplying the rapidly growing needs for petroleum products in Economic Regions IX, X, XI, and XII is still difficult, Regions VI and VIII are in a better position to do so than Region V. The consumption of petroleum products in Regions IX, X, XI, and XII reached about 15.6 million tons in 1957, almost twice the level of 1953. At the same time, the indigenous production of crude oil in these regions increased only from 5.1 million tons to about 7.6 million tons, and thus there has arisen a major problem of supply. The solution to this problem is seen in the construction of a trunk pipeline system which will ultimately extend from the oilfields of Regions VI and VIII to the Pacific Ocean and which will supply the eastern regions with both crude oil and petroleum products. In conjunction with this project, a large-scale program for the construction and expansion of refineries in the eastern regions is also under way.

It is estimated that Soviet production of crude oil in 1960 may reach more than 140 million tons,* of which 110 million tons

* Compared with 135 million tons as stated in the original directives of the Sixth Five Year Plan (1956-60).

will be provided by the oilfields of Regions VI and VIII. Production of crude oil in the eastern regions may reach 120 million tons in 1960, or more than 83 percent of the Soviet total compared with 76 percent in 1957. Smaller increases in the consumption of petroleum products in the eastern regions may be expected as the result of Soviet plans to achieve a more equal and rational distribution of industrial production, of agriculture, and of transport. On the basis of successful implementation of this program, a more equal distribution between the western regions and the eastern regions in the civil consumption of petroleum products may be achieved by 1965 or possibly earlier.

IV. Prospects for Exports.

As shown in Table 22,* increases are anticipated in the consumption** of all of the selected petroleum products except tractor kerosine, for which an average annual decline of 8.7 percent is estimated. The continued dieselization of several of the sectors of the civil economy will be responsible for sharp increases in the demand for diesel fuel. Comparable increases in the consumption of residual fuel oil will occur not because of increased demands but because a significant portion of the additions to proved reserves of crude oil in recent years has been characterized by heavy, high-sulfurous, high-tar content. It will be less expensive for the USSR to produce large quantities of residual fuel oil from these crudes than to refine the crudes to yield middle-distillate fuels.

It is unlikely that a demand for such quantities of residual fuel oil will exist in the USSR in 1965. The continuing phenomenal growth of the natural gas industry and the probable impact of this expansion on the consumption of petroleum products lends strength to this belief. As shown in Table 23,*** natural gas is expected to provide a still larger share of the supply of petroleum and of total mineral fuel**** in the USSR in 1965 than in 1957. Natural gas is to account for more than one-third of the supply of petroleum in the USSR by 1965 compared with only one-seventh in 1957. As a share of the supply of mineral fuel, natural gas is to increase from 4.2 percent of the total in 1957 to 17.2 percent in 1965. Much of the planned production of 150 billion cubic meters of natural gas in 1965 will serve to reduce the growth in demand for residual fuel oil by a number of consuming sectors and, in certain instances, will substitute almost entirely for residual fuel oil.

A probable supply and demand balance for crude oil and natural gas liquids in the USSR in 1965 is as follows:

* Table 22 follows on p. 81.
** These estimates include both military and civil consumption.
*** Table 23 follows on p. 82.
**** Coal, crude oil, natural gas, peat, shale, and fuelwood.

Type of Product	Amount (Million Metric Tons)
Supply	
Crude oil	240.0
Natural gas liquids	6.5
Synthetic petroleum products and imports	Negligible
Total supply	246.5
Demand	
Civil and military consumption	187.5*
Losses, storage increments, and freshening of state reserves	14.0**
Exports of crude oil and petroleum products to other countries of the Sino-Soviet Bloc	20.0***
Residual exportable surplus	25.0
Total demand	246.5

As shown above, it is estimated that civil and military requirements probably will account for 76 percent of the total supply of 246.5 million tons in 1965, and losses, storage increments, and freshening of state reserves probably will account for about 6 percent in addition. Thus it is estimated that 45 million tons, or about 18 percent of the total supply in 1965, will be available for export to other countries of the Sino-Soviet Bloc and to the Free World. Of this quantity, about 20 million tons presently appear to be marked for export to countries of the Bloc. The residual, 25 million tons, or approximately one-half million barrels per day, apparently would be available for export to the Free World. Preliminary estimates of the amounts of energy required by the European Satellites to support

* Data were compiled from Table 22, p. 81, below.

** Estimated to be 14 million tons, or the equivalent of 6 percent of production of crude oil: losses, 3 percent; increments in storage, 2 percent; and freshening of state reserves, 1 percent.

*** Published trade agreements for 1965 between the USSR and other countries of the Sino-Soviet Bloc indicate that the USSR will export a minimum of 16 million tons of crude oil and products to these other countries. Because agreements are not available for all countries of the Bloc, this sum has been estimated to be roughly 20 million tons.

Table 22

Estimated Total Consumption of Petroleum Products in the USSR by Type of Product a/
1965

Million Metric Tons

Type of Product	Amount
Gasoline	
Motor	37.0
Aviation	2.0
Total	39.0
Kerosine	
Tractor	1.4
Lamp, stove, and jet fuel	21.6
Total	23.0
Diesel fuel	
Light	31.8
Heavy	11.2
Total	43.0
Lubricants	7.1
Residuals and others	
Residual fuel oil	67.0
Petroleum bitumen	6.6
Coke	0.6
Others	1.2
Total	82.5
Grand total	187.5

a. Including both military and civil consumption.

