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WAR CABINET.

Joint Intelligence Sub-Committee.

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To: The Right Hon. C. R. Attlee, M.P.,
Lord President of the Council and
Deputy Prime Minister.

THE AXIS OIL POSITION IN EUROPE—NOVEMBER 1943.

REPORT BY THE JOINT INTELLIGENCE SUB-COMMITTEE.

THERE is attached a report* upon the oil position in Axis Europe which has been prepared by the Technical Sub-Committee on Axis Oil, of which Sir Harold Hartley is Chairman. The report covers the eight months ended the 31st August, and also includes a forecast of the position for the six months ending the 1st March, 1944.

2. The report emphasises the following points:—
- (a) Up to the end of August the oil position has continued to be extremely strained and stocks were then at about the same low level as at the beginning of this year.
 - (b) The savings in distributional requirements due to losses of territory are likely to be offset to a large extent by additional commitments in other directions.
 - (c) An improvement in supplies may be possible during the next few months by Germany acquiring Italy's former oil imports and by increasing the output of the synthetic plants.
 - (d) The position is extremely sensitive to dislocation and the importance of refineries as targets has become greatly enhanced.

3. We agree the findings of this report and we would reaffirm that it is clear from intelligence that oil continues to cause the Germans serious anxiety. It appears improbable that there has been any important improvement in the position since August, and we agree that any major interference with Germany's oil resources would seriously weaken her ability to continue the war.

4. In particular we would emphasise the vulnerability of the refineries in Central Europe and the Balkans and the special importance as targets of those situated at nodal transport points on the petroleum supply lines, e.g., Vienna, Regensburg, and Budapest; though in the case of Budapest the question should be considered in conjunction with the policy for bombing of objectives in Hungary.

(Signed) V. CAVENDISH-BENTINCK.
E. G. N. RUSHBROOKE.
F. H. N. DAVIDSON.
F. F. INGLIS.
C. G. VICKERS.

Offices of the War Cabinet, S.W. 1,
26th November, 1943.

* J.I.C. (43) 463.

SECRET.

J.I.C. (43) 463.

(Also A.O. (43) 55.)

17th November, 1943.

DECLASSIFIED MR 22 SEPT 72

WAR CABINET

TECHNICAL SUB-COMMITTEE ON AXIS OIL

**THE AXIS OIL POSITION IN EUROPE
NOVEMBER 1943**

*Offices of the War Cabinet, S.W. 1,
17th November, 1943.*

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TECHNICAL SUB-COMMITTEE ON AXIS OIL.

The Oil Position in Axis Europe, November 1943.

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Summary of Conclusions.

1. German plans to provide adequate supplies of oil in 1943 have failed to attain their objective. The construction of synthetic oil plants is behind schedule; the programme for further conversions to substitute fuels has not resulted in important additional savings; and the Allied offensives have forced consumption to levels that have not permitted any restoration of the depleted stock position.

2. During the eight months ended the 31st August, 1943, oil production has approximately equalled consumption and losses. Stocks therefore remain unchanged at the January level, which at that time was considered to be little more than the minimum required to maintain distribution, namely 4,000,000 tons.*

3. The savings in distributional requirements due to losses of territory are likely to be offset to a large extent by the additional oil immobilised in establishing military reserves to meet both the threat of fresh Allied assaults and the possibility of interruptions to communications.

4. During the six months ending the 1st March, 1944, Germany may be able to add rather more than 1,000,000 tons to her resources, provided that—

(a) Italy's former oil imports are acquired (500,000 tons).

(b) Progress is made with additions to synthetic oil production capacity (250,000 tons).

(c) The losses of oil stocks which were caused by Allied attacks during the first eight months of 1943 do not recur (400,000 tons).

5. However, the position is now more vulnerable than at any previous time for the following reasons:—

(a) The Allied advances in Italy and Russia have brought all the principal sources of oil within range of air attack.

(b) The refining capacity of South-Eastern Europe is at present barely sufficient to meet requirements. Any substantial reduction in this capacity would not only entail the transport of crude oil to refineries remotely situated elsewhere in Europe but, as a large proportion of oil products are consumed in Eastern Europe, a major re-organisation of oil distribution would also be involved. The position is extremely sensitive to dislocation and the importance of refineries as targets has become greatly enhanced.

6. The insufficiency of oil stocks is still causing Germany grave anxiety, and any substantial interference with her oil supplies would seriously weaken her ability to continue the war.

Deduction.

We should, as far as circumstances will permit, use every endeavour this winter to destroy as much of the enemy's oil resources as possible.

* This figure was originally considered to be about 3 million tons, but has been amended to 4 million tons as a result of the American-British discussions.

REPORT.

Our last report on the Axis Oil Position in Europe (J.I.C. (43) 253)* covered the six months ended the 1st May, 1943. A further statement on the position was made in July when the conclusions arising from a series of conversations with the Representatives of the United States Enemy Oil Committee were reported (J.I.C. (43) 312).† In view of the changes that have occurred in Europe since these reports were issued, the following report is now submitted.

Introductory.

In our report for the six months ended the 30th April, 1943, it was pointed out that the oil position was uncomfortably tight and not likely to improve substantially until either the new synthetic oil plants came into large-scale production or until Italy went out of the war. It was clear from intelligence that Germany was regarding her oil position at that time with considerable anxiety.

We envisaged the possibility that, if the construction of additional synthetic oil output capacity proceeded at a rate that would result in an increase in production of a million tons a year by the end of September, and if the capitulation of Italy resulted in Germany acquiring additional oil equivalent to a million tons a year, the position would then be eased to an important extent. On the other hand, if the new synthetic plants did not add substantially to supplies until some time after the rate of military consumption had reached the 1942 figure, and if Italy remained in the war, it was considered that Germany's oil structure would be stretched to the utmost.

Developments during the First Eight Months of 1943.

Total stocks of oil at the beginning of this year were considered to be at such a low level that further withdrawals to make up any material deficit between production and consumption were no longer possible without causing stoppages in distribution. This level was originally considered to be about 3,000,000 tons but was amended to 4,000,000 tons in July as a result of the American-British discussions. The tabulation in Annex I now shows that up to the end of August intake and consumption had approximately balanced, stocks remaining practically at the January level. An addition to supplies of 400,000 tons would have occurred in these eight months if this quantity of oil had not been destroyed by Allied attacks.

During this period, however, territorial changes have occurred that will have had some effect upon tied stocks and the distributional minimum. The retreats on the Russian and Mediterranean Fronts will have resulted in eliminating the military and non-military tied stocks in the areas evacuated. On the other hand, the additional military reserves required to meet the threat of Allied assaults, and the growing uncertainty of communications, will have resulted in increases in the quantity of oil immobilised in stock. It is therefore considered that the necessary distributional minimum remains virtually unchanged.

Evidence of Strain.

It is evident from current intelligence that oil is continuing to cause Germany great anxiety. Information recently obtained from members of the Italian General Staff confirms that the shortage of liquid fuel constitutes a major preoccupation of the German High Command.

Non-military consumption has recently had to be restricted still further. Allowances of oil to the occupied countries, already small, have again been reduced and apparently without regard to the economic difficulties that must inevitably be arising.

In the case of the armed forces, allocations to non-operational army units have been further restricted and increasing reliance is being placed upon producer-gas for the operation of military vehicles. The inadequacy of the fuel allowances for the individual training of drivers, and for exercises, is a constant source of complaint.

The shortage of bunker fuel for German Naval vessels has resulted in activities having to be principally confined to essential escort duties. The lack of oil is reflected in further conversions to coal-firing.

* J.I.C. (43) 340—Annex A.

† J.I.C. (43) 340—Annex B.

In the case of the G.A.F. there have not been the reports of shortages of aviation spirit at flying schools that were prevalent last year. However, the increasing conversion of G.A.F. ground units to producer gas points to a growing stringency of motor fuel.

The Attack upon the Roumanian Refineries.

The attack upon the Roumanian refineries on the 1st August has resulted in the elimination, for such time as it will take for repairs to be carried out, of the surplus refining capacity in Roumania. The refining capacity of Central and Eastern Europe is, in fact, now working at maximum pressure and is barely sufficient to treat the production forthcoming from Roumania, Austria, Hungary and Poland. Any substantial reduction in this capacity would not only entail the transport of crude oil to refineries remotely situated in Italy or Northern Europe but, as a large proportion of oil products are consumed in Eastern Europe, a major reorganisation of oil distribution would be involved.

The position is extremely sensitive to dislocation, and the importance of refineries as targets has become greatly enhanced. (See page 23.)

The Collapse of Italy.

The defection of Italy has relieved the Axis of an annual oil commitment equivalent to approximately 1,000,000 tons. Immediate advantage of this wind-fall, in the form of diverting to Germany Italy's former share of Roumanian oil, has been partly mitigated by the dislocation at Ploesti. Nevertheless Germany should now be acquiring approximately 80,000 tons a month of oil that formerly went to Italy. If these supplies can be maintained, and safeguarded from interference from the new Allied bases in Italy, they will be an important addition to Germany's resources. (See page 25.)

The Future Trend.

The following indicates the possible future trend of production and consumption, the period covered being the six months from the 1st September, 1943, to the 29th February, 1944.

The Production Trend.

The production of crude oil from all sources, in terms of finished products, is at present at the rate of rather less than 8,500,000 tons a year (see Annex II). The declining trend in the output of Roumania and Poland is likely to be offset by increasing production from Austria. Hungary is capable of increasing her production but the Hungarian Government has so far apparently shown no inclination to supply the Germans with any larger quantities of oil than hitherto. Assuming, therefore, that Hungary does not change her present attitude, no important increase in the output of mineral oil is to be expected during the next few months.

