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RELATIONSHIP BETWEEN COAL AND BLACK OILS IN THE WEST EUROPEAN FUEL MARKET

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Prepared by the
Industry Division,
Economic Commission for Europe

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Prefatory Note

The present study, which is the first of a series dealing with the relationship between coal and other forms of energy in the European fuel market, has been prepared by the Industry Division of the Secretariat of the Economic Commission for Europe with the advice and assistance of the Research and Planning Division. Provisional versions were submitted to the Coal Committee of the Economic Commission for Europe in December 1953 and March 1954 and a special ad hoc meeting of experts was held in August 1954. The comments made at the meetings and those received in writing have been carefully considered when preparing the final version.

The Secretariat wishes to express its appreciation of the assistance and co-operation of the numerous experts who gave freely of their time and knowledge.

The Secretariat accepts entire responsibility for the facts presented and the conclusions drawn.

August, 1954.

Geneva.

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The following symbols have been used throughout the present study:

.. = figure not available

\- = nil or negligible quantity

* = Secretariat estimate

INTRODUCTION

During the last two years the coal situation in continental western Europe has been characterized by selling difficulties unknown since before the last war, except for a relatively short period in 1950. In addition, pit-head stocks have accumulated and in a number of cases there has even been some unemployment. Such stocks are of particular concern to continental western Europe, where at the end of 1953 they stood at 10,464,000 tons, which was two-and-a-half times the corresponding figure for 1950 and more than four times that of 1951.(1) Furthermore, coke stocks at cokeries, at the end of 1953, amounted to 5,512,000 tons or more than five times the tonnage held in 1950; these also weighed heavily on the fuel market.(2)

This situation has developed in western Europe during a period when the production and consumption of petroleum products which compete with coal have continued to increase, and this has prompted the question whether the European coal industry is faced with the prospect of the same steady attrition of its markets as has been seen in the United States.

The Secretariat, therefore, has produced this study in an attempt to throw light on the probable developments in the relationship between coal and petroleum products which might compete with it in the west European fuel market.

The body of the study contains four analytical chapters, while Chapter V summarizes the findings in the previous chapters and sets out the conclusions.

Chapter I deals with past trends in the relationship between coal and oil and particularly trends in the development of consumption;

Chapter II gives a picture of the probable developments, up to 1963, in the general energy situation;

Chapter III indicates technical aspects of the use of coal and of heating oils;

Chapter IV outlines the probable supply position of black oils in the future; and

Chapter V sets out the conclusions reached.

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(1) For details see Table 13.

(2) Difficulties of this nature have not so far arisen in the United Kingdom. Sporadic unemployment, mainly in Belgium and France, has until now been limited to occasional stoppages of one or two days but may increase if the pit-head stock position does not improve.

Further, an Appendix has been added which is divided into three sections, dealing with the supply of coal, the supply of oil, and government policies towards oil.

Since the issue under consideration is essentially one of the market relationships between the two forms of energy, and the implications arising from this, and since similar market relationships do not exist in economies with centrally owned and co-ordinated systems of fuel supply, the study has been confined to west European countries.

CHAPTER I

PAST TRENDS IN THE RELATIONSHIP BETWEEN COAL AND OIL

Between the 1930's and the present time black oils[1] have, as is shown by Table 1, substantially increased their share in western Europe's energy consumption. In 1937 western Europe consumed 498 million tons of coal and lignite, and only 13 million tons of black oils in coal equivalent. By 1953, total energy consumption had risen by 22.5 per cent, but consumption of coal and lignite by only 6 per cent. The major part of the increased supply of energy was provided by hydro-electricity and liquid fuels; consumption of black oils rose by 340 per cent and that of hydro-electricity by 86 per cent. The share of black oils in total energy consumption rose from 2 to 8 per cent, and that of liquid fuels of all kinds from 6.5 to 12 per cent.

Some observers regard this as the first stage in the same general trend as in the United States, where in 1951 black oils supplied some 15 per cent of total energy requirements and where the market for coal has certainly been sharply limited by the competition from oil. Black oils have, however, not been the sole competitor in the United States, as, between 1945 and 1951, the share of natural gas went up from 13 to 20.6 per cent; the result of this was that the share of coal in the market decreased from 50.8 to 39 per cent.

(1) The term black oils used throughout the study covers gas/diesel oils (corresponding approximately to US fuels Nos. 2, 3 and 4) and fuel oils (corresponding approximately to US fuels Nos. 5 and 6).

Table 1

Energy Consumption in Western Europe[a] in 1937, 1950, 1952 and 1953

(in millions of metric tons, coal equivalent)[b]

Primary forms of energy	1937	1950	1952	1953
Coal and lignite [c]	498	488	534	528
Inland consumption of liquid fuels	38	68	82	91
of which black oils	13	40	50	57
white oils	25	28	32	34
Natural gas	0	1	3	4
Hydro-electricity	44	66	80	82
Total	580	623	699	705
Bunkers (liquid fuels)	9*	11	16	17*
Grand total	589	634	715	722

Sources: Coal and lignite - Quarterly Bulletin of Coal Statistics, ECE, Geneva.
Fuel-oil - World Energy Supplies in Selected Years, 1929 to 1950, New York, September 1952.
- Energy Resources of the World, United States Government Printing Office, Washington, D.C., 1949.
- Third Report on Co-ordination of Oil Refinery Expansion in the OEEC countries, Paris, June 1953.
- OEEC Statistical Bulletin, General Statistics, Paris, November 1953.

(a) Austria, Belgium, Denmark, Finland, France and Saar, Western Zones of Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom and Yugoslavia.

(b) The various fuels have been converted into coal equivalent, according to their calorific values, as follows:

1 ton of coke = 0.9 tons of coal
1 ton of Austrian, Czechoslovak, French or Hungarian lignite = 0.6 tons of coal
1 ton of German or Polish lignite = 0.3 tons of coal
1 ton of other lignite = 0.33 tons of coal
1 ton of refined oil products = 1.5 tons of coal
1,000 m^3 of natural gas = 1.33 tons of coal

Hydro-electricity has been valued at the amount of coal that would have been needed to produce it in thermal-power stations, viz:

1,000 kWh = 0.7 tons of coal in 1937,
and 1,000 kWh = 0.6 tons of coal from 1950 to 1953.

(c) Variations of stocks at pit-head have been taken into account. Foreign bunkers have been excluded in the case of the United Kingdom but included in that of other countries. The consumption of fuel wood, peat etc., and coal and coke exported have been excluded. Energy used for the conversion of coal and lignite into gas, coke, briquettes or electricity has been included.

Natural gas resources in western Europe, according to present knowledge, are relatively unimportant but large-scale prospecting is in progress. The main question is the trend in production of black oils.

In considering this trend, it is, however, difficult to distinguish between three major factors: first, the influence of government policies; secondly, the general energy shortage with which western Europe has been afflicted throughout most of the post-war period; and third, comparative economic and technical advantages. The changes which have so far taken place in the pattern of energy consumption in western Europe result from the combined effect of all these factors, and it is not easy to make any trustworthy estimate of the strength of any one factor separately.

