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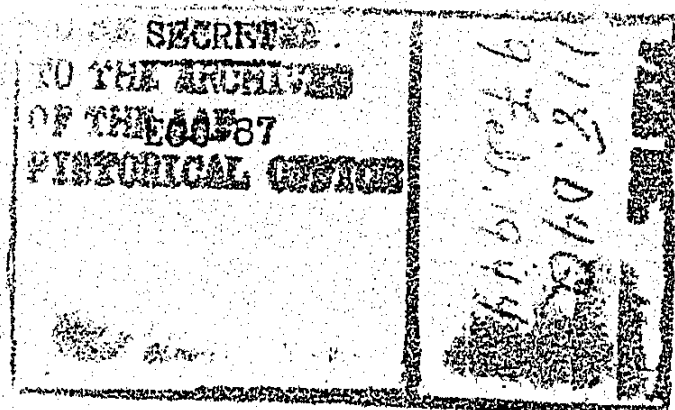
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CONSUMPTION OF PETROLEUM PRODUCTS IN AXIS EUROPE,

JULY-DECEMBER 1944

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CONSUMPTION OF PETROLEUM PRODUCTS IN AXIS EUROPE, JULY-DECEMBER 1944.1. Appraisal of the German Position

The year 1944 was as disastrous for the German oil economy as for the German armed forces. While no exact causal relationships can be established in a situation as complex as the near collapse of a powerful armed nation, it can be said that oil shortages contributed significantly to the developing relative inferiority of the German forces to their opponents. The dominant factor in the oil situation was the severe drop in production inflicted by Allied air attacks and Russian territorial conquests. Because stocks were not large enough to permit continuous large withdrawals, it was necessary for the Germans to adjust current consumption to the level of production -- and it was a low level -- which they expected to be able to maintain. Although allocations to the armed forces and the civilian economy were sharply and almost continuously cut, such a balancing was not achieved until the last quarter of the year and total military and civilian consumption exceeded production by probably half a million tons during the year.

The reduction of consumption to the last quarter level of roughly 400,000 metric tons per month could not have been achieved without a drastic reduction of commitments; that is, it would have been impossible to maintain operations on the extended fronts of 1943, or even early 1944, with oil supplies at the present level. Although the withdrawal to areas

in which there were dense rail nets, the loss of conquered and satellite countries, and the inability to replace a large part of the losses of motorized equipment, together with the adoption of a defensive strategy, have led to a considerable decline in requirements, it has not been possible to reduce consumption to the present level without the most extreme measures.

The effects of these measures have been visible for some time: industrial and civilian allocations have been slashed to about one-third of average monthly consumption in 1943, when oil shortages were already adversely affecting the war economy. At the present low level of allocations, the long-run ability of the economy to support the armed forces is being sacrificed for short-run needs of higher priority. Allocations to the ground forces for all purposes other than combat and the supply of combat forces, to the navy, and to the air force for the training of flying personnel and even for certain types of operations, notably long-range bombing, have also been cut severely, which represents a sacrifice of fairly short-run considerations for immediate front-line needs of the most pressing character.

It must be acknowledged, however, that the Germans have shown skill and ingenuity in adjusting to the position which has been forced upon them. The logic of this position required an attempt to reduce their vulnerability by a stabilization of fronts in areas with dense railroad nets, for only by the imposition of positional warfare upon the Allies could the Germans economize their limited supplies of motorized equipment and oil and to some extent neutralize the superiority of the Allies in all cate-

gorics of military strength. While it is still too early to judge at what particular moment the collapse will come, the possibility cannot be excluded that in the East and in the West, the Germans will be able to wage effective defensive warfare for some months despite their relative inferiority and the inevitability of the final decision. It should be pointed out that counteroffensives, local, limited, and essentially defensive in character, are not inconsistent with this strategy and that, on fronts as long as those in the West and the East, local superiority can still be temporarily achieved in a chosen sector by a concentration of available forces and supplies. These considerations do not alter the basic fact, however, that the relative inferiority of the German forces has been, and will be, intensified by a shortage of oil, as long as the Germans are unable to raise production materially over the December level.

