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ECONOMIC INTELLIGENCE REPORT

PETROLEUM IN THE USSR



CIA/RR 66

19 December 1955

CENTRAL INTELLIGENCE AGENCY

OFFICE OF RESEARCH AND REPORTS

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(ORR Project 25.472)

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FOREWORD

The major purpose of this report is to present, by means of an integrated analysis of the postwar petroleum economy of the USSR, an over-all petroleum supply and demand balance for the 1951-54 period. Derivation of a petroleum balance for the postwar years before 1951 is impossible because certain pertinent data -- particularly on intra-Bloc trade in petroleum -- are not available.

As the documentation of this report indicates, most of the estimates that provide the basic data were developed in other reports, either published or being prepared for publication, which deal with specific aspects of the petroleum economy of the USSR. For reasons specified in these reports, some of the basic data are subject to rather wide ranges of error. Those ranges of error, of necessity, have been carried over into this report. The over-all petroleum supply and demand balance should be accepted, then, with qualifications -- it is accurate only to the extent that the basic data from which it was derived are accurate, and it is subject to revision as more complete and more reliable data become available.

The cost data in this report -- average production costs of crude oil and natural gas liquids (natural gas is not discussed in this report) and average prices of the principal petroleum products -- have been computed in terms of 1951 rubles.



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PETROLEUM IN THE USSR*

Summary

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The production of crude petroleum** in the USSR increased steadily during the 1951-54 period, and the demand for petroleum products increased at an even greater rate. To meet this demand, a part of which was created by rising exports to the West, the USSR supplemented domestic production with imports from the European Satellites. Counting the petroleum received as reparations and indemnities, the USSR has been a net importer of petroleum throughout the postwar period.

Production of crude petroleum in the USSR in 1954 is estimated to have reached an all-time high of 57.6 million metric tons,*** 53.6 million tons of crude oil and 4 million tons of natural gas liquids. Soviet production of crude petroleum in 1954 was about 8 percent of total world production. Only the US and Venezuela produced greater portions of the world supply. In addition to crude petroleum the USSR produces synthetic oils from oil shale and from coal. The output of these synthetic oils is as yet relatively unimportant; in 1954 the output of about 500,000 tons was equal to less than 1 percent of the production of crude petroleum. 50X1

As of 1 January 1955, estimated proved reserves and undiscovered resources of crude oil and natural gas liquids in the USSR were nearly 22 billion tons, about 30 percent of the total of such resources remaining in the world. Soviet exploration has discovered, however, only about one-tenth of the potential resources, which indicates the magnitude of the task for exploration. Such exploration is being actively pursued, and Soviet knowledge of such aids to petroleum exploration as geophysics and geochemistry is on a par with that of the Free World. [redacted]

* The estimates and conclusions contained in this report represent the best judgment of ORR as of 1 August 1955. [redacted] 50X1

** In this report the term crude petroleum is used to include only crude oil and natural gas liquids. Unless otherwise indicated by context, the term petroleum is used generically and may include both crude petroleum and petroleum products.

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

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After World War II, Soviet production of crude petroleum increased steadily at a moderate rate. In the course of the Fifth Five Year Plan (1951-55), production was to increase 85 percent over the 1950 output, which is claimed by the USSR to have reached 37.6 million tons. These data indicate a 1955 production of nearly 70 million tons. If Soviet reports of production during the first half of 1955 are accurate, and if the implied production rate is maintained throughout the year, the 70-million-ton goal probably will be reached.

Currently and potentially the most important single producing region in the USSR is the large Ural-Volga Basin, frequently called the "Second Baku" because of its importance as a source of petroleum. Historically, the Baku fields have been the main producers of the country, but in 1952 leadership was acquired by the Ural-Volga fields. In 1954, production from the Ural-Volga fields accounted for about 42 percent of total Soviet output, and the Baku fields accounted for about 33 percent. Production of crude petroleum in the USSR has thus become more secure strategically.

Throughout the postwar period, refining capacity in the USSR has been adequate to handle the available quantities of crude oil. The Soviet refinery yield pattern differs considerably from that of the US. In particular, the Soviet yield of gasoline is less than that of the US relative to amounts of crude oil refined. In the USSR, more emphasis is placed on intermediate distillates -- earlier on kerosine and currently on diesel fuel. The difference in yield pattern is logical in view of the fact that in the US the large gasoline demand of the 50 million passenger cars is the dominant consideration. On the whole, the quality of refined petroleum products in the USSR is high and is well adapted to the needs of the Soviet economy.

Of all the various aspects of petroleum in the USSR, distribution is the least developed. Territorial expanse, widespread location of consumers, and severe winter shipping conditions combine to make distribution a complex problem. This problem has led to the construction of an exceptionally large storage capacity for petroleum products, but storage and distribution facilities apparently are not yet sufficient at all stages of the distribution process. Railroad and water transport, with their inherent shortcomings in handling liquid products efficiently, are relied on most heavily to move crude petroleum and petroleum products. The USSR, however, is fully cognizant of the superior efficiency of pipelines for moving liquids and is gradually increasing the pipeline network.

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Under the Soviet pricing system, crude oil and natural gas liquids appear to be priced at wholesale on the basis of industry-wide average unit costs of products, plus a planned profit of 3 to 5 percent. In setting prices for petroleum products, a basing point system probably is used, with Baku as the likely basing point. Estimated 1951 prices are 70 rubles per ton for crude oil and natural gas liquids and an average of 432 rubles per ton for petroleum products. Prices of petroleum products in the USSR thus were more than six times the raw material price. In the US, average prices of principal petroleum products exceed raw material prices by only 30 to 35 percent. Only part of the wide price differential in the USSR can be ascribed to refining costs. The bulk of the difference is accounted for by a high turnover tax, which is included in the average price cited. The high turnover tax is the device used by the USSR to promote economy in the use of petroleum fuels relative to other fuels.

Immediate postwar planning by the USSR gave evidence of a more rapid rate of production contemplated for coal than for petroleum. Recent developments in the USSR suggest that this policy may be changed in the immediate future and that the share of petroleum fuels in the Soviet fuel energy balance can be expected to increase.

I. Exploration.

A. Distribution of Petroleum Resources.

Those areas in the USSR which are geologically favorable for the occurrence of petroleum and contain known deposits cover about 1.7 million square miles, nearly one-fifth of the total Soviet land and inland sea area of 8.4 million square miles. The petroleum areas include those in which petroleum is being produced and those in which deposits are known but not yet developed. Areas in the USSR containing known oil deposits, as of 1954, are shown in Table 1* and on the map, Figure 1.**

* Table 1 follows on p. 4.

** Following p. 4.

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Table 1

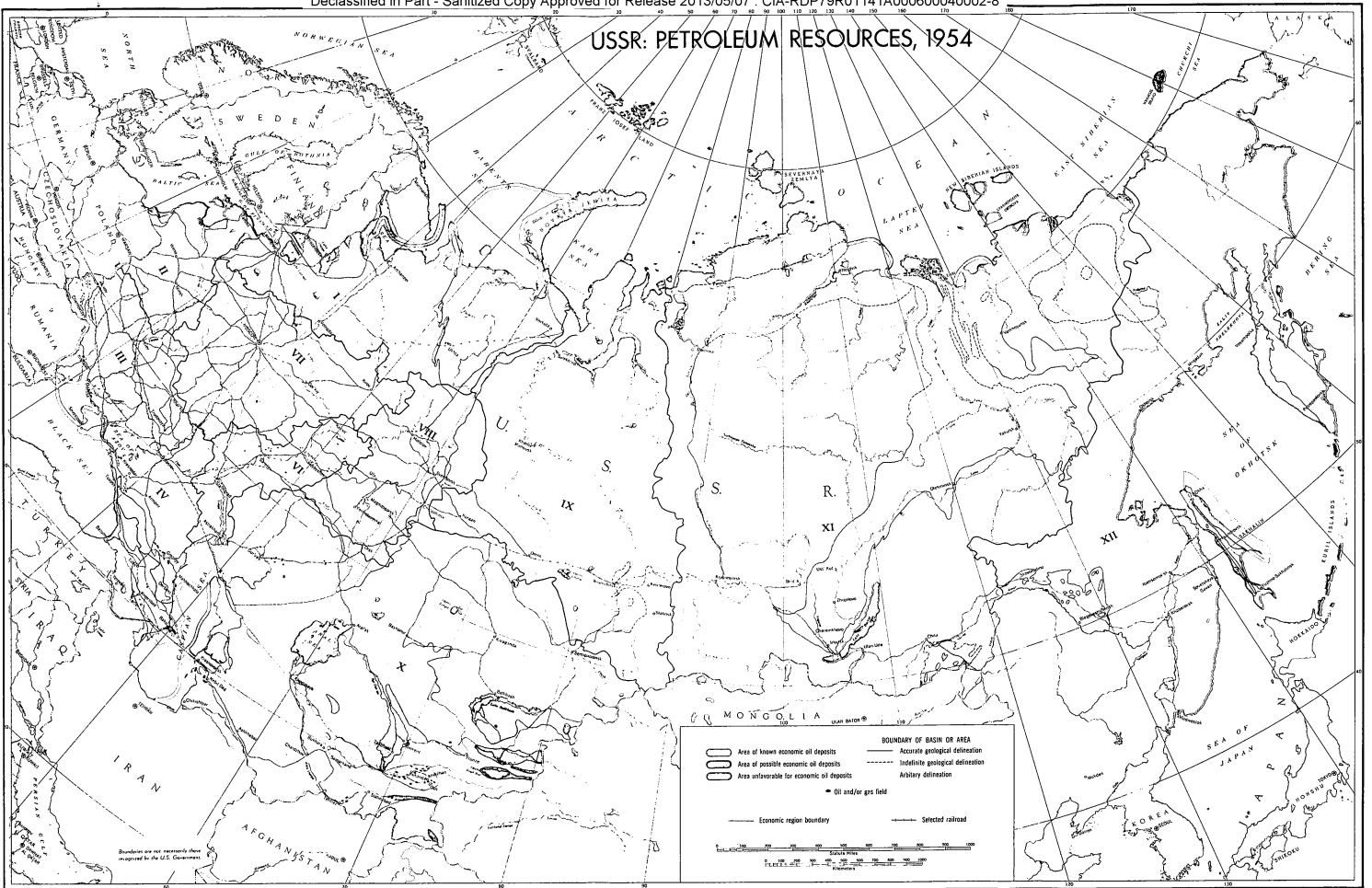
Areas in the USSR Containing Known Oil Deposits a/
1954

Area	Thousand Square Miles		
	Inland	Offshore	Total
Pechora River Basin	257	114	371
Ural-Volga	433	0	433
Emba River Basin	198	28	226
Western Ukraine	19	0	19
Moldavia - Southern Ukraine	37	0	37
Eastern Ukraine	96	0	96
Northern Caucasus	122	27	149
Baku - Kura River Basin	22	9	31
Nebit-Dag - Southern Turkmen	18	15	33
Turkmen (Kara-Kum)	172	0	172
Ferghana Valley	14	0	14
Chu River Basin	38	0	38
Sakhalin Island	9	26	35
Total	<u>1,435</u>	<u>219</u>	<u>1,654</u>

a. Determined by planimeter measurements of areas shown on the map, Figure 1, following p. 4.

In addition to the areas in the USSR containing known oil deposits, there are about 2.3 million square miles of areas of possible petroleum deposits wherein limited production may eventually be developed. The remainder of the country, about 4.4 million square miles, is geologically unfavorable for the occurrence of petroleum deposits.

Except for a limited area producing small quantities of petroleum near Nordvik (Kozhevnikovo) in the Arctic, there is no confirmed petroleum production in those areas of the USSR shown on the map, Figure 1, as areas of possible petroleum deposits. There are, however,



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unconfirmed reports from secondary sources 1/* claiming new petroleum discoveries in the following areas:

1. Aldan River Basin, about 63° N and 135° E, between the Aldan and Indigirka Rivers;
2. Lena River Basin near Yakutsk, about 62° N and 130° E;
3. Area between the Lena and Aldan Rivers, about 60° N and 130° E;
4. Area in the upper Lena River Basin, near 60° N and 110° E;
5. Various sites in the Lake Baikal Region, about 53° N and 105° E;
6. Area on the Yenisey River south of Dudinka, about 67° N and 86° E; and
7. Kamchatka Peninsula, extending from about 51° N to 60° N and from about 155° E to 165° E.

The Kamchatka Peninsula has been the site of petroleum exploration for several years. 2/ Detailed results are not known, but petroleum deposits of significant size and productivity probably have not been discovered. There is no evidence of current operations beyond the exploratory level, and probably all of these sites are exploratory only. In 1954 the chief geologist of the Ministry of the Petroleum Industry of the USSR** stated that gas deposits had been found in Siberia. 3/ This statement tends to confirm the assumption that any petroleum deposits that may have been discovered in Siberia are still in the initial stages of development. Very limited petroleum deposits possibly may have been discovered at some of these locations, however, because highly localized geological conditions favorable for the occurrence of petroleum undoubtedly exist within the possible areas -- and perhaps even within the unfavorable areas. Small quantities of petroleum may be produced occasionally from such deposits.

[Redacted]

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** For a full description of the organization of the petroleum industry, see Appendix A.

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Total remaining Soviet resources of crude oil and natural gas liquids have been estimated at 21.92 billion tons* as of 1 January 1955. These resources include proved reserves and undiscovered resources. Tentative and preliminary estimates indicate that only 11 percent of total Soviet resources of crude oil have been discovered and proved as of 1 January 1955. With about 89 percent of total resources undiscovered, the scope for Soviet exploratory activity is very broad.

B. Current Activities.

Official plans and programs call for extensive exploration for petroleum in the regions shown on the map, Figure 1,** as areas of known petroleum deposits. Sustaining or increasing the petroleum production of the USSR depends on continued exploration in these regions.

C. Technology.

The large volume of literature published in the USSR on the application of geological and geophysical sciences to petroleum exploration is evidence of the comprehensive knowledge available to the Soviet petroleum industry. 4/ According to the chief geologists of the Ministry of the Petroleum Industry of the USSR, geophysical prospecting is widely practiced in the USSR. Gravitational, magnetic, and seismic methods have been in use for several years, and in 1954 a radioactive method (probably the scintillometer) was introduced. 5/ It appears that the theoretical development of geophysical methods of petroleum exploration in the USSR is approximately on the same level with that of the Free World. The USSR probably is 2 to 5 years behind the Free World, however, in the efficiency and relative extent of application of the more recent techniques.