The output of synthetic oil is currently estimated at the rate of about 5,400,000 tons per annum. Assuming that the existing plants continue to operate at their present level of efficiency, any increases in output will be principally dependent upon the completion of the Brüx plant and of the two plants at Blechhammer. There has, however, been a notable slowing down in the construction of these plants and in the additions being made to certain existing plants (see Annex II). Consequently there are no means of measuring the additional output capacity that may be available early in 1944. It is, however, regarded as improbable that the additional annual productive capacity available by next February will exceed 600,000 tons; as this increase will occur gradually, the actual improvement in supplies during the six months ending the 29th February next is unlikely to exceed 250,000 tons.

The output of substitute fuels is estimated to be equivalent to an annual rate of 2,670,000 tons. Whereas there is scope for potential increases in the use of alcohols, the uses to which they can be put appear to be limited.

On the assumption that the present output of oil from all sources is maintained, the position may become improved, during the six months ending the 29th February, as follows:—

	<i>Tons.</i>
(1) By the oil that was formerly imported by Italy	500,000
(2) By increases in synthetic oil production, say	250,000
(3) By the non-recurrence of the losses of oil stocks by Allied attacks that occurred during the first eight months of 1943, say	400,000

Consequently it may be possible for Germany to add rather more than 1,000,000 tons to her resources during this period.

The Consumption Trend.

The oil consumption of the armed forces has been running at high figures throughout the summer and autumn. Judging by the level of consumption last winter, and by the present trend of events, it is reasonable to expect the figures will not decline to any important extent before February next. (See Notes 1 and 2 below.)

While further reductions are possible in the allocations of liquid fuel for non-military purposes in Germany, it is evident from the limitations already imposed upon the supplies to the armed forces that such reductions would imperil the economic stability of the home front. Consumption in Roumania and Hungary continues at a high level; German attempts to reduce the domestic consumption of these countries have been unavailing, and any drastic diversion of these supplies is unlikely.

Conclusions upon the Future Trend.

German plans to provide for adequate supplies of oil in 1943 have failed to attain their objective. The output of synthetic oil has not increased as expected, the programme for further conversions to substitute fuels has not resulted in important additional savings, and the Allied offensives have forced consumption to levels that have not permitted any restoration of the depleted stock position.

While a valuable addition to supplies should result from the collapse of Italy and an appreciable increase in synthetic production can still be anticipated, the future position is dependent upon the maintenance of present sources of supply, and particularly upon the oil resources of Roumania and Hungary. The contribution of these satellite countries remains as important as ever, and it will be seen from Annex VII that it is equivalent to almost half the total requirements of the German army. Moreover, Germany is now confronted with the fact that the Allied advances in Italy and Russia have brought all the principal sources of oil within range of air attack. The consequent threat to refineries and synthetic oil plants, combined with the growing uncertainty of maintaining communications (*e.g.*, the traffic interruptions with Northern Italy) imposes upon Germany the problem of having to build up reserves of a product already in deficient supply.

The present position is vulnerable and any substantial interference with Germany's oil economy would seriously weaken her ability to continue the war.

Signed on behalf of the Sub-Committee:

H. HARTLEY, *Chairman.*

Note 1.

A reduction in Axis consumption of about 55,000 tons per month has resulted from the elimination of the Italian armed forces. This saving is taken into account under the heading of the additional supplies available to Germany.

Note 2.

It may be expected that savings in consumption may result from reductions in the number of fuel-consuming units in operation, such reductions being due to a possible falling off in the output of new vehicles, lack of rubber, losses in battle, &c. Such reductions are, however, omitted from these calculations, since such a shortage would be correspondingly weakening to the Axis position.

ANNEX I.

THE STATISTICAL POSITION.

In the discussions with the Representatives of the United States Enemy Oil Committee in July (J.I.C. (43) 312) it was agreed that stocks at the beginning of 1943 were at such a level that further withdrawals to make up any material deficit between current supply and consumption were no longer possible. There was a difference of opinion upon the probable size of these stocks and a compromise figure of 4,000,000 tons was agreed upon. The estimated statistical position for the first eight months of the year is as follows:—

1st January—31st August, 1943

(in metric tons).

Stocks as at 1st January, 1943	...	...	...	4,000,000	
Production	...	...	...	11,002,000*	
Consumption (see Annex III)—					15,002,000
Civil	...	...	...	4,992,000	
Losses from evaporation and leakage†	...	...	...	40,000	
Armed Forces—					
(i) Armies	...	...	...	2,602,000	
(ii) Naval	...	...	...	1,247,000	
(iii) Air Forces	...	...	...	1,330,000	
(iv) Todt organisation	...	...	...	320,000	
Exports to Neutrals	...	...	...	5,499,000	
Losses—				40,000	
From destruction of stocks in Germany, Roumania and Italy by air attacks	...	...	...	150,000	
Stocks lost in the retreats on the Russian and Mediterranean Fronts	...	...	...	150,000	
Loss by tanker sinkings	...	...	...	100,000	
				400,000	
					10,971,000
Leaving a balance of	...	...	...		4,031,000

These figures indicate that during these eight months intake and consumption had practically balanced, permitting no improvement in the depleted stock position.

During this period, however, territorial changes have occurred that will have had some effect upon tied stocks and the distributional minimum. The retreats on the Russian and Mediterranean Fronts will have resulted in eliminating the military and non-military tied stocks in the areas evacuated. On the other hand, the additional military reserves required to meet the threat of Allied assaults and the growing uncertainty of communications, will have resulted in increases in the quantity of oil immobilised in stock. It is therefore considered that the necessary distributional minimum remains virtually unchanged.

* The following calculation has been made to arrive at the estimated production for the eight months ended the 31st August, 1943:—

Annual rate of production (Appendix A)	...	...	...	...	Tons. 16,541,700
Deduct—					
Synthetic oil production: Blechhammer Plants	...	...	...	150,000	
Albania: Crude oil (in terms of finished products)	...	...	...	90,000	
Italy: Alcohol &c.	...	...	...	29,000	269,000
Adjusted annual rate	...	...	...	...	16,272,700
Equivalent to production for eight months of	...	...	...	...	10,848,400
Add—					
Synthetic oil production, Blechhammer South	...	...	...	35,000	
Albania: Crude oil	...	...	...	90,000	
Italy: Alcohol &c.	...	...	...	29,000	154,000
Total production for the eight months	...	...	...	...	11,002,400

† $1\frac{1}{2}$ per cent. Aviation/Motor Fuel consumption of Air Forces (1,281,000), Civilian (1,028,000) and Todt (240,000). Armies' losses included in the estimate of Armies' consumption.

ANNEX II.

ESTIMATE OF OIL PRODUCTION FOR 1943.

In Appendix A are shown the estimates of the yields, in terms of Finished Products, from the production of oil in Axis-occupied Europe for the year 1943. The total of 16,542 million tons compares with the annual rate of 16,954 million tons given in our last report for the six months ended the 30th April, 1943, and comprises:—

	<i>Annual Rate in</i> <i>Thousands of metric tons.</i>	
	<i>1943.</i>	<i>6 months to</i> <i>30th April, 1943.</i>
1. Crude and shale oil production ...	8,496	8,366
2. Synthetic oil production ...	5,376	4,864
3. Tar oils ...	1,590	1,838
4. Substitute and miscellaneous oils ...	1,080	1,886
Total ...	16,542	16,954

Crude Oil Production.*Hanover Fields, Germany.*

The previous estimate of 450,000 tons for the whole of the Hanover fields has been revised on the assumption that the rate of increase of production in the Nienhagen area since 1938 has been 4 per cent. per annum compared with a yearly increase of 4.5 per cent. and 3.5 per cent. in 1937 and 1938 respectively. It is known that the development of the Eicklingen field has made considerable progress.

Production from the smaller outlying fields is estimated at 120,000 tons per annum. The output for the whole Hanover area is, therefore, assumed to be at the rate of 560,000 tons per annum. Production is likely to be maintained at a level rate.

Reitbrook Field, Germany.

Peak production is assumed to have been reached during the period of maximum drilling activity in 1941, when, it is estimated, production was 257,000 tons compared with about 140,000 tons in 1939. As some drilling was shown by aerial photographs to be in progress in 1942 it is assumed that the nett decline in production during that year was only 15 per cent. The decline in 1943 is put at 30 per cent. Production for 1943 is therefore put at 144,000 tons compared with the previous estimate of 240,000 tons. The trend is declining.

Heide Field, Germany.

Air cover in May 1943 showed that this field had been delimited and that drilling activity comprised inter-spacing between existing wells. The number of drilling wells was smaller in May 1943 than in February 1942 and the field is assumed to have passed its peak. The former estimate of 50,000 tons is maintained for 1943, and this figure corresponds with such intelligence as is available. Production is probably declining.

Rhine Valley Fields, Germany.

No important activity has been revealed by air cover. Photographs of the field near Forst show that no new drilling was in progress. Production in 1939 was estimated at 18,000 tons and, assuming an annual decline of 10 per cent., current production is taken to be 12,000 tons. The fact that there have been no reports of activity in the Rhine Valley may afford some confirmation of this figure.

Unknown German Fields.

It is known that drilling activity is taking place in various parts of Germany and there are numerous structures to be tested. A figure of 100,000 tons has been included to cover possible production from areas not known to us.

Austria.

The 1943 estimate of 1,200,000 tons covers the following fields:—

	<i>Tons.</i>
Zistersdorf	63,000
Gaiselberg	360,000
Kreuzfeld	65,000 (approx.)
Prinzendorf/St. Ulrich	750,000 (approx.)
	1,238,000 (approx.)