Table 23

Position of Crude Oil and Natural Gas
in Production of Petroleum and Mineral Fuel in the USSR a/
1957 and 1965

Percent

	1957		1965	
Fuel	Petroleum b/	Mineral Fuel c/	Petroleum b/	Mineral Fuel c/
Crude oil	85.7	25.3	64.4	32.3
Natural gas	14.3	4.2	35.6	17.2
Total	100.0	29.5	100.0	49.5

a. In terms of units of standard fuel.
b. The conversion to units of standard fuel of the reported production of 98.3 million tons of crude oil in 1957 and of the 240 million tons planned for 1965 was effected at the ratio of 1.43 tons of standard fuel per ton of crude oil. The conversion to units of standard fuel of the reported production of 18.5 billion cubic meters of natural gas in the USSR in 1957 and of the 150 billion cubic meters planned for 1965 was effected at the ratio of 1.2 tons of standard fuel per thousand cubic meters of natural gas.
c. The mineral fuels which are reported in the Soviet mineral fuel balances are coal, crude oil, natural gas, peat, shale, and fuelwood.

the planned industrial growth in these countries through 1965, however, indicate a possible energy deficit which may not be covered by planned imports of petroleum. It is further possible that the USSR may direct a portion of the exportable surplus of 25 million tons to reduce this energy deficit. If so, correspondingly smaller quantities would be available for export to the Free World.

Facilities now under construction will allow the USSR to handle its exportable surplus of petroleum. Important among such facilities are the oil base at Klaipeda, on the Baltic, which will be supplied with crude oil and petroleum products by means of pipeline from the prolific Urals-Volga oilfields. Also significant is the proposed USSR-Satellite petroleum pipeline system, which is to deliver Soviet crude oil to new refining centers in Poland, Czechoslovakia, Hungary, and East Germany. A major part of this pipeline system is to be in use by 1963.

APPENDIX A

SUPPLEMENTARY STATISTICAL DATA

The tables that follow show further details on the total supply and the total consumption of petroleum products in the USSR during 1953-57. Table 24* shows the estimated quantities of petroleum products available for consumption. Table 25** shows the estimated yield of petroleum products from the refining of crude oil.

* Table 24 follows on p. 84.
** Table 25 follows on p. 85.

Table 24

Estimated Quantities of Petroleum Products Available for Consumption in the USSR
1953-57

Thousand Metric Tons

	1953	1954	1955	1956	1957
Refinery yield a/	47,300	52,700	62,500	73,800	85,100
Imports b/	4,900	4,800	4,400	5,100	5,500
Exports b/	-1,500	-3,500	-3,700	-5,400	-6,700
Total c/	50,700	54,000	63,200	73,500	83,800
Crude oil consumed as a petroleum product d/	500	600	700	800	1,000
Total supply c/	51,200	54,600	63,900	74,300	84,800

a. Data were compiled from Table 25, p. 85, below.
b. These estimates were based primarily on information given in Soviet statistical handbooks. It must be borne in mind, however, that these statistics were adjusted to allow for the fact that they include quantities of petroleum products imported for reexport and quantities purchased abroad by Soviet foreign trade organizations for direct shipment to other countries.
c. Totals were derived from unrounded data and do not always equal the sums of the rounded components.
d. It is estimated that in each year about 1 percent of the indigenous production of crude oil is consumed by the petroleum industry as a petroleum product.

Table 25

Estimated Yield of Petroleum Products from the Refining of Crude Oil in the USSR a/
1953-57

Thousand Metric Tons

	1953	1954	1955	1956	1957
Indigenous production of crude oil	52,800	59,300	70,800	83,800	98,300
Imports b/	0	0	35	93	171
Exports b/	-300	-800	-1,500	-2,000	-4,100
Total crude oil available	52,400	58,400	69,300	81,900	94,400
Losses, storage c/	1,000	1,200	1,400	1,600	1,900
Charge to refining	51,400	57,300	67,900	80,300	92,500
Refining yield of petroleum products d/	47,300	52,700	62,500	73,800	85,100

a. Totals were derived from unrounded data and do not always equal the sums of the rounded components.
b. These estimates were based primarily on information given in Soviet statistical handbooks. It must be borne in mind, however, that these statistics were adjusted to allow for the fact that they include quantities of crude oil imported for reexport and quantities purchased abroad by Soviet foreign trade organizations for direct shipment to other countries.
c. Estimated to be 2 percent of the availability of crude oil.
d. Estimated to be 92 percent of the crude oil charge to refineries.

APPENDIX B

METHODOLOGY

The methodology employed to derive the estimates of the civil consumption of petroleum products in the USSR by consuming sector and to distribute these estimates by economic region is of prime importance. Wherever possible, these estimates were based on Soviet open material. In certain instances, however, because of a lack of qualifying information, data developed through subjective analysis of the problem were used.

It has been considered appropriate to reproduce in this report only a description of the methodology.

1. By Consuming Sector.

a. Transport.

(1) Rail.

Estimates of the consumption of diesel fuel were developed by using the average consumption factors applied to the annual gross ton-kilometers performed by diesel locomotives. The consumption of diesel fuel per 1,000 gross ton-kilometers (tkm) was reported to be 4 kilograms (kg) in 1953-55 and 3.7 kg in 1956-57. Annual totals were subsequently increased by 5 percent to include consumption in switching and to allow for building up stocks and for losses.

