

S E C R E T

June 22, 1944

Report to the Committee of Operational Analysts

On

THE STATUS AND VULNERABILITY OF THE EUROPEAN AXIS

PETROLEUM INDUSTRY

1. Introduction. Our report of 16 June 1944, presented a preliminary summary of the German oil position. The present report amplifies the previous one as directed, and also revises it in the light of subsequent information. The essential thesis and conclusions of the 16 June report are unaffected by these corrections.

2. Supply, demand and stocks. During the first 5 months of 1944 total production of liquid fuels and lubricants is estimated to have been at the average rate of 1,431,000 tons/month. Average consumption during this period is estimated at 1,221,000 tons/month. During the first 5 months of 1944, therefore, a total of 1,050,000 tons of all products could have been added to stocks. As a result of air attacks during May, the production for June was lowered to 1,006,000 tons, a decrease of 425,000 tons as compared with the previous average monthly rate. Consumption during June is estimated at 1,137,000 tons, thus requiring a withdrawal of 131,000 tons from stocks during June. About 100,000 tons of stocks, also, are estimated to have been destroyed during attacks in May. The quantities held in free stocks, therefore, are assumed to amount to about 1,800,000 tons, as indicated in our earlier report. If extensive heavy fighting should develop on the Russian front, military consumption will increase by a further 100,000 tons/month; sustained fighting in the Balkans and in Northern and Western Europe may add another 50,000 tons/month to requirements. At the June rate of supplies the deficit would then amount to 231,000 tons a month.

3. "Irreducible minima" in supplies. We believe that it is feasible to reduce Axis oil supplies, by aerial destruction of 9 synthetic plants and 16 refineries, from the June level of production of 1,006,000 tons to something like 350,000 tons a month. Seven of these plants, indeed, may already have been destroyed. It may not be practicable to attempt to reduce Axis oil supplies below this level, as the bulk of such remaining production would then consist in fuel oil and liquid substitutes, which can either be produced in very simple installations or are manufactured in a large number of very small plants. In particular, even with all refineries and synthetic plants destroyed, crude oil, the supply of which is unaffected, might

be converted to a usable fuel oil by permitting it to weather in open pits until the lighter ends had evaporated. Also, there would remain the large production of tar oils from the various coking plants, including those normally supplying the synthetic oil industry. These sources of fuel oil therefore constitute the largest factor in the "irreducible minimum" of supply, below which the German oil economy cannot be forced by air attack.

In addition to the above, the production of certain substitute fuels and lubricants is not directly related to the petroleum industry proper, and might continue unimpaired. Such products are as follows:

Benzol	600,000 tons year
Alcohol	175,000 " "
Reclaimed Lubricants	200,000 " "
Vegetable Oils	10,000 " "

Finally, it is unlikely that air attack would ever reduce refining and synthetic oil production to absolute zero. Enough base stock might always be produced to permit the blending of the alcohol and benzol noted above. In any case the "irreducible minimum" is much below military consumption. If supplies should be brought down to such a level military activity would have to be reduced drastically.

4. Products position. It has been indicated above that adequate quantities of fuel oil can always be obtained. The German ability to use fuel oil is limited to the larger (and usually inactive) units of the Navy and to civilian and industrial consumption. A surplus over present demand would be of little value to them.

With regard to lubricants, these are required in relatively small volume, and although they require highly specialized facilities for production, certain of these facilities can be improvised fairly promptly. Also, because of their relatively small volume and stability in storage, the stock position may be better in regard to lubricants than the average for other products.