This estimate is the result of photographic reconnaissance made in August 1943, together with a certain amount of information gained from intelligence. The figures for Zistersdorf and Gaiselberg are probably reasonably accurate, but the outputs for the Kreuzfeld and Prinzendorf structures are dependent upon a number of factors not yet known to us. The total estimated output of 1¼ million tons for 1943 corresponds with the consensus of intelligence reports.

Air reconnaissance has shown that the large field at Prinzendorf is being actively developed and that the producing limits of the area have not yet been defined. It is considered probable that Flysch production was discovered shortly before the war and it is therefore considered logical to assume that the Prinzendorf field has been in process of development for some time. Upon the assumption that a number of drilling strings were one up to 1940, two during the next two years and fifteen during 1943, it is estimated that 136 producing wells have been obtained. Allowing for an initial production of about 300 tons per day falling rapidly to about 17 tons per day by the second month (viz., about 1.150 tons for the first month and 500 tons for the next two months) with the oldest wells producing only 3 tons per day, it is calculated that 1943 production will be about three-quarters of a million tons. It may be that production has not yet quite reached this level but, subject to further studies of the available evidence, it is proposed to adopt the figure of 750,000 tons for 1943.

The field is being developed rapidly, and further reconnaissance will be necessary at a reasonably short interval if the rate of development is to be assessed. Production from Prinzendorf is probably capable of attaining a figure of 1.4 million tons in 1944, in addition to which it is probable that there are prospects of new production in other parts of the Vienna Basin.

Czechoslovakia.

Production is estimated at 32,000 tons per annum.

Poland.

Figures of production of the fields in East and West Poland which have been received for a number of months, indicate an annual total production of 360,000 tons. In addition, the production of natural gasoline is believed to amount to approximately 40,000 tons, making a total figure of 400,000 tons. Although there may be ultimate prospects of increased production in Poland, the present trend is a declining one.

France.

It is likely that the small production at Pechelbronn has declined rather than increased. It is considered that the annual production, which was 80,000 tons in 1942, does not now exceed a rate of 70,000 tons.

Hungary.

It is believed that a continued policy of rapid exploitation would have resulted in the output for 1943 reaching a level of about 1¼ million tons. However, notwithstanding the fact that this quantity of oil might be available, as so many reports have been received denoting that production has been restricted and that the policy of the Hungarian Government has been to conserve oil resources, the annual rate of output is considered to be about 800,000 tons. If there should be a change of policy, an appreciably larger output should be possible.

Yugoslavia.

Total production is estimated at 50,000 tons.

Albania.

It is now known that the total production of Albania for the first eight months of 1943 was approximately 100,000 tons. The crude has been processed by simple distillation.

Roumania.

Evidence points to a declining trend and the total output for 1943 is estimated at 5,450,000 tons, of which 200,000 tons is natural gasoline. The attack upon the refineries on the 1st August may have had an adverse effect upon output although detailed information upon output during August and September is not yet available.

Shale Oil.

The estimate of Estonian shale oil is based on a reliable report that production was 40,000 tons for first six months and will be about 55,000 tons during the second half of 1943.

The estimate for French shale oil is likely to be approximately correct.

Synthetic Oil Production.

The estimated capacities of the various plants are detailed in Appendix B.

The figures are based upon the results of aerial reconnaissance and give the estimated rate of capacity of these plants for the year 1943.

The output of these plants will have been affected to a greater or lesser degree by adverse factors due to war conditions.

A study of the losses of production caused by direct damage that has been observed in photographs during 1943, indicates a loss of output from the four plants where damage has been observed equivalent to 20,500 tons.

To cover reductions in output due to direct damage, and also to transport, equipment, raw material and labour difficulties, the following factors have been applied:—

	<i>Per cent.</i>
(a) Plants in areas seriously dislocated by heavy attacks ...	15
(b) Plants in areas less seriously dislocated	2½
(c) Plants in areas where there have been no important attacks	Nil

Construction Progress.

During the past summer there has been a marked slowing down in the progress of the construction of new plants and of extensions to existing plants. The following shortages in equipment have been observed:—

High Pressure Reaction Vessels and Equipment:—

Blechhammer North, Brück, Magdeburg, Pölitz, Wesseling, Troglitz
Zeitz.

C.O. Conversion Plant—Brück, Blechhammer North.

Refinery Equipment—Blechhammer North.

Refinery Pipe Connections—Blechhammer North.

There has been a slowing up in general construction progress at the Blechhammer and Brück Plants, and apparently a cessation of building at Wesseling.

With reference to the shortage of high-pressure reaction vessels, the following table indicates the quantities available and required:—

	Number of stalls equipped between April 1942 and August 1943.	Number of stalls remaining without equipment for six months or more.
Blechhammer North ...	3	5
Blechhammer South ...	12 (short stalls)	14
Böhlen Rotha ... ..	...	...
Brück	8	4
Gelsenkirchen-Nordstern ...	...	...
Leuna ... ..	...	...
Lützkendorf Mühlen ...	...	...

	Number of stalls equipped between April 1942 and August 1943.	Number of stalls remaining without equipment for six months or more.
Magdeburg	1	1
Pölitz	4	2
Scholven-Buer	4	...
Troglitz Zeitz ... ..	...	4
Welheim Bottrop ... ..	...	...
Wesseling ... ..	...	2
Total equipped	32	Total not equipped 32

New Production Capacity.

In view of the delays in the construction of Brüx and the two Blechhammer plants, no accurate forecast can be made of the increases in production to be expected. It appears unlikely that the present total output capacity of the three plants will be increased by more than, say, 600,000 tons during the six months ending the 29th February next. As this increase would be progressive, the additional oil obtained would not be more than about 250,000 tons.

Utilisation of Hydro-Carbon Gases.

In Appendix C is tabulated a possible distribution of the hydro-carbon gases assumed to be available from the hydrogenation plants. This table shows a balance of 634,000 tons unaccounted for. It is believed that an appreciable proportion of this surplus is used in the manufacture of synthetic chemicals.

ANNEX III.

ESTIMATE OF CONSUMPTION BY CIVILIAN AND INDUSTRIAL USERS.

1st January–31st August, 1943.

The estimated oil consumption by non-military users during the eight months ended the 31st August, 1943, is detailed in Table I at the end of this Annex.

Greater Germany (1).

The following table shows the average monthly rate of consumption by civilian and industrial users for the period under review, compared with our estimates for the six months ended the 30th April, 1942:—

Monthly Average of Eight Months.

(In thousands of Metric Tons.)

	Motor Spirit, &c.	Gas Diesel.	Kero- sine.	Fuel Oil, &c.	Lub. Oil.	Total.	Average of six months ended 30th Apr. 1942.	1938*
(a) Lorries	28.25	58	...	...	...	86.25	114	153
(b) Motor cars and cycles	27	...	...	...	...	27	32	173
(c) Omnibuses ... ..	...	14	...	...	...	14	17	25
(d) Tractors ... ..	...	7	5	...	...	12	7	14
(e) Industrial Black Oil ... ..	...	12	...	24	...	36	36	102
(f) Bunkers—								
Danube Shipping ... ..	...	19	...	1	...	20	12.5	22
Inland Shipping ... ..	...	5	...	2	...	7	4	8
Mercantile Ships ... ..	...	3	...	2	...	5	25	73
(g) Gasoline for testing aero- engines	3	...	...	...	...	3	4	...
(h) Kerosine ... ..	...	...	8	...	...	8	10	9
(i) Lubricating Oils ... ..	...	...	...	...	50	50	50	50
(k) Asphalt ... ..	...	...	...	20	...	20	41	51
Total	58.25	118	13	49	50	288.25	352.5	680

* Monthly average for Whole Year.

(a) Lorries.

It is estimated that at the end of June 1943, in addition to the lorries operating on Producer Gas, the following lorries were in use:—

- (i) On Petrol: 19,000 at 3.5 tons p.a. = 66,500 t.p.a.
- (ii) On Diesel oil: 69,000 at 9 tons p.a. = 621,000 t.p.a.
- (iii) On Bottled Gas: 66,000 at 3 tons p.a. = 198,000 t.p.a.

The combined consumption of petrol and bottled gas is therefore 264,500 t.p.a. or 22,000 tons per month. To allow for the fact that the 40,000 conversions effected between January and June would not have been completed until the end of June, an addition of 50,000 tons is made, or an average for the 8 monthly period of 6,250 t.p.m. The 40,000 conversions are estimated to have all but completed the target figure of civilian conversions planned under the conversion scheme, and it is thought that comparatively few conversions will have been made since June (see Annex IV).

In addition to the Diesel oil used by the 69,000 lorries, 3 tons of Diesel oil per lorry is consumed by the 25,000 lorries which are estimated to have been converted to "Producer Gas cum Diesel oil." The total consumption of Diesel oil by lorries is thus 621,000 plus 75,000 tons, equivalent to 58,000 tons per month. (NOTE.—The Diesel oil now contains a high proportion of gasoline; for the purpose of these statistics the blend is regarded as Diesel oil.)

(b) Motor Cars and Cycles.

It is estimated that 190,000 and 42,000 cars are operating on petrol and bottled gas respectively. At an average annual consumption of 1.15 tons, the motor car consumption is equivalent to 22,200 tons per month. The petrol consumption of 800,000 motor cycles is estimated at 56,000 tons or, say, 4,800 tons per month, making the combined monthly figure for cars and cycles 27,000 tons.

(c) Omnibuses.

There is little evidence as to how far omnibus services have been affected by wartime conditions, but on the assumption that the total number now operating is 14,000, of which 2,000 are running on Town Gas, and 12,000 on Diesel oil, the liquid fuel consumption is estimated at 14,000 tons per month. About 20,000 omnibuses were in service before the war.