Differences as between countries in Black Oil Consumption

The varying importance of the three factors is reflected in the considerable differences, as between countries, in the share of black oils in the energy market, excluding hydro-electricity, natural gas and wood shown in Table 2.

Table 2

Inland Consumption of Solid Fuels and Black Oils in Western Europe and the United States, 1953

(in millions of metric tons)

Country	Solid fuels (coal equivalent)	Gas and diesel oil (real weight)	Fuel oil (real weight)	Black oils as percentage of columns A + B + C
	A	B	C	
Greece	0.3*	0.29	0.51	80
Norway	1.3	0.60	0.71	60
Sweden	6.0	1.82	2.08	49
Italy and Free Territory of Trieste	10.4	1.26	3.82	42
Portugal	1.1	0.17	0.30	39
Switzerland	2.2	0.70	0.15	37
Denmark	6.0	0.36	0.82	23
Ireland	1.9	0.10	0.24	21
Finland	2.0	0.19*	0.14	20
Austria	6.0	0.19	0.56	16
Spain	11.7*	0.44(a)	0.90(a)	15
France and the Saar	72.8	2.13	5.16	13
Netherlands	16.8	0.70	0.96	13
Turkey	4.0	0.28	0.06	11
Belgium and Luxembourg	28.9	0.91	0.80	8
Yugoslavia	4.8	0.14(b)	0.15(b)	8
United Kingdom	212.9	3.04	3.87	5
W. Zones of Germany	138.1	2.19	0.82	3
Total western Europe(c)	527.8	15.51	22.15	10
United States	402.8	68.0	84.8	36

Sources: Quarterly Bulletin of Coal Statistics for Europe, ECE, Geneva.
OEEC Statistical Bulletins, General Statistics, Paris, May 1954.
Petroleum Press Service, London, May 1954.

Note: For the conversion into coal equivalent, the coefficients given in Table 1 have been used. The percentage of black oils refers to total black oils, in coal equivalent, expressed as a percentage of black oils and solid fuels together, also in coal equivalent.

(a) Including bunkers to all vessels in the Spanish Peninsula but excluding deliveries to ocean-going vessels at Canary Island Ports.
(b) Apparent consumption.
(c) Including Malta, Gibraltar and the Channel Islands.

The high percentages shown for Sweden and for most other countries with little indigenous solid or liquid fuel, are mainly a reflection of the fact that first, where transport charges are involved, oil can support long hauls because of a higher calorie-per-ton ratio; and secondly, that during the post-war period of coal shortage it has been the coal-importing countries which have suffered most from high prices and irregularities in supplies.

Swedish experience, as an example, showed that between 1950 and 1953 oil supplies were more dependable than coal. Between these years, Swedish consumption of fuel oil rose significantly (and would undoubtedly have risen even more had not total energy consumption in 1953 been depressed first by the unusually mild winter, and secondly by a certain falling-off in industrial production) but Sweden was able to secure these increased supplies of oil in spite of the fact that, prior to 1951, about 40 per cent of her fuel oil requirements had been supplied from Iran.

Conversely, the low figure of oil consumption for the United Kingdom reflects its position as a net exporter of coal as well as the low price of coal there in comparison with other West European countries. West German figures are even lower and reflect a long-standing policy of deliberately reducing the dependence of the economy on imported fuel.

Government policies in most countries have often discriminated against oil in favour of coal. Fiscal convenience has led to the imposition of relatively heavy indirect taxes on petroleum products, most frequently and most heavily on while oils but also, in a number of instances, on black oils. These have not, in most cases, been explicitly intended to favour coal but it is significant, nevertheless, that they have been most commonly resorted to in coal-producing countries, although in countries without significant indigenous coal supplies effort has been directed towards the development of hydro-electricity and natural gas at the expense of both coal and oil. While the incidence of tax on coal is uneven as between different west European countries, it is nowhere very marked, the maximum being 12 per cent of the c.i.f. price against a corresponding figure of almost 35 per cent for fuel oil. As in the case of petroleum, it is fiscal rather than protectionist reasons which have led to the development of coal taxes.

A number of governments, inspired by a variety of considerations, have encouraged the development of indigenous refining industries and, in some cases, domestic production of crude oil. The extent of this action has varied considerably from country to country, and details will be found in Section III of the Appendix. In most cases, however, import duties of one kind or another have been involved, so that the effect has been, as with indirect taxation, to raise the price of oil and therefore to discriminate in favour of coal.

Differences in Black Oil Consumption as between Consuming Sectors

Examination - on the basis of somewhat incomplete statistics - of changes in the proportions of different types of fuel used in consuming sectors, suggests that the modest degree of substitution which has so far taken place has been on a wide front, and that with one striking exception, penetration has not been especially deep in any one sector. The exception is shipping, which has almost entirely gone over to oil.

Shipping

According to Lloyd's Register, oil-fuelled steamships and motorships together accounted for just under 81 per cent of the total gross tonnage of the world's merchant fleet in 1950, as compared with 39 per cent in 1929. The change-over to oil in the world merchant fleet may be virtually complete in another ten years if the steady trend of the last thirty years continues. Of the 1,074 ships launched in the world in 1952, with a gross tonnage of 4.4 million tons, only forty-eight small vessels totalling 54,000 tons, or 1 per cent of the total, were designed to use coal.

As a result of this transition, oil bunkers are increasingly superseding coal bunkers and western Europe has lost its predominance as a bunkering area, since oil bunkering can now take place in most ports of the world. However, as shown by Table 3, western Europe has retained its share of the declining volume of coal bunkers, of which the United Kingdom supplies the major part.

Table 3

Coal and Oil[a] Overseas Bunkers, Europe and Rest of the World

1929 to 1950

(in millions of metric tons)

Area and Year		Coal	%	Oil	%	Total[b]
Europe	1929	29.3	88.5	2.5	11.5	33.1
	1937	24.7	70.0	7.1	30.0	35.4
	1950	6.9	40.5	6.7	59.5	17.0
(of which United Kingdom, 1950)		(4.0)	47.5	(2.9)	52.5	(8.4)
Rest of the World	1929	17.4	67.5	5.6	32.5	25.8
	1937	17.8	45.5	14.3	54.5	39.3
	1950	4.2	7.1	36.5	92.9	59.0
Total	1929	46.7	92.0	8.1	8.0	50.9
	1937	42.5	57.0	21.4	43.0	74.6
	1950	11.1	14.5	43.2	85.5	75.9

Source: World Energy Supplies in Selected Years, 1929 to 1950, New York, 1952.

(a) Including petrol for aircraft for which separate statistics are not in most cases available. The tonnages involved do not appear to be significant.

(b) Coal equivalent: 1 ton of oil equals 1.5 tons of coal.