Estimates of the consumption of residual fuel oil were the most difficult to determine and are probably the least accurate. The estimates presented in this report are the midpoints of a series of range estimates. The low range was calculated in each year as 2.6 percent of total standard fuel consumed by the railroads. The high range was derived on the basis of rates of the consumption of residual fuel oil in the form of standard fuel per 1,000 gross tkm. These rates have been reported as follows: 1953, 20.5 kg; 1954, 20.1 kg; 1955, 19.4 kg; 1956, 19.6 kg; and 1957, 19.6 kg. Figures for residual fuel oil in standard fuel units were converted to natural units by applying the conversion factor of 0.93 tons of standard fuel per ton in natural units. Because of the factor of boiler efficiency, the conversion factor for residual fuel oil consumed by railroads is considerably lower than that used for the other consuming sectors (1.4 tons of standard fuel per ton in natural units).

It was estimated that 1 ton of diesel lubricating oil was consumed for every 80 tons of diesel fuel. This proportion of 1 to 80 was derived from the experience of a leading US railroad.

For car axle oil, estimates again were based on US experience. The factor used was 44.7 kg of car axle oil per million gross tkm. Estimates were subsequently increased by one-third in the belief that Soviet railroads would be considerably more liberal in their use of car axle oil.

For steam locomotive cylinder oil and grease, total steam locomotive movement in each year was multiplied by representative factors of usage derived from US practice. Consideration was made of consumption of cylinder oil and grease in double-heading, switching, and deadhead movement.

(2) Inland Waterway.

First, total standard fuel consumed in each year by inland waterway transport in the actual transportation of freight was calculated. These totals were then distributed according to type of fuel on the basis of a standard fuel balance for 1953 in which each type of fuel consumed by inland waterway was expressed as a percentage of the total. To this base was applied a graph which portrayed relative changes in the consumption of major types of fuel by inland waterway transport under the Sixth Five Year Plan (1956-60). Standard fuel balances for 1954 and 1955 were derived by the analysis of trends in fuel consumption as indicated in the other years. The percentage distributions thus obtained for each year were applied to the total consumption of standard fuel in that year, which yielded the consumption, among others, of diesel fuel and residual fuel oil in standard fuel units for the period 1953-57. Conversion to natural units was effected by using a factor of 1.45 units of standard fuel per natural unit of diesel fuel and a factor of 1.4 units of standard fuel per natural unit of residual fuel oil. These totals were then increased by 32.5 percent to allow for the composite effect of a 6-percent increase to account for fuel consumed in carrying passengers (based on the ratio of fleet passenger-kilometers to ton-kilometers) and of a 25-percent increase to account for fuel consumed in route maintenance, by service vessels, by shore installations, and in other nontransport functions.

Estimates of consumption of lubricants were derived in the following manner: Diesel-powered vessels consume lubricants at the rate of 6.13 percent of the diesel fuel consumed. Vessels powered by steam (both coal-fired and oil-fired) consume lubricants at the rate of 5.25 percent of residual fuel oil consumed in oil-fired vessels. This factor was applied uniformly on a ton-kilometer basis to all inland waterway transport powered by steam on the assumption that consumption of lubricants per ton-kilometer was the same for both coal-fired and oil-fired vessels.

(3) Oceangoing.

The estimates of consumption of petroleum fuels and lubricants by oceangoing transport essentially were based on the volume of work output or net ton-kilometers of freight movement in each of the years, on the portions of the total accomplished by diesel-powered vessels and those powered by residual fuel oil, and on the application to these portions of average consumption factors of diesel fuel and residual fuel oil which had been derived through analysis of a number of sources. For diesel fuel, the factors used were as follows (in kilograms of natural units per 1,000 tkm): 1953, 9.275 kg; 1954, 8.848 kg; 1955, 9.091 kg; 1956, 8.878 kg; and 1957, 8.878 kg. For residual fuel oil the factors were (in kilograms of natural units per thousand tkm): 1953, 38.33 kg; 1954, 36.95 kg; 1955, 34.08 kg; 1956, 32.49 kg; and 1957, 32.49 kg. In each case the basic consumption rate was increased by 32.5 percent to allow for the fuel expended in passenger transport and in nontransport functions.

Estimates of consumption of lubricants were obtained by use of the methodology described for inland waterway transport.

(4) Motor.

The total consumption of petroleum products by motor transport represents an aggregation of the estimated consumption by each type of vehicle in the automotive park. For the purposes of this research aid the automotive park of the USSR was divided into the following types of vehicles: freight trucks, motor buses, passenger taxis, truck taxis, and privately owned automobiles and motorcycles. In addition, freight trucks and buses were divided into those consuming gasoline and those consuming diesel fuel. The other types of vehicles were considered to consume only gasoline as a primary fuel.

The estimates of consumption of primary fuel by each type of vehicle were based on operational movement data and on consideration of such regional influences as weather conditions and the type

of roads. Operational movement data for freight trucks is the sum of loaded movement plus movement while empty. For the other types of vehicles, operational movement is simply the amount of vehicle travel and has been calculated on either a daily or an annual basis. To operational movement were applied the average consumption norms obtained from numerous Soviet handbooks and expressed in liters of primary fuel per 100 km of movement. These rates, according to type of fuel and to type of vehicle, are as follows:

Type of Fuel	Type of Vehicle	Liters per 100 Km
Gasoline	Freight truck	34
	Bus	35
	Truck taxi	30
	Passenger taxi	13.5
	Private automobile	12.9
	Private motorcycle	4
Diesel fuel	Freight truck	37
	Bus	46