2. Summary.

In a period such as the last six months the problems involved in estimating consumption become very serious and their solution difficult. The former bases of the estimates partly, at least, lose their applicability and new bases, when the enemy himself is forced to improvise, are not easily established. It is more difficult and less accurate to generalize on the basis of scraps of information from this or that sector of a particular front: in fact, the issuance of a new order relating to fuel allocations in such a period may indicate a deviation from the general rule rather than a general trend. The detailed estimates presented below should, therefore, be treated with more than the usual caution.

though it is believed that they accurately indicate the significant trends. The most important conclusion to be drawn from Table 1 below is that the Germans have made tremendous efforts to adjust current consumption to current production in such a way that continued defensive warfare will be possible and that on the whole these efforts have been relatively successful, if the test of success be made the postponement of collapse and defeat.

Table 1. EUROPEAN AXIS OIL BALANCE SHEET, 1944^a

(In thousands of metric tons)

Month	Production ^b	Monthly Consumption of Liquid Fuels and Lubricants in Axis Europe					Grand Total
		Air Forces	Naval Forces	Ground Forces	Total Military ^c	Total Industrial and Civilian	
January	1,300	158	142	514	816	490	1,306
February	1,320	161	142	503	808	490	1,298
March	1,340	168	145	497	800	480	1,280
April	1,360	167	145	323	695	460	1,155
May	990	154	145	315	614	440	1,054
June	828	215	173	341	729	400	1,129
First 6 months	7,138	1,013	896	2,553	4,462	2,760	7,222
July	672	137	102	271	510	290	800
August	526	130	102	249	481	240	721
September	311	72	102	167	341	160	501
October	396	59	95	133	287	120	407
November	432	59	95	115	269	100	369
December	419	64	93	140	297	90	387
Second 6 months	2,755	521	589	1,075	2,185	1,000	3,185
Total 1944	9,891	1,534	1,485	3,628	6,647	3,760	10,407

a. No account is taken in the estimates of stock losses suffered in attacks on producing facilities and strategic reserves.

b. Production estimates are based on The Weekly Survey of Axis Europe Oil Production, prepared by the Joint Anglo-American Oil Targets Committee.

c. Includes ordinary wastage and losses.

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Total consumption during the year is estimated at about 10.4 million metric tons, as compared with an estimated production of 9.9 million metric tons. These estimates do not include such losses in stocks as have been suffered by attacks on producing facilities and strategic reserves and take no account of the transfer from tied stocks to free stocks resulting from the withdrawal to shorter lines and the cut in production and consumption. These two factors -- stock losses by air attacks and release of tied stocks -- have tended to counterbalance each other, though the resulting net balance cannot be estimated.² Disregarding this, the difference between total current production and current consumption over the year was therefore of the order of half a million tons. The chronology of events is significant and may be described as follows: during the first four months of the year production safely exceeded consumption and small additions to stocks were made; during the next five months (May through September) production was seriously reduced, consumption was also sharply cut but still substantially exceeded production, and withdrawals from stocks not only wiped out the previous additions but also accounted for the total deficit for the year; during the last quarter production and consumption were brought into balance at about the level of 400,000 tons per month. This overall evaluation ignores the position, product by product, which is considered below.

Total consumption during the second six months is estimated at 3,190,000 tons, or only 30 percent of the total for the year, as compared with 7,220,000 tons in the first six months. The decline in production

1. For this and other reasons the size and product composition of free stocks cannot be gauged, but they are certainly at a very low level.

was, however, even more rapid -- from 7,140,000 tons in the first six months to 2,750,000 tons in the second, or only 28 percent of the total for the year.

Military consumption is estimated at 6,650,000 tons during the year, or 64 percent of total consumption. Consumption in the second six months is put at 2,190,000 tons, or less than half of consumption in the preceding half year. Of the total military consumption during the year ground forces accounted for 3,530,000 tons (55 percent), air forces for 1,530,000 tons (23 percent), and naval forces for 1,480,000 tons (22 percent). Allocations to the ground forces were cut most severely during the second half year -- to only 42 percent of the preceding six months -- but air force allocations were also sharply reduced -- to 51 percent of the first half year. Naval consumption declined least (by 34 percent), owing chiefly to the fact that fuel oil, which constituted the bulk of naval consumption, was relatively more abundant than gasoline and gas oil.