Railways

Steam locomotives in western Europe have not switched over to oil to the same extent as ships. During the shortage of coal immediately after the war, some oil-burning steam locomotives were introduced but, except in France, little oil is now being used for this prupose. In France, annual oil consumption in steam locomotives is of the order of 1 million tons, as against 6 million tons of coal[1].

No considerable increase is likely to take place in the use of oil for steam locomotives but an increasing use of diesel-electric and electric engines is to be expected. As is shown by Table 4, it is striking that no countries in west Europe, except for the United Kingdom, contemplate putting new steam locomotives into service.

(1) International Railway Statistics, Bern, 1951.

Table 4

Number of Locomotives in Western Europe, 1951, 1952 and 1953

Position at the end of Each Year

Country	Year	Total stock				New locomotives brought into service and on order in 1952							
		Steam	Diesel electric	Electric	Rail motor vehicles	Steam		Diesel		Electric		Rail motor-cars	
						In service	On order	In service	On order	In service	On order	In service	On order
Austria	1951	1,813	16	258	67								
	1952	1,677	18	275	75	-	-	2	18	13	26	8	..
	1953	..	..	..	..								
Belgium	1951	2,559	5	26	192								
	1952	2,176	5	26	204	-	-	-	12	-	50	8	71
	1953	2,057	5	26	..								
Denmark	1951	775	51	-	399								
	1952	726	57	-	456	-	-	-	4	-	-	33	41
	1953	..	..	-	..								
Finland	1951	817	5	-	20								
	1952	812	2	-	37	..	..	..	..	..	..	..	..
	1953	..	..	..	..								
France	1951	11,032	144	936	1,164								
	1952	10,100	160	964	1,220	23	-	12	99	28	197	93	253
	1953	..	..	..	..								
Western Zones of Germany	1951	14,430	140	463	513								
	1952	10,913	146	462	648	8	-	4	-	2	22	54	34
	1953	10,071	148	466	..								
Greece	1951	251	6	6	72								
	1952	..	..	..	..	..	..	..	..	..	..	..	..
	1953	..	..	..	..								
Ireland	1951	632	7	-	32								
	1952	624	7	-	39	-	-	-	12	-	-	8	56
	1953	..	..	..	..								
Italy	1951	3,810	57	1,559	1,185								
	1952	3,707	60	1,562	1,251	-	-	-	-	5	12	34	13
	1953	3,651	60	1,561	..								
Luxembourg	1951	132	-	-	20								
	1952	131	-	-	20	-	-	-	-	-	-	-	-
	1953	131	5	-	..								
Netherlands	1951	669	212	52	345								
	1952	588	220	91	375	-	-	10	151	40	4	42	100
	1953	419	239	94	418								
Norway	1951	481	1	81	142								
	1952	479	1	91	151	-	-	-	-	10	28	11	47
	1953	459	1	96	..								

- continued overleaf -

Table 4 (Continued)

Country	Year	Total stock				New locomotives brought into service and on order in 1952							
						Steam		Diesel		Electric		Rail motor-cars	
		Steam	Diesel electric	Electric	Rail motor vehicles	In service	On order	In service	On order	In service	On order	In service	On order
Sweden	1951	..	..	..	..								
	1952	..	..	..	..	..	..	..	..	..	..	..	..
	1953	..	..	..	..								
Switzerland	1951	268	3	646	86								
	1952	263	3	651	87	-	-	-	4	5	1	1	37
	1953	235	3	..	..								
Trieste (British and United States Zones only)	1951	44	-	24	9								
	1952	44	-	24	11	..	..	..	..	..	..	..	..
	1953	44	-	24	..								
Turkey	1951	888	-	-	18								
	1952	882	-	-	33	3	-	-	-	-	-	14	21
	1953	..	..	..	..								
United Kingdom	1951	19,103	148	33	2,147								
	1952	18,859	211	58	2,170	211	209	63	66	25	13	38	..
	1953	18,553	258	64	..								

Sources : - Annual Bulletin of Transport Statistics, ECE, Geneva, 1952.
- Quarterly Bulletin of European Inland Transport Statistics, Geneva, ECE, Vol. V, No.4, 1953.

The main part of railway traction in Europe, owing to the high density of traffic, will probably be better suited to electrification, which may indirectly, where hydro-electricity is not available, save part of this market for coal. Diesel locomotives have hitherto mainly been used for shunting but in some countries they are now used for long-distance haulage and this trend, though not yet of great importance, will probably continue at a higher rate. A similar trend has taken place in the United States, and it is reported that since 1950 a number of the major railway companies have completed the dieselization of their railways.

Iron and Steel Industry

In the iron and steel industry the use of oil has been confined to the open-hearth steel-making process, and in the British iron and steel industry this is having a pronounced effect on the demand for raw coal, i.e., excluding coal needed for coke ovens which represents 75 per cent of its requirement. The use of oil is progressing but has not yet advanced very far.

Table 5

Oil Consumption in the Steel Industry in Western Europe and the United States, 1952 and 1953

(in thousands of metric tons)

Country or region	Oil consumed		Crude steel produced	
	1952	1953	1952	1953
Belgium	82(a)	77	5,084	4,533
France	180	..	10,867	10,000
Saar	-	-	2,823	2,684
Western Zones of Germany	-	-	15,806	15,420
Italy and Free Territory of Trieste	270	335	3,535	3,498
Luxembourg	9	8	3,002	2,659
Sweden	284(b)	283(b)	1,689	1,786
United Kingdom	910	1,333	16,681	17,892
Other west European countries	200*	200*	3,869	4,360
Total western Europe	1,935	..	63,356	62,832
United States	8,008	..	84,521	101,253

Sources:- Quarterly Bulletin of Steel Statistics for Europe, ECE Geneva, June 1954.
- Annual Statistical Report 1952, and Monthly Report, December 1953, American Iron and Steel Institute, New York.

(a) 1951.
(b) Including iron foundries attached to steel works.

Thermal Power Production

The electric power industry, the largest coal-consuming industry, also uses very little oil except in coal-importing countries.

Table 6 shows the 1952 consumption of solid fuels and oil in public power plants in those European countries for which statistics are available; United States figures are also shown:

Table 6

Consumption of Solid Fuels and Oil in Public Power Plants in Selected Countries in 1952

(in thousands of metric tons)

Country	Solid fuels	Oil
Austria	337	63
Belgium	4,048	25
Denmark	1,302	179
France	4,555	552
Western Zones of Germany	16,186	60
Netherlands	3,173	198
Portugal	79	3
Turkey	307	25
United Kingdom	35,900	68
United States	97,105	9,610

Source : Information submitted by the country concerned.

Residual fuel oil and coal are strong competitors in United States power plants in cases where oil can reach the plants by water, since modern electric power plants can burn coal as efficiently as oil. The use of coal in United States power plants is steadily increasing. These plants as a whole have greatly increased their efficiency in the use of coal even since 1937 when they required 0.650 kg of coal to generate one kilowatt hour, whereas in December 1953 the amount was 0.470 kg only, a rate of consumption only attained in individual modern plants in western Europe.