The estimates derived from the operational data were then increased by 5 percent to allow for these amounts of primary fuel consumed in engine warm-up, engine idling, in movement not apparent in operational data, spillage, and other losses. In the distribution by economic region of these quantities of primary fuel, consideration has been made of above-norm consumption resulting from adverse weather conditions and inadequate roads. Therefore, to reflect this above-norm consumption, annual totals for Economic Regions I (Northwest and West) through VIII (Urals), and Region X (Kazakhstan and Central Asia) have been increased by 5 percent; for Economic Regions IX (West Siberia), XI (East Siberia), and XII (the Far East), by 10 percent. The total effect of these increments on the annual consumption of primary fuel in operational movement has been to increase the consumption of gasoline as follows: in 1953, by 9.12 percent; 1954, by 9.21 percent; 1955, by 9.14 percent; 1956, by 8.75 percent; and 1957, by 8.62 percent. Annual increases in the consumption of diesel fuel were as follows: 1953, 10.30 percent; 1954, 10.53 percent; 1955, 10.52 percent; 1956, 10.22 percent; and 1957, 10.48 percent.

Estimates of consumption of lubricants were based on the consumption of primary fuel. An average lubricant consumption factor, as specified in a number of sources, of 6.8 percent of fuel consumed, was considered appropriate. To reflect consumption of lubricants

by gas-generator and gas-cylinder vehicles, the total consumption of lubricants by vehicles using liquid fuel was increased by 4 percent.

(5) Civil Air.

The number of reciprocating-engine aircraft in operation during the period 1953-57 is estimated at 1,600. Assuming that each aircraft was in the air for an equal length of time in each year and given the hourly rates of primary fuel consumption for each type of aircraft, annual consumption totals can be calculated. These totals were then increased by 2 percent to allow for consumption of fuel in take-offs, in arriving at cruising speed, and in landings.

In 1957, the first year of significant use of jet aircraft by civil air transport, it was estimated that 30 jet aircraft were in operation. Assuming that each aircraft was in use 80 hours per month and that each aircraft consumed fuel at the rate of 1,600 gallons per hour, it can be calculated that the consumption of jet fuel (kerosine) by civil air transport reached about 146,880 tons in 1957.

The consumption of lubricating oil by reciprocating-engine aircraft was calculated at the rate of 2 quarts per aircraft per hour. The consumption of lubricating oil by jet aircraft is considered to be negligible and was omitted.

b. Agriculture.

For diesel tractors an average consumption rate of 10 kg of diesel fuel per soft-plowing unit was used. An average of 15.031 kg of primary fuel per soft-plowing unit was used for kerosine tractors. The annual amount of soft-plowing units performed by diesel and by kerosine tractors, when multiplied by the appropriate consumption factor, yields the annual consumption of primary fuel by the agricultural tractor park only in field work. The consumption of fuel in both field and nonfield work, including losses, is determined as a factor of consumption in field work. The consumption of diesel fuel in both field and nonfield work is determined as 1.21 times the consumption in field work, and the consumption of kerosine fuel in field and nonfield work is determined as 1.135 times consumption in field work. In addition, both types of tractors consume certain amounts of starter gasoline. The consumption of starter gasoline by diesel tractors is estimated at 1 percent of primary fuel consumption; that by kerosine tractors, at 1.934 percent of such consumption.

The consumption of lubricants is expressed as a percentage of primary fuel consumed in field work. The consumption of lubricants by diesel tractors is estimated at 9.154 percent of the fuel

consumption in field work; that by kerosine tractors, at 10.5 percent of such consumption.

All combines in use in the USSR consume gasoline as a primary fuel. Consumption of gasoline by combines was estimated by use of a weighted average rate of consumption of gasoline per hectare harvested, which was computed on the basis of the composition of the combine park in each year, the daily productivity of each combine model, and the consumption of fuel per hectare by each combine model. The rate of consumption in each year was as follows:

Year	Consumption (Kilograms per Hectare)
1953	6.2
1954	6.3
1955	6.3
1956	6.2
1957	5.7

Annual totals were increased by 5 percent to cover losses incurred in transportation and in storage. Lubricants consumed by combines is considered to be equivalent to 5 percent of the total gasoline consumed by combines, including losses.

There is no direct evidence to indicate the amount of petroleum products consumed in the USSR by agricultural machinery other than tractors and combines. The estimates which are presented for this category were based on the relationship between the amount of energy developed by tractors and combines and that developed by other agricultural machinery. As a percentage of the energy developed by tractors and combines, the energy developed by other agricultural machinery was as follows:

Year	Percent
1953	7.2
1954	7.6
1955	8.3
1956	8.3
1957	8.3*

* 1956 relationship held constant.

In order to obtain those quantities consumed by other agricultural machinery, these percentages were applied to the total amounts of primary fuel consumed by tractors and combines, to total starter gasoline consumed by tractors, and to lubricants consumed by tractors and combines. The total amount of primary fuel for other agricultural machinery was proportioned between diesel fuel and kerosine according to the share of diesel fuel in the total amount of primary fuel consumed by tractors, because evidence suggests that most other agricultural equipment is powered by diesel engines.

c. Households.

Household consumption of kerosine was obtained by dividing total state and cooperative retail sales of kerosine for the respective years, in terms of 1955 prices, by the estimated average state and cooperative retail price of kerosine in 1955. Collective farm market sales of kerosine are negligible or zero. The prices for kerosine in 1955 were calculated at 0.81 rubles per kilogram for the urban areas and 1.02 rubles per kilogram for the rural areas. The urban and rural prices of kerosine were then averaged on the basis of the division of the Soviet population between urban and rural areas. The weighted average price per ton of kerosine thus derived was 929 rubles. In terms of 1955 prices, total kerosine sales during 1953-57 were estimated as follows:

Year	Million Rubles
1953	1,091
1954	1,351
1955	1,536
1956	1,859
1957	2,194

d. Construction.