(d) Tractors.

It is assumed that of the 110,000 tractors, 40,000 are operated on Producer Gas and 70,000 on liquid fuels. At 2½ tons per tractor per year, the total liquid consumption would be 175,000 tons, or an average of about 14,000 tons per month. As very little agricultural work will have been done during the months of January and February, the monthly average during the first eight months is estimated at 12,000 tons, divided between Gas/Diesel oil and Kerosine in the ratio of 7 to 5.

(e) Industrial Black Oils.

In our May report consumption was estimated at the rate of 32,000 tons per month. However, it is now considered that the production of the necessary generating plant has not been sufficient to bring about the high rate of conversion of diesel-driven stationary engines which had been assumed. It is therefore now estimated that for the eight months under review consumption was at the rate of 36,000 tons per month. Of the 36,000 tons, 12,000 relates to Gas/Diesel oil and 24,000 tons to Fuel Oil.

(f) Bunkers.

It is estimated that the Danube Shipping is operated chiefly on Diesel oil as far as liquid fuels are concerned, and that consumption remains at the level of the estimate of 240,000 tons per year given in our May 1943 Report. A small increase has been allowed in our estimates of Inland Shipping consumption to cover some oil used in vessels converted to producer gas; in previous calculations this had not been allowed for.

As most of the fuel oil burning vessels of the Mercantile fleet have been either laid up or converted to coal burning, our monthly estimate has been reduced from 12,000 tons of fuel oil to 2,000 tons. The Diesel oil estimate remains at 3,000 tons per month.

(g) *Gasoline for Testing Aero-Engines.*

The estimate is unaltered at 3,000 tons per month.

(h) and (i) *Kerosine and Lubricating Oils.*

The average monthly consumption is thought to be at the level of our previous estimates, namely, 8,000 tons and 50,000 tons respectively. The figure of 50,000 tons includes regenerated oils.

(k) *Asphalt.*

The figure of 20,000 tons per annum compares with the current production estimates. No intelligence is available upon present consumption.

Czechoslovakia, Poland and Danzig (2 and 3).

Estimates are based upon the assumption that current consumption is at the same percentage of pre-war consumption as in Germany, namely, about 42 per cent.

Finland (4).

It was believed that in the spring of 1942 consumption had fallen to slightly less than 3,000 tons per month, most of which comprised motor fuel and kerosine and was only about 13 per cent. of pre-war figures. It is thought that consumption has remained at about this level.

Norway (5).

Reliable figures are available for the first part of this year. It is believed that motor fuel consumption is now rather lower than the average figure of about 2,500 tons per month for the first eight months of 1943, and the total consumption of all products is estimated at the rate of 125,000 tons per annum.

Denmark (6).

Motor fuel consumption has been drastically reduced during recent months and there have been further conversions to producer gas. Gasoline consumption was recently reported at 1,000 tons per month and kerosine at 800 tons per month. Consumption of these products is estimated for the eight months at an average monthly rate of 1,500 and 800 tons respectively. The consumption of black oils has recently been reported at about 3,000 tons per month, of which 1,800 tons are supplied to the fisheries. The foregoing estimates are confirmed to some extent by the reported sales in July of one of the principal oil companies.

Belgium (7).

The estimates are based upon detailed reports which are considered reliable.

Holland (8).

The estimate of 74,000 tons per annum for all products is based on the consumption figures for Denmark and Belgium. Consumption of gas/diesel oil by inland water transport is estimated at 21,000 tons per annum (compared with 15,000 tons in Belgium) to allow for greater inland waterway activity.

France (9).

Reliable figures for the month of June show imports of gasoline and gas oil of 10,800 and 5,200 tons respectively. The gasoline is blended, the proportions of gasoline, alcohol and benzol being 58 per cent., 29 per cent. and 13 per cent.; the monthly consumption of motor spirit at the June level is therefore estimated at 18,600 tons.

Imports of lubricants have been at the rate of 2,000 tons monthly, and a further 2,000 tons are obtained from anthracenic oil and resins.

It appears probable that imports are now on a lower scale than in June, but as they were higher in the early part of the year the June figures have been adopted as the average rate for the eight months.

The annual rate of 358,000 tons for all products is approximately double previous estimates, which had been largely based on the report of a director of a French oil company whose figures for imports of oil were taken to refer to all unblended products. It now appears that these figures covered motor spirit only.

Hungary (10).

Previous estimates of the consumption of oil products in Hungary are now believed to have been too low. The weight of intelligence implies that consumption is still at a comparatively high level. Current estimates indicate that the annual rate is to the order of 240,000 tons, including consumption in the territory acquired since 1939, and this compares with the 1938 figure of 264,000 tons for pre-war Hungary.

Italy and Albania (11).

Consumption in the eight months is estimated at the rate of 500,000 tons per annum. No calculations can yet be made of non-military consumption in Northern Italy after the 1st September.

Roumania (12).

Consumption has been estimated at the same level as shown in our May 1943 Report, namely, 1,875,000 tons per annum. A high demand for oil products is being maintained, and there have been no indications, notwithstanding a reduction in production, of any falling-off in domestic consumption or of tangible savings through the use of alternative fuels. Pending further information, consumption is therefore assumed to be at the same level as early this year.

Yugoslavia, Greece and Bulgaria (13, 14 and 15).

No detailed evidence is available upon the consumption of these countries, but it appears to be on a very low scale.

Estonia, Latvia, Lithuania (16, 17 and 18).

No statistics have been reported of the current consumption of these countries, and the estimates are consequently arbitrary.

Occupied Russia (19).

No information is available upon the non-military consumption of occupied Russia, and the figure of 225,000 tons is a guess.

TABLE I.—ESTIMATED OIL CONSUMPTION BY NON-MILITARY USERS DURING THE EIGHT MONTHS ENDED 31ST AUGUST, 1943.

(Figures at the Annual Rate in Thousands of Metric Tons.)

	Aviation Spirit.	Motor Spirit and Blenders.	Kerosine.	Gas Diesel Oil.	Fuel Oil and Asphalt.	Lubricating Oil.	Total A.	Average of 6 months ended 30th April, 1942.	1938 B.	Percentage A: B.							
1. Greater Germany	24	699	156	1,416	588	600	3,483	4,254	8,160	42.5							
2. Czechoslovakia	50	10	60	25	30	175	204	408	43.0							
3. German Poland and Danzig	48	36	36	12	24	156	168	372	42.0							
4. Finland	12	10	5	...	5	32	36	264	13.0							
5. Norway	31	8	76	3	7	125	146	576	22.0							
6. Denmark...	18	10	32	5	7	72	96	816	9.0							
7. Belgium	18	6	15	5	10	54	108	816	6.5							
8. Holland	18	13	21	10	12	74	178	1,620	4.5							
9. France	224	12	62	12	48	358	600	6,600	5.0							
10. Hungary	60	48	60	48	24	240	180	264	91.0							
11. Italy and Albania	5	120	95	100	110	70	500	996	3,420	14.0							
12. Roumania	140	305	150	1,250	30	1,875	1,886	2,004	93.0							
13. Yugoslavia	6	3	7	5	2	23	}	}	}							
14. Greece	13	8	13	12	6	52				192	}	}				
15. Bulgaria	6	3	5	3	2	19				}			}			
16. Estonia	3	4	2	9								?	50	18.0
17. Latvia	3	4	2	9								?	70	13.0
18. Lithuania	2	3	...	...	2	7	?	50	14.0					
19. Occupied Russia	40	45	65	50	25	225	?	±7,830	3.0							
Total	29	1,513	773	2,133	2,138	902	7,488*	8,984	33,944								

* Equivalent to 4,992,000 tons for eight months.

TABLE II.—ESTIMATE OF CONSUMPTION BY THE EUROPEAN AXIS ARMED FORCES, 1942 AND 1943.

(In thousands of Metric Tons.)

[26407]	Armies.		Naval.		Air Forces.		Totd Organisation.		Total.	
	1942.	1943.	1942.	1943.	1942.	1943.	1942.	1943.	1942.	1943.
January	390	382	162	155	169	163	40	40	761	740
February	330	315	135	156	160	151	40	40	665	665
March	360	366	129	156	167	171	40	40	696	733
April	317	248	173	156	170	169	40	40	700	613
May	338	256	205	156	152	166	40	40	735	618
June	365	295	205	156	157	169	40	40	767	660
July	417	360	205	156	152	180	40	40	814	736
August	430	380	205	156	154	158	40	40	829	734
Total eight months	2,947	2,602	1,419	1,247	1,281	1,330	320	320	5,967	5,499
September	384	380	205	121	148	157	40	40	777	698
October	372	...	205	...	142	...	40	...	759	...
November	358	...	165	...	153	...	40	...	716	...
December	374	...	165	...	153	...	40	...	732	...
Total for 1942	4,435	...	2,159	...	1,877	...	480	...	8,951	...

NOTES.

Armies.—The following factors have been allowed for:—

- (a) Wastage and evaporation. An addition of 7½ per cent. has been made to the consumption estimates. (Note: This allowance was not included in previous reports.)
- (b) To allow for increased consumption during cold weather on the Eastern Front, an excess consumption equivalent to 20 per cent. is assumed for the period mid-November to mid-April. This allowance has been tentatively put at 50 per cent. by those making the same study in Washington, and as compared with a factor of 25 per cent. that has been suggested by Canadian Army authorities; however, it is felt that 20 per cent. is a more conservative figure pending receipt of more accurate data. This factor has not been applied for the estimates January–April 1942 as the figures for these months were calculated on a slightly different basis.
- (c) The monthly figures are exclusive of the allowance for the estimated savings due to the use of producer gas totalling 35,000 tons in 1942 and 100,000 tons from January to August inclusive 1943 (see Appendix IV).