II. Drilling and Producing Operations.

A. Drilling.

1. Turbine Drilling.

In 1954, more than 65 percent of all well drilling in the USSR was performed by turbine drilling. The number of wells drilled by

* For the basis of estimates, see Appendix B.

** Following p. 4, above.

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this method increased 2.4 times in the 1951-54 period. In Bashkirskoye, 95 percent of all wells drilled in 1954 were turbine drilled. 6/ These statements are particularly noteworthy because turbine drilling is not used in the Free World.

2. Use of Water as a Drilling Fluid.

In rotary drilling, the conventional method of drilling oil wells in the US, one of the high-cost inputs is the drilling fluid, which generally consists of a water-base mud plus certain additives. In turbine drilling, water can be used both as a drilling fluid and as a power fluid to operate the turbine. Because of more favorable geological conditions, water can be used as a drilling fluid in the Ural-Volga area to a much greater extent than in the Caucasus-Caspian areas. This probably explains the high percentage of turbine drilling in Bashkirskeye.

3. Dual-Well Drilling.

A technique developed in the USSR in recent years is the simultaneous drilling of 2 wells with 1 drilling rig. Such wells are side by side at the surface and are diverted by the usual directional drilling methods so that the bottoms of the wells in the petroleum deposit are separated by the desired distance. By running the drill pipe with the attached bit down one well as it is pulled out of the adjacent well, actual drilling can be done alternately in each well. Thus a greater percentage of the total time that each rig is at a location can be utilized in drilling. 7/

Dual-well drilling offers worthwhile advantages when it is necessary to pull out the drill pipe frequently because of bit wear, turbine repairs, or other reasons. Normal practice in the US is to rack the pipe in the derrick as it is pulled from the well. Although directionally drilled wells in the US are sometimes side by side at the well head, this particular technique of dual-well drilling is not used.

4. Comparison of US and Soviet Drilling Speeds.

Soviet drilling equipment and practices differ somewhat from those in the US, but measured in terms of actual drilling performance, they do not appear to equal those of the US. Drilling speeds in the USSR in 1954 for prospect drilling and development

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drilling averaged 231 meters and 741 meters per rig-month, respectively. 8/ In the US in 1953, however, all rotary drilling averaged 1,574 meters per rig-month. 9/

B. Production.

In 1900 the USSR was the leading producer of petroleum in the world. In that year, Russian output of 10.4 million tons was about 50 percent of the world's total production. 10/ Production declined thereafter and did not regain the 1900 level until 1927-28. Beginning with the First Five Year Plan (1928-32), production continued to increase. Modest gains were also made during the Second Five Year Plan (1933-37). The Third Five Year Plan (1938-42) placed great emphasis on exploiting the Ural-Volga Basin and connecting its oil-fields with the industrial regions of the Ural Mountains and central USSR through a widespread pipeline network. The Third Five Year Plan was interrupted by World War II, and the Soviet expectations of a rapid increase in production of petroleum were not realized. 11/

World War II resulted in a marked decline in Soviet output of petroleum, especially in the Caucasus fields. While this was in part caused by occupation of some of the fields by the Germans and subsequent destruction of producing facilities in these fields by both the German and the Soviet armies, the main decline occurred in the Baku fields where the difficulties were shortages of labor and equipment. 12/

In recognition of the magnitude of the reconstruction task following the end of the war, the production goals set forth in the Fourth Five Year Plan (1946-50) were modest in comparison with previous goals. According to Soviet reports, the production goal of 35.4 million tons for the last year of the plan was accomplished on 10 December 1950, and in the remaining 21 days of that year 2.2 million tons above the plan were to be produced. 13/

The Fifth Five Year Plan (1951-55) called for an increase of 85 percent in the output of petroleum.* This increase is equivalent to an average annual growth of 13.1 percent and would result in a 1955 production of 69.6 million tons of petroleum. 15/ Actual

* In this report it is assumed that the Russian term neft' (petroleum) in recent announcements refers to crude oil and natural gas liquids.

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annual increases announced by the Central Statistical Administration for 1951-54 have all been 12 percent. 16/ If this rate of increase were continued through 1955, the over-all increase for the Fifth Five Year Plan would be only 76 percent rather than 85 percent. In his speech of 4 July 1955, however, Premier Bulganin announced that production during 1955 would amount to 70 million tons. 17/ Shortly thereafter, Pravda reported that production during the first half of 1955 was 119 percent of the first half of 1954. 18/ If this rate of increase is maintained throughout 1955, petroleum output during the Fifth Five Year Plan will have increased a little more than 85 percent, bringing the tonnage produced during 1955 to a total of about 70 million tons. As mentioned previously, the USSR possesses an abundant area of land in which geological conditions are favorable for petroleum deposits, particularly in the Ural-Volga Basin. Bulganin's recent statement and fulfillment report for the first half of 1955 suggest that postwar exploration programs have been increasingly successful.

In contrast to these claims of fulfillment and suggestions of overfulfillment are some contradictory statements by Radio Moscow. On at least three occasions, Radio Moscow has stated that an 85-percent increase in petroleum production will be achieved during the Fifth Five Year Plan and that this will result in a 1955 production of 60 million tons. 19/ It is probable that the 60-million-ton objective will be met and exceeded, but these Radio Moscow announcements correlating an 85-percent increase over 1950 with a 1955 production of 60 million tons indicate a 1950 production of only 32.4 million tons. As stated above, 1950 production appears actually to have reached at least 37.6 million tons.

The estimated production of crude oil and natural gas liquids in the USSR in 1937-40 and 1946-54 as shown in Table 2* represents a compromise between the conflicting official Soviet statements. In Table 2 the 1950 production of crude oil is given as 37.6 million tons. By 1954, production of crude oil is estimated to have reached 53.6 million tons. In addition, the USSR has been producing increasingly large quantities of natural gas liquids in the postwar period, production reaching 4 million tons in 1954. These quantities are also estimated in Table 2. Most of the increase results from the rapid postwar development of the Ural-Volga deposits, which have gases rich in natural gas liquids. To produce the estimated 4 million tons of natural gas liquids in 1954 would have required no more than 100

* Table 2 follows on p. 10.

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Table 2

Estimated Production of Crude Oil and Natural Gas Liquids
in the USSR a/
1937-40 and 1946-54

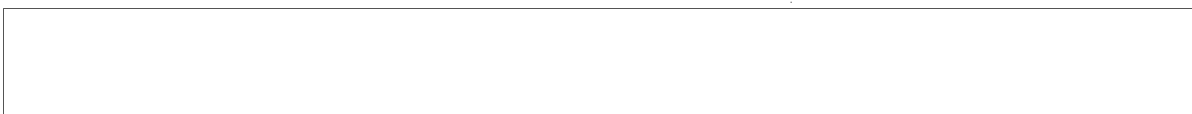
Thousand Metric Tons

<u>Year</u>	<u>Crude Oil</u>	<u>Natural Gas Liquids</u>	<u>Total</u>
1937	28,501	136	28,637
1938	30,186	167	30,353
1939	30,417	189	30,606
1940	30,661	221	30,882
1946	21,700	200	21,900
1947	26,000	300	26,300
1948	29,400	400	29,800
1949	33,600	600	34,200
1950	37,600	800	38,400
1951	41,600	1,200	42,800
1952	45,600	2,100	47,700
1953	49,600	3,100	52,700
1954	53,600	4,000	57,600

a. 20/

average-sized field plants for processing the wet gas. 21/ The construction and operation of such natural gasoline plants is considered to be within Soviet capabilities, although there is little direct evidence that this number of plants actually has been built.

Estimated production of crude oil in the USSR by economic region* in 1937 and 1946-54 is shown in Table 3.** Of primary significance is the northward and eastward shift of production of crude oil. In 1937, Region V accounted for 76 percent of the total production of crude oil, and Regions VI and VIII, the Ural-Volga area (also popularly called the "Second Baku"), accounted for only 3 percent of total production. In 1954, however, production from Region V is estimated to have dropped to about one-third of the total,



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** Table 3 follows on p. 11.

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Table 3

Estimated Production of Crude Oil in the USSR
by Economic Region a/
1937 and 1946-54

Thousand Metric Tons

Year	Economic Region								Total
	Ib	III	IV	V	VI and VIII	Xa	Xb	XII	
1937	65	0	4,315	21,692	936	422	670	401	28,501
1946	200	300	2,500	11,600	3,700	800	1,600	1,000	21,700
1947	300	300	3,300	13,100	5,200	800	2,000	1,000	26,000
1948	300	300	3,900	13,800	6,700	800	2,600	1,000	29,400
1949	400	400	4,700	14,500	8,400	1,000	3,200	1,000	33,600
1950	400	400	5,800	14,800	10,300	1,100	3,700	1,100	37,600
1951	400	500	6,000	15,100	13,400	1,400	3,700	1,100	41,600
1952	500	500	6,000	15,700	16,500	1,400	3,900	1,100	45,600
1953	500	500	6,000	16,500	19,200	1,500	4,300	1,100	49,600
1954	500	500	6,000	17,500	22,100	1,500	4,400	1,100	53,600

a. [redacted] data for 1954 have been derived by extrapolation.

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but production from Regions VI and VIII is believed to have increased to over 40 percent of the total. The strategic significance of the shift of production from the periphery to the interior of the USSR is obvious.

C. Reserves.

On 1 January 1938, the latest date for which official Soviet statistics are available, proved reserves amounted to 977.1 million tons. The Soviet method of classifying and reporting reserves differs from that generally used in the US, however, and according to US practice, this official Soviet estimate may be somewhat too liberal in classifying proved reserves, but no data are available on which to base a correction. Assuming that this reserve figure is approximately correct, it is significant that in 1938 the yearly production of crude oil and natural gas liquids was only about 3 percent of the proved reserves. 23/

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Exaggerated Soviet use of the reserves concept is illustrated by the statements in a 1952 Soviet popular publication to the effect that the USSR had more than one-half of world petroleum reserves of more than 10 billion tons and that its reserves were more than double those of the US. These reserves were characterized as "known" reserves and did not include "unexplored reserves" of indeterminately large dimensions. ^{24/} Although the world reserves were considerably understated, the magnitude of purported Soviet "known" reserves was many times overstated, as indicated by the following data which are based on the US concept of proved reserves.

As a result of the accelerated efforts to develop the petroleum resources in the Fourth and Fifth Five Year Plans, proved reserves of crude oil and natural gas liquids in the USSR as of 1 January 1955 are estimated to have increased to the following levels*:

	<u>Estimated Proved Reserves</u> <u>(Million Metric Tons)</u>
Crude oil	
Ural-Volga area	723
Remainder of USSR	530
Total crude oil	<u>1,253</u>
Natural gas liquids (entire USSR)	140
Total liquid petroleum	<u>1,393</u>

Comparing the estimate of liquid petroleum reserves with the 1954 estimated production of crude oil and natural gas liquids, it appears that the USSR is still producing annually only about 4.1 percent of its proved petroleum reserves. The US, on the other hand, is producing annually over 7 percent of its proved reserves. ^{25/}

* For the basis of estimates, see Appendix B.

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III. Refining and Processing.

A. Natural Crude Oil Refineries.

Although the growth of refining capacity in the USSR has closely paralleled the expansion of production of crude oil, modern refining processes were not introduced until 1928. In that year the USSR installed a number of thermal cracking units. Soviet refining equipment before that time consisted almost entirely of straight-run crude oil distillation units, most of which were either of UK or US origin or design.

The USSR has not shown much originality in process design, but Soviet technicians have proved ingenious in adopting and modifying foreign designs for their own purposes. In the 1930's a number of Soviet-modified thermal cracking units were constructed, but the first catalytic facilities to be installed in the country were the Universal Oil Products (UOP) polymerization units at Ufa, Saratov, and Grozny and a UOP hydrogenation plant at Ufa. All these units were of US design and manufacture. Installation was completed in 1940.

Under the Lend-Lease agreements (1941-46) the USSR received and installed noncatalytic refinery units at Orsk, Krasnovodsk, Gur'yev, and Kuybyshev and Houdry fixed-bed catalytic cracking and sulfuric-acid alkylation units at Orsk and Gur'yev. 26/ These Houdry units were the first known catalytic cracking units in the USSR. Similar units were planned for Krasnovodsk and Kuybyshev but were not installed under Lend-Lease. 27/

Petroleum refineries in the USSR in 1950 and 1953 are shown in Table 4.* The locations of these refineries are also shown on the map, Figure 2.** In addition to the increase in total distillation capacity of 12.6 million tons from 1950 to 1953, an increase of about 32 percent, the northward and eastward shift of refining capacity is significant. Of the total distillation capacity in 1950, Regions VI and VIII had only 16 percent. By 1953 these regions had over 31 percent of the total. In other words, over 80 percent of the total new crude distillation capacity between 1950 and 1953 was installed in the Ural-Volga Basin. Although this construction has brought refining capacity more closely in line with estimated regional production of***

* Table 4 follows on p. 14.

** Following p. 16.

*** Continued on p. 16.

Table 4

Petroleum Refineries in the USSR a/*
1950 and 1953

Site	Name	Coordinates	Economic Region	Thousand Metric Tons Annual Crude Oil Charge Capacity	
				1950	1953
Baku		40°23' N - 49°53' E	V	15,000	15,000
Groznyy		43°18' N - 45°40' E	IV	7,000	7,000
Saratov	Krasnodar	51°27' N - 45°57' E	VI	1,800	3,700
Ufa	Chernikovsk	54°50' N - 56°06' E	VIII	1,500	3,200
Tuapse		44°06' N - 39°06' E	IV	2,000	2,600
Batumi	Stalin No. 429	41°39' N - 41°41' E	V	2,000	2,000
Syzran'	Stalin	53°11' N - 48°27' E	VI	500	1,800
Orsk		51°16' N - 58°30' E	VIII	1,500	1,500
Krasnovodsk		40°01' N - 52°58' E	Xb	1,020	1,500
Vannovskoye		40°25' N - 71°31' E	Xb	750	1,500
Krasnodar		45°00' N - 38°58' E	IV	1,000	1,000
Moscow	Lybertsy	55°39' N - 37°35' E	VII	820	1,000
Gor'kiy		56°20' N - 43°54' E	VII	235	235
Drogobych		49°21' N - 23°30' E	III	360	600
Komsomol'sk	No. 409	50°37' N - 137°03' E	XII	600	600
Gur'yev	Lend-Lease No. 1	47°05' N - 51°56' E	Xa	560	560
Khabarovsk	Ordzhonikidze No. 299	48°30' N - 134°03' E	XII	550	550
Ishimbay	Peregonyy	53°28' N - 56°02' E	VIII	480	500
Kuybyshev		53°07' N - 50°04' E	VI	460	460
Konstantinovskiy	Mendeleyev	57°49' N - 39°36' E	VII	450	450

* Footnote to Table 4 follows on p. 15.