Gas Industry

The gas industry of western Europe is still dependent upon coal or coke as raw material for the overwhelming part of manufactured gas production. However, the recent expansion of petroleum refining in western Europe, which has resulted in the placing of increasing quantities of black oils on the fuel market, coming at a time when in certain countries there is a progressive reduction in the availability of gas coal, has encouraged those responsible in the gas industry to look for raw materials other than coal or coke.

Black oils have, up to the present time, been primarily used for the carburation of water gas, but the development of these processes, which was linked with that of water gas production, has never grown to such an extent as to endanger the manufacture of gas from coal by classical methods.

Recently, however, an event, which passed almost unnoticed, took place in various countries when processes were developed and industrial plants were set up for the direct processing of fuel oils into town gas. Although the volume of gas produced by such plants is still relatively insignificant, there is little doubt that the coming years will witness an increasing development of such plants in regions where fuel oil is available at cheap prices. It has been estimated that the consumption of fuel oils by such plants might, in each of certain European countries, amount within two or three years to over 100,000 tons per annum.

This will imply some shift from coal to oil and, although the full economic potentiality of these processes is not yet fully known and there are still some minor technical problems to be overcome, there is no doubt that the possibility of producing a gas at about 10,000 kcal/m^3, which makes it particularly suitable for long-distance transportation, together with some yield in tar oils will prove of interest.

In the face of such developments, coal has a possible answer in integral gasification which should enable the gas manufacturer to free himself from the fluctuations of the coke market.

Fuel oil has also, in the last few years, entered another sector of the gas industry. It has become a regular practice in coke-oven operation, when it is desired to increase the yield in gas calories by 8 to 10 per cent, to incorporate

into the coal feed from 1.5 to 2 per cent in weight of heavy fuel oil. In this process fuel oil is complementary rather than competitive with coal as it gives a greater flexibility in the manufacture of coal gas. An increase in the use of oil for this purpose can only arise from increased activity in the coke-oven industry.

Household Consumption

Information on the use of oil in the domestic sector is scanty. The available statistics are shown in Table 7, (the percentages are calculated on a basis which excludes fuel wood).

Table 7

Oil Consumption[(a)] in the Domestic Sector in Selected Countries

(in thousands of metric tons and percentage of total heat consumed)

Countries	Pre-war		1950		1951		1952		1953	
	Tons	%	Tons	%	Tons	%	Tons	%	Tons	%
Belgium	70	1.2	230	3.9	225	3.7	294	4.8	326	..
France	250	2.0	612	5.4	716	5.2	818	5.8	959	..
W.Zones of Germany	160	1.0	77	0.6	129	0.8	160	0.9	..	..
Sweden	130	8.0[(b)]	600	..	775	..	950	..	1,100	41[(b)]
United Kingdom	245	2.7	365	2.4	425	2.5	465	2.7	480	2.5

Sources: Information made available to the Secretariat by countries in connexion with the Secretariat Study on Fuel Consumption Trends in the Domestic Sector now in hand.

(a) In addition, an increasing amount of liquefied petroleum gas is being used in the domestic sector everywhere; in France, for instance, 364,000 tons of such gases were used in 1952 against 119,000 tons in 1938.

(b) Including only solid mineral fuels and oil.

The figures given in Table 7 should be treated merely as giving the order of magnitude; a strict comparison between countries is not possible because of the difference in coverage. It emerges from the table, however, that Sweden is an outstanding example of a rapidly growing oil consumer, one of the reasons being that central heating predominates in that country, and most existing boilers are easily converted to burn oil.

Although information is not available for Denmark and Norway, the development of oil consumption is probably similar, although in the latter country heating by electricity plays an important rôle.

On the west European continent, where heating by individual stoves predominates, available information indicates that in Belgium and France oil burning is increasing, though the level is so far still very low.

In the United Kingdom, oil consumption is of little importance and will probably remain so as long as the open fire continues to be the main method of home-heating.

Conclusions

The past gives little guide as to either the severity of the competition which coal may expect from oil in the future, or the fields in which that competition might be most felt. What it suggests is that the field of competition between the two fuels is extremely wide and indeed almost co-terminous with the general energy field. This view finds support from the experience of the United States where comparison of five widely different important fuel-using industries(1) over a large number of States (in which the price relationship between coal and oil varied considerably) suggested that there was no systematic tendency for one industry to rely more on one fuel than any other, and that the main explanation of inter-industry and inter-State differences in the proportions of the two fuels was to be found in variations in relative prices.

It is now necessary to try to form some impression of the probable balance of supply and demand in the general energy field over the next ten years or so, and to examine the suitability of oil and other forms of energy for different purposes, within the general energy field, from a technical standpoint and other aspects.

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(1) Beverages, paper, structural clay products, oils and fats, and machinery.

CHAPTER II

SUPPLY AND DEMAND IN THE GENERAL ENERGY MARKET IN 1963

The development of the relationship between coal and black oils closely depends on the general balance of energy supply and demand, which cannot be forecast with any confidence. The following exercise should be regarded, therefore, rather as an attempt to work out the implications of a number of assumptions than to predict probable trends over the next ten years. Nevertheless, unless the assumptions are far-fetched, it is possible in this way to ascertain at least the range of probability.

The Demand for Energy

As already indicated, it is in the general energy market (i.e. excluding road, air and increasingly sea transport) that coal and black oils compete. Consideration of the probable development of demand can, therefore, be confined to this field. The probable development of demand by the transport industry is of interest only in so far as this helps to determine the supply of black oils which will enter the general energy market.

In 1953, apparent consumption in the general energy market in western Europe amounted to some 660 million tons in coal equivalent.(1) Assuming a 2.5 per cent average annual increase in gross national production and a gradual reduction in the energy consumed per unit of national output of 1.25 per cent per year, the apparent consumption in the general west European energy market could be expected to reach 750 million tons by 1963, an increase of 13.5 per cent over the 1953 figure. A 2.5 per cent annual increase in gross national production is, for many countries, inferior to, and for a few others only slightly above, that achieved during the period 1938 to 1951 - a period

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(1) See Table 1, where total energy consumption is shown in coal equivalent as 705 million tons; of this, white oils amounted to 34 million tons and about 10.4 million tons of gas/diesel oil are estimated to have been used as motor fuel. This table and the subsequent calculations exclude wood fuel from consideration, although in some countries it is used to a considerable extent, particularly in the domestic sector. It is, however, not possible to find reliable statistics on wood fuel consumption, which is known to be decreasing steadily not only in relative importance, but also in absolute amount.

affected by the war years.[1] A reduction in the energy consumed per unit of national output of 1.25 per cent per year is slightly more than that recorded in the United States and in the United Kingdom during the period 1913 to 1947.[2]

The adoption of assumptions leading to a lower energy demand than 750 million tons coal equivalent by 1963 would seem unreasonable and, indeed, if generally adopted as planning assumptions, might carry with them a risk of fuel shortage - the effects of which on national production would be most damaging.