Naval.—The estimated consumption for September 1943 excludes any consumption by Italian naval units.

Air Forces.—Savings in motor fuel consumption by the conversion of ground vehicles to producer gas are assumed to follow the course of the Army figures; the saving begins to take effect in January and rises by equal steps to a figure of 15 per cent. in August. The total saving in the eight months is, however, only 36,000 tons, and no correction to the existing figures for the period January to August 1943 is made at present.

Totd Organisation.—Consumption by the Totd Organisation (including Aerodrome Constructors) has been put at the same figure as it was estimated to be in 1941. Operations have greatly expanded since that date but it is assumed that producer gas has obviated any increases in liquid fuel consumption. It is, however, quite possible that this estimate for oil consumption in 1943 may be too low.

ANNEX IV.

A PRELIMINARY STUDY OF THE EXTENT OF THE USAGE OF SUBSTITUTE FUELS
IN ENEMY EUROPE.

Germany has now had four years in which to carry out a programme for the conversion of petrol-driven vehicles to other fuels. While this programme cannot be considered to have reached completion, it is believed that the progress of substitution has reached its final stages and that such further savings in liquid fuels as may be made during the next few months are unlikely to amount to important quantities.

Conversions of Civilian Vehicles.

Bottled Gases and Town Gas.

Whereas possibilities exist for greater use being made of propane-butane, it is probable that the more extensive employment of low-pressure gases is limited by distribution difficulties. This also applies to town and sewer gases, the use of which is restricted to relatively few localities. Producer gas, therefore, remains the principal source of further economies, although, for a number of reasons, these are not considered likely to attain important dimensions.

Producer Gas.

The attached Table represents a tentative approximation of the position as at June 1943. It is based upon the assumption that, up to the end of 1942, practically all generator production, both in Germany and in the occupied countries working for Germany, has been destined for the conversion of non-military vehicles. Since then, such production as was not engaged on replacements has been increasingly diverted to supplying generators for the armed forces with a consequent slacking off, probably to quite small figures, of the production of generators for civilian purposes. It is therefore considered that there have not been any appreciable changes in the number of civilian vehicles converted since June 1943.

Some confirmation that the conversion of civilian vehicles is reaching a climax is afforded by a study of the various Decrees that have been made since the beginning of the war. These Decrees are summarised below.

The original Decree of 1939 was intended to bring about the conversion of all suitable vehicles that were permitted to be in operation. It was then found that the limited output of generators was not being utilised in such a way that the maximum savings could be effected. The Decrees of October 1940 and May 1941, by narrowing the scope of conversion, rectified this and virtually meant that a scale of priorities for conversion was fixed. The regulations of September 1942, issued by the Central Board of Generators, which had been set up in May of that year, further clarified the position, but slightly relaxed the prohibition on the conversion of private cars and delivery vans ordered in May 1941. The Decree of September 1943 cancels all previous restrictions on conversions to solid fuels.

The gradual relaxation of the restrictions can be taken as an indication that, as the conversion of high-priority vehicles was completed, lower-priority vehicles were included, and that this progress has finally resulted in there now remaining only the lowest-priority class, passenger cars without the red triangle and delivery vans, which can be converted.

Although these and other still unconverted vehicles may still be regarded as a theoretical further source of economies by conversion, it is believed that the possibilities in this direction are limited by four main considerations:—

- (i) The increase in the number of generator-operated vehicles has resulted in generator manufacturing capacity being diverted to a major extent to the provision of spares and replacements. The Germans have admitted that a useful life of only three years can be expected from a generator, and in view of the rapid progress of conversion over the last two years, manufacturing capacity is now being increasingly

- occupied by the demand for new generators for fitting to newly constructed vehicles, and for replacements for existing equipment.*
- (ii) Those categories of vehicles which, by nature of their purpose or conditions of service were most suitable for conversion, have now been converted. Any vehicles now remaining to be converted will be those for which there was some good reason for objection to conversion in the early stages of the programme.
 - (iii) The physical difficulties of constructing, fuelling and maintaining producer units are increasing. The problems of providing fuel supplies are probably greater than those connected with labour and materials. Facilities for providing wood and charcoal now appear to be fully extended; it is aimed to increase the use of special coal and coke fuels, although these, too, add their share to the burden upon transport.
 - (iv) The number of commercial vehicles now believed to be operating in enemy Europe is already insufficient to maintain efficient distribution. Any further impairment of the efficiency of these vehicles, such as would necessarily be involved in conversion, would only aggravate the problem and may therefore be considered impractical.

Conclusions regarding the Conversion of Civilian Vehicles.

1. In Germany all vehicles except those with the lowest conversion priority and those barred by safety, or other considerations and by the inherent disadvantages of producer gas, have by now been converted.

2. Supply and distribution facilities of the various gases used as substitute fuels are, temporarily at any rate, fully extended in meeting the demands of those vehicles already converted to use these fuels.

3. Consequently further civil conversions in Germany on any appreciable scale are unlikely, and the position is approaching stabilisation.

4. In the occupied countries of Western Europe, in which on an average two-thirds of all motor transport is already converted, the position, similarly, is nearly stabilised with saturation point not far away. In Eastern Europe, especially in Hungary and Roumania, there is scope for extensive conversions; in present circumstances, however, it is improbable that producer gas will be adopted in these countries to any important extent.

Conversion of Military Vehicles to Producer Gas.

Evidence from occupied countries, of which an increasing volume has been received during the past six months, justifies the conclusions (i) that a large proportion of the motor transport of the German Army in some of the occupied territories is now producer-gas driven; (ii) that conversions of German Army vehicles in those areas to producer-gas are still continuing. It is known that producer-gas vehicles are used by the army in Germany itself, but to what extent is still rather doubtful. Evidence of the use of producer-gas vehicles in Russia, although probably at some distance from the front-line, has also been received.

In view of the fragmentary nature of the evidence no reliable estimate of the total number of producer-gas vehicles in the German Army can be formed. A figure can only be arrived at on the basis of assumptions, largely of a theoretical character. These are as follows:—

- A. It is assumed that, owing to the practical disadvantages of this form of propulsion, producer-gas will not be employed in Divisions belonging to the Field Army, which may be required to take part in mobile warfare on any front at any time.
- B. For similar reasons, it will not be employed to any great extent in non-divisional units attached to and forming part of the Field Army.

* Some confirmation of the number of producer units required for the replacement of existing units is to be found in the following statistics. During the past twelve months the output of producer units is estimated to have been absorbed approximately as follows:—

For the conversion of Wehrmacht vehicles	...	...	...	...	80,000
Fitted to new vehicles	...	...	...	...	24,000
Replacements of civilian and military wastage	...	...	...	...	66,000

The total number of producer units now in use in German Europe to absorb these replacements is now approximately 440,000.

- C. Producer-gas can, however, be used by training divisions, coast defence divisions and other types of divisions to which a static rôle is allotted.
- D. It can also be used by non-divisional vehicles apart from those which operate with the Field Army. This will include most of the non-divisional vehicles in use in Germany and the occupied territories of Western Europe.

Conclusions regarding Conversion of Military Vehicles.

1. The total number of motor vehicles, other than motor-cycles, comprised in categories C and D is estimated at about 70,000, of which 60,000 (or approximately 85 per cent.) are likely to have been converted, or to be in process of being converted, with a further 10,000 which may be converted later.

2. The total number of vehicles in category B is considered to be nearly 150,000, of which it is improbable that more than 15,000 have been converted.

The likelihood of further conversions of vehicles in this category will be governed by the degree of stringency which prevails in the liquid fuel position as a whole.

3. It is therefore assumed that the total number of producer-gas vehicles in use by the German Army in September 1943 was about 75,000.

Conversion of German Air Force Vehicles to Producer Gas.

There is evidence that some vehicles of G.A.F. ground units are being converted to producer gas, but there is very little information as to the extent of such conversion. It is assumed, however, that conversion is proceeding at a rate comparable with that of the German army.

Summary of the more Important Decrees concerning Conversion to Substitute Fuels.

16th September, 1939.

All vehicles permitted to circulate after the 20th September, 1939, which will be marked with a red triangle, are to be converted after due notice from the Registration Authorities.

28th December, 1939.

Vehicles used for transporting explosives and inflammable liquids must not be converted.

13th June, 1940.

Diesel engines not suitable for conversion to producer gas may be converted to liquid gas provided they are garaged not more than 10 kms. from a liquid gas storage tank.

20th June, 1940.

Subsidies announced for conversion of petrol vehicles, semi-converted and wholly converted Diesel vehicles.

25th October, 1940.

The following vehicles are exempted from conversion:—

1. Vehicles which will remain in working order at least two years.
2. Liquid gas transport vehicles.
3. Laid-up vehicles and those not bearing the red triangle.
4. Vehicles when the cost of conversion would be greater than the cost of the vehicle.
5. Vehicles with tyres exceeding 9.75×20 .
6. A.R.P. vehicles.
7. Two and three-way tippers.

15th May, 1941.

No further permits to be granted for the conversion of private cars. Only commercial vehicles will be converted.

1st July, 1941.

All new lorries for civilian use are to be generator driven.

30th May, 1942.

Setting up of the Central Board for Generators.

22nd May, 1942.

The following are to be converted to producer gas:—

1. Diesel lorries of 2, or more, tons capacity.
2. All petrol lorries of 3, or more, tons capacity including those now operating on Treibgas.
3. Omnibuses.
4. Tractors over 25 h.p.
5. Stationary and marine engines, if suitable.