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Table 4

Petroleum Refineries in the USSR a/
1950 and 1953
(Continued)

Site	Name	Coordinates	Economic Region	Thousand Metric Tons Annual Crude Oil Charge Capacity	
				1950	1953
Krasnokamsk		58°04' N - 55°39' E	VIII	200	400
Ukhta		63°34' N - 53°42' E	Ib	250	250
Kim		40°12' N - 70°22' E	Xb	N.A.	50
L'vov		49°51' N - 24°03' E	III	50	50
Mukachevo	Del Karpati	48°26' N - 22°42' E	III	30	30
Tbilisi		41°43' N - 44°49' E	V	20	20
Chop		48°26' N - 22°12' E	III	10	10
Odessa		46°31' N - 30°41' E	III	0	0
Kherson		46°38' N - 32°37' E	III	N.A.	0
Ufa	Ufa No. 2	N.A.	VIII		2,600
Kuybyshev	Kuybyshev No. 2	N.A.	VI		2,600
Total				39,145	51,765

a. [redacted] data for Gor'kiy are estimated. The name of the refinery is given only when it differs from the name of the site.

50X1

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crude oil, the processing capacity in Regions VI and VIII in 1953 was still inadequate to handle the local output of crude oil. Thus Ural-Volga crude oil was shipped long distances for refining in Baku and other areas short of crude oil. 29/

The estimated output of petroleum products from the refining of crude oil in the USSR in 1937 and in 1946-54 is shown in Table 5.

Table 5

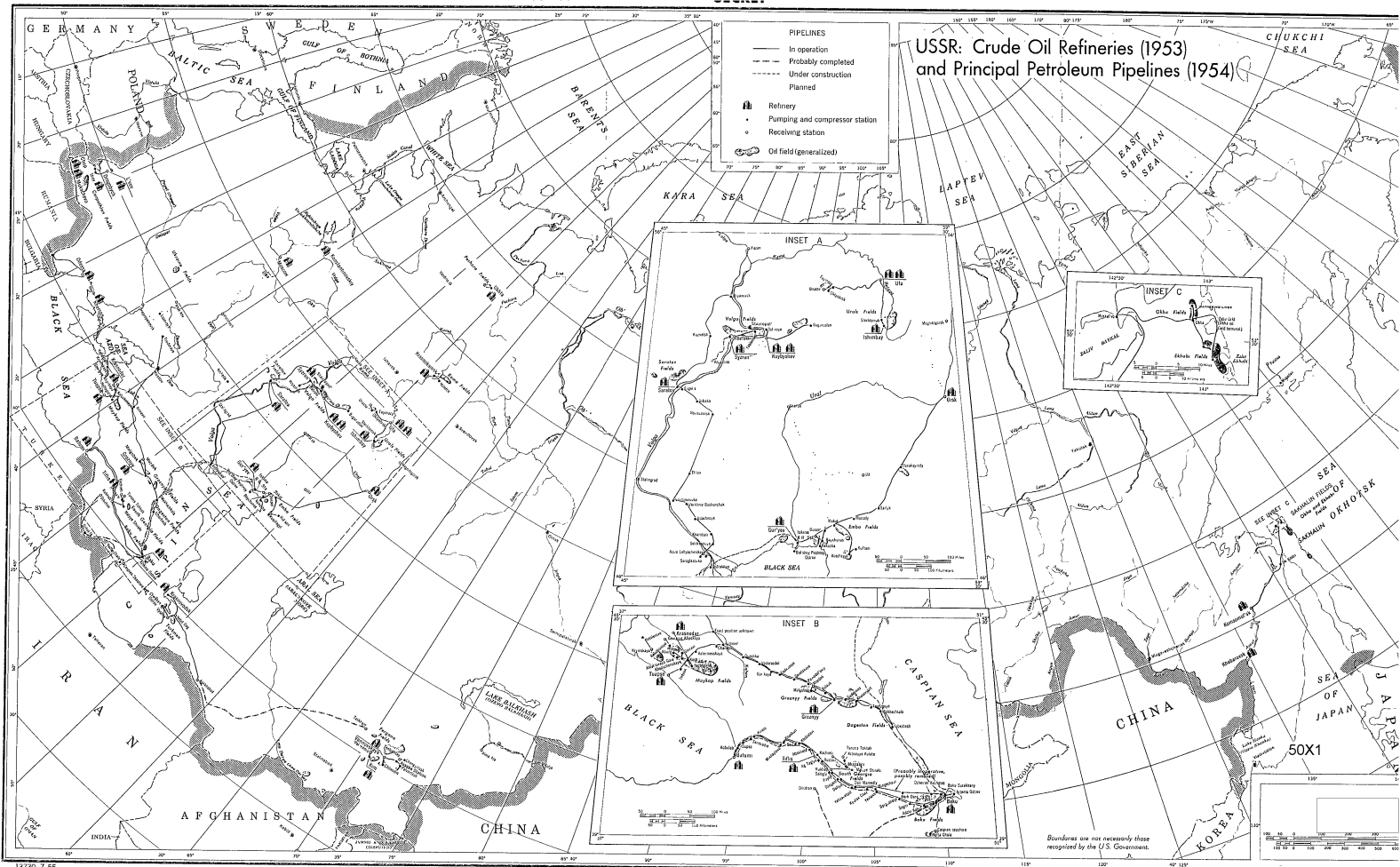
Estimated Output of Petroleum Products from the Refining
of Crude Oil in the USSR a/
1937 and 1946-54

Thousand Metric Tons

<u>Year</u>	<u>Gasoline</u>	<u>Ligroine</u>	<u>Kerosine</u>	<u>Gas Oil</u>	<u>Lubricants</u>	<u>Residuals and Others</u>	<u>Total</u>
1937	3,010	1,295	6,132	1,598	1,701	10,584	24,320
1946	2,604	682	4,760	734	1,236	8,482	18,498
1947	3,546	620	5,922	962	1,469	9,469	21,988
1948	3,948	632	6,901	1,271	1,679	10,703	25,134
1949	4,282	519	7,997	1,678	1,915	12,269	28,660
1950	4,978	529	8,546	2,655	2,135	13,107	31,950
1951	5,882	564	8,577	3,850	2,362	14,119	35,354
1952	7,186	676	8,037	5,160	2,586	15,054	38,699
1953	7,669	757	9,578	6,916	2,826	13,991	41,737
1954	8,112	233	9,610	9,965	3,028	13,774	44,722

a. 30/

The yield of gasoline from the Soviet refineries is proportionately much less than that obtained from US refineries. Because gasoline has continued to be the petroleum product in greatest demand in the US, the refining operations and techniques are generally directed toward maximizing the yield and quality of gasoline. In the USSR, however, emphasis apparently is placed on maximizing the yield of intermediate distillates -- earlier on kerosine and more recently on diesel fuel.



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The characteristics of crude oil in the two countries help to explain this divergence in the output patterns of petroleum products. In nontechnical terms the average Soviet crude oils, compared with US crude oils, contain a much smaller percentage of straight-run gasoline, probably an equal percentage of straight-run kerosine, and a larger percentage of straight-run gas oil.

The naphthenic gas oils in Soviet crude oils would make good catalytic cracking-charge stock and would yield relatively large quantities of high-quality gasolines, including base stocks for high-octane aviation gasoline. There is evidence, however, that catalytic-cracking processes do not have high priority in the USSR, although some new catalytic-cracking plants probably have been constructed since World War II and some had been received from the US. Table 5* indicates that the trend has been to use more thermal cracking to derive a larger percentage of intermediate distillates. 31/ Table 5 also shows that there has been a corresponding relative decrease in the yield of products in the "Residuals and Others" category.

B. Synthetic and Shale Oil Facilities.

In the USSR before World War II, there was little, if any, production of true synthetic or shale oil. During the postwar period, however, the USSR has been striving to expand the synthetic oil industry, particularly in regions that are deficient in output of crude oil. It is apparent that if these areas can be made self-sufficient in liquid fuels, the heavy burden of supply now imposed on Soviet transportation facilities would be greatly reduced. Major synthetic and shale oil plants in the USSR in 1953 are shown in Table 6.** (For the location of these facilities, see the map, Figure 3.***)

After World War II the USSR dismantled several of the most important German synthetic oil plants and relocated them in the USSR. Approximately 1.6 million tons of production capacity were so dismantled, but only 50 percent of this could be utilized in reconstruction. One of the most important dismantled plants acquired was the Blechhammer installation, which was employed as part of the Krasnoye Project at Kitoy, Irkutsk Oblast. Upon completion, this project will****

* P. 16, above.

** Table 6 follows on p. 18.

*** Following p. 20.

**** Continued on p. 20.

Table 6

Major Synthetic and Shale Oil Facilities in the USSR a/*
1953

Thousand Metric Tons						
Site	Name	Coordinates	Economic Region	Petroleum Product Capacity	Process Used	Remarks
Kitoy	Krasnoye	52°35' N - 103°56' E	XI	0	Bergius hydrogenation	Under construction. The designed capacity is about 1 million tons per year. Some production probably was begun in 1954.
Cheremkhovo		53°07' N - 103°09' E	XI	20	Low-temperature carbonization	
Kemerovo		55°21' N - 86°00' E	IX	N.A.	Possibly Bergius hydrogenation	Existence doubtful.
Novocherkassk		47°29' N - 40°06' E	IV	N.A.	Possibly Fischer-Tropsch	May have begun operation in 1954.
Leninsk-Kuznetskiy		54°38' N - 86°10' E	IX	10	Low-temperature carbonization	
Gornozavodsk	Naihor	46°33' N - 141°51' E	XII	10	Low-temperature carbonization	
Uglezavodsk	Naibuchi	47°19' N - 142°37' E	XII	10	Low-temperature carbonization	
Kiviyl		59°22' N - 26°57' E	IIa	180	Shale-oil processing	
Kokhtla-Yarve		59°24' N - 27°14' E	IIa	150	Shale-oil processing	

* Footnote to Table 6 follows on p. 19.

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Table 6

Major Synthetic and Shale Oil Facilities in the USSR a/
1953
(Continued)

						Thousand Metric Tons
Site	Name	Coordinates	Economic Region	Petroleum Product Capacity	Process Used	Remarks
Akhtme		59°18' N - 27°27' E	IIa	140	Shale-oil processing	
Kohtla		59°20' N - 27°23' E	IIa	10	Shale-oil processing	
Slantsy		52°11' N - 43°35' E	Ia	50	Shale-oil processing	
Syzran'	Kasperovka	53°02' N - 48°26' E	VI	N.A.	Shale-oil processing	
Total				580		

a. 32/ The name of the facility is given only when it differs from the name of the site.

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be the largest synthetic oil plant in the USSR. Original plans provided for the annual output of approximately 1 million tons of liquid fuels. This quantity would serve to relieve considerably the present burden on the Trans-Siberian railroad for supplying East Siberia and the Far East. [redacted] the plant was operating in mid-1954, but no quantitative production data are available. 33/

50X1

The shale oil industry in the USSR is concentrated in the Estonian SSR, where extensive exploitation of rich oil shale has been under way since the early 1920's. In the postwar period the USSR has been concentrating on rehabilitating the facilities which were heavily damaged in 1944 by the retreating Germans.

According to the Fourth Five Year Plan, the output of oil shale was to have reached 8.4 million tons in the Estonian SSR in 1950, and 900,000 tons of shale oil and other synthetic oil were to have been produced in the whole country. All evidence indicates, however, that actual production fell far short of planned production. The oil shale output for 1950 is estimated to have been about 3.4 million tons, and the output of both shale oil and synthetic oil was about 250,000 tons for the same year.

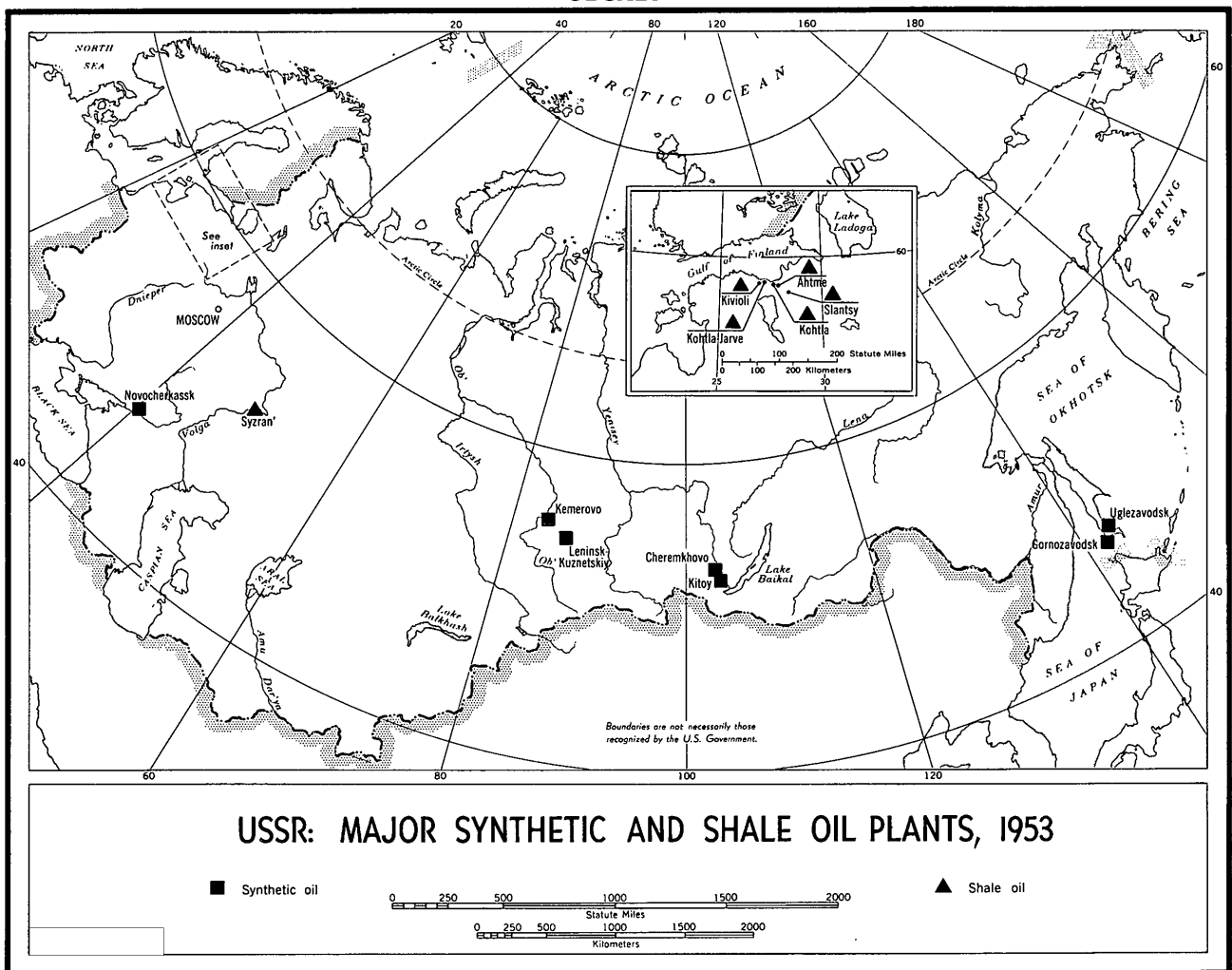
The failure to attain the planned production goals in shale oil and other synthetic oil is believed to have resulted from two factors: First, part of the shale oil plant capacity may have been converted to production of gas to supply industrial, commercial, and residential demands for gas in Leningrad. Second, the unusual difficulties probably encountered in the construction of the Krasnoye Project because of the extremely cold climate and the distance from centers of equipment supply delayed completion. Thus the over-ambitious goals established for the Fourth Five Year Plan could not be reached. 34/