The Supply of Energy

The sources of supply to meet this demand are indigenous coal, lignite, crude oils, hydro-electricity, natural gas, and imported solid and liquid fuels. It is assumed that supplies of energy from nuclear fission will not be sufficiently developed during this period to play any significant role.

In this section an attempt has been made to arrive, by deduction, at the requirements in hard coal in 1963 on the basis of certain assumptions, mainly concerning oil. Before outlining these the following assumptions for other sources of energy must be stated:

Hydro-electricity: Continued development may be expected but, as much of the economic water power has already been tapped, it will continue at a lower rate than in recent decades. Output of hydro-electricity in 1953 was equivalent to 82 million tons of coal and it is estimated to increase by 1963 to the equivalent of about 111 million tons of coal equivalent.[3]

Natural gas: Production of natural gas amounted to about 4 million tons coal equivalent in 1953; a further increase of 10 million tons is anticipated by 1963,[3] mainly in Italy and in France.

Imported solid fuels: Imports of coal into western Europe in 1953 amounted to 15 million tons. It has been assumed that the total figure will remain unchanged in 1963.

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(1) "Economic Survey of Europe since the War", ECE, Geneva, 1953, page 66, column 3.

(2) "Economic Survey of Europe in 1951", ECE, Geneva, 1952, page 152.

(3) Secretariat estimate.

Oil: Because of its preponderant contribution to total revenue, the sale of oil to the inland transport market is the factor which most influences refinery throughput. If, therefore, western Europe were a closed economy, the supply of black oils entering the general energy market would depend on the demand from transport for white and black oils and the pattern of refinery output.

It has been assumed that the demand from inland transport - essentially for motor vehicles - will increase by not less than 40 per cent and perhaps as much as 70 per cent during the period under review. Although this represents a faster rate of increase than that shown in Table 1 for the period 1937 to 1953, in fact the annual rate of increase in recent years has been about 7 per cent. When considering these figures it should be remembered that between 1940 and 1950 war-time influences were predominant and that only recently has the situation begun to develop normally. It has further been assumed that the rate of increase in demand will be the same for motor spirit and gas/diesel oil.

For bunkers, on the other hand, no significant increase in demand has been envisaged. Bunkering of black oils in western Europe has developed as follows (in millions of metric tons):

1937	-	6.0
1950	-	7.5
1952	-	11.0
1953	-	11.3

The steep increase since 1950 reflects the closing-down of the Abadan refinery. As it seems likely that this refinery will come on stream again in the near future, and as the Aden refinery has recently started production, it has been assumed that, at most, oil bunkering in western Europe will not exceed 12 million tons.(1)

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(1) Table 20 shows the refinery position in the Middle East and elsewhere.

As stated elsewhere in this study, the proportion of black and white products obtainable from a given quantity of crude oil can be varied greatly. It may, however, be assumed that the proportion of black oils produced will not be higher than in 1952 and probably no higher than that planned for 1954. Indeed, as indicated in Chapter IV, it may well be lower. In view of these uncertainties, calculations have been made on two bases: the output pattern of 1952 and that planned for 1954, as derived from the figures regarding product output proportions shown in Table 18, i.e.:

	1954 (planned) %	1952 (actual) %
Motor spirit	26.7	23.5
Gas/diesel oil	20.3	20.5
Fuel oil	38.7	44.5

These calculations are brought together in Table 8, from which it is apparent that even on the most favourable assumptions the quantities of black oil available on the general energy market will, in 1963, not amount to more than 55 million tons, or 82.5 million coal tons equivalent, and they might, under certain circumstances, be no more than 30 million tons, or 45 million coal tons equivalent.(1)

Table 8

Availabilities of Black Oils in 1963
Based on the Indicated Assumptions

(in millions of metric tons)

	Estimated availabilities for 1963 based on:			
	1954 planned output pattern		1952 actual output pattern	
	A	B	A	B
Output of white oils	23.5	28.5	23.5	28.5
(yield in % see previous paragraph)	(26.7)	(26.7)	(23.5)	(23.5)
Output of black oils	52	63	65	79
(yield in % see previous paragraph)	(59)	(59)	(65)	(65)
Deduct:				
Used in inland transport	10	12	10	12
Shipping bunkers	12	12	12	12
Available for general energy market	30	39	43	55

A = 40 per cent increase in demand for white oils.

B = 70 per cent increase in demand for white oils.

(1) It is assumed that, as regards oil, no major change in fiscal policies will take place.

Europe's external trade in oil products should, of course, be taken into account, but at this point the difficulty of making reasonable assumptions becomes almost insuperable. The position may be affected by trade in either direction in either black oils or white oils. It has been assumed arbitrarily, therefore, that in 1963, as in 1952, the net effect of all such operations will be to add to Europe's supplies a tonnage of black oils equal to 15 per cent of her total refinery output of such oils. Adopting the same assumptions as in Table 8, this would mean additions of respectively 8, 9.5, 10 and 12 million tons to the black oils available for the general energy market and the total figures would then become 38, 48.5, 53 and 67 million tons. In coal equivalent, this would correspond to 57, 73, 80 and 100 million tons, figures appearing under item 5 of Table 9 which sets out the demand for home-produced solid fuels.

Table 9

Demand for Coal in 1963 based on Indicated Assumptions

(in millions of metric tons coal equivalent)

	Estimated demand for 1963 based on:				1953
	1954 planned output pattern		1952 actual output pattern		
	A	B	A	B	
1. Demand for general energy	750	750	750	750	660
2. Supply of hydro-electricity	111	111	111	111	82
3. Supply of natural gas	14	14	14	14	4
4. Imported coals	15	15	15	15	15
5. Supply of black oils	57	73	80	100	46
Total, Items 2 to 5	197	213	220	240	147
6. Requirements of coal	553	537	530	510	513
7. - of which, brown coal	40	40	40	40	33*
8. Requirements of indigenous hard coal	513	497	490	470	480

A = 40 per cent increase in demand for white oils.

B = 70 per cent increase in demand for white oils.

It will be seen that, on the basis of the assumed maximum availability of black oils, a similar rate of coal production by west European countries to that attained in 1953 would suffice, but some reduction of coal imports might be contemplated; at the other end of the range of possibility there would be a need for an increase of 40 million tons in coal production.

The possibility of expanding brown coal production is somewhat limited, and it seems unlikely that it could be raised to more than 40 million tons hard coal equivalent from the 33 million tons produced in 1953. This implies an increased need for hard coal production ranging from nil (with a possible reduction in the tonnage of coals imported) to 33 million tons (with imports of coals remaining unchanged) or an increase of 6.9 per cent during the period 1953 to 1963, or slightly less than 0.6 per cent per year.