The following are to be converted to high pressure gas:—

- | | | |
|---|---|--|
| <ol style="list-style-type: none"> 1. Buses. 2. Tractors. | } | If garaged within 3 kms. of a filling station. |
|---|---|--|

The following are to be converted to low pressure gas:—

Certain buses.

The conversion of private cars and delivery vans is to be allowed only in exceptional cases. Military and other unsuitable vehicles are exempt from the conversion order.

1st November, 1942.

All commercial vehicles, except delivery vans, which can be converted to a substitute fuel without the assistance of outside workshops, may be converted on application to the authorities. Subsidies will be paid.

13th September, 1943.

All restrictions on conversion to solid fuels removed.

CIVILIAN MOTOR VEHICLES IN ENEMY EUROPE.

Estimated Position, Summer 1943.

Country.	Total number of vehicles in use operating on liquid or substitute fuels.			Vehicles divided according to fuel used.					
				Substitute Fuels.			Liquid Fuels.		
	Cars.	Commercial Vehicles.	Total.	Producer Gas.	Other Substitute Fuels.	Total on Substitute Fuels.	Petrol.	Diesel.	Total on Liquid Fuels.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	
Bulgaria	300	2,000	2,300	1,000	500	1,500	800	---	800
Belgium	8,000	23,700	31,700	12,200	9,500	21,700	9,650	350	10,000
Denmark	7,130	25,510	32,640	20,140	500	20,640	12,000	---	12,000
Finland and Baltic States	1,300	17,500	18,800	13,500	---	13,500	5,300	---	5,300
France	75,000	150,000	225,000	102,000	13,000	115,000	105,000	5,000	110,000
Germany	232,000	418,000	650,000	240,000(a)	120,000	360,000	221,000	69,000(b)	290,000
Greece	250	2,000	2,250	250	---	250	2,000	---	2,000
Holland	8,000	17,000	25,000	17,250	4,000	21,250	3,750	---	3,750
Hungary	2,500	5,000	7,500	600	400	1,000	6,500	---	6,500
Italy	30,000	50,000	80,000	10,000	25,000	35,000	42,500	2,500	45,000
Norway	5,000	27,000	32,000	14,000	2,000	16,000	15,500	500	16,000
Protectorate and Slovakia	8,000	17,000	25,000	6,600	---	6,600	16,000	2,400	18,400
Roumania	3,500	9,000	12,500	---	400	400	10,000	2,100	12,100
Yugoslavia	350	3,000	3,350	650	400	1,050	2,300	---	2,300

(a) Including 25,000 "Gas-Diesel" vehicles.

(b) Excluding 25,000 "Gas-Diesel" vehicles.

NOTES ON THE FOREGOING TABLE.

1. In general, all figures for the occupied countries in West and North-West Europe come from reliable sources, particularly those for Belgium, Norway and Denmark, though in these, as in the others, there may be inaccuracies due to the time lag in the reception of reports.

2. Figures of the total numbers of vehicles in operation which, on the whole, are open to more doubt than the total numbers operating on substitute fuels, are based on (a) the pre-war totals, (b) the availability of liquid fuel, (c) the progress in the use of substitute fuels, (d) the industrial activity of the country and (e) the effectiveness of requisitioning. They must therefore be regarded as approximations based mainly on a study of intelligence. The total figures for Belgium, Norway and Holland are taken directly from good intelligence reports, while the total for Germany is to some extent confirmed by a fairly reliable source.

3. The number of vehicles operating on substitute fuels other than producer gas in Germany is based on what is believed to be a good report that 100,000 vehicles are operating on Treibgas, 12,000 on high pressure gas and 2,000 on low pressure gas. A slight adjustment has been made to bring these figures up to date.

4. The number of producer-gas vehicles in Germany is based on three published figures. In October 1941 General von Schell stated that there were 150,000 producer-gas fuelled vehicles in occupied Europe. A year later a target figure of 250,000 such vehicles was announced and soon afterwards Hitler is reported to have demanded 100,000 additional conversions within a year. In addition, the calculation takes note of, and tallies with, estimated generator production based upon intelligence and upon two known figures of producer-gas vehicles in use in Germany at two known dates.

5. The Todt organisation relies to a large extent upon locally requisitioned civilian vehicles, which vehicles are included in the totals shown in the above table. Extensive use is also made of military vehicles drawn from the Military Reserve Motor Parks. It is consequently assumed that the use of producer-gas in the Todt organisation is broadly covered by the foregoing statistics for civil and military vehicles.

ANNEX V.

THE CRUDE OIL REFINING CAPACITY OF AXIS EUROPE.

The oil refineries in Europe may be divided into the following groups:—

- Group 1.—Roumania.
 „ 2.—The Central Europe group.
 „ 3.—Germany.
 „ 4.—The Low Countries.
 „ 5.—France.
 „ 6.—Italy.

The production of crude oil, and the capacity* available for processing it at the present time, are as follows:—

* Country.	Crude Output.	Refining Capacity.	Surplus Capacity.	Deficient Capacity.
		(In metric tons per annum.)		
Group 1— Roumania	5,450,000	5,894,000 (?)	444,000 (?)	...
Group 2— Austria	1,200,000	600,000	}	132,000
Czechoslovakia	32,000	700,000		
Poland	400,000	600,000		
Hungary	800,000	400,000		

* Some additional capacity might be made available by the use of the hydrogenation plants. The Pölitz plant, near Stettin, could handle crude oil at the rate of several hundred thousand tons per annum by diverting the coal tar currently believed to be handled there to some of the newer synthetic oil plants in South-East Germany, which are unlikely to be suitably equipped to handle mineral oil. Whereas the other large hydrogenation plants could possibly be adapted for the processing of crude oil, the conversion could only be undertaken with some difficulty and at the expense of the loss of output from the bituminous feed stocks now being processed in these plants.

Country.	Crude Output.	Refining Capacity. (In metric tons per annum.)	Surplus Capacity.	Deficient Capacity.
Group 3— Germany	866,000	2,500,000	1,600,000	...
Group 4— Low Countries ... ..	...	1,200,000*	1,200,000*	...
Group 5— France ... ..	...	3,265,000†	3,265,000	...
Group 6— Italy ... ..	...	1,550,000	1,550,000	...

* Part of this capacity may be unavailable through damage.

† Compared with 8,000,000 tons before the war.

Group 1.—Roumania.

An air reconnaissance carried out towards the end of October shows that the three refineries that were most seriously damaged by the attack on the 1st August were still out of action. Repairs to the other three refineries that were less badly damaged are well advanced and these plants may now be working at about 80 per cent. of their normal output. Upon this assumption there would theoretically be a surplus of refining capacity in Roumania at the present time of about 444,000 tons. However, judging by the urgency of the repairs that are being undertaken, this surplus is more apparent than real and it is probable that present capacity is insufficient for requirements.

Group 2.—The Central Europe Group.

This group comprises the refineries in Austria, Hungary, Czechoslovakia and Poland. Theoretically they form a self-contained block and the capacity in Poland and Czechoslovakia should be almost capable of absorbing the unrefinable surpluses from Austria and Hungary. The above table shows an unrefined surplus of 132,000 tons to be exported elsewhere.

Group 3.—Germany.

There is no evidence of serious damage to the Hamburg refineries which represent 1,130,000 tons of the surplus capacity of 1,600,000 tons in Germany.

The refineries at Hanover comprise the bulk of Germany's refining capacity other than at Hamburg or on the North Sea coast, and these are fully engaged in handling the production of the oil fields in that part of Germany.

Group 4.—The Low Countries.

This group contains 1,200,000 tons of unused refining capacity. More than half of this capacity is represented by the Shell Refinery at Rotterdam. As it is believed that this refinery is in a damaged condition, actual capacity at the present time may be less than this figure.

Group 5.—France.

Capacity in France has been reduced from a pre-war level of nearly 8 million tons to about 3 million tons by the destruction or dismantling of five of the most important refineries in the country. As a result, the remaining capacity is located either on the Atlantic coast or near Marseilles.

Group 6.—Italy.

The Italian refinery capacity at present available to the Axis amounts to approximately 1½ million tons.

Summary.

Whereas there is a surplus of crude oil refining capacity, the spare capacity is very inconveniently situated if circumstances should make it necessary for idle plants to be brought into use. Furthermore, many of the plants are not designed for the handling and processing of certain types of crude.

Any reduction of the refining capacity of Roumania or of the Central Europe group would entail the transport of crude oil to Italy, Northern Europe, or to the refineries situated on the French coast.

Approximately 75 per cent. of Roumanian crude is a waxy, viscous oil which becomes solid at temperatures below 68°F. The transport of this crude, either by barge or by rail-tank-car, during the winter months incurs numerous difficulties. Furthermore, if the Axis should be confronted with the problem of exporting from Roumania some 250,000 tons of crude per month or, say, some 17 oil trains per day, during the period that the Danube is frozen, a considerable task is involved.

A large proportion of the oil products processed in south-eastern Europe are consumed in that area and upon the Russian front. Consequently any important dislocation of the refineries now operating to capacity in Roumania, or of those in Central Europe, would necessitate a major reorganisation of oil distribution in enemy Europe. The transport problems involved would not only be very great but a severe check in the continuity of supplies would inevitably occur.

ANNEX VI.

THE EFFECT OF ITALY'S WITHDRAWAL FROM THE AXIS ON THE GERMAN OIL POSITION.