The estimated output of synthetic oil products in 1954 exceeded 500,000 tons, or more than double the output of 1950. This rate of increase is expected to continue at least until the completion of the Krasnoye Project. The estimated output of synthetic oil products in the USSR in 1946-54 is shown in Table 7.*

* Table 7 follows on p. 21.

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Table 7

Estimated Output of Synthetic Oil Products
in the USSR a/
1946-54

Thousand Metric Tons

<u>Year</u>	<u>Gasoline</u>	<u>Kerosine</u>	<u>Gas Oil</u>	<u>Residuals and Others</u>	<u>Total</u>
1946	51	10	5	80	146
1947	54	10	6	93	163
1948	58	10	7	123	198
1949	61	10	9	147	227
1950	64	10	10	166	250
1951	72	10	14	224	320
1952	81	10	17	282	390
1953	89	10	20	336	455
1954	96	10	23	389	518

a. Synthetic oils consist of shale oil and small quantities of coal carbonization oils. Data are from source 35/.

C. Quality of Soviet Petroleum Products. 36/

The quality of the petroleum products produced in the USSR is generally adequate to satisfy the requirements of domestic consumers. Although some of the highest quality products, such as high-octane aviation gasoline and motor gasoline, are considered inferior to similar products produced in the US, the consuming sectors of the Soviet economy do not demand the high-grade gasolines which the development of engine design and motorization has made essential in the US. Thus, in some instances, quality comparison between US and Soviet products is not valid.

The high-octane grades of aviation gasolines produced in the USSR range from 92/120 to 100/130. There is no known specification for the 115/145 grade, which is in use in the US military services. The maximum tetraethyl lead fluid (TEL) permitted in Soviet high-octane grades of aviation gasoline is higher (5.6 cubic centimeters per gallon) than that specified for US aviation gasolines (4.6 cubic

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centimeters per gallon). If this higher maximum limit of TEL were actually added, it could cause abnormal operating difficulties and reduce the trouble-free operating time of reciprocating-type engines.

The current Soviet specification for fuel for jet aircraft engines corresponds to the US JP-1, which is no longer used because of its limited availability from US crude oils. This Soviet jet fuel (known as T-1, a kerosine cut) has been entirely satisfactory for the Soviet jet engines. Availability of stocks of this jet fuel from Soviet crude oils is apparently adequate, and no revisions in jet fuel specifications have been detected.

Specifications for Soviet motor gasolines provide for octane numbers from 66 to 74 -- with automobiles having maximum compression ratios of 5 to 5.5, there is no need for a higher quality product. The maximum TEL addition is about 2.1 cubic centimeters per gallon, which corresponds to US specifications.

In other Soviet products, ranging from the kerosines through the lubricating oils, there are no significant differences from US standards. Although there are certain minor differences in use patterns for some kerosines and diesel fuels, the general quality is acceptable and similar to that of US products.

From an analysis of samples of Soviet petroleum products, it has been determined that the petroleum products which the USSR is capable of producing can compete in Western markets with any products from the US or other nations. In fact, in some actual shipments the USSR has "given away" quality over and above that necessary to meet contract specifications, which would represent an uneconomical operation to US and Western refineries.

As of 1952 the stage of utilization of additives, inhibitors, antioxidants, and the like in Soviet products appeared to be slightly below the technological level of US practices. Nevertheless, the items produced by the USSR were adequate for actual operating requirements.

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IV. Distribution and Storage.

A. Transportation Systems.

The distribution of petroleum throughout the USSR is made particularly complex because of the following three factors: (1) the large area of the country with petroleum consumers situated in all parts; (2) the localized nature of petroleum production and refining; and (3) the extremely severe winter weather, which hampers operations of petroleum transportation systems in many parts of the country. The first two factors are estimated to result in petroleum hauls averaging about two-thirds longer than the average length of hauls of all other commodities, and the third necessitates special heating devices and higher-than-normal storage capacity. Flow lines and tank cars must be equipped with heating facilities so that oil can be made to flow when ambient temperatures are below 0° F. In some parts of the country, heavy snowfalls throughout the winter retard the loading and running of trains. In order for deliveries to be made on a regular basis, these conditions require an increased rate of hauling in summer months and increased storage capacity at various distribution points.

Winter conditions also make transportation by water highly seasonal and add to the need for storage facilities. In the major Caspian oil-receiving port of Astrakhan', for example, water shipments usually are possible only from the beginning of April to the end of November because of freezing at the mouth of the Volga and in the northern Caspian Sea. 37/ (Petroleum products move in volume through Astrakhan' up the Volga to central USSR destinations.)

In contrast to the US, where pipelines carry most of the oil, in the USSR railroads carry the largest share of the oil. The following estimate, dated about 1947, compares Soviet oil transport media with those of the US 38/:

<u>Media</u>	<u>USSR</u>	<u>US</u>
	<u>(Percent)</u>	
Railroad	42.7	2.2
River	11.8	} 26.6
Other water	34.1	
Pipeline	11.4	71.2

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By the end of the Fifth Five Year Plan the burden on the railroads was to have been decreased. Along with the planned 85-percent increase in petroleum output, the following increases in petroleum traffic were expected 39/:

<u>Media</u>	<u>Percent of Increase</u>
Railroad	85 to 95
River	75 to 80
Sea	55 to 60
Pipeline	400

Some progress in these directions apparently has been made, particularly in the much-emphasized pipeline category. It was reported in 1954 that about 25 percent of Soviet petroleum was transported by pipeline, 35 percent by sea and river tankers, and the remaining 40 percent by railroads.* 40/

Certain reported difficulties in the USSR with other forms of transport emphasize the desirability of the planned shift toward the more efficient pipelines. The Ufa railroad, which serves the major oil-producing areas in Bashkir ASSR and Tatar ASSR, has been described as constantly encountering difficulty in fulfilling its plan for hauling petroleum and petroleum products. Monthly assignments for the first quarter of 1954 were not met, although the absolute number of tank cars available was often above the norm. Tank-car returns were apparently not well organized, and there were repeated failures to supply the railroad with the proper number of empty cars for each type of liquid cargo to be handled. Routing of empty cars back to the railroad was stated to be excessively roundabout, and delays in loading and unloading were a constant problem. 41/ Soviet reports of tank-car turnover in 1951 indicated that the turnaround cycle of tank cars averaged 36.1 percent en route, 40.3 percent at operational stations, and 23.6 percent at loading stations. Further analysis of the time en route showed that 13.4 percent was spent on loaded runs, 10.4 percent on empty runs, and 12.3 percent on stops at intermediate stations. About 80 percent of turnaround time was stated to have been wasted. 42/

* For the locations of the principal petroleum pipelines in the USSR, see the map, Figure 2, following p. 16, above.

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A further problem in utilization of rail transport facilities appears to be uneconomic hauls of crude oil and products. According to 1954 Soviet press reports of official statements, ineffective long-distance cross hauling of crude oil, mainly from the Volga area and central Asia, amounted to 4.6 million tons in 1953. Another example of this problem -- one frequently cited -- is the lagging of crude oil production and refining in the Far East and the consequent need for long-distance shipments of petroleum products to that area at an annual cost of 1 billion rubles. 43/

Inefficiencies are also reported in water transport. Vessels arriving at Astrakhan' from Baku often wait for days because of shortage of storage space. 44/ Complex transshipment operations are also required for entering the port of Astrakhan' and for subsequent movement up the Volga. Late deliveries, excessive loss and damage of cargoes, lack of coordination between ship lines, and off-schedule arrivals at Caspian transshipping points are also cited as deficiencies in transport operations. 45/

B. Storage of Petroleum.

The storage of crude oil and petroleum products in the USSR is handled primarily in cylindrical-shaped steel tanks of varying capacities. Groups of these tanks, or what are commonly termed "tank farms," are usually situated at the origin and/or terminus of pipelines, at refineries, and at both land and marine terminals. In some cases the tanks are constructed of reinforced concrete for storage of crude oil and certain products. These concrete tanks typically range in capacity from 500 to 7,500 cubic meters and usually are located underground. They have been developed as a means of economizing on steel plate and reducing storage construction costs. Early difficulties with seepage of crude oil apparently have been overcome in recent years by improved interior coating methods. 46/

The estimated storage capacity for petroleum products in the USSR, by economic region, as of 1 January 1955, is shown in Table 8.* Only about half of these facilities has actually been identified -- the remainder has been deduced by indirect means. 47/ These data, when compared with total output of petroleum products in 1954, indicate that the estimated total storage capacity for petroleum products was equivalent to about 170 days' supply. In

* Table 8 follows on p. 26.

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Table 8

Estimated Storage Capacity for Petroleum Products
 in the USSR, by Economic Region a/
 1 January 1955

Thousand Metric Tons

<u>Economic Region</u>	<u>Primary <u>b/</u></u>		<u>Secondary <u>c/</u></u>	<u>Total</u>	<u>Percent</u>
	<u>Refinery</u>	<u>Nonrefinery</u>			
I	10	820	313	1,143	5.5
II	50	422	332	804	3.9
III	117	1,132	998	2,247	10.8
IV	506	972	372	1,850	8.9
V	1,148	706	190	2,044	9.9
VI	505	1,848	743	3,096	14.9
VII	236	2,386	1,060	3,682	17.9
VIII	401	857	547	1,805	8.7
IX	2	492	352	846	4.1
X	189	728	405	1,322	6.4
XI	59	359	193	611	2.9
XII	130	721	422	1,273	6.1
Total	<u>3,353</u>	<u>11,443</u>	<u>5,927</u>	<u>20,723</u>	<u>100.0</u>

a. 48/

b. Including storage capacity for finished products at primary refinery and nonrefinery bases only.

c. Including secondary storage at machine tractor stations, motor pools, airfields, industrial plants, and so forth.

the US, however, the total storage capacity for petroleum products usually ranges from 75 to 80 days' supply. The great difference in this relationship between the USSR and the US emphasizes the technological gap which exists between the two petroleum transportation systems. Where transportation between production and delivery of petroleum products is rapid and dependable, storage capacity may be greatly reduced; this aim is accomplished in the US by extensive use of pipelines.

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Centralized planning may at times impede smooth and rapid movement of petroleum products and cause congestion at storage points. Petroleum products are hauled to bulk plants in accordance with central allocations made to republic organizations and to subordinate consuming enterprises. From bulk plants, products are then distributed among these clients in proportion to such allocations. The centrally determined allocations are often not commensurate with, or synchronized with, current requirements of the consuming units. In fact, at times they even exceed needs and are not picked up by consumers. For example, the oil marketing director of Kiev Province complained in a 1953 press statement of repeated excessive allocations of gasoline and tractor kerosine, pointing out the limited capacity of bulk plants, their inability to store the products for long periods, and the resultant large increase in inactive railroad rolling stock. Examples were given of sizable demurrage payments to railroads and of charges made to consumers for failure to pick up shipments. This director also charged that random deliveries of products were made regardless of plan or of instructions from higher echelon organizations, necessitating refusal of loaded tank cars by the provincial marketing administrations. 49/

Some sizable consuming units in industry and agriculture have complained of a lack of readily accessible fuel storage centers and distribution facilities, requiring much additional transportation at their own expense. In 1953, such a complaint from the Astrakhan' agricultural area indicated the absence of filling stations for refueling of kolkhoz trucks and farm machinery. The kolkhozes were obliged to detach trucks from other work and send them long distances to town to procure needed petroleum products. 50/ Similarly, some industrial plants and fishing kolkhozes in Belomorsk (Karelo-Finnish SSR) depend on fuel from the petroleum center in Kem', about 30 miles distant and must transport their own petroleum from Kem' at high additional costs for containers and rail freight. 51/

V. Trade.

A. Imports of Petroleum.

Sizable Soviet imports of petroleum are a postwar phenomenon. After World War II the USSR supplemented its petroleum supply through reparations and requisitions from Soviet-controlled areas in Europe, principally Rumania.

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Although reparations have been officially discontinued, the USSR continues to import petroleum from the European Satellites. Over the years, Rumania has continued to be the largest supplier and shows every sign of continuing to be so in the foreseeable future. Albania, East Germany, Hungary, and the Soviet Zone of Austria have all contributed to the Soviet supply of petroleum in recent years. Estimated imports of petroleum by the USSR, by type of product, in 1951-54 are shown in Table 9.