In the absence of an economic recession, the figures given in Table 9, as demand for general energy, might represent a minimum. If a different set of assumptions, based on an increase of 3.5 per cent per annum in gross national production and a reduction in the energy consumed per unit of national output of 1 per cent per annum were adopted, figures which are not unreasonable, the demand for general energy in 1963 would then be increased from 750 to 840 million tons coal equivalent and the last three items of Table 9 would read as follows:

	Estimated demand for 1963 based on:				1953
	1954 planned output pattern		1952 actual output pattern		
	A	B	A	B	
6. Requirements of coal	643	627	620	600	513
7. - of which, brown coal	40	40	40	40	33
8. Requirements of hard coal	603	587	580	560	480

It is improbable that hydro-electricity or natural gas production could be expanded much beyond the figures shown in Table 9, and it will therefore be seen

that on the basis of these assumptions, hard coal output would have to increase during the period 1953 to 1963 by between a minimum of 80 million tons and a maximum of 123 million tons. This would be equivalent to a rate of growth of 16.6 per cent or 25.7 per cent during the period, or an annual increase of 1.6 and 2.3 per cent, unless the energy requirements are to be met from other sources such as a still higher figure of imported coal or an increased use of black oils.

Conclusion

While it is impossible to say which set of assumptions should be adopted, it would be reasonable to assume that over the next ten years the position in the general energy market would possibly be balanced and at times might be one of shortage. In any event, it would appear that a radical contraction of the market for hard coal is improbable.

CHAPTER III

TECHNICAL ASPECTS OF THE USE OF COAL AND HEATING OILS

The comparative technical characteristics of coal (and of some of its products) and of oil as heat-producing agents, are examined in this chapter. Attention is then directed to the present extent and possible future growth of installations permitting rapid switches from coal to fuel oil.

1. Properties of Coal and Heating Oils as Fuels

When trying to evaluate the most important properties of coal and heating oils as fuel, it is necessary to distinguish between heavy and light fuel oil as well as between the main forms in which coal is used. The following summarizes in general terms the properties - not all equally important - of those fuels.

A high heat content per ton is seldom important as such, except in the case of sea-going shipping although it has, of course, an influence on transport costs; for areas remote from producing centres, oil will be cheaper than coal because it weighs less per calorie and is less bulky to transport(1).

The high flame-temperature which oil possesses is important, not only because it enables high furnace temperatures to be reached, but also because it improves heat transfer in cases where the areas heated are limited. This is further improved by the luminous flame of oil. The use of oil instead of coal often increases the capacity of an industrial furnace by a reduction of heating-up time. This property, however, may become a disadvantage when the furnace is constructed of material which cannot stand up to high temperatures, or to sharp temperature gradients, as is the case with off- and on-flame regulation. This is the main reason why conversions from coal to oil have not given entire satisfaction in every case. The high temperature may also be a mixed blessing when long flames are

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(1) In times of fuel scarcity in some cases shipments of low-grade coal were made to importing countries over distances where normally only good coal could support the transport costs; although as soon as the extreme shortage was over this practice was discontinued, there is no doubt that it inspired some conversion to oil.

required, as in glass-furnaces, for although it is possible to obtain a long flame with an oil-burner, this may lead to incomplete combustion of oil with all its consequent inconveniences.

Efficiency is mainly important when the cost of the fuel is a matter of primary importance and there are many cases where it is not. It should be borne in mind, when coal and oil prices are compared, that coal is usually less efficiently used, not always because this is technically unavoidable, but also because coal-burning equipment is generally older. It is clear that the combustion of a liquid that can be atomized or vaporized is easier than that of a solid; also the loss of combustible material in the ashes should be taken into account.

The solid state of coal is also the cause of its slow response to changes in heat requirements. Oil burners, however, are not always of such type as to be able to work at much reduced rates and if large variations in heat production are needed, many small burners will have to be used instead of a smaller number of large ones, which results in more complicated installations.

Oil has the important advantage of consistency of quality, made possible by the flexibility of modern refineries and guaranteed in many countries by precise standards.

However, it should not be supposed that oil standards leave nothing to be desired. The sulphur content, for instance, which may range from 2 to 7 per cent is often high enough to give rise to a serious corrosive effect, particularly when associated with the presence of vanadium or sodium. This problem may become more serious in the future, as there is a tendency to use more crudes with a high sulphur content and, for residual fuel oil in particular, no de-sulphurizing process has yet reached the commercial stage. It may well be that coal has an advantage in this respect. Frequent laboratory tests at the refinery stage and large storage facilities at central distributing centres should obviate errors in blending, but further down the distribution line it may occur that when two sediment-free oils are mixed, sludge formation may result in the clogging of filters, preheaters and burners. High sulphur oils are more liable to behave in this way.

Such strict specifications as are given for oil do not exist for coal, and, although they have their counterparts in many contracts for the supply of industrial

coal, the consumer has all too often to content himself with indifferent qualities. In oil, this occurs far less, because the various products may be "tailored" at will. As with oil, even detailed specifications of coal qualities may fail as a guarantee against stoking troubles; a given ash-content limit, for instance, is not a safeguard against the clinkering of low-melting ash. Coal would appear to have an advantage over oil in this question of guarantees, as a defect in the quality of coal is easily detected by a simple combustion test, while the deteriorating effect on equipment through the use of defective oils may be discovered at a much later stage and may be far more costly to remedy.

Piped gas (town gas, coke-oven gas, enriched water-gas) is, on the other hand, usually delivered within very narrow specifications and should be less liable to cause unpleasant surprises.

2. Different Uses of Coal and Oil in their Technical Aspects

Domestic stoves

Oil-stoves are now appearing on the market, although portable kerosine stoves, which provide temporary heating in the same way as portable electric fires, have been in use for some time. An oil-stove provides the modest fuel consumer with many advantages: cleanliness, the absence of ash, ease in lighting, extinguishing and regulating. Distillate heating oil should be used for this purpose, but in some countries, such as France, this is not available cheaply in a sufficiently pure state, owing to the fact that it can also be used in diesel engines, which makes it subject to taxation.

The chimney draught has to be fairly strong, and the flue ducts and joints absolutely tight, to secure efficient and safe operation.

Radiant heat is, as yet, not commonly provided by oil-stoves, which is a disadvantage in comparison with many coal stoves; however, equipment is being developed in this field.

Improvements in the distribution of coal and in the construction of coal stoves may give the latter many of the advantages of the oil stove. Easy lighting can be achieved by using gas (e.g. "gas pokers"); improved construction of the grid and ash pans can do away with much of the ash nuisance; and, for easier handling, in some countries coal is sold in paper bags. But it is the uneven and

often unsuitable qualities of the solid fuel itself which are often the main drawback to the efficient use of coal stoves.

Some stoves can take a large range of solid fuels - in large or small lumps; with a high or a low percentage of volatile matter; with much or little ash of high or low sintering points. But in most cases a rather narrow range of qualities is required for efficient operation, and too frequently the stove manufacturer has not taken the trouble to ascertain what those qualities are, and whether such coals are, or will, remain generally available. The oil-stove manufacturers are better placed in this respect because they know what oils are currently produced; also, if oil stoves increased in importance, there no doubt would be the same intensive co-operation between oil companies and stove manufacturers as there now is with producers of industrial oil-burning equipment.