The consumption of petroleum products in construction is essentially an aggregation of annual consumption of primary fuel and lubricants by the individual types of construction equipment, in addition to losses in storage, hauling, and handling. An annual consumption rate of primary fuel for each type of equipment was derived, applying to given hourly fuel requirements an annual equipment-use figure of 2,000 hours, and was held constant for the period under study. These types of equipment include tractors, graders, excavators, cranes, and miscellaneous equipment, all of which are

powered by diesel engines. The number of units of each type of equipment, calculated on an annual basis from a number of sources, was then multiplied by the appropriate consumption rate, to yield the consumption of diesel fuel according to type of equipment. The consumption of diesel fuel by equipment not elsewhere classified was computed as 5 percent of the quantity consumed by the known types. Losses of diesel fuel were estimated at 2.5 percent of the consumption of diesel fuel by the known types of equipment. The consumption of gasoline by construction equipment was estimated as a percentage of the total consumption of diesel fuel, excluding losses. These percentages were estimated as follows: 1953, 14 percent; 1954, 12 percent; 1955, 10 percent; 1956, 8 percent; and 1957, 6 percent. Allowance was made for dieselization of equipment and retirement of old or obsolete gasoline-burning machinery. The consumption of lubricants by the equipment park was computed as 5 percent of the total diesel fuel requirements and 7 percent of all other petroleum fuel requirements. The consumption of kerosine and ligroine by construction equipment for the period in question is insignificant.

Although there is no information on the consumption of petroleum products by the construction materials industry, it is believed that certain plants, such as those producing cement, use considerable amounts of fuel for heat and power. As a minimum, it is estimated that the diesel fuel consumed by the construction materials industry would amount to 10 percent of the diesel fuel consumed in construction. The gasoline consumed by the industry would amount to 20 percent of the gasoline consumed in construction.

In addition to the quantities of gasoline, diesel fuel, lubricants, ligroine, and kerosine consumed by construction equipment and by the construction materials industry, it is believed that all of the annual production of road oils and asphalts in the USSR is consumed in construction.

e. Industry.

(1) Petroleum.

The consumption of petroleum products in crude oil drilling and producing operations was calculated on the basis of the quantity of fuels needed to produce one ton of crude oil. Average consumption factors were available for 1956 and were held constant for the period under study. These factors are as follows:

Type of Product	Kilograms per Ton of Crude Oil Produced
Diesel fuel	5.97
Residual fuel oil	2.86
Gasoline	1.79

The consumption of lubricants in crude oil drilling and producing operations is believed to be approximately 9 percent of primary fuel consumption. Because of the lack of qualifying data, the consumption of lubricants was limited to that amount consumed by drilling rigs and by engines consuming liquid fuel that are used in the exploitation of oil deposits. The consumption of lubricants by drilling rigs has been reported as 10.2 percent of primary fuel consumption. The consumption of lubricants by the V2-300 diesel engine, the most common engine in use in the oilfields of the USSR, has been reported as 8 percent of primary fuel consumption. The lubricant consumption factor which was used is an average of these rates.

It was estimated that the consumption of residual fuel oil during the process of refining crude oil is equivalent to 3 percent of the crude oil refinery charge. Under comparable operating conditions, this factor is analogous to US experience.

Minor amounts of gasoline, ligroine, bitumen, and bituminous tar are consumed in the construction and repair of oil and gas pipelines in the USSR. The total length of pipelines installed was estimated for each year. Average rates of consumption of these products per kilometer of pipeline installed were selected from a Soviet handbook in accordance with the diameter of the pipeline and the degree of insulation applied. A similar approach was taken to determine the consumption of these products in the repair of pipelines.

Finally, the consumption of crude oil as a petroleum product by the petroleum industry was estimated as 1 percent of the indigenous production of crude oil.

(2) Chemical.

The methodology employed in the derivation of estimates of the consumption of petroleum products consumed by the chemical industry involved the use of ratios of petroleum product input to commodity output. In the chemical industry of the USSR, petroleum

products find use in process heating in the manufacture of soda ash and caustic soda and as a raw material in production of synthetic rubber, tires, and carbon black.

It is estimated that 100 kg of residual fuel oil are consumed for each ton of soda ash produced, and 625 kg for each ton of caustic soda produced. Rubrax, a petroleum alkaline bitumen, is consumed at a ratio of 1 kg per tire produced. In addition, it is estimated that the consumption of rubrax in nontire plants of the chemical industry is two-thirds of that consumed by the tire industry. The yield of carbon black from the raw material green oil, which is a heavy distillate oil, is approximately 50 percent. Thus, about 2 tons of green oil are consumed in producing 1 ton of carbon black.

(3) Coal.

It is estimated that 20 to 30 percent of the annual production of coal was submitted to the flotation process during the period 1953-57. With a reported 0.36 kg of diesel fuel consumed per ton of coal in this process, it can be calculated that the consumption of diesel fuel ranged from about 25,000 tons in 1953 to more than 47,000 tons in 1957.

For lubricants, reported inventories of equipment during 1953-57 and consumption norms per machine per year were available. Equipment inventories in 1956 and 1957 were estimated on the basis of available information. Consumption norms were held constant for the period 1953-57.

(4) Steel.