Table 9

Estimated Imports of Petroleum by the USSR, by Type of Product
1951-54

Type of Product	Thousand Metric Tons			
	1951	1952	1953	1954
Crude oil	170	200	200	Negligible
Gasoline	1,870	2,380	2,504	2,459
Kerosine	440	560	588	611
Gas oil	800	1,025	1,071	1,019
Residual fuel oil	525	660	662	680
Lubricants	35	45	62	63
Total	<u>3,840</u>	<u>4,870</u>	<u>5,087</u>	<u>4,832</u>

Estimated imports of petroleum by the USSR, by country of origin, in 1951-54 are shown in Table 10.* The largest share of the total imports is made up of gasoline, about one-third of which came from Rumania via the Ploesti-Reni-Odessa pipeline. Crude oil imports, on the other hand, have been extremely small, which may indicate that there is little, if any, refinery capacity in the USSR in excess of crude oil production.

B. Exports of Petroleum.

Before World War II the USSR regularly exported substantial though decreasing amounts of petroleum products. In the early 1930's,

* Table 10 follows on p. 29.

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Table 10

Estimated Imports of Petroleum by the USSR, by Country of Origin
1951-54

Country of Origin	Thousand Metric Tons			
	1951	1952 ^{a/}	1953 ^{b/}	1954
Albania	30	95	0	0
East Germany	313	310	252	121
Hungary	100	345	336	336
Rumania	3,103	3,720	4,277	4,300
Soviet Zone of Austria	294	400	222	75 ^{c/}
Total	<u>3,840</u>	<u>4,870</u>	<u>5,087</u>	<u>4,832</u>

a. 52/

b. 53/

c. For methodology, see Appendix B.

when domestic petroleum demands were still at very low levels, production for export was a significant factor in the Soviet petroleum economy. During the initial stages of the industrialization of the USSR, petroleum exports served as one means of importing needed machinery. These exports reached their highest point in 1932, when 6 million tons of petroleum, 28 percent of the total amount of finished petroleum products, were exported. 54/ Shortly thereafter, however, the petroleum industry of the USSR found it difficult both to keep pace with growing domestic demands and to maintain the 1932 export level. Petroleum exports subsequently declined steadily, and during World War II the USSR became a net importer of petroleum. 55/

After the close of World War II the USSR signed commercial agreements with various oil-deficient countries, principally the European Satellites, providing for deliveries of petroleum products. Most of these commitments probably were met by deliveries from Rumania or the Soviet Zone of Austria on the Soviet account, but some shipments of aviation fuels and lubricants are reported to have gone from the USSR to the Satellites. 56/ Later in the postwar period, after the Communists gained control of China, exports of petroleum

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from the USSR increased. Exports to the European Satellites have been very small, while those to Communist China have been considerable. Estimated exports of petroleum from the USSR, by country of destination, in 1951-54 are shown in Table 11.*

The recent increase in petroleum exports to the West is particularly significant. In 1950, Soviet exports to the West amounted to only 69,000 tons, but in 1954 they had expanded to 2,647,000 tons. This quantity had a value of current US \$55,827,000. 57/ In terms of world petroleum trade, however, these quantities and values are not large -- in 1954, for example, Soviet petroleum exports to the West amounted to less than 1.5 percent of the value of world trade in petroleum. 58/

Estimated exports of petroleum from the USSR, by type of product, in 1951-54 are shown in Table 12.** Comparison of Tables 12 and 9 shows that the USSR is exporting to the West some of the same types of products which it is importing. Crude oil imports are, however, considerably less than exports, which correlates very well with what has been postulated about the lack of excess refining capacity.

The movement of petroleum from the USSR into Western markets in increasing quantities has great significance to the USSR but only local significance to the West. These exports have become a valuable means of implementing the Soviet trade program, which is hindered by the drop in the availability for export of such items as agricultural products. The USSR appears to be using petroleum to earn foreign exchange and as an item in barter trade for two reasons. First, the dollar shortage has resulted in a strong demand in Western markets for petroleum which can be purchased or traded without using dollar exchange, and this demand largely explains the shipments of Soviet petroleum to the non-Communist countries shown in Table 11. Second, imports of petroleum have risen -- in fact, receipts from the European Satellites, principally Rumania, have made Soviet exports to the West possible because postwar domestic production has been inadequate to supply Soviet domestic demands. Thus, although Soviet exports of petroleum to the West have been increasing, this rise has been paralleled by increased imports from the European Satellites.

* Table 11 follows on p. 31.

** Table 12 follows on p. 32.

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Table 11

Estimated Exports of Petroleum from the USSR
 1951-54

Country of Destination	Thousand Metric Tons			
	1951 <u>a/</u>	1952 <u>b/</u>	1953 <u>c/</u>	1954 <u>d/</u>
European Satellites				
Albania	5	5	5	5
Bulgaria	35	40	40	40
East Germany	30	30	35	35
Hungary	0	1	3	3
Poland	25	25	25	25
Rumania	20	22	22	22
Total, European Satellites	<u>115</u>	<u>123</u>	<u>130</u>	<u>130</u>
Communist China	767	1,015	954	900
Total, Sino-Soviet Bloc	<u>882</u>	<u>1,138</u>	<u>1,084</u>	<u>1,030</u>
West				
Argentina	0	0	0	518
Egypt	0	0	0	155
Finland	16	9	83	150
Greece	0	0	0	40
Iceland	0	0	65	229
India	0	0	0	0
Italy	103	216	123	229
Japan	0	0	0	0
Sweden	0	0	135	691
Turkey	0	0	5	27
UK	0	0	0	10
Yugoslavia	0	0	0	41
Other Western Europe	0	35	82	288
Others	9	9	10	269
Total, West	<u>128</u>	<u>269</u>	<u>503</u>	<u>2,647</u>
Total exports	<u>1,010</u>	<u>1,407</u>	<u>1,587</u>	<u>3,677</u>

- a. Figures for the West, from source 59/.
 b. Figures for the West, from source 60/.
 c. Figures for the West, from source 61/.
 d. Figures for the West, from source 62/.

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Table 12

Estimated Exports of Petroleum from the USSR, by Type of Product
1951-54

<u>Type of Product</u>	<u>Thousand Metric Tons</u>			
	<u>1951</u>	<u>1952</u>	<u>1953</u>	<u>1954 a/</u>
Crude oil	339	494	342	618
Gasoline	233	299	354	512
Kerosine	186	306	330	569
Gas oil	62	125	312	794
Residual fuel oil	136	121	192	1,094
Lubricants	54	62	57	90
Total	<u>1,010</u>	<u>1,407</u>	<u>1,587</u>	<u>3,677</u>

a. 63/

VI. Civil Demands.

Analysis of the seven petroleum demand sectors which constitute the Soviet civil economy indicates that consumption of petroleum has increased rapidly in the postwar period. From 1946 through 1954 the average annual rate of growth is estimated to have been about 13 percent. This rate of increase is several times higher than that in the US. From 1946 through 1954 in the US, domestic demand increased only 4.5 percent annually.

Estimated civil demands for petroleum products in the USSR, by economic sector, in 1946-54 are shown in Table 13.* Except for industry, each sector's demand rises throughout the period. Although industrial demand in 1954 is estimated to have leveled off, industry has been the largest consumer and agriculture the second largest. Agricultural demand has shown the fastest rate of growth. It is estimated that by 1955 three sectors -- industry, agriculture, and motor transport -- will account for nearly 80 percent of the total civil demands for petroleum in the USSR.

* Table 13 follows on p. 33.

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Table 13

Estimated Civil Demands for Petroleum Products in the USSR, by Economic Sector a/
1946-54

Economic Sector	Thousand Metric Tons								
	1946	1947	1948	1949	1950	1951	1952	1953	1954
Motor transport	1,596	2,694	3,318	4,241	5,015	6,137	7,060	7,734	8,482
Rail transport	687	702	858	1,014	1,129	1,261	1,369	1,460	1,534
Air transport	179	198	219	240	273	311	349	387	426
Water transport	1,958	2,082	2,199	2,323	2,440	2,564	2,849	3,212	3,500
Agriculture	3,895	4,985	6,132	6,943	7,680	8,643	9,369	10,772	11,973
Household	1,886	1,932	2,026	2,171	2,317	2,698	3,163	3,732	4,661
Industry <u>b/</u>	9,763	11,948	13,459	15,560	17,578	19,729	22,372	22,725	22,401
Total	<u>19,964</u>	<u>24,541</u>	<u>28,211</u>	<u>32,492</u>	<u>36,432</u>	<u>41,343</u>	<u>46,531</u>	<u>50,022</u>	<u>52,977</u>

a. 64/

b. The source data for this sector have been revised.

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Estimated civil demands for petroleum products in the USSR, by type of product, in 1946-54 are shown in Table 14.* Except for ligroine, which is expected to disappear from the list of petroleum products consumed by the civil economy in 1955, demand for each major product increases throughout the period. The rate of growth of gasoline demand is indicated to have been greater than that of the other products, which correlates with the rate of growth of motor transport demand shown in Table 13.** Of particular interest is the rate of growth of gas oil (diesel fuel) demand since 1950. This increased rate of growth of gas oil (diesel fuel) demand since 1950. This increased rate stems primarily from a shift in the types of tractors used in agriculture -- diesel tractors have been added to the agricultural tractor park in greater numbers each year. Contributing to this rate increase are growing numbers of diesel units in industry and in both rail and water transport.

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VII. Over-All Supply and Demand of Petroleum.

Production of crude petroleum in the USSR in 1954 is estimated to have reached an all-time high of 53.6 million tons of crude oil and 4 million tons of natural gas liquids -- about 8 percent of total world production. (As a world petroleum producer the USSR was surpassed only by the US and Venezuela.) Supplementing the Soviet production of crude petroleum was the output of synthetic oils, including the shale oils of the Estonian SSR.

The estimated over-all petroleum supply and demand balance in the USSR in 1951-54 is shown in Table 15.*** Included in the annual new supply of petroleum in the USSR are imports, which represent a post-war phenomenon in the modern Soviet petroleum industry -- before World War II, petroleum imports were small, less than 150,000 tons annually. 65/

Total petroleum demands in the USSR since 1951 are estimated to have been greater than domestic production. Although some of this difference is accounted for by exports, the USSR has been a net importer throughout the postwar period. In 1954, however, imports exceeded exports by only 1,155,000 tons compared with nearly 3.5 million tons in 1952.****

* Table 14 follows on p. 35.

** P. 33, above.

*** Table 15 follows on p. 36.

**** Continued on p. 38.

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Table 14

Estimated Civil Demands for Petroleum Products in the USSR, by Type of Product a/
1946-54

Type of Product	Thousand Metric Tons								
	1946	1947	1948	1949	1950	1951	1952	1953	1954
Gasoline	1,908	3,112	3,819	4,834	5,721	7,031	8,108	8,928	9,780
Ligroine)	615	617	523	517	548	649	732	323
Kerosine and LPG b/	6,028	6,003	7,050	7,543	8,082	8,976	9,072	9,669	10,418
Gas oil (diesel fuel))	470	724	1,281	2,111	3,111	5,066	6,589	8,800
Residual fuel oil c/	10,866	12,837	14,516	16,589	18,050	19,497	21,162	21,449	20,782
Lubricants c/	1,162	1,504	1,485	1,722	1,951	2,180	2,474	2,655	2,874
Total	<u>19,964</u>	<u>24,541</u>	<u>28,211</u>	<u>32,492</u>	<u>36,432</u>	<u>41,343</u>	<u>46,531</u>	<u>50,022</u>	<u>52,977</u>

a. 66/

b. LPG (liquefied petroleum gas) is being used increasingly as a lighting and cooking fuel in Soviet households. Kerosine, however, continues to be the principal petroleum product used for these functions.

c. Source data for these products have been revised.

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Table 15

Estimated Over-All Petroleum Supply and Demand Balance in the USSR a/*
 1951-54

	Thousand Metric Tons			
	<u>1951</u>	<u>1952</u>	<u>1953</u>	<u>1954</u> (Preliminary)
New supply				
Domestic production				
Crude oil <u>b/</u>	41,600	45,600	49,600	53,600
Natural gas liquids <u>b/</u>	1,200	2,100	3,100	4,000
Synthetic oils <u>c/</u>	320	390	455	518
Total production	<u>43,120</u>	<u>48,090</u>	<u>53,155</u>	<u>58,118</u>
Imports <u>d/</u>				
Crude oil	170	200	200	insignificant
Products	3,670	4,670	4,887	4,832
Total new supply, all oils	<u>46,960</u>	<u>52,960</u>	<u>58,242</u>	<u>62,950</u>
Change in stocks, all oils	+ 989	+1,045	+1,018	+ 998
Demand				
Total demand	<u>45,971</u>	<u>51,915</u>	<u>57,224</u>	<u>61,952</u>
Exports <u>e/</u>				
Crude oil	339	494	342	618
Products	671	913	1,245	3,059

* Footnotes for Table 15 follow on p. 37.

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Table 15

Estimated Over-All Petroleum Supply and Demand Balance in the USSR a/
 1951-54
 (Continued)

	Thousand Metric Tons			
	<u>1951</u>	<u>1952</u>	<u>1953</u>	<u>1954</u> (Preliminary)
Demand (Continued)				
Domestic demand <u>f/</u>				
Gasoline	7,937	9,979	11,036	11,654
Ligroine <u>g/</u>	559	662	747	328
Kerosine	8,838	8,369	9,653	9,658
Gas oil (diesel fuel)	4,452	5,913	7,475	9,831
Lubricants	2,315	2,541	2,801	2,976
LPG	690	1,192	1,785	2,332
Residuals and others	15,009	16,201	15,415	14,272
Gas and loss	5,161	5,651	6,725	7,224
Total domestic demand	<u>44,961</u>	<u>50,508</u>	<u>55,637</u>	<u>58,275</u>
Stocks (end of year) <u>h/</u>				
Crude oil	5,200	5,700	6,200	6,700
Products, including natural gas liquids	4,661	5,206	5,724	6,222
Total, all oils	<u>9,861</u>	<u>10,906</u>	<u>11,924</u>	<u>12,922</u>

a. The format of this table corresponds with standard US practice in reporting national petroleum statistics.

b. See Table 2, p. 10, above.

c. See Table 7, p. 21, above.

d. See Table 9, p. 28, above.

e. See Table 12, p. 32, above.

f. Domestic demand is based on the following equation: production plus imports minus exports equals domestic demand. See Appendix B.

g. Ligroine is a light petroleum distillate used primarily as a tractor fuel.

h. 67/

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Comparing total new supply with total demand, it is concluded that the USSR has added about 1 million tons of petroleum per year to stocks from 1951 through 1954. It is also believed that smaller additions to petroleum stocks were made in earlier postwar years. 68/ The estimated end-of-year stocks of crude oil and petroleum products, arrived at by comparing estimates of total new supply with total demand, should not, however, be taken to represent the magnitude of the Soviet petroleum stockpile.* Inasmuch as the analogue used in making this estimate contained a petroleum stockpile element of unknown magnitude, these data may be taken as a tentative estimate of the normal working inventories of the Soviet petroleum industry as well as the Soviet petroleum stockpile. 70/ To date, all available evidence indicates that the size of the normal working inventories exceeds that of the Soviet petroleum stockpile.