The consumption of oil by the Italians during the first eight months of 1943 is estimated as follows:—

	<i>Approx. rate in metric tons per annum.</i>
Civilian	500,000
Army	200,000
Navy	575,000
Air Force	200,000
Total	1,475,000

These requirements were met from the following sources:—

	<i>Tons.</i>	<i>Tons.</i>
(1) Imports from Roumania	900,000	
(2) Imports from Hungary	75,000	
(3) Imports from Germany	145,000	
		1,120,000
Crude oil from Albania	150,000	
Indigenous crude oil	10,000	
Alcohols	30,000	
Tar oils	100,000	
Benzol	10,000	
Regenerated lubricating oils, &c ...	20,000	
		320,000
		1,440,000

Assuming that no oil is being used for civilian and industrial purposes in the parts of Italy now occupied by German forces, the amount of oil available to Germany as a result of Italy's withdrawal will be equivalent to 1,120,000 tons per annum (items (1), (2), (3)). As, however, there will be some increase in the Germans' own oil requirements resulting directly from the Italian withdrawal, the net saving of oil to Germany is estimated at about 1 million tons per annum.

It is not known whether Germany is now taking all the Roumanian and Hungarian oil formerly acquired by Italy, but, pending further information, it is assumed that this is happening.

ANNEX VII.

ESTIMATED GERMAN OIL POSITION IF SUPPLIES OF ROUMANIAN AND HUNGARIAN OIL ARE LOST TO GERMANY.

Upon the hypothetical assumption that Germany was denied the oil supplies of Roumania and Hungary, there would result a net reduction of the oil available to Germany equivalent to about 2,125,000 tons per annum, or a reduction in

current consumption of 177,000 tons per month. The calculation upon which these figures are based is given in the table below.

This reduction would be equivalent to almost half of Germany's present army consumption.

The denial of this oil would also have a serious effect upon the distribution of petroleum to the German dispositions in South-Eastern and Eastern Europe, the gravity of the situation being dependent upon the suddenness with which it came about.

The deficiency caused on the overall supply position would seriously handicap Germany's powers of resistance.

Annual rate in thousands of metric tons.

Total Axis Production (Appendix A)	16,542
Less (crude oil in terms of finished products)—	
1. Albania, crude oil	90
2. Southern Italy (alcohol, &c.)	29
	119
	<u>16,423</u>
The following would also be lost to Germany:—	
1. Roumania, crude oil	5,135
2. Hungary, crude oil	736
Hungary, alcohol	15
3. Yugoslavia, crude oil	46
	<u>5,932</u>
(A) Leaving a Production level of	10,491
Total Axis Consumption 1st September, 1943—	
1. Civil	6,691
2. Armed Forces (at August level)—	
Armies	4,440
Naval	1,450
Air Forces	1,896
Total	480
	<u>8,266</u>
	<u>14,957</u>
Of which the following would be saved:—	
1. Civil—	
Roumania	1,875
Hungary	240
Yugoslavia	23
Greece	50
Bulgaria	19
	<u>2,207</u>
2. Military—	
Satellite armies in Balkans	132
	<u>2,339</u>
	<u>12,618</u>
(B) Consumption level	12,618
ANNUAL RATE OF DEFICIT (B-A)	<u>2,127</u>

APPENDIX "A."

OIL PRODUCTION IN AXIS EUROPEAN COUNTRIES.

Estimated annual rate of Production for 1943 in Thousands of Metric Tons.

The yields shown in terms of Finished Products are arbitrary as the breakdown is dependent on changing requirements.

[26407]

Source Groups. See Note A.	Raw Materials.	Aviation and Motor Petrol.	Kerosine.	Gas/Diesel Oil.	Aviation and Motor Lubri-cants.	Other Lubri-cants.	Fuel Oils, Wax, Asphalt, Pitch and Coke.	Loss and Refinery Fuel.	Total Finished Products.	Key.
1. Hanover—										
(a) Nienhagen. See Note B. ...	440	44	70.4	79.2	66 B	66	44 Asphalt	35.2	404.8	1(a)
(b) Eichlingen. See Note B. ...		12	19.2	21.6	18 B	18	35.2 Wax			1(b)
(c) Other fields. See Note B. ...		120					12 Asphalt			9.6	1(c)
2. Reitbrook. See Note B. ...	144	8.5		46	36 B	11.5	9.6 Wax	7	137	2
3. Heide ...	50	2.5		16	13	4	32 Asphalt	7	47.5	3
4. Rhine Valley ...	12	2	2	2	2	2	3 Wax	2.5	11	4
5. Small or unknown German fields ...	100	20	20	25	11	11	1 Asphalt	1	92	5
6. Austria ...	1,200	36		462	342	168	3 Asphalt	8	1,104	6
7. Czechoslovakia ...	32	2		12	10	5	2 Wax	96	30	7
8. Poland ...	400	88	84	108	34	34	1 Asphalt	2	368	8
9. France ...	70	4	14	14	6	8	12 Asphalt	5	65	9
10. Hungary. See Note C. ...	800 C	256	183	60	28	87	8 Wax	64	736	10
11. Yugoslavia ...	50	15	10	5		10	19 Asphalt	4	46	11
12. Italy. See Note D. ...	10 D	7	1	1			78 Wax	1	9	12
13. Albania. See Note D. ...	100 D	13		2		18	44 Asphalt	10	90	13
14. Roumania. See Note E. ...	5,450 E	1,460	720	650	45	65	6 Wax	315	5,135	14
15. Estonia: Shale ...	95	9.5	9.5				2,195 Asphalt		95	15
16. France: Shale ...	15	2	2				76		15	16
Total from Crude and Shale Oils ...	9,088	1,981.5	1,135.1	1,503.8	611	507.5	11	592.8	8,495.7	

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[Continued on next page.]

Source Groups. See Note A.	Raw Materials.	Aviation and Motor Petrol	Kerosine.	Gas/Diesel Oil.	Aviation and Motor Lubricants.	Other Lubricants.	Fuel Oils, Wax, Asphalt, Pitch and Coke.	Loss and Refinery Fuel.	Total Finished Products.	Key.
17. Synthetic Oils— Bergius Plants. See Note F.										
(a) Bit. Coal, H.T. Tar and Pitch. See Note G.	1,708	1,529	...	...	...	...	...	...	1,529 F	17(a)
(b) Brown Coal and Brown Coal Tar ...	1,822	848	...	725	333	..	...	...	1,906 F	17(b)
(c) Hydrocarbon Gases— (i) C ₃ . See Notes H. and L. ...	...	100 H	...	...	...	...	...	...	100	17(c)
(ii) C ₄ . See Notes K. and L. ...	...	450 K	...	...	...	...	...	...	450	17(c)
18. Synthetic Oil. Fischer Tropsch Plants. See Note F.	1,465	952	34	341	20	..	43	74	1,391 F	18
Total from Synthetic Oil Plants ...	...	3,879	34	1,066	353	...	43	...	5,376	
19. Substitute Fuels. See Note M.—										
(a) H.T. Tars ...	3,450	34.5	...	103.5	...	...	897	...	1,035	19(a)
(b) L.T. Tars										
(i) Bituminous Coal ...	200	10	...	10	...	...	100	...	120	19(b)
(ii) Brown Coal ...	500	75	...	190	...	...	170	...	435	19(b)
(c) Benzol ...	...	600	...	...	...	...	...	...	600	19(c)
(d) Ethanol. See Note N. ...	...	115 N	...	...	...	...	...	...	115	19(d)
20. Vegetable Oils as Lubricants. See Note P.	...	...	...	...	10 P	...	90	...	100	20
21. Lubricating Oil regenerated ...	...	...	...	...	...	...	240	...	240	21
22. France: Anthracene Oil, &c. ...	...	...	...	...	...	...	25	...	25	22
Total Substitutes and Miscellaneous ...	...	834.5	...	303.5	10	355	1,167	...	2,670	
Grand Total ..	...	6,695	1,169.1	2,873.3	974	862.5	3,967.8	...	16,541.7	

NOTES.

- A. "Raw Materials" represents total quantities put through refineries, including Casinghead Gasoline.
 B. The Motor and Aviation Lubricants may be considered as wholly Aviation grade.
 C. Whereas it is considered there is a possible production of 1½ million tons, output is at present restricted to these figures.
 D. First eight months only.
 E. Includes 200,000 tons of Casinghead Gasoline.
 F. After deduction from output capacities on account of adverse factors due to wartime conditions.

- G. Includes 400,000 tons from Leuna.
 H. Excludes 50,000 tons used for other purposes than motor fuel. (See Appendix C.)
 K. Excludes 18,000 tons used for synthetic rubber. (See Appendix C.)
 L. It is assumed that any surplus hydrocarbon gasses are not utilised. (See Appendix C.)
 M. Producer and Town Gas has been deducted from consumption estimates, therefore not shown in this table.
 N. There is a large potential production; this figure represents estimated consumption.
 P. 60,000 tons of low viscosity grade could be raised to Aviation quality by the Voltol and Elektrion processes.

APPENDIX B.

THE GERMAN SYNTHETIC OIL PLANTS.

Estimated Annual Rate of Capacity for 1943.

In Thousands of Metric Tons.

The Bergius Hydrogenation Plants.

Plant.	Raw materials used.					Total.
	Hard Coal.	Brown Coal.	Brown Coal Tar.	High Temperature Tar.	Pitch.	
1. Blechhammer North ...	...	...	50	...	...	50
2. Blechhammer South ...	...	...	100	...	...	100
3. Böhlen Rotha ...	...	...	300	...	...	300
4. Brüx ...	...	...	400	...	...	400
5. Gelsenkirchen-Nordstern (A)	400	...	...	...	...	400
6. Leuna (B) ...	...	400	200	...	...	600
7. Lützendorf Mueheln ...	...	...	125*	...	...	125
8. Magdeburg (B) ...	...	...	250	...	...	250
9. Pölitz (B) ...	200	...	...	400	...	600
10. Scholven-Buer (A) ...	350	...	...	...	...	350
11. Troglitz Zeitz ...	...	...	320	...	...	320
12. Welheim-Bottrop (A) ...	...	...	...	...	100	100
13. Wesseling (B) ...	...	100	...	...	...	100
Total ...	950	500	1,745	400	100	3,695
Less allowances for adverse factors due to war-time conditions. (See note below) ...	117	12	11	10	15	165
Total ...	833	488	1,734	390	85	3,530

* Gas Oil.