The position with respect to gasoline, kerosine and Diesel oil emerges as the one most important from the standpoint of vulnerability of supply and urgency of demand. A summary of the situation in June, 1944, with regard to these products is shown in the following tables:

Production of Gasoline, Kerosine & Diesel Oil

June 1944 - 000's metric tons

Hydrogenation plants	333
Fischer plants	112
Benzol	50
Tar oils	10
Bottled gases	25
Alcohol	14
Crude oil refining	<u>180</u>

Total 724

Consumption of Gasoline, Kerosine & Diesel Oil

June 1944 - 000's metric tons

Civilian - industrial	243
Ground forces	341
Air forces	184
Navy	<u>48</u>

Total 816

There is thus a deficiency of about 100,000 tons/month in gasoline, kerosine and Diesel oil supply in June as a result of air attacks carried out before June 1. The attacks made thus far during June, (see 5 below) although not yet quantitatively evaluated, have greatly worsened this situation, particularly through the great destruction of cracking facilities.

5. The refinery position. Considering first the Ploesti district of Romania, as the most important refining center in Europe: At the beginning of April the operable refineries in the Ploesti district could treat about 8,500,000 tons of oil per year, whereas the crude oil production from the region amounted to 6,100,000 tons/year. There was thus a surplus refining capacity of 3,400,000 tons/year. Attacks during April and May reduced the refinery capacity at Ploesti to an estimated 400,000 tons (annual rate) in June, thus practically wiping it out. If no further attacks are made on Ploesti, it is estimated that repairs may bring back the refining capacity of the district to an annual rate of 1,800,000 tons in July, and to 4,000,000 tons by August. As the current Romanian crude oil production amounts to about 410,000 tons month, the Germans are forced to store or ship essentially all of this quantity during June, and to similarly handle 260,000 tons of crude during July and about 20,000 tons during August. The extent

to which the oil thus stored or shipped can be utilized depends on rehabilitation of the Ploesti refineries, or upon adequate excess refinery capacity elsewhere in Europe, in which it might be treated; a description of such excess capacity, as it existed on June 1, 1944, is as follows:

Poland. The refineries at Trzebinja, Drohobycz and Jaslo have unused capacity which could handle 60,000 tons/month of Romanian crude oil. It may be assumed that equivalent amounts of Romanian crude will be exported to them, beginning in June, and that such exports will continue so long as there is a deficit of capacity in Romania.

Jugoslavia. About 15,000 tons/month of Romanian oil could normally be refined in Yugoslavia, but air attacks made during June may have damaged all Yugoslav refineries sufficiently to eliminate this country, at least for the present, as an outlet for Romanian crude oil.

Italy. An excess of refinery capacity in northern Italy amounting to nearly 1,300,000 tons/year has been reduced by recent air attack to about 550,000 tons/year of currently usable capacity. Evidence is not yet available to estimate how rapidly the damaged Italian plants could be repaired, but damage to several of the larger ones appear to be of long term character. The difficulty of maintaining regular flow of oil from Romania to northern Italy, in the face of partisan attacks in Yugoslavia and United Nations interference with rail routes in north Italy makes this area an undependable outlet for Romanian crude oil. Nevertheless, at present some 50,000 tons/month of Romanian oil might be refined at Trieste and La Spezia if it can be transported there.

Holland - Belgium. All the refineries of Austria, Hungary, Czechoslovakia and Germany are currently worked to capacity to handle the large new production of crude oil from Austria and Hungary. Holland and Belgium, with unused refineries having an aggregate capacity of about 144,000 tons/month are therefore geographically best situated after Poland, Italy and Yugoslavia, to treat crude oil displaced from Romania. Considered collectively, these refineries currently form the most important prospective outlet for Romanian crude oil.

Southern France. The refineries of the Marseille and Bordeaux regions of France are large and modern, and are able to treat some 220,000 tons/month of crude oil. The only drawback to utilizing them is that they are, by available routes, some 2,000 miles distant from Romanian sources of supply, and are about 650

miles removed from any important centers of consumption. When allowance is made for shipments of excess Romanian crude oil to Poland, Italy, Belgium and Holland, as indicated by the preceding review of refining possibilities, there still remains some 150,000 tons/month of Romanian crude oil for which no refinery capacity is available except in southern France. To carry this amount of Romanian crude oil to southern France, and the products back to northwestern Europe for distribution, would require some 16,000 tank cars additional to those already in use. We do not believe any such quantity of tank cars is available, and consider the southern French refineries primarily of value as sources of replacement equipment for repairing refineries elsewhere in Europe.