Whatever the properties of the stove or the qualities of the fuels, solid fuels will remain more difficult to burn efficiently than oil. Either frequent additions of small quantities of coal are needed, or, after the addition of a large quantity, the stove has to be carefully brought back to a normal rate of burning. Special constructions exist, where a bunker of coal sufficient for a whole day is slowly emptied into a limited combustion zone, at a speed regulated by the draught allowed. However, to operate this type of refined equipment efficiently, the range of fuels required is narrow.

In most coal-producing countries domestic heating by stove predominates and stove manufacturers in those countries have only recently started to manufacture oil-burning appliances. This has prevented a large-scale switch from coal to oil in the domestic sector so far. There is no doubt, however, that in future, competition between oil and coal in this consuming sector will become keener.

Central-heating boilers

In large central-heating plants the boilers resemble industrial boilers, which are discussed below.

Small boilers using coal or coke have to be attended to once or twice a day for the removal of ash and the addition of new fuel. They may be easily equipped with a simple thermostatic control, adequate for regulating the combustion at least

over the period between two attendances.

Oil appliances are usually entirely automatic, but are dependent on an uninterrupted supply of electricity and tend to be dearer to install, especially small-capacity boilers. Light fuel oil has the important advantage of easy and clean storage in under-ground tanks, from which it can be pumped through small pipes. In built-up areas, the storage of oil may be difficult and comparatively expensive, because of fire-prevention regulations. Storage in unburied tanks, which is the practice in the United States, would certainly reduce the cost of small heating plants.

Industrial boilers

Many of the larger industrial boilers can be fired with pulverized coal. Although there are still problems of erosion of refractories and tubing, and of fly-ash, especially in urban areas, this "fluidized" state of the otherwise solid fuel gives it many of the advantages of oil, if not as much flexibility. A lower fuel cost in most instances more than balances increased investment costs.

Because of the high flame-temperature of oil, the construction of the boiler has to be more carefully planned than in the case of coal, and the flames should not be allowed to come into direct contact with the tubing.

For all fuels, but particularly in the case of oil-firing on account of the high flame-temperature, heat transfer through the tubing should never be allowed to fall below normal; otherwise over-heating ensues, and in order to prevent this, better feed-water treatment and scale removal are necessary. If it is not water but viscous liquids that have to be heated, care has to be taken that their circulation is rapid and even.

The oils used for industrial boilers usually consist of residual oils from straight-run distillation or thermal cracking, possibly blended with lighter oil to reduce the viscosity. They may contain appreciable amounts of ash, the composition of which rather than the percentage is important, as for instance, the presence of certain constituents such as vanadium and sodium, particularly in combination with sulphur, may damage refractory linings and even super-heater tubes. Additives to the oil or protective coatings on the tubes do not seem to provide a

satisfactory solution; careful design of the boiler and fire-box, avoiding direct contact of the flames with the tubes is necessary, as well as provision for cleaning and easy access to danger spots.

Specifications related to ash, salt and metallic contents, sometimes laid down by equipment manufacturers, cannot always be met, and in this respect oil consumers may sometimes have to face the same problems as coal consumers.

Easy handling and storage, which count heavily in favour of oil in the case of domestic consumption, matter less for industrial boilers of a certain minimum size. The fuel oil to be handled may in itself be a source of slight complication, as for instance in the case of residual fuel oil, where the high viscosity may make it necessary to pre-heat it before it is pumped from barges or rail tankers into storage tanks and from these into the burners. Storage tanks containing larger amounts of oils may be subject to stringent fire-prevention measures, and have to be located away from the rest of the plant. The storage of big tonnages of coal requires only sufficient free room and handling by means of modern equipment and conveyor calls for little manpower. Coal-handling equipment, however, costs more than oil storage and handling equipment, unless large stocks are habitually held, as a proportionate capacity of tanks, pumps, heaters and so on, must be provided, whilst bigger coal stocks only require more space and can be handled by the normal equipment.

While in domestic use oil has the great advantage of being easy to regulate automatically, in industrial boiler installations the automatic regulation of burners may become quite complicated. To secure the best operation of the burner, the viscosity of the oil has to be regulated by means of accurate pre-heating. At all firing rates the flames should be equally spread, to prevent damage to refractories and heated surfaces, and the air required for combustion should be just sufficient to prevent smoke. As, in any case in most countries, the presence of at least one attendant is required in every boiler-room, there is some advantage in making him do the work instead of using a complicated and expensive system of control mechanisms. This fact reduces the difference in labour cost between mechanical coal-stoking and oil-firing.

The slow starting of coal boilers can be overcome either by installing an

auxiliary oil burner or by adding an oil-base-igniter to the coal[1].

Industrial furnaces

The variety of charges heated in industrial furnaces is so great that it is impossible to review the relative advantages or disadvantages of coal and oil in each case.

If the charge can be heated in a rough and ready way coal is usually cheapest and generally adequate, higher temperatures can be reached by using coke. If the heat has to be applied gradually, and accurately distributed over the charge, so as to prevent thermal stress, piped gas, manufactured or natural gas is best, but if the temperature of a large charge has to be carefully controlled producer gas is the solution.

Unfortunately the coal industry has not always been able to produce the required quantities of suitable coals for existing gas producers. Newly constructed gas producers suitable for using a wider range of coal qualities have been put on the market but only to a limited extent so far. Producer-gas users represented a fairly high proportion of the post-war converts to oil-firing, particularly in non-integrated steelworks and glass-works.

Oil has a definite advantage where the rate of output can be increased, particularly where the capital cost of the furnace is high in relation to the value of the product or where firing is intermittent.

Steam locomotives

Comparatively few steam locomotives specially built to burn oil exist in western Europe and constant research in this field has given coal an advantage. The modern coal-burning steam locomotive, especially if equipped with a mechanical stoker, can fully stand up to competition at any rate under European conditions. One of the disadvantages of oil is that it requires a large fire-box lined with refractory material, while modern coal-burning locomotives have very restricted fire-boxes. As it is uneconomical to carry large quantities of water as a heat accumulator, the rate of combustion has to follow the fluctuating demands for steam, for instance when the locomotive is pulling up-hill or is standing by in a switch-yard. As it is nearly impossible to work an oil burner efficiently in the

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(1) Such an igniter may consist of diesel oil thickened with aluminium soap ("Napalm")

small firebox of a locomotive at less than full rate, it has to be either on or off, and this does not make for fuel economy. A coal fire can be banked to reduce combustion while it stays hot enough to give full output at short notice; intermediate stages are just as manageable and steam-raising by oil is therefore only more economical on continuous service.

French experience with oil-firing has been far from favourable. In practice, fuel efficiency was lower with oil than with coal, and the final tractive effort that could be produced was no larger[1].