THE FISCHER TROPSCH PLANTS.

Plant.	Capacity.
1. Deschowitz ...	110
2. Dortmund (A) ...	90
3. Holten Sterkrade (A) ...	125
4. Homberg (A) ...	190
5. Kamen Dortmund (A) ...	100
6. Lützkendorf Mueheln ...	150
7. Rauxel (A) ...	100
8. Ruhland-Schwarzheide ...	350
9. Wanne Eickel (A) ...	130
Total ...	1,345
Less allowances for adverse factors due to war-time conditions (See note below.) ...	110
Add allowance for unknown plants ...	1,235
Total ...	230
Total ...	1,465

NOTE.—Plants marked (A) and (B) are assumed to operate at 15 per cent. and 2½ per cent. below estimated capacity. The total of these allowances amounts to 275,000 tons.

APPENDIX C.

ESTIMATED PRODUCTION AND CONSUMPTION OF HYDROCARBON GASES FROM THE SYNTHETIC OIL PLANTS IN GERMAN-CONTROLLED EUROPE IF RUN TO AVIATION AND MOTOR SPIRIT, DIESEL OIL AND LUBRICANTS.

Annual Rate for 1943.

In thousands of metric tons.

<i>Hydrocarbon Gases.</i>	C_1	C_2	C_3	C_4
A.—Production	617	345	520	732
B.—Consumption accounted for—				
1. C_2 in Motor Spirit	...	...		160
2. C_2 in Aviation Spirit	...	...		15
3. C_2 converted to octanes	...	...		125
4. Bottled gas as substitute fuel	...	...	100	150
5. Bottled gas for other uses	...	...	50	...
6. Synthetic Rubber (Hüls)	...	...	...	18
			— 150	— 468
Balance unaccounted for	617*	345*	370	264

* Probably consumed as fuel gas.

APPENDIX "D."

DATA SHEET FOR THE GERMAN BERGIUS HYDROGENATION PLANTS.

Plant.	Blechhammer N.	Blechhammer S.	Böhlen Rotha.	Brüx.	Leuna.	Magdeburg.	Gelsenkirchen-Nordstern.	Pölitz.	Scholven-Buer.	Welheim Bottrop.	Wesseling.	Troglitz Zeitz.
C.I.U. Report Nos.	D. 183, D. 321	D. 184, D. 322	D. 77, D. 245	D. 100, D. 287	D. 92, D. 196	D. 93, D. 276A	D. 240, D. 312	D. 13, 57, 82, D. 277A, D. 295	D. 86, D. 316	D. 118	D. 275, D. 308	D. 94, D. 203
Series No. (earliest and latest sorties only shown)	C. 463, Oct. 1942 E. 44, Aug. 1943	C. 463, Oct. 1942 E. 44, Aug. 1943	A. 435, Mar. 1943 E. 248, Sept. 1943	A. 733, May 1942 D. 463, Apr. 1943	B. 277, July 1941 D. 139, Feb. 1943	B. 130, Apr. 1941 F/287, Oct. 1943	HAA/010, Mar. 1940 E/179, Sept. 1943	H/814, Apr. 1941 N/946, Oct. 1943	B. 17, Dec. 1940 E/179, Sept. 1943	B. 75, Mar. 1941 H/133, Sept. 1943	HAA/013, Apr. 1940 D/972, Aug. 1943	A/603, Ap. 1942 D/834, July 1943
Raw Materials	Tar, bituminous coal, &c.	Fluid feedstocks	Brown coal tar (750 tons per day)	Brown coal tar	Brown coal and brown coal tar	Brown coal tar	Bit. coal + (tar ?)	Bit. coal and fluid feedstocks	Bit. coal and tar	Pott Broche and Pitch	Brown coal	Brown coal tar
Boilers...	Area ... 810 x 164	400 x 279 (ext. to 770 ft.) 6 (+ 6 u/c)	440 x 370 380 x 90	775 x 120 ft. 3 x 4 (or x ?)	...	No boiler house	400 x 180 ft.	360 x 98 ft. 170 x 98 ft.	253 x 106 ft.	2 x ?	395 x 127 ft. 2 x 6	400 x 110
L.T.C. Retorts	Number ... 3 x 6 + ? 10 (6 complete) + 10 u/c	None	24	40 (x 40 u/c)	None	None	None	None	None	None	None	None
Water Gas Generators	18 (9 complete)	18 (+ 10)	3 Winklers	5 Winklers (+ 2 ?)	Winklers	3 Winklers	20 Generators; and Winklers Not normal type	29	(1) 4, (2) 8	...	10	3 Winklers
H ₂ S Removal Towers	Number ... 20 Diam. ... 15 ft.	31 (14 in use) 16 ft.	16 17 ft.	10 42	...	5 40 ft.	...	24 16 ft.	(1) 10 20 ft. and oxide boxes	Deep cooling	...	5: 40 ft.
C.O. Conversion	Number ... Incomplete	?	7 12 ft. ?	10 8 ft.	...	7 10 ft.	18 12 ft. ?	28 ? 6 ft.	(1) ? (2) 7: 14 ft.	...	14: 5 ft.	6: 13 ft.
Compressors	Area ... 460 x 110	670 x 107 | 500 x 107 14 compr. | 9 compr.	340 x 77	300 x 120 ft. 7 compr.	...	282 x 87 ft.	600 x 87	565 x 72 ft.	(1) 409 x 220 (2) 429 x 66	230 x 72	680 x 100	262 x 79
CO ₂ Removal Towers	Number ... 14 Diam. ... 10 ft. diam.	15 (+ 5 ?) 8 ft. diam.	?	14 8 ft.	...	?	12 19	15 11	?	...	12 8	8 6
CO Removal	Number ... 4 Diam. ... 3 ft. diam.	...	?	6 ? ft.	...	?	5 ft. ...	8 ft. 7	?	...	6 ft. 8	4 ft. 4
Formate Recovery	Number ... 3 Diam. ... 17 ft. diam.	...	?	3 11 ft.	...	?	3 13 ft.	3 ft. 10 ft.	?	...	3 ft. 12 ft.	2 ins. 12 ft.
Paste Preparation	Present	Not normal type None	None	None	Present	None	Present	Present	Present	None	Present	None
Stalls	Number ... 8 Area ... 40 x 26	90 6 | and 1 27 x 20 | quadruple 20 12 | set	7 30 x 25 ft.	12 (+ 4 u/c and quadruple set) 42 x 24	18 36 x 30	6 40 x 25	10: 12 | 2: 44 x 30 | 53 x 15	16 + 2 u/c 32 x 15 ft.	(1) 6: 37 x 27 (2) 2: 54 x 20 2: 40 x 20 6: 34 x 15	2: 45 x 28 1: 55 x 28 1: 62 x 25 1: 40 x 25	4: 85 x 25 4: 60 x 25	6 (+ 4 u/c. 30 x 21 ft. and quadruple set)
Injection	Area ... 430 x 100 300 x 80 615 x 104 u/c	670 x 80 270 x 80 123 x 85 325 x 80 (for quadruple set)	320 x 60 110 x 60	390 x 90 410 x 90 323 x 90	300 x 60 300 x 60 345 x 60	360 x 60	380 x 72 328 x 50	525 x 71 472 x 63 420 x 63 350 x 63	(1) 410 x 63 (2) 220 x 70 and 230 x 48	325 x 65 209 x 61	460 x 79 384 x 94	233 x 85 157 x 85 290 x 92 u/c
Sludge Ovens	Number ... 4	...	...	...	13	...	6	6	4	...	3	...
Stills	Area ... 38 x 24 (approx.) Number ... 9	None 17	None 4	None 14 + 12 u/c	40 x 30 4	None 4	47 x 37 ft. 9	29 x 24 ft.	41 x 27 | 31 + 24 (1) 3 (2) ?	None 1	40 x 25 5 + ?	None 5 + ?
Tank Farm	Total Capacity Tons 69,600 + 74,600	37,000 +	Tar ... 12,500 Primary ... 12,000 Finished ... 25,400 49,900	148,000 +	49,000	31,500	87,000	261,100	?	?	98,800	91,400
Liquid Air	Area ...	...	?	515 x 160	...	200 x 92	325 x 57	136 x 50	...	...	...	275 x 112
Estimated Capacity (t.p.a.)	(500,000 ult.)	(750,000 ult.)	300,000	(750,000-1,250,000 ult. ?)	600,000	300,000	400,000	600,000	350,000	100,000	200,000	320,000
Comments	Reduced to 50,000 tons in 1943 from later photographs. Sludge ovens indicate 150,000/175,000 from coal. CO ₂ removal would fit the ultimate petrol, but other features, water gas generators, H ₂ S removal, compression house indicates smaller quantity.	Reduced to 100,000 tons in 1943 from later photographs. CO ₂ removal on small side, but other features, especially compressors, indicate high output.	...	Small compression plant and CO ₂ conversion	...	This should be reduced to 250,000 as only one of the new stalls is in operation	Sludge ovens and water gas generators correspond to 270,000/300,000	...	Gas produced in large part from coke oven gas (Linde)	...	Several unusual features: large size stalls, large compression plant, small CO ₂ removal stock, probably not a normal petrol plant	Very small CO ₂ removal, otherwise very similar to Magdeburg and Böhlen.