In view of the foregoing, it appears that if refinery capacity in Europe could be kept at about the level of 1 June, 1944, there would be 150,000 tons/month of crude oil which could not be refined for lack of capacity.

The June position is entirely temporary, and will be changed by reconstruction of damage on the one hand, and by further attacks on the other. Already in June attacks whose success we cannot yet evaluate have been made on essentially all the important refineries in Hungary, Austria, Slovakia, Holland and Germany. If these attacks were, on the average, sufficient to close down 50% of their targets, a quantity of some 200,000 tons/month of crude oil, additional to the above calculated 150,000 tons, may be currently unrefinable, and must be stored or shut in. So long as refining capacity can be kept at this low level, the crude oil is lost to the Germany economy except for a doubtful use as fuel oil. This is equivalent to the loss of about 25% of German supplies from all sources.

5. Transportation. As a result of the present need for hauling large quantities of Romanian crude oil long distances for refining and subsequent product distribution, a considerable additional strain will be placed on Europe's oil transportation facilities. A careful calculation indicates that even with all feasible use of inland waterways, some 5,000 - 6,000 tank cars additional to the number used before the dislocation of Romanian production will be required to effect the necessary handling of crude oil and products.

During the maximum advance into Russia the Germans were able to maintain a comparable strain on their oil transport facilities, and it is thus assumed that they will also be able to cope with the present situation, although the tank car position earlier this year was reported very tight. Success in this, however, should represent about the maximum they can achieve, and we believe that use of the refineries of southern France can be ruled out, for any large quantities of oil, because of the very great additional number of tank cars required.

It appears that attacks on transport as a means of further damaging the oil position would have little significance so long as there are primary targets available in the form of synthetic plants and refineries. There are few transportation targets available which could not be rapidly repaired, and, as a high priority material, oil would presumably continue to move even when other supplies were delayed. Continued mining of the Danube, however, might prove efficacious.

7. The position with respect to Synthetic plants. The damage inflicted on synthetic plants to 1 June 1938 can be summarized in tabular form:

<u>PLANT</u>	<u>RATED PRODUCTION</u> Tons/year	<u>TOTAL LOSS OF</u> <u>PRODUCTION-TONS</u>	<u>TIME REQUIRED</u> <u>FOR FULL REPAIRS</u>
Pöhlitz	600,000	55,000	4 months
Boehlen	350,000	72,000	4 months
Magdeburg	300,000	28,000	2 months
Zeitz	500,000	185,000	(over) 5 months
Brux	700,000	139,000	3 months
Leuna	600,000	42,000	1½ months
Lutskendorf	135,000	22,000	2 months
Welheim	100,000	9,000	1 month
Ruhland	550,000	52,000	3 months
Total	3,635,000	601,000	

Thus, the attacks on synthetic plants to 1 June 1944, reduced Germany's annual rate of synthetic oil production by some 10%, and her total annual supplies by about 4%. Since the beginning of June, the Gelsenkirchen hydrogenation plant has been attacked twice, and the hydrogenation plants at Magdeburg and Pöhlitz once; the Fischer-Tropsch plant at Kolden has also been attacked once. Some of these attacks were reported as very successful, but data for their final evaluation are not yet available.

8. Target priorities. The primary oil targets in Axis Europe are hydrogenation plants and crude oil refineries. For reasons brought out below, the Fischer-Tropsch plants, with one or two exceptions, are at present of less importance than any but the smaller refineries.

With respect to hydrogenation plants, it may be noted that they are primary sources of oil supply, and manufacture only gasoline (including nearly all of Germany's aviation gasoline) Diesel oil and high-grade lubricants. They are, also, all strategically located within Germany's innermost defense zone, and would constitute the source of her oil supply for any last-ditch stand within her own borders.