Comparing domestic demands for petroleum, as shown in Table 15,** with the estimated civil demands listed in Table 14,*** it can be seen that domestic demands for each product exceed civil demands. The difference between these two sets of data is accounted for by the demands of the Soviet military forces and by losses in petroleum production, refining, and distribution. Handling losses of petroleum products (losses in distribution) are distributed pro rata among the individual products in Table 15, and all other losses are included in "gas and loss."

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VIII. Prices of Petroleum in the USSR.

A. Crude Oil and Natural Gas Liquids.

Very little data concerning prices or production costs of crude oil and natural gas liquids have been released by the USSR. The most recent Soviet valuation of crude oil available is given in the 1941 State Plan, 71/ wherein the planned cost of production per ton of oil and gas was stated to be 20.50 rubles. Inasmuch as oil and gas in a mixture or solution is the natural state of the material that comes out of an oil well, and the light hydrocarbons entrained in this gas are the principal source of natural gas liquids, it appears reasonable to assume that the 1941 planned cost would also apply to natural gas liquids. By 1951, fuel prices are estimated to

* A petroleum stockpile is that quantity of petroleum products over and above working inventories and earmarked for future emergency use. 69/

** P. 36, above.

*** P. 35, above.

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have increased to about 3.33 times the level of 1940. ^{72/} Because there is generally a high positive correlation between prices and costs of production, it is assumed that the increase is reasonably applicable to costs of production. It is further assumed that the cost per ton of oil and gas planned for 1941 was approximately equal to the actual cost in 1940. Thus a cost per ton of oil and gas of roughly 70 rubles is obtained.

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In the Soviet pricing system this cost must very nearly equal the price of crude oil and natural gas liquids -- inasmuch as these materials are not marketed in their raw state, producing costs are the basis for the wholesale price paid by the refining organizations to the producing organizations for raw materials (crude oil and natural gas liquids). Such a price is "based on industry-wide average unit costs of the products plus 3- to 5-percent net income of the enterprise (profit)." ^{73/} In the case of crude oil and natural gas liquids, the 3 to 5 percent probably accrues as profit to the producing organizations. The refining organizations pay the wholesale price plus transportation costs from the points of production to the refinery sites.

B. Petroleum Products.

In contrast to the scarcity of data on prices of crude oil and natural gas liquids, fairly recent and detailed information is available on internal prices of petroleum products. Source ^{74/} gives wholesale release prices for all the major petroleum products and also for most of the minor and miscellaneous products such as lubricating oils and greases. These prices were made effective on 1 July 1950 and are believed to have been in effect at least through all of 1951.

For most of the petroleum products used in the USSR, wholesale release prices are given for various zones. Although the areas of the zones differ for various products, it is noteworthy that Baku, the largest production center for petroleum products in the USSR, is always in the zone with the lowest prices. It is concluded, therefore, that a basing-point pricing system is used, with Baku as the probable basing point. Inasmuch as the price of the same product increases with distance away from Baku, the higher prices probably reflect greater transportation costs.

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For motor gasoline, ligroine, and kerosine, there are only two price zones, which together encompass all of the USSR. Zone I includes Regions IX, Xa, Xb, XI, and XII, and Zone II includes all the remaining regions of the USSR. Prices in 1951 rubles per ton for these products in each of the zones are as follows 75/:

<u>Type of Product</u>	<u>Zone I</u>	<u>Zone II</u>
Motor gasoline	800	720
Ligroine	720	640
Kerosine, for city*	560	560
Kerosine, for country*	640	560

It has been pointed out that the internal prices of petroleum products in the USSR evidently are established on a basing-point system. It has also been suggested that the prices in the different zones include some transportation costs. To arrive at an f.o.b. price for petroleum products in the Soviet economy, it is necessary, therefore, to remove from the zonal prices whatever transportation charges have been included. A satisfactory methodology is to deduct from the lowest wholesale release price of a product one-half the difference between it and the wholesale release price of that product in the next price zone. The resulting price, therefore, would correspond roughly to an f.o.b. price, presumably f.o.b. Baku. Applying this methodology to the prices for motor gasoline, ligroine, and kerosine cited above yields the following prices f.o.b. Baku:

<u>Type of Product</u>	<u>Rubles per Ton</u>
Motor gasoline	680
Ligroine	600
Kerosine**	520
LPG***	520

* The distinction between these types of kerosine and the reason for different prices is not readily apparent. The price of kerosine for country presumably is higher in the eastern part of the USSR because of greater costs of transportation from distribution centers.

** Only the price of kerosine for country has been used in this computation.

*** In the absence of any information concerning a ruble price of LPG, a price equivalent to that of kerosine appears reasonable because the primary use of LPG is the same as that of kerosine -- that is, for lighting and cooking fuel.

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In the same source, 76/ prices are given for various grades of aviation gasoline, diesel fuel, lubricating oils, residual fuel oils, and such miscellaneous products as asphalt, vaseline, paraffin, and one or two greases. These prices are given for each of six zones. Price data, however, are available for a much greater number of products than are production and consumption estimates. For the remaining categories of petroleum products for which production and consumption estimates are available (aviation gasoline, diesel fuel, residuals and others, and lubricants), the problem is one not only of removing the transportation charges from the zone prices, but also of aggregating the individual product prices so as to represent a reasonable average value for each product category.

In source 77/, prices are given for 4 types of aviation gasoline base stocks: B-70, B-74, B-78, and B-100. To the prices given must be added 200 rubles* per ton for ethylation. The prices (in rubles per ton) for these various grades and the calculated f.o.b. Baku prices are as follows:

<u>Aviation Gasoline</u>	<u>Zone I</u>	<u>Zone II</u>	<u>F.O.B. Baku (Includes Ethylation)</u>
B-70	800	856	972
B-74	832	888	1,004
B-78	896	952	1,068
B-100	1,208	1,267	1,378

Estimates of consumption and production of aviation gasoline by grades are not available, and it is assumed that these grades are produced in equal quantities. The average price obtained from these data is about 1,100 rubles per ton f.o.b. Baku.

The price of diesel fuel (gas oil) is given (in rubles per ton) as follows:

* In source 78/ there is the statement that 80 rubles per ton is added to the zone prices of motor gasoline for ethylation. About 2.5 times as much ethyl fluid is required to ethylate a ton of aviation gasoline as a ton of motor gasoline, and it is estimated that ethylation of aviation gasoline adds about 200 rubles to the zonal prices.

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<u>Product</u>	<u>Zone III*</u>	<u>Zone IV*</u>	<u>F.O.B. Baku</u>
Diesel fuel	365	369	363

In the petroleum product category designated as residuals and others the most important single product from the point of view of quantity of output is residual fuel oil, called "furnace mazut" in Soviet terminology. Inasmuch as 90 percent or more of the estimated tonnage output of residuals and others from the refining of crude oil is residual fuel oil, the price of furnace mazut is considered representative of the whole category. The price of furnace mazut (in rubles per ton) is as follows 79/:

<u>Product</u>	<u>Zone I</u>	<u>Zone II</u>	<u>F.O.B. Baku</u>
Furnace mazut	280	340	250

As shown in Table 5** and in Table 14,*** estimates are available for lubricants only as a category. This over-all category, however, includes hundreds of lubricating oils and greases of various types, each of which is manufactured for a specific purpose and has special characteristics. Consequently, each lubricant has a different price. Although ruble prices are available for most of the main types of lubricating oils and greases, data are not available on which to base estimates of production or consumption of these various types. In order to give a value to this product category, use has been made of estimates of the over-all consumption of lubricants in each sector of the civil economy for 1953. These estimates are as follows 80/:

<u>Economic Sector</u>	<u>Estimated Quantity Consumed (Thousand Metric Tons)</u>
Motor transport	368
Rail transport	117
Air transport	7
Water transport	94
Agriculture	606
Industry****	1,463
Total	<u>2,655</u>

- * These are the two lowest price zones for diesel fuel.
** P. 16, above.
*** P. 35, above.
**** The source data for this sector have been revised.

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In order to subdivide these quantities into particular kinds of lubricants for which prices are available, the following postulates have been used:

1. Lubricants consumed by motor transport are made up principally of avtols (auto and tractor lubricating oils). The price of avtols in source 81/, therefore, may be considered representative for all lubricants used by motor transport.

2. [redacted] 432,000 tons of diesel fuel were consumed by rail transport in 1953. [redacted] a consumption estimate of 117,000 tons of lubricants for the entire rail transport sector. In diesel engines, lubricant consumption usually averages about 5 percent of the quantity of fuel consumed. In this case, diesel oil consumption can be estimated at about 22,000 tons, while the remaining 95,000 tons are estimated to be cylinder oil for steam locomotives.

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3. Lubricants consumed by the air transport sector consist essentially of aircraft engine lubricating oils, which are more highly refined oils than the avtols used in automobile, truck, and tractor engines. Unfortunately, no prices for aircraft engine lubricating oils are contained in source 83/. The highest price given for an avtol (special avtol for the ZIS-110) is 920 rubles per ton in the lowest price zone (Zone I). Bright stock, plain, which is a base stock for blending various lubricating oils is priced at 1,088 rubles per ton in the same zone. Considering these data, a price of about 1,200 rubles per ton for aircraft engine lubricating oils appears reasonable.

4. Of the 94,000 tons of lubricants estimated to have been consumed during 1953 by water transport in the USSR, 63,000 tons used by steam-powered vessels are believed to have been cylinder oils, 30,000 tons used by diesel-powered vessels are believed to have been diesel oil, and 1,000 tons used by gasoline-powered vessels probably were avtols. 84/

5. Lubricant consumption by the agricultural sector is believed to be accounted for by internal combustion engines in tractors, combines, and other agricultural machinery. The engines that burn gasoline, ligroine, and kerosine are lubricated by avtols, and those that burn diesel fuel are lubricated by diesel oil. 85/ These general statements apply to ideal operating conditions when local supplies of

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each type are adequate. From time to time, however, local shortages of one or more types occur, and substitutions are quite frequent. Nevertheless, in order to arrive at a weighted average value for lubricants consumed by agriculture, it is necessary to assume that ideal operating conditions prevailed during the period to which the estimate applies. In this case it is the year 1953, when 606,000 tons of lubricants are estimated to have been consumed by the agricultural sector. The breakdown of this total is as follows 86/:

<u>Type of Lubricating Oil</u>	<u>Estimated Quantity Consumed (Thousand Metric Tons)</u>
Avtol	424
Diesel oil	182
Total	<u>606</u>

6. In the industrial sector of the Soviet economy, 1,463,000 tons of lubricants are estimated to have been consumed in 1953. 87/ Of this total, 190,000 tons are believed to have been consumed in such internal combustion engines as those in tractors and compressors. The breakdown of this total into types of lubricating oil is as follows:

<u>Type of Lubricating Oil</u>	<u>Estimated Quantity Consumed (Thousand Metric Tons)</u>
Avtol	96
Diesel oil	94
Total	<u>190</u>

Included in the remaining 1,273,000 tons of lubricants estimated to have been consumed by industry in the USSR in 1953 are hundreds of different types of lubricating oils and greases, and Soviet prices are available for many of them. Unfortunately, no estimates of consumption or production are available in sufficient detail to permit a systematic application of the Soviet price data that are on hand. It has been necessary, therefore, to subdivide the total quantity among the principal types of industrial lubricants on the basis of qualitative data given in source 88/. The subdivision made on this basis is as follows:

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<u>Type of Lubricant</u>	<u>Estimated Percentage of Total Consumption</u>	<u>Estimated Quantity Consumed (Thousand Metric Tons)</u>
Machine oil	30	382
Spindle oil	30	382
Cylinder oil	30	382
Bright stock	10	127
Total	<u>100</u>	<u>1,273</u>

On the basis of these postulates, it is believed that the amount of each type of lubricant consumed by the civil economy during 1953 in the USSR was approximately as follows:

<u>Type of Lubricant</u>	<u>Estimated Quantity Consumed (Thousand Metric Tons)</u>
Avtol	889
Cylinder oil	540
Aviation oil	7
Diesel oil	328
Machine oil	382
Spindle oil	382
Bright stock	127
Total	<u>2,655</u>

With the consumption of lubricants broken down by types and with price data from source 89/, the total value of lubricants consumed by the civil economy in 1953 can be estimated as follows:

<u>Type of Lubricant</u>	<u>Zone I (Rubles per Metric Ton)</u>	<u>Zone II (Rubles per Metric Ton)</u>	<u>F.O.B. Baku* (Rubles per Metric Ton)</u>	<u>Total Value (Million Rubles)</u>
Avtol	744	800	716	636
Cylinder oil	512	584	476	257
Aviation oil	1,200	**	1,160	8
Diesel oil	908	972	876	287
Machine oil	500	522	489	187
Spindle oil	480	568	436	167
Bright stock	1,088	1,168	1,048	133
Total				<u>1,675</u>

* Estimated by subtracting from the price in Zone I one-half the difference between the price in Zone I and the price in Zone II.

** See the difference between the prices in Zone I and Zone II for bright stock.

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In summary, estimated internal ruble prices of petroleum products f.o.b. Baku for the period beginning 1 July 1950 and extending at least through the end of 1951 are as follows:

<u>Type of Product</u>	<u>Rubles per Metric Ton</u>
Aviation gasoline	1,100
Motor gasoline	680
Ligroine	600
Kerosine	520
LPG	520
Diesel fuel	363
Residuals and others	250
Lubricants*	631

C. Turnover Tax.

The price (cost) of crude oil in the USSR has been estimated at about 70 rubles per ton in 1951, whereas wholesale release prices of petroleum products range from 1,100 rubles per ton for aviation gasoline to 250 rubles per ton for residuals and others. Using the output pattern of petroleum products in Table 5** and the average price estimates developed above, the average value per ton of petroleum products in 1951 was about 432 rubles. Thus the average price per ton of petroleum products was more than 6 times that of crude oil. In the US in 1954, however, average wholesale prices of principal petroleum products exceeded the value of the raw material by only 30 to 35 percent. It is apparent, therefore, that all of the great difference in value between crude oil and petroleum products in the USSR cannot be attributed to refining costs or equated with "value added by manufacturing."