Running both coal- and oil-fired locomotives on one line means that fuelling installations have to be doubled; this would impose particularly heavy costs on the highly integrated European railways, as they obviously cannot all switch over to oil at once.

Steam locomotives, whether coal- or oil-fired, are more expensive to run, so far as fuel costs are concerned, than the electric or the diesel locomotive, especially for shunting and to a lesser degree for other purposes.

* * *

The conclusion may be drawn that oil normally has the advantage over coal of a greater consistency of quality, but that this advantage could be overcome if coal suppliers paid more attention to the provision of consistent qualities to each consumer.

Gas produced from coal stands at no disadvantage as compared with oil, so far as the technical aspects are concerned, except perhaps where high-flame luminosity is required. Pulverized coal in large steam-raising plants has practically all the advantages of oil.

Other factors affecting the choice of a fuel being equal, there is no doubt that oil, being less bulky than coal for a given heat content and easier to handle at normal temperatures, will benefit greatly where heavy transportation costs are

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(1) R. Dugas: "Comparaisons des différentes formes d'énergie utilisées dans les transports par chemin de fer", Transactions of the Fuel Economy Conference, Vol.III, The Hague, September 1947, page 1330.

involved, especially if the plant is located close to the sea or to a waterway and is distant from coal-mining areas.

In industries where gas is not available or where its price is prohibitive, if a hot luminous flame means increased over-all production capacity and the relation between the fuel cost and value of manufactured products is small, the use of oil will increase despite comparatively large price differentials between oil and coal.

The same will be true for industries where adequate supplies of gas are not available and where a sharp control over changes in furnace temperatures is essential.

Increased use of oil, particularly for small plants, will also occur where (apart from the lack of a suitable gas supply)

(a) the use of oil will sensibly lower elements of costs other than fuel costs, such as manpower;

(b) the easier regulation of oil-firing will lead to substantial gains in efficiency.

It is to be noted that, as has been the case in the United States with heating oils, it is the more manageable fraction, i.e. distillate and light residual oils, which will ultimately take the lead in this process of substitution. This is particularly important, as the yield in these middle fractions in the refining process is scarcely affected by catalytic cracking, the feedstock of which tends to consist more and more of heavier fractions than gas oils.

3. Short-term Flexibility in Fuel Use

It has been seen that in most cases reviewed the technical characteristics of coal and oil do not determine which shall be used and many fuel consumers have equipped themselves so as to be able to switch over from coal to oil, or vice versa, at short notice. This is much less marked in the main coal-producing countries, since industrial areas have grown up on the coalfields and this has resulted in low coal prices (on account of the short haul for coal) and reliability of supply. In fuel-importing countries, on the other hand, dual-purpose equipment is often installed, as this provides an assurance against interruptions in supply and the possibility of taking advantage of price differences between the two fuels.

Sweden is a case in point and Table 10 shows changes in Swedish industries over a period of years.

Table 10

Fuel Oil Consumption in Swedish Industry, 1946 to 1951

	Years	Total of coal, coke, wood and oil	Fuel oil	Fuel oil as percentage of total
		Thousand tons coal equivalent(a)		
Cement industry	1946	259	123	47
	1947	278	169	61
	1948	293	42	14
	1949	332	89	27
	1950	403	144	36
	1951	444	108	24
Iron and steel mills	1946	717	47	7
	1947	848	126	15
	1948	903	136	15
	1949	968	150	15
	1950	1,244	200	16
	1951	1,171	290	25
Mechanical engineering	1946	276	39	14
	1947	302	97	32
	1948	310	109	35
	1949	306	111	36
	1950	341	130	38
	1951	389	178	46
Pulp and paper	1946	1,229	384	31
	1947	1,520	703	46
	1948	1,529	429	28
	1949	1,553	544	35
	1950	1,478	648	44
	1951	1,561	724	46

Source: Industriberättelse, Stockholm, 1952.

(a) Conversion factors: 1 ton of coke = 1.05 tons of coal.
1 m^3 fuel wood = 0.17 ton of coal.
1 m^3 wood shavings, sawdust, etc. = 0.10 ton of coal.
1,000 l. fuel oil = 1.35 tons of coal.

Table 10 (Continued)

Fuel Oil Consumption in Swedish Industry, 1946 to 1951

	Years	Total of coal, coke, wood and oil	Fuel oil	Fuel oil as percentage of total
		Thousand tons coal equivalent(a)		
Sugar industry	1946	138	1	1
	1947	127	14	11
	1948	114	47	41
	1949	138	64	46
	1950	156	127	81
	1951	146	125	86
Cotton industry	1946	66	22	33
	1947	79	50	63
	1948	80	36	45
	1949	80	36	45
	1950	89	49	55
	1951	78	59	76
Electricity	1946	192	82	43
	1947	627	305	49
	1948	508	167	33
	1949	333	81	24
	1950	200	43	22
	1951	363	146	40
Others	1946	2,171	226	10
	1947	2,317	587	25
	1948	2,383	620	26
	1949	2,102	652	31
	1950	2,499	823	33
	1951	2,617	991	38
Total	1946	5,048	924	18
	1947	6,098	2,051	34
	1948	6,120	1,586	26
	1949	5,812	1,727	30
	1950	6,410	2,164	34
	1951	6,769	2,621	39

It will be seen from Table 10 that in many cases the consumer seems to be equipped for burning both fuels and is able to switch more or less immediately from one to the other. Exceptions to this are the iron and steel and mechanical engineering industries, where oil is used in furnaces of different kinds and where a switch from one fuel to another would mean changing the entire equipment.

Sweden's present requirement of imported fuel is equivalent to about 12 million tons of coal per year. According to Swedish estimates, dual-firing equipment is in use by consumers accounting for about 7 million tons coal equivalent.

The widespread development of dual-firing in Swedish industry has been greatly stimulated by the recurrent shortages of solid fuel in the post-war period.

Conclusion

If, as has been suggested in Chapter II, the tendency in the next decade is towards continued fuel shortage, further developments in the direction of dual-firing are to be expected. Unless such shortages are very acute or prolonged, however, installation of dual-firing facilities in existing plants will, presumably, only take place when the heating equipment comes to be renewed.

Whether, in the absence of special incentives, this will take place so rapidly as to make short-term fuel substitution a major characteristic of the fuel market is difficult to say, but it seems probable that there will be an increasing tendency to install dual-firing equipment.

CHAPTER IV

THE CONDITIONS OF SUPPLY OF BLACK OILS

Information on coal availabilities in western Europe is provided in Section I of the Appendix. On physical grounds coal becomes increasingly, and will become progressively more, difficult to produce, while manpower has been in the post-war period, and still remains in a number of countries, difficult to recruit and still harder to keep. The only hope of retaining or increasing the labour force in coal-mining lies in maintaining full employment within the industry. No such problem exists in the oil industry.

The general economic behaviour of black oils and the nature of the market relationship between them and coal are mainly influenced by the fact that black oils are jointly produced with other petroleum products in a unified refinery operation. The contrast between