The major use of residual fuel oil in the steel industry is for firing open hearth furnaces, soaking pits, and reheating furnaces. It is estimated that 113.5 kg of residual fuel oil are required for each ton of steel coming from the open hearth furnaces, that 50.5 kg for each ton are needed for the soaking pits, and that another 50.5 kg are needed to cover the requirements for reheating the partially rolled product. Thus, total residual fuel oil requirements amount to 204.4 kg per ton of crude steel, except in special cases in Economic Regions VII (Central) and VIII (Urals), where certain amounts of steel are produced in electric furnaces or convertors. In these regions, only 90.9 kg of residual fuel are consumed per ton of crude steel.

(5) Electric Power.

One method of expression of production of electric power in the USSR by thermal electric powerplants is in accordance with the type of fuel consumed during process of generation. For example, in 1955 it was reported that of the total production of electric power 5,574 million kilowatt hours (kwh) were generated by stations equipped with diesel engines. To determine the quantity of diesel fuel consumed in this generation, in the absence of a suitable consumption rate of diesel fuel per unit of electric power produced, it was necessary to employ a factor based on experience in US industry. On the basis of US experience and certain basic assumptions, it may be estimated that to generate 5,574 million kwh required 1.9 million tons of diesel fuel, or the equivalent of 2,934 kwh per ton of diesel fuel. This rate of consumption was held constant throughout the period 1953-57.

A similar approach was selected in the determination of the consumption of gasoline in the generation of electric power in the USSR. In 1955, 915 million kwh of electric power were generated in internal-combustion engines which consumed fuels other than gas or diesel oil. It was assumed that gasoline constituted virtually the entire supply of these other fuels. Again, on the basis of US experience, it can be estimated that the generation of 915 million kwh consumed 430,000 tons of gasoline, or 1 ton of gasoline for each 2,128 kwh. This rate of consumption was held constant throughout the period 1953-57.

With regard to residual fuel oil, the USSR has supplied to the Economic Commission for Europe consumption data which covered the years 1953-56. These data, however, applied only to those power stations under the authority of the Ministry of Electric Power Stations, USSR. Furthermore, these estimates were considered to represent minimum consumption. On the basis of available information, the estimates supplied by the USSR were revised upward by 12 percent in each of the years to cover the consumption of residual fuel oil by powerplants not under the authority of the Ministry. The consumption of residual fuel oil in 1957 was estimated on the assumption that consumption would increase over the previous year by approximately 9 percent, as it did in 1956.

The consumption of lubricants by the electric power industry has also been based upon US analogy. The rates utilized were 0.009 gallons of lubricating oil per kilowatt of capacity of thermal power plants and 0.004 gallons of lubricating oil per kilowatt of capacity of hydroelectric powerplants.

(6) Nonferrous Metals and Manufacturing.

Forced balances between the supply and the total civil and military consumption of lubricants and residual fuel oil in 1953 and 1955 were derived by deducting estimates of the total consumption of lubricants and residual fuel oil by all other sectors of the economy, including the military, from the quantities estimated as available for consumption. The remainder for each year was allocated to the nonferrous metals and manufacturing industries, thus establishing an apparent trend in consumption. Estimates of consumption in the remaining years were calculated by use of this trend, as well as an index of demand for lubricants by the manufacturing industries estimated for the period 1953-57. There was also information indicating that in the latter years under study a decrease in the consumption of residual fuel oil had resulted from the increased use of gas in machine construction plants and in other similar industrial enterprises. For 1953 the yield of residual fuel oil was estimated to be 27 percent of the refinery charge, and for 1955 the yield was estimated to be 25 percent. The yield of lubricants was estimated to be 4 percent of the refinery charge in each of the 2 years. Military consumption of lubricants, for want of other data, was estimated to be 5 percent of the yield of lubricants, and military consumption of residual fuel oil was estimated to be 10 percent of the yield of residual fuel oil.

2. By Economic Region.

a. Transport.

(1) Rail.

The distribution by economic region of the quantities of diesel fuel and residual fuel oil consumed by railroads in the USSR is a reflection of the regional distribution of ton-kilometers of freight hauled by locomotives powered with diesel fuel and by those powered with residual fuel oil. For car axle oil, regional distribution was effected in accordance with the regional pattern of total gross ton-kilometers of all rail movement in 1955. The regional distribution of diesel lubricating oil is in direct relation to that of diesel fuel. Steam locomotive cylinder oil and grease were apportioned regionally in accordance with the regional pattern of steam locomotive movement.

(2) Inland Waterway.

In order to provide a basis for distributing petroleum fuel consumption by economic regions, the total ton-kilometer performance by inland waterway transport that had been used in the calculation of standard fuel consumption totals was broken down according to type of fuel into performance figures for each of the

two Volga steamship companies (Volga United SS Company and the Volga Tanker Company) and for each of the union republics. From this pattern, distribution could be made to all those economic regions not within the RSFSR. For the RSFSR, after deducting the ton-kilometer performance of the Volga United and Volga Tanker companies, the breakdown of the remaining ton-kilometers was used as a basis for distributing the fuel consumption by other companies among the economic regions within the republic.

The regional distribution of lubricating oils consumed by diesel-propelled vessels is in direct relation to the regional distribution of diesel fuel. The distribution of lubricating oils consumed by vessels propelled by steam (both coal-fired and oil-fired) was equated with the regional pattern of ton-kilometers performed by steamships.

(3) Oceangoing.