Industrial and civilian consumption is estimated at 3,760,000 tons during the year, or 36 percent of total consumption. Allocations in the second six months were cut to 1,000,000 tons, or only 26 percent of the total for the year. The loss of conquered and satellite territories and the ruthless slashing of allocations for German war industry and transportation accounts for this decline.

It is especially difficult to estimate at all satisfactorily the product composition of production and consumption in the second six months of 1944. The breakdown shown in Table 2 should, therefore, be treated

with the greatest reserve. The important conclusion to be drawn from Table 2 is that aviation gasoline and light motor fuel were in relatively shorter supply than the black products. This conclusion is in agreement with the few intelligence reports on this subject which are available.

Table 2. AXIS EUROPEAN PRODUCTION AND CONSUMPTION OF LIQUID PETROLEUM PRODUCTS,
BY PRODUCTS AND USES

(In thousands of metric tons)^a

	Total Military and Civilian Consumption		Consumption, July-December 1944						Total Pro- duction ^b
	1944	Jan.-June 44	Ground	Air	Naval	Total Military	Industrial & Civilian	Total Con- sumption	
Aviation gasoline	1,239	830	--	406	3	409	--	409	(975
Light motor fuel	3,848	2,749	725	66	8	799	800	1,099	(
Kerosene	373	303	--	--	--	--	70	70	145
Lubricants	813	541	40	21	11	72	200	272	234
Gas oil	2,091	1,414	310	28	139	477	200	677	635
Fuel oil	2,043	1,385	--	--	428	428	230	658	766
TOTAL	10,407	7,222	1,075	521	589	2,185	1,000	3,185	2,755

a. A breakdown of production by products for the first six months is not available and therefore a comparison can not be made at this time between production and consumption by products for the year.

b. The breakdown of aggregate production by products has been taken from The Weekly Survey of Axis Oil Production prepared by the Joint Anglo-American Oil Targets Committee and has therefore been arrived at independently of the consumption pattern. The flexibility of the refining and synthetic processes used would allow certain adjustments of production in accordance with the consumption pattern. The differences between supplies and requirements, product by product, do therefore not indicate more than the probable relative degree of shortage of the various products.

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3. Ground Force Consumption

a. Summary. Consumption of liquid petroleum products by enemy ground forces in Europe, including auxiliary services, in the second six months of 1944 is estimated at 1,075,000 metric tons, as compared with 2,550,000 tons in the first half of the year. As is shown in Table 3, monthly consumption fell from a peak of 271,000 tons in July to a low of 115,000 tons in November. The factors chiefly responsible for this decline are discussed below. The forces on the Eastern Front continued to be the largest consumer, accounting for 57 percent of total consumption in the period, as compared with 27 percent in the West and 12 percent in Italy.

Table 3. CONSUMPTION OF PETROLEUM PRODUCTS BY AXIS EUROPEAN GROUND FORCES AND AUXILIARY SERVICES, BY MONTHS, JULY-DECEMBER 1944 ^a

(In thousands of metric tons)

<u>Month</u>	<u>Western Front</u>	<u>Eastern Front</u>	<u>Italy</u>	<u>Other</u>	<u>Total</u>
July	62	181	36	12	271
August	62	152	24	11	249
September	43	91	21	10	167
October	33	77	18	7	133
November	32	64	13	6	115
December	52	67	16	5	140
TOTAL	286	612	126	51	1,075

a. Includes ordinary wastage and losses.

It is difficult to make a satisfactory estimate of the product composition of the total, but it appears from various intelligence reports -- which agree with the somewhat easier supply position for gas oil as compared with gasoline -- that the proportion of gas oil has risen somewhat over previous periods. As the proportion in the preceding six months was estimated at 28 percent of total liquid fuel consumption, it has been arbitrarily assumed at 30 percent in the second six months of the year. On this basis the product composition would be roughly 725,000 tons of gasoline, 310,000 tons of gas oil, and 40,000 tons of lubricants.

b. Explanation of the Decline in Ground Force Consumption. The sharp downward trend of ground force consumption since June 1944 reflects the cumulative effect of the efforts of the Germans to reduce consumption and of the new conditions under which the German armies have been fighting. Captured orders reveal that severe measures have been taken to restrict the use of motorized equipment, to convert as much equipment as possible to substitute fuels, and to use alternative means of transport even at a cost in tactical mobility.