A search through the meager Soviet material dealing with the formulation of internal petroleum prices has revealed only one source that touches on the reason for this great difference in value. Source 90/ states that the turnover tax is included in the wholesale release

* An average price for lubricants was obtained by dividing the total value of lubricants consumed by the civil economy in 1953 by the total tonnage consumed. Implicit in this calculation is the hypothesis that the mix of lubricants consumed by the civil economy approximates the mix of the total output.

** P. 16, above.

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prices of petroleum products, which are the prices cited above. Moreover, the US data on refining costs and the spread between prices of crude oil and petroleum products suggest that the turnover tax on petroleum products is very high. The reason for including a high turnover tax in the wholesale release prices of petroleum products is "to make the price for petroleum products relatively high in comparison with the price of other fuels." This is done to discourage the use of "high quality" petroleum products and conforms to "over-all state interests which demand universal economy of petroleum fuel."

Although no quantitative evidence is available on the magnitude of the turnover tax on petroleum products, the same Soviet source states that the tax is levied in the form of an absolute rate in rubles per unit weight of the product. ^{91/} The application of this form of assessment is explained by the technical difficulties of calculating the turnover tax for petroleum products in the form of a percentage rate (as is the practice with most other commodities) because of the existence of differential zones of wholesale prices.

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IX. Capabilities, Vulnerabilities, and Intentions.

The foregoing analysis indicates that the USSR has not been self-sufficient in petroleum since World War II. During these years the USSR has relied principally on Rumanian petroleum for augmenting its domestic supply. The most remarkable aspect of this situation is that this partial dependence on external sources has developed in the face of large domestic potential petroleum resources. The area in the USSR which is favorable for the occurrence of oil deposits exceeds 1.6 million square miles, which is equal to more than one-half the total area of the US. The quantity of crude oil and natural gas liquids believed to be present but as yet undiscovered in this large area is estimated at 21 billion tons. In contrast, the 1954 output of 57.6 million tons of crude oil and natural gas liquids was less than 0.3 percent of the potential. These data lead to the conclusion that despite past and present low petroleum-production levels, the rich natural endowment of potential petroleum resources gives the USSR the inherent capability for a large production of petroleum.

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Although there are some indications that Soviet petroleum technology has lagged behind that of the US, on the whole it cannot be assessed as a vulnerability of the Soviet economy. In some fields of exploration and production the USSR has actually made some innovations. Even in the complex refining phase of the industry, Soviet

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theoretical works indicate that the USSR is fully cognizant of the most recent developments in US practice but is applying to its industry only those features which are feasible under the prevailing technological and economic conditions. Although the postwar increases in domestic petroleum production are modest relative to potential resources, they have been made largely with equipment of Soviet manufacture. Before World War II, however, much equipment such as geophysical instruments, drilling rigs, and refining apparatus was imported from Western sources, mainly from the UK and the US.

Perhaps the greatest vulnerability of the Soviet petroleum industry is the transportation and distribution of crude oil and petroleum products. Shipping of crude oil to refineries and distributing products to consumers in all parts of the country impose a heavy burden on the Soviet transportation system. In particular, the movement of petroleum products from refineries in the Caucasus and in the Ural-Volga region to the Far East necessitates very long and costly hauls via the Trans-Siberian Railroad. Attempts that have been made to relieve the railroad by tanker-hauling from Black Sea ports and to develop new production in the Soviet Far East have not been wholly successful. Tankers destined for Chinese ports have been deterred by Free World naval forces, and petroleum resources in accessible parts of the Soviet Far East are limited. It appears, therefore, that the shipment of petroleum products to the oil-deficient Far East may continue to be a vulnerability of the industry.

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The task of transporting petroleum products to all parts of the USSR has fallen to a large degree on the railroad and waterway systems -- the more efficient pipeline has been used only to a limited extent. In the US, on the other hand, the bulk of the petroleum shipped within the continental limits is by pipeline. The reasons for the Soviet lag in pipeline development and utilization probably can be found in the magnitude of the construction job and the demands on such relatively scarce materials as steel pipe and high-pressure pumping machinery. 92/ The USSR is, however, well aware of the techniques and economies of pipeline operation.

The distribution of petroleum products from oil-sales bases to consumers is made especially difficult by factors of long distances, widely dispersed consumers, and adverse shipping conditions during the severe winters. Successful supply operations under these conditions necessitate an inordinately large storage capacity for petroleum products relative to the annual volume handled. In the US, storage

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capacity for petroleum products usually ranges from 75 to 80 days' supply, whereas in the USSR it is estimated to average about 170 days' supply. Constructing, operating, and maintaining this capacity, of course, makes the distribution of petroleum products a more costly activity than it is in countries where these factors are less prevalent. Despite such a large storage capacity relative to supply, distribution to the average consumer in the USSR is still irregular and uncertain. Machine tractor stations, for example, are frequently without adequate supplies of liquid fuel, resulting in idle tractors and low labor productivity. 93/

Although the USSR has an abundance of potential petroleum resources, it has achieved only modest production levels and is a net importer of petroleum. This situation cannot be ascribed wholly to technological deficiencies; it appears to result directly from official policy regarding comparative rates of development of various types of energy fuels. In the last year (1950) of the Fourth Five Year Plan, an output of 250 million tons of coal and 35.4 million tons of petroleum, 7.06 tons of coal per ton of petroleum, was planned. 94/ In the course of the Sixth Five Year Plan (presumably by 1960), an output of 500 million tons of coal and 60 million tons of petroleum -- 8.33 tons of coal per ton of petroleum -- was foreseen. 95/ Soviet planners were thus establishing a more rapid rate of development of coal production than of petroleum production, an emphasis that is just the reverse of the world trend.

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Recent developments in the USSR may foreshadow a modification of this course. On 14 May 1955 an article in Pravda described the current fuel-energy balance (85 percent from solid fuels and 15 percent from petroleum fuels) as outmoded and indicated the desirability of increasing the share of petroleum fuels in the fuel-energy balance. In this article the State Planning Commission and some of its members were criticized severely for failing to plan a more proper economic relationship between these fuels, such as had been realized in other countries. On 25 May 1955 the former Minister of the Petroleum Industry was appointed Chairman of the State Planning Commission (for long-range planning). On 19 May 1955, Party Secretary Khrushchev had declared that this body (the new State Planning Commission) should concentrate on problems of energy resources over the course of 10 to 15 years. Whether these developments will ultimately result in bringing the annual petroleum output levels of the USSR into better correspondence with potential petroleum resources and with current Free World trends in the energy field is uncertain. In any event, these

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developments clearly indicate that the USSR is not completely satisfied with a fuel-energy balance which corresponds to the one that existed in the US in 1920. 96/

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APPENDIX A

ORGANIZATION OF THE PETROLEUM INDUSTRY IN THE USSR

The organization of the petroleum industry in the USSR has been in a state of flux since May 1954, when the All-Union Ministry of the Petroleum Industry of the USSR converted to union-republic status and the republic Ministry of the Petroleum Industry of Azerbaydzhan SSR was created. ^{97/} The most important recent change was the creation in January 1955 of the All-Union Ministry of Construction of Petroleum Enterprises, ^{98/} which presumably assumed responsibility for construction functions previously controlled by the Ministry of the Petroleum Industry of the USSR. Whether these shifts have resulted from a re-appraisal of the importance of petroleum in the Soviet economy relative to other energy sources or are attempts to decentralize lines of control is not as yet clear.

The most important organizational components of all phases of the petroleum industry in the USSR are shown on the accompanying chart, Figure 4.* The chart shows the principal administrative subdivisions of the three ministries responsible for the various phases of the petroleum industry in the USSR. In addition, the chart gives the regional breakdown of the producing phase of the industry. It will be noted that the chart is skeletal in that no attempt has been made to show administrative units smaller than main administrations at the ministerial level. Only for the producing phase of the industry has it been possible to make a regional or administrative breakdown of main administrations. The only trusts that have been included are those not subordinate to any association -- such trusts may now be designated by the USSR as "oilfield administrations." ^{99/} Although Soviet sources have provided most of the data for the chart, some of the subordinations have been assumed on the basis of functions. The most tenuous of these assumptions are shown by dashed lines. In addition to those shown on the chart, there may be further subordinations under the petroleum-production associations, such as gas trusts, which are also subordinated to the Main Administration of Natural Gas. The following list of administrative units is the basis for the organizational chart:

* Following p. 52.

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1. Union Republic Ministry of the Petroleum Industry, SSR. 100/

Collegium 101/

Main Administration of Personnel and Wages 102/

Main Administration of Planning 103/

Main Administration of Training Institutes 104/

Main Administration of Industrial and Building Materials 105/

Main Administration of Workers Supply 106/

Main Administration of Technical Supply 107/

Main Administration of Petroleum Equipment 108/

Main Administration of Power Supply 109/

Main Administration of Petroleum Sales 110/

Main Administration of Synthetic Liquid Fuel and Gas 111/

Main Administration of Petroleum Refineries 112/

Main Administration of Petroleum Machine Building 113/

Main Administration of Special Assembly Operations 114/

Main Administration of Natural Gas 115/

Main Administration of Geophysical Operations 116/

Main Administration of Petroleum and Natural Gas Prospecting 117/

Main Administration of Petroleum Production in the Eastern Regions 118/

Main Administration of Petroleum Production in the Western Regions 119/

2. Main Administration of Petroleum Production in the Eastern
Regions (of the Ministry of the Petroleum Industry, USSR). 120/

Far East Petroleum Association 121/

Ukhta Petroleum Combine 122/

Buguruslan Petroleum Trust 123/

Kuybyshev Petroleum Association 124/

Molotov Petroleum Association 125/

Tatar Petroleum Association 126/

Bashkir Petroleum Association 127/

Central Asia Petroleum Association 128/

Kazakhstan Petroleum Association 129/

3. Main Administration of Petroleum Production in the Western
Regions (of the Ministry of the Petroleum Industry,
USSR). 130/

Georgian Petroleum Association 131/

Dagestan Petroleum Trust 132/

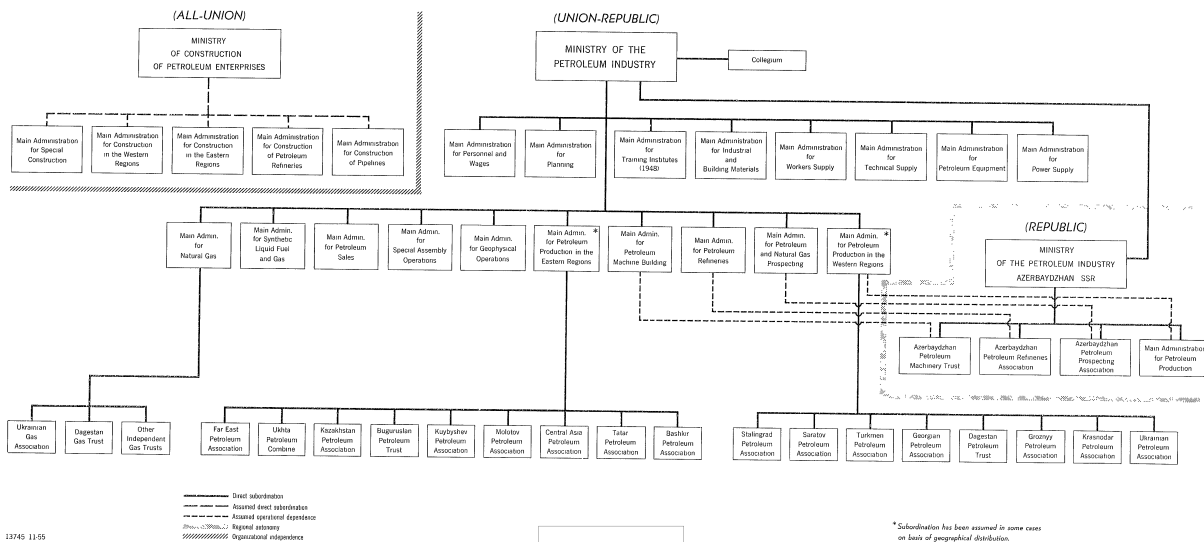
Groznyy Petroleum Association 133/

Krasnodar Petroleum Association 134/

USSR

Figure 4

ORGANIZATION OF THE PETROLEUM INDUSTRY, 1954



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Ukrainian Petroleum Association 135/
Stalingrad Petroleum Association 136/
Saratov Petroleum Association 137/
Turkmen Petroleum Association 138/

4. Main Administration of Natural Gas (of the Ministry
of the Petroleum Industry, USSR). 139/

Ukrainian Gas Association 140/
Dagestan Gas Trust 141/
Other Gas Trusts

5. Ministry of the Petroleum Industry of Azerbaydzhan SSR
(Subordinate to the Ministry of the Petroleum Industry, USSR). 142/

Azerbaydzhan Petroleum Machinery Trust 143/
Azerbaydzhan Petroleum Refineries Association 144/
Azerbaydzhan Petroleum Prospecting Association 145/
Main Administration of Petroleum Production 146/

6. All-Union Ministry of Construction of Petroleum Enterprises,
USSR. 147/

Main Administration of Special Construction 148/
Main Administration of Construction in the Western Regions 149/
Main Administration of Construction in the Eastern Regions 150/
Main Administration of Construction of Petroleum Refineries 151/
Main Administration of Construction of Pipelines 152/

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APPENDIX B

METHODOLOGY

1. Proved Reserves of Crude Oil and Natural Gas Liquids.

Proved reserves include only those petroleum hydrocarbons (crude oil, natural gas liquids, and natural gas) which are recoverable from known deposits under existing economic and operating conditions. 153/

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50X1

Estimated resources of crude oil in the USSR as of 1 January 1955 are shown in Table 16. Estimated proved reserves

Table 16

Estimated Resources of Crude Oil in the USSR
 1 January 1955

Million Metric Tons

	(1)	(2)	(3)	(4)	(5)	(6)
Area	Total Re- sources <u>a/</u>	Cumu- lative Produc- tion <u>a/</u>	Proved - Re- serves <u>a/</u>	Total Found <u>b/</u>	Un- discovered Resources <u>c/</u>	Re- maining Resources <u>d/</u>
Ural-Volga	6,744	126	723	849	5,895	6,618
Remainder of the USSR	13,900	940	530	1,470	12,430	12,960
Total	<u>20,644</u>	<u>1,066</u>	<u>1,253</u>	<u>2,319</u>	<u>18,325</u>	<u>19,578</u>
Percent of Total	100.0	5.2	6.0	11.2	88.8	94.8

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- b. Column (4) equals column (2) plus column (3).
- c. Column (5) equals column (1) minus column (4).
- d. Column (6) equals column (5) plus column (3).