The regional distribution of fuels consumed by oceangoing vessels corresponds to that of the ton-kilometers performed by the vessels using those fuels. In allocating petroleum fuel consumption by economic region, Arctic Ocean and Baltic Sea operations were considered as being serviced from Economic Region I (Northwest and North), Black Sea and Caspian Sea operations from Region V (Transcaucasus), and Pacific Ocean operations from Region XII (the Far East).

The regional pattern of distribution of diesel lubricating oil is that of diesel fuel. For lubricating oils for vessels propelled by steam (both coal-fired and oil-fired), the regional pattern was equated with the regional distribution of ton-kilometers performed by steamships.

(4) Motor.

The basis used for distribution by economic region of the quantities of primary fuel and lubricants consumed by commercial motor transport in the USSR was the distribution by economic region of the number of workers in the motor transport industry. This basis is not applicable to the consumption of fuels and lubricants by privately owned automobiles and motorcycles. Furthermore, there is available very little information relating directly to the regional distribution of these quantities. In view of this lack of data an index for the distribution of fuels and lubricants consumed by this sector was organized on the basis of the regional distribution of specialists with a higher education for the year 1955. Although Soviet propaganda may claim that private ownership of vehicles in the USSR is found among every category of worker, it is believed that during the period 1953-57 such vehicles were owned primarily by persons having a higher education and presumably a higher income than the average.

(5) Civil Air.

The regional distribution of the consumption of petroleum products by the civil air fleet is a reflection of airline activity within each region. The weekly operations at individual air traffic hubs within each region were added to provide totals for various regions, which in turn were used to derive a national total. The proportionate share of each region in the national total was then derived, and this pattern was used to distribute the total amounts of fuels and lubricants.

Separate regional distributions were made for reciprocating-engine aircraft consumption and for jet aircraft consumption. A pattern of reciprocating-engine aircraft activity was derived for 1955 and held constant for the period under study. The pattern utilized was as follows:

Region	Percent of Total
I (Northwest and North)	1.5
II (West)	2.0
III (South)	11.0
IV (Southeast)	5.0
V (Transcaucasus)	3.0
VI (Volga)	11.0
VII (Central)	24.0
VIII (Urals)	11.5
IX (West Siberia)	9.0
X (Kazakhstan and Central Asia)	13.0
XI (East Siberia)	6.0
XII (Far East)	3.0
Total	100.0

For jet aircraft, schedules for November 1957 show operations into Moscow, Tashkent, Tbilisi, Irkutsk, Omsk, and Novosibirsk. The pattern for 1957 was as follows:

Region	Percent of Total
V	5.0
VII	42.0
IX	17.0
Xb	24.0
XI	12.0
Total	100.0

The regional distribution of lubricants was equated with that of aviation gasoline.

b. Agriculture.

The annual totals of diesel fuel and kerosine consumed by agricultural tractors were distributed regionally in accordance with the pattern described in the regional allocation of soft-plowing units. Similarly, the regional distribution of petroleum products consumed by combines was equated with the regional distribution of hectares harvested. For both agricultural tractors and combines the regional distribution of lubricants consumed follows the regional pattern of primary fuel. In the absence of data to the contrary, the regional allocation of the quantities of fuel and lubricants consumed by other agricultural machinery has been equated in each year with the regional allocation of primary fuel consumed by agricultural tractors.

c. Households.

Soviet household consumption of kerosine was distributed among the various union republics on the basis of reported 1955 retail sales of kerosine. Within the RSFSR, no data on sales were available. Therefore the distribution of kerosine consumption among the economic regions within the RSFSR has been based on the distribution of total population among these regions. The close relation between the distributions of kerosine sales and total population of the various republics suggests that distributing kerosine sales on the basis of population within the RSFSR provides a reasonably accurate estimate. Because data on the regional distribution of sales are available only for 1955, the pattern in that year has been held constant for the period under study.

d. Construction.

In the absence of a more reliable approach to the problem the distribution of petroleum products consumed in construction was made on the basis of cement consumption by economic region.

e. Industry.

(1) Petroleum.

Lack of data precludes the distribution by economic region of the quantities of petroleum products consumed in the construction and repair of trunk pipelines. The distribution by economic region of the consumption of gasoline, diesel fuel, lubricants, residual fuel oil, and crude oil by the petroleum industry

in crude oil drilling and producing operations was based on the distribution by economic region of annual production of crude oil. The distribution by economic region of residual fuel oil consumed by the crude oil refineries was based on a pattern believed to be representative of the regional crude oil charge to refineries.

(2) Chemical.

Estimates of the quantities of petroleum products consumed by the Soviet chemical industry were based on the ratio of the consumption of petroleum products to the output of commodities by the chemical industry involving the use of petroleum products. The distribution by economic region of the quantities of petroleum products consumed has been equated with the estimates of regional production of such commodities.

(3) Coal.

The general pattern used to distribute the quantities of petroleum products consumed by the coal industry was that of the regional production of coal. Because of the mining conditions and methods peculiar to the Donets Basin in Economic Regions III (South) and IV (Southeast), however, it is estimated that the consumption of petroleum products in these two regions averages about 50 percent of the total consumption by the coal industry, although production in Regions III and IV accounts for only 38 or 39 percent of the total. The balance has been allocated on the basis of approximate regional distribution of production of coal.

(4) Steel.

The distribution by economic region of the residual fuel oil consumed by the steel industry is in direct correlation with the regional production of crude steel by oil-fired furnaces. It was possible to create such a pattern only for 1956, and this pattern was held constant for the remaining years.

(5) Electric Power.