A second and more important factor is the decline in manpower and vehicular strength, which has led to a reduction of requirements. The total manpower of the German ground forces fell by about one-sixth during the second six months of the year and, in addition, Rumania and Finland, which had contributed nearly fifty divisions to the enemy ground forces, were forced out of the war. Losses of motorized equipment have been even more severe: it is estimated that between the middle and end of the year divisional vehicular strength dropped by about one-third. Inasmuch as the proportion of second line divisions in the total strength of the German

army rose considerably during the period, the total decline in vehicular strength has been even more than one-third. It is estimated that in October 1944 the German armies (excluding auxiliary services) had a total of 238,000 trucks, of which 54,000 are believed to have been converted to substitute fuels, as compared with 375,000 in July 1943, of which only about 20,000 were converted. Moreover, small and medium trucks now constitute a larger percentage of the total than in previous periods.

A third factor contributing to a fall in requirements was the withdrawal of the German ground forces in both the West and the East. New lines were established in areas with denser rail nets and better roads than the evacuated territories and, especially in the West, in areas suited to a defensive warfare from prepared positions.

Finally, the sharp drop in consumption in September and the continued low level of consumption in succeeding months of 1944 is in large part attributable to the general inactivity on the Eastern Front north of the Carpathians during these months.

c. Method of Estimation. While the method of estimation is the same as that employed in previous reports, new factors have been used which reflect the changed conditions. In summary, the important revisions are as follows: (1) GHQ allowances have been reduced to account for the extensive use of converted vehicles and for the restrictions on use of motor transport in rear areas. (2) Daily divisional consumption factors have been adjusted monthly to allow for changes in divisional vehicular strength and to reflect the decrease in average daily mileage per vehicle

which was made possible by better rail communications. (3) The allowance for increased consumption under winter conditions in the East has been cut in half to allow for the withdrawal to areas in which winter conditions were less severe than previously and which were better served by railroads and roads.

4. Naval Consumption

Consumption of liquid petroleum products by German and satellite naval forces in the second six months of 1944 is estimated at 589,000 metric tons, as compared with 896,000 tons in the first half of the year. Naval consumption is estimated on a quarterly basis and the consumption during an average month in the third and fourth quarters is shown in Table 2. It will be noticed that naval consumption has remained fairly steady during the period (and it should be pointed out that the averages conceal certain spurts of activity, such as that occasioned by the withdrawal from the Baltic area in early October). The most important explanation of the continued fairly high level of naval consumption is that fuel oils, which constitute the bulk of naval consumption, are relatively more abundant than other petroleum products. The bulk of the gas oil is used by submarines and still permits a rather high degree of submarine activity.

Table 4. CONSUMPTION OF PETROLEUM-PRODUCTS BY AXIS EUROPEAN NAVAL FORCES
DURING AN AVERAGE MONTH OF THE THIRD AND FOURTH QUARTERS OF 1944

(In thousands of metric tons)

<u>Period</u>	<u>Gasoline</u>	<u>Lubricants</u>	<u>Gas oil</u>	<u>Fuel oil</u>	<u>Total</u>
Average month:					
3rd Quarter	2	2	23	75	102
4th Quarter	2	2	23	68	95
Total, second six months	11	11	139	428	589

5. Air Force Consumption

a. Summary. Consumption of liquid petroleum products by enemy air forces in Europe in the second six months of 1944 is estimated at 521,000 metric tons, as compared with 1,013,000 tons in the first half of the year. As is shown in Table 5, monthly consumption fell from a peak of 137,000 tons in July to a low of 59,000 tons in October and November. About 50 percent of the total for the second six months was required in Germany and on the Western Front, 45 percent in the East, and 5 percent in the Mediterranean area.