Refineries are dependent on extraneous crude oil supply for their operation, but normally turn out much greater quantities of product than do hydrogenation plants. However, hydrogenation plants also possess very large refining capacity, and if they were run as refineries, certain of them would rank among the largest in Europe. Thus, the Leuna plant, if operated as a refinery could treat several million tons of crude oil per year, and the Politz plant has comparable refining capacity. Such operation would mean the loss of the products obtained from coal, but if Germany is faced with a great shortage of refinery capacity, it would be highly profitable to run certain of the hydrogenation plants solely as crude oil refineries. The Fischer-Tropsch plants, on the other hand, generally have insufficient refinery capacity to treat their primary products, which are in large part shipped to refineries for final treatment. With the general absence of sufficient refinery capacity in Europe, the Fischer-Tropsch primary product is of no more value than crude oil, and most of these plants are not therefore currently important.

It has been noted above that it is impracticable to attempt to deny the Germany fuel oil; the oil position must be assessed basically in terms of supply of, and demand for, gasoline, kerosine and Diesel oil. A logical means of finding a common denominator for rating the target priorities of both hydrogenation plants and crude oil refineries appears, therefore, to be obtained by classifying them in terms of their capacity to refine gasoline, kerosine and Diesel oil. On this basis, and with due allowance for the results of damage inflicted on certain plants to 1 June, 1944, the target priority for oil installations in Axis Europe appears as follows:

<u>PLANT</u>	<u>PRESENT CAPACITY (JUNE) TO REFINE TO GASOLINE-DIESEL OIL</u>
	1,500,000 tons/year
1. Leuna, Germany	1,000,000 "
2. Scholven -Buhr, Germany	770,000 "
3. Pernis, Rotterdam 1/	760,000 "
4. Romano-Americana, Ploesti 1/	560,000 "
5. Rhenania-Ebano, Hamburg 1/	480,000 "
6. Politz, Germany 1/	425,000 "
7. Blechhammer (2 plants), Germany	400,000 "
8. Brux, Czechoslovakia 2/	350,000 "
9. Gelsenkirchen, Germany 1/	340,000 "
10. Astra Romana 2/	300,000 "
11. Steaua Romana 2/	256,000 "
12. Eurotank, Hamburg	200,000 "
13. Wesseling, Germany	198,000 "
14. Trzebinja, Poland	192,000 "
15. Lobau, Vienna 1/	192,000 "
16. Dourag, Hannover	

<u>PLANT</u>	<u>PRESENT CAPACITY (JUNE) TO REFINE TO GASOLINE-DIESEL OIL</u>
17. Jaslo, Poland	178,000 tons/year
18. Kenia, Ploesti	150,000 "
19. Holten, Germany	115,000 "
20. Welheim, Germany	100,000 "
21. Ludwigshafen, Germany	100,000 "
22. Prahova, Bucarest ^{3/}	130,000 "
23. Csepel, Budapest ^{1/ 3/}	128,000 "
24. Pardubice, Czechoslovakia ^{3/}	128,000 "
25. Polmin, Poland	106,000 "

- 1/ Plant attacked during June; may be destroyed or of lower priority.
2/ Capacity after allowance for damage in May 1944.
3/ Priority lowered because of inferior product output.

It has been noted previously, and is apparent from the above list, that many hydrogenation plants have a high potential capacity for refining crude oil to gasoline, kerosene and Diesel oil. Their own primary products also require elaborate refining if they are to be used as anything but fuel oil. It appears, therefore, that to enhance the current shortage of refining capacity in Europe, the refining installations of synthetic plants should rate a high priority during attacks on such plants. They are, also, relatively vulnerable parts of the important equipment, and their destruction would effectively incapacitate the plant for a long period. It is suggested that the following priority sequence be given in planning attacks on hydrogenation plants:

1. Refinery section (distillation)
2. Power house (steam generation)
3. Hydrogen production
4. Compressor houses
5. Injector houses
6. Reactor stalls
7. Tankage

The more important installations in crude oil refineries, from the standpoint of destruction, remain the primary distillation equipment, the boiler house and the cracking installations.