The regional distribution of the gasoline and diesel fuel consumed in the generation of electric power was made on the basis of the regional distribution of the rural population of the USSR, as reported for April 1956. The consumption of residual fuel oil was distributed regionally on the basis of the regional distribution of the estimated 1955 capacity of thermal electric powerplants, which consumed mainly residual fuel oil.

(6) Nonferrous Metals and Manufacturing.

In the absence of other data the regional distribution of the lubricants and residual fuel oil consumed by the nonferrous metals and manufacturing industries of the USSR was based on the regional pattern of consumption of lubricants and residual fuel oil established for all other consuming sectors of the civil economy in the year 1955. In view of the relatively short time-span involved, as well as the relative insignificance of consumption by these industries, it is believed that the margin of error inherent in the application of the 1955 pattern to the entire period in question would not be appreciable.

APPENDIX C

SELECTED BIBLIOGRAPHY

Information is abundant on many phases of the petroleum industry of the USSR. The Soviet press in particular gives much attention to drilling practices, to production of crude oil and methods of production, and to the transportation of crude oil and finished products by pipeline. With regard to the refining of crude oil, output of refined products -- either in percentage yields or in absolute quantities -- and the eventual disposition of annual output, there has been a reluctance to divulge any information since 1940. Yet through a painstaking search of the vast amount of material in the Russian language covering virtually all phases of the Soviet economy, it has been possible to find and fit together pieces of information to form a fairly clear and understandable pattern.

A selection of relevant books, periodicals, and newspapers in the Russian language is listed below. These sources, in addition to the vast number of US trade journals, newspapers, and available publications of universities and private research institutions, have provided the basis for the material presented in this report.

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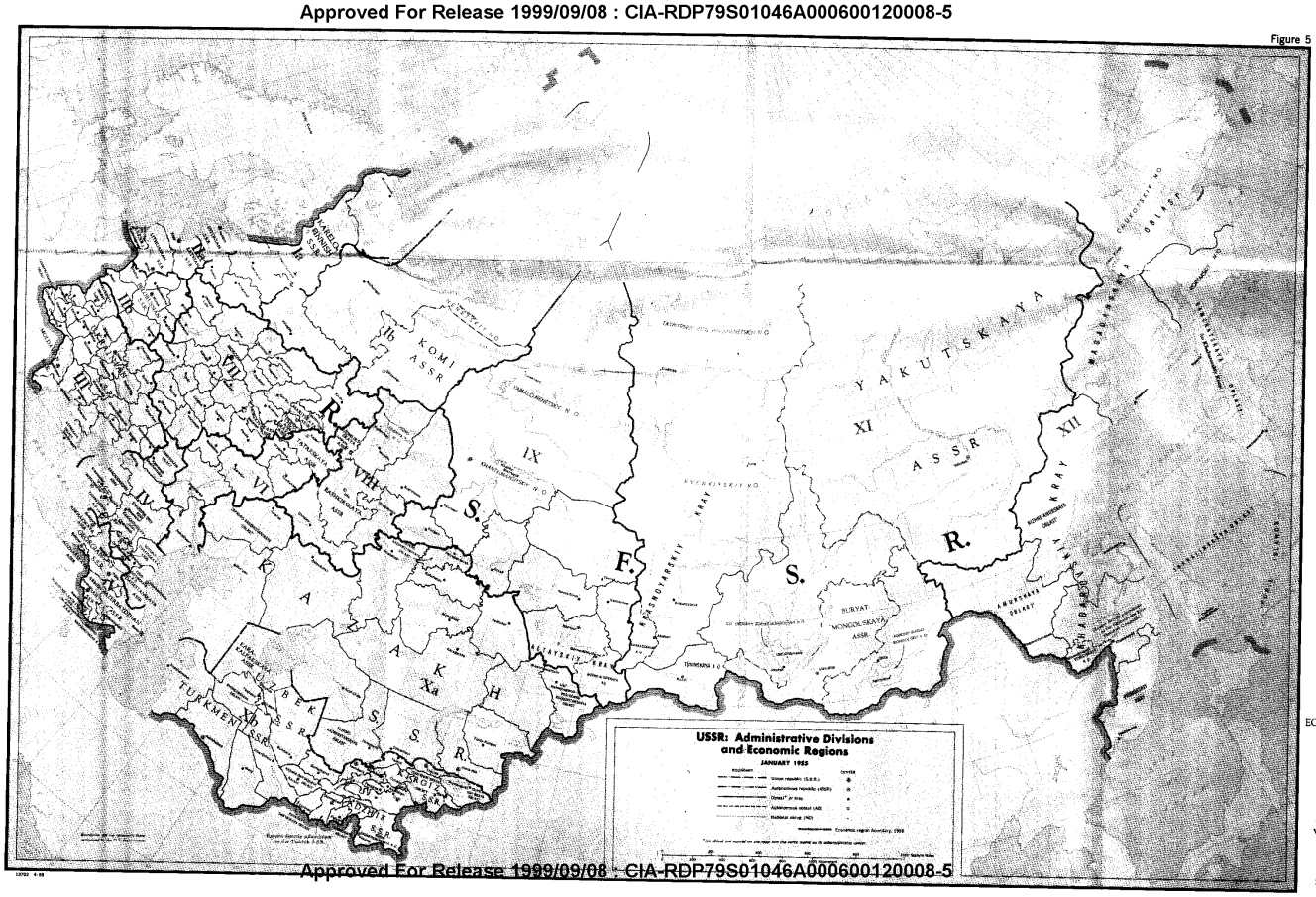
Figure 5



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