Table 5. CONSUMPTION OF PETROLEUM PRODUCTS BY AXIS EUROPEAN AIR FORCES, BY MONTHS, JULY-DECEMBER 1944^a

(In thousands of metric tons)

<u>Month</u>	<u>Germany and Western Front</u>	<u>Mediterranean</u>	<u>Eastern Front</u>	<u>Total</u>
July	62	10	65	137
August	57	7	66	130
September	35	4	33	72
October	33	2	24	59
November	31	2	23	59
December	38	1	25	64
TOTAL	259	26	236	521

^a. Includes ordinary wastage and losses.

A breakdown of the monthly totals by products is shown in Table 6: aviation gasoline accounted for 78 percent of the total, motor fuel 13 percent, gas oil 5 percent, and lubricants 4 percent. In the last four months of the year aviation gasoline consumption had been cut to half of the July figure, or to 36 percent of the average consumption in the first six months of 1944.

Table 6. CONSUMPTION OF PETROLEUM PRODUCTS BY AXIS EUROPEAN AIR FORCES, BY MONTHS AND PRODUCTS, JULY-DECEMBER 1944

(In thousands of metric tons)

<u>Month</u>	<u>Aviation Gasoline</u>	<u>Motor Fuel</u>	<u>Lubricants</u>	<u>Gas oil</u>	<u>Total</u>
July	105	18	6	8	137
August	100	18	5	7	130
September	55	10	3	4	72
October	47	7	2	3	59
November	48	6	2	3	59
December	51	7	3	3	64
TOTAL	406	66	21	28	521

b. Explanation of the Decline in Air Force Consumption. By the middle of 1944 the chief tasks of the GAF had become defense against Allied strategic bombing and close support of ground operations. Long range bombing operations virtually ceased and by fall air transport operations were sharply cut, partly, of course, because the withdrawals in

the East, the West, and the Balkans had led to a considerable reduction in the need for air transport. It appears that a major contributing factor to this reorientation was the fuel shortage. At any rate the change made possible a maintenance of a high level of fighter and close support operations (in terms of former GAF activity), while total operational consumption of aviation gasoline was sharply reduced. The change also made possible a reduction in allocations for training, because many released bomber and transport pilots were given short conversion courses to fighter craft, thus reducing the number of men to be given complete training, and because, in a defensive warfare, a large proportion of pilots shot down can be saved.

The decline in operational consumption has been accompanied by an absolute fall in non-operational requirements, though these requirements have increased as a percentage of the total. For want of adequate information on this subject, it has been necessary to make an arbitrary assumption that, in percent of operational consumption, non-operational requirements have risen over the six months from the previous level of 40 percent to 60 percent. The trend of non-operational consumption thus established seems to be in agreement with the experience of the US AAF in inactive theaters as compared to active theaters and in the same theater as between quiet and active periods. It is also in agreement with the observations of US AAF officers who have followed the GAF.

Finally, the withdrawal of Rumania and Finland led to a reduction in consumption by satellite air forces.

6. Civilian Consumption

The estimate for the petroleum requirements for civilian and industrial purposes during the second six months of 1944 of about 1,000,000 metric tons represents nothing but an informed guess. With supplies cut to a fraction of their former level, allocations could no longer be based on the actual needs for maintaining industrial activity at a reasonably efficient level, but on the size of the quantities which could be spared from current supplies or from the small reserves after the most urgent military needs had been satisfied. As a matter of fact, all petroleum stocks in the hands of consumers were confiscated early in September 1944 and civilian stocks may even have been depleted for the sake of supplying military demand.

The relevant facts on which the estimated requirements of about 1,000,000 tons for civilian and industrial needs have been based may be listed as follows:

a. The area under Germany's control was reduced during the second half of 1944 by the liberation of most of the occupied countries and by the conquest of nearly all Axis satellite territory. This reduction in the size of German-dominated Europe, though sapping Germany's economic and military strength, released Germany from the necessity of supplying certain minimum quantities of petroleum to the industries of liberated Europe.

b. The conversion of all oil using motors to substitute fuels was continued under even greater pressure than before, though shortage in the supply of substitute fuels made such efforts rather futile.

c. Allocations to transport, agriculture, and industry bear no re-

lation to actual vital needs. Numerous intelligence reports reveal the desperate nature of the measures which had to be taken in order to prevent a complete breakdown of production and distribution.