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of crude oil are shown in the table as 1,253 million tons. Since these data refer only to crude oil, a separate estimate of proved reserves of natural gas liquids is required. Because data on actual or potential conservation and utilization of natural gas liquids in the USSR are lacking, US analogy is used.

The distribution of US proved reserves of petroleum, by components, as of 31 December 1946 is shown in Table 17. Basic US data by volume have been converted to weight in tons. Proved reserves of natural gas liquids are shown to amount to 11.18 percent by weight of the proved reserves of crude oil. If it is

Table 17

Distribution of Proved Reserves of Petroleum in the US
by Components
31 December 1946

<u>Component</u>	<u>Quantity ^{a/} (Million Metric Tons)</u>	<u>Percent ^{b/}</u>
Crude oil	2,829	100.0
Natural gas liquids	317	11.2
Total liquid petroleum	<u>3,146</u>	<u>111.2</u>
Natural gas	3,481	123.0
I Total petroleum	<u>6,627</u>	<u>234.2</u>

a. US data are from source 156/ by volume and have been converted to weight in metric tons.

b. Percent, by weight, of crude oil.

assumed that withdrawals represent the same ratio to crude oil reserves in the USSR as natural gas liquids did to crude oil in the US according to the 1946 proved reserve data above, then proved reserves of natural gas liquids in the USSR can be estimated to be 11.18 percent by weight of crude oil reserves. Application of

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11.18 percent to the Soviet crude oil reserve figure of 1,253 million tons yields an estimate of 140 million tons for Soviet proved reserves of natural gas liquids. For this estimate, US data on proved reserves for 1946 were believed to be more appropriate than current data for representing the present stage of Soviet development of oil resources and withdrawal of natural gas liquids. Proved reserves of crude oil and natural gas liquids in the USSR as of 1 January 1955 are thus estimated as follows (in millions of tons):

Crude oil

Ural-Volga area	723
Remainder of the USSR	530
Total crude oil	<u>1,253</u>
Natural gas liquids (entire USSR)	140
Total crude oil and natural gas liquids	<u><u>1,393</u></u>

2. Total Remaining Resources of Crude Oil and Natural Gas Liquids.

Total petroleum resources represent the estimated ultimate quantity of petroleum which may be found and recovered. Such resources thus include the cumulative production to date, the current proved reserves, and the estimated recoverable quantities of petroleum in undiscovered deposits. 157/ Total remaining petroleum resources represent the summation of proved reserves and undiscovered resources. The data for crude oil only, based on estimates from a report in process, are presented in Table 16.* Total remaining resources of crude oil in the USSR are shown in column (6) of Table 16 as 19,578 million tons as of 1 January 1955. Proved reserves of natural gas liquids have already been estimated as more than 140 million tons.

To complete the estimate of remaining resources of natural gas liquids, an estimate of undiscovered resources of natural gas liquids must be made. Gross withdrawals from oilfields in the USSR of wet natural gas (natural gas plus the entrained natural gas liquids) has been estimated as equivalent to 43 percent by weight of the crude

* P. 55, above.

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oil. 158/ For 1954 these withdrawals are estimated to have comprised 15.8 million tons of natural gas and 7.2 million tons of natural gas liquids. 159/ It is further estimated that only 3.3 million tons of withdrawals of natural gas (21 percent of withdrawals of natural gas) were produced and utilized, the remainder being wasted because of lack of natural gas pipelines. Of the 7.2 million tons of natural gas liquids withdrawn in oilfields, it is estimated that 54 percent, 3.9 million tons, were recovered; the remainder was wasted because of lack of field plants for processing the wet natural gas. 160/

Estimates of potential Soviet resources of natural gas liquids and natural gas in oil deposits are based on a reasonable conservation of those resources in the future rather than on the current high rate of waste. In the US in 1950 the total recorded waste of natural gas was equivalent to 27.8 percent of the total gross withdrawals of natural gas from oil wells, 161/ and US technology could recover 83.1 percent of the natural gas liquids available in natural gas. 162/ It appears reasonable to assume from these data that in the USSR 75 percent of the natural gas and natural gas liquids in oil deposits yet to be discovered will be conserved. Applying this percentage to the pattern of gross withdrawals cited above, the following resources of natural gas liquids and natural gas in the 18,325 million tons of undiscovered oil deposits of the USSR are indicated:

$$0.43 \times 0.75 \times 18,325 = 5,910 \text{ million tons of natural gas liquids and natural gas combined}$$

This total may be distributed between natural gas and natural gas liquids on the basis of the 1954 estimated gross withdrawals of each in Soviet oilfields, which were as follows 163/:

	Quantity (Million Metric Tons)	Percent
Natural gas	15.8	68.7
Natural gas liquids	7.2	31.3
Total	<u>23.0</u>	<u>100.0</u>

Applying these percentages to the figure of 5,910 million tons, the potential resources of natural gas and natural gas liquids in undiscovered oil deposits are as follows (in millions of tons):

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Natural gas	4,060
Natural gas liquids	1,850
Total	<u>5,910</u>

Estimation of resources of natural gas and natural gas liquids in gas deposits in the USSR cannot be based on any intrinsic relationship to crude oil resources. In the US in 1946, proved reserves of natural gas and natural gas liquids in gas deposits, in percent by weight of proved reserves of crude oil, were as follows 164/:

Natural gas	96.14
Natural gas liquids	6.93

In estimating world reserves of natural gas outside the US, source 165/ has suggested a ratio of 3,000 cubic feet per barrel of oil. This is equivalent to 21,798 cubic feet per ton of crude oil. Applying this factor to the 18,325 million tons of undiscovered crude oil in the USSR (21,798 x 18,325) yields 399,488,350 million cubic feet. This is equivalent to 8,939 million tons of natural gas. Subtracting from this figure the 4,060 million tons of natural gas resources estimated above in undiscovered oil deposits indicates natural gas resources in gas deposits of 4,879 million tons. The resources of natural gas liquids in gas deposits can then be estimated on the basis of the percent weight ratio of these components in proved reserves shown above for the US in 1946. Thus

$$\frac{6.93}{96.14} \times 4,879 = 352 \text{ million tons.}$$

From the foregoing calculations, total undiscovered resources of natural gas liquids are as follows (in millions of tons):

In oil deposits	1,850
In gas deposits	352
Total	<u>2,202</u>

Total remaining resources of crude oil and natural gas liquids may be summarized as follows (in millions of tons):

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Total remaining resources of crude oil	19,578
Proved reserves of natural gas liquids	140
Undiscovered resources of natural gas liquids	2,202
Total remaining resources of crude oil and natural gas liquids	<u>21,920</u>

3. Imports of Petroleum Products from the Soviet Zone of Austria.

Table 10* gives an estimated total of 75,000 tons of petroleum products imported by the USSR from the Soviet Zone of Austria. This estimate is based on incomplete data from reports on petroleum shipments by two shipping companies which plied the Danube River between the Soviet Zone of Austria and other Soviet Bloc countries. Source 166/ reports that one company (the Soviet DDSG) shipped a total of about 25,000 tons of kerosine from the Soviet Zone of Austria to the USSR during 1954. Reports are available for only the first three quarters of 1954 on the petroleum shipping activities of the other company (Meszhart). These data are as follows:

<u>Quarter</u>	<u>Quantity</u> <u>(Metric Tons)</u>
First	4,279 <u>167/</u>
Second	10,836 <u>168/</u>
Third	23,256 <u>169/</u>
Total	<u>38,371</u>

Expanding these data to an annual basis yields a 1954 estimate of about 50,000 tons for the Meszhart Company -- 25,000 tons of gasoline and the rest kerosine.

4. Derivation of Over-All Domestic Demands for Petroleum in the USSR.

Table 15** gives the estimated annual petroleum supply and demand balance in the USSR for 1951-54. The derivation of domestic demand and the sources of the various data used are shown in Table 18,*** which gives the estimated annual petroleum products balances in the USSR in 1951-54.

* P. 29, above.

** P. 36, above.

*** Table 18 follows on p. 61.

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Table 18

Estimated Balance of Petroleum Products in the USSR
1951-54

Year and Type of Product	Source of Products							Thousand Metric Tons	
	(1) Crude Oil Refining <u>a/</u> *	(2) Natural Gas Liquids <u>b/</u>	(3) Synthetic Oils <u>c/</u>	(4) Unrefined Crude Oil <u>d/</u>	(5) Imports <u>e/</u>	(6) Exports <u>f/</u>	(7) Stock Change <u>g/</u>	(8) Domestic Demand <u>h/</u>	
1951									
Gasoline	5,882	480	72	0	1,870	233	134	7,937	
Ligroine	564	0	0	0	0	0	5	559	
Kerosine	8,577	0	10	0	440	186	3	8,838	
Gas oil	3,850	0	14	0	800	62	150	4,452	
Lubricants	2,362	0	0	0	35	54	28	2,315	
LPG	0	720	0	0	0	0	30	690	
Residuals and others	14,119	0	224	416	525	136	139	15,009	
Gas and loss	3,497	0	0	1,664	0	0	0	5,161	
Total	<u>38,851</u>	<u>1,200</u>	<u>320</u>	<u>2,080</u>	<u>3,670</u>	<u>671</u>	<u>489</u>	<u>44,961</u>	

* Footnotes for Table 18 follow on p. 65.

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Table 18

Estimated Balance of Petroleum Products in the USSR
1951-54
(Continued)

Year and Type of Product	Source of Products							Thousand Metric Tons	
	(1) Crude Oil Refining <u>a/</u>	(2) Natural Gas Liquids <u>b/</u>	(3) Synthetic Oils <u>c/</u>	(4) Unrefined Crude Oil <u>d/</u>	(5) Imports <u>e/</u>	(6) Exports <u>f/</u>	(7) Stock Change <u>g/</u>	(8) Domestic Demand <u>h/</u>	
1952									
Gasoline	7,186	840	81	0	2,380	299	209	9,979	
Ligroine	676	0	0	0	0	0	14	662	
Kerosine	8,037	0	10	0	560	306	-68	8,369	
Gas oil	5,160	0	17	0	1,025	125	164	5,913	
Lubricants	2,586	0	0	0	45	62	28	2,541	
LPG	0	1,260	0	0	0	0	68	1,192	
Residuals and others	15,054	0	282	456	660	121	130	16,201	
Gas and loss	3,827	0	0	1,824	0	0	0	5,651	
Total	<u>42,526</u>	<u>2,100</u>	<u>390</u>	<u>2,280</u>	<u>4,670</u>	<u>913</u>	<u>545</u>	<u>50,508</u>	

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Table 18

Estimated Balance of Petroleum Products in the USSR
1951-54
(Continued)

Year and Type of Product	Source of Products						Thousand Metric Tons	
	(1) Crude Oil Refining <u>a/</u>	(2) Natural Gas Liquids <u>b/</u>	(3) Synthetic Oils <u>c/</u>	(4) Unrefined Crude Oil <u>d/</u>	(5) Imports <u>e/</u>	(6) Exports <u>f/</u>	(7) Stock Change <u>g/</u>	(8) Domestic Demand <u>h/</u>
1953								
Gasoline	7,669	1,240	89	0	2,504	354	112	11,036
Ligroine	757	0	0	0	0	0	10	747
Kerosine	9,578	0	10	0	588	330	193	9,653
Gas oil	6,916	0	20	0	1,071	312	220	7,475
Lubricants	2,826	0	0	0	62	57	30	2,801
LPG	0	1,860	0	0	0	0	75	1,785
Residuals and others	13,991	0	336	496	662	192	-122	15,415
Gas and loss	4,741	0	0	1,984	0	0	0	6,725
Total	<u>46,478</u>	<u>3,100</u>	<u>455</u>	<u>2,480</u>	<u>4,887</u>	<u>1,245</u>	<u>518</u>	<u>55,637</u>

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Table 18

Estimated Balance of Petroleum Products in the USSR
1951-54
(Continued)

Year and Type of Product	Source of Products							Thousand Metric Tons	
	(1) Crude Oil Refining ^{a/}	(2) Natural Gas Liquids ^{b/}	(3) Synthetic Oils ^{c/}	(4) Unrefined Crude Oil ^{d/}	(5) Imports ^{e/}	(6) Exports ^{f/}	(7) Stock Change ^{g/}	(8) Domestic Demand ^{h/}	
1954									
Gasoline	8,112	1,600	96	0	2,459	512	101	11,654	
Ligroine	233	0	0	0	0	0	-95	328	
Kerosine	9,610	0	10	0	611	569	4	9,658	
Gas oil	9,965	0	23	0	1,019	794	382	9,831	
Lubricants	3,028	0	0	0	63	90	25	2,976	
LPG	0	2,400	0	0	0	0	68	2,332	
Residuals and others	13,774	0	389	536	680	1,094	13	14,272	
Gas and loss	5,080	0	0	2,144	0	0	0	7,224	
Total	<u>49,802</u>	<u>4,000</u>	<u>518</u>	<u>2,680</u>	<u>4,832</u>	<u>3,059</u>	<u>498</u>	<u>58,275</u>	

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Table 18

Estimated Balance of Petroleum Products in the USSR
1951-54
(Continued)

-
- a. 170/
b. 171/
c. 172/
d. It has been estimated that 1 percent of the crude oil produced is used in the oilfields in-50X1
stead of residual fuel oil. For accounting purposes, this quantity has been transferred to the "residuals and
others" category. The figure for losses of unrefined crude oil is 4 percent of the production of crude oil.
e. See Table 9, p. 28, above.
f. See Table 12, p. 32, above.
g. 174/
h. Equals the sum of columns (1) through (5) minus the sum of columns (6) and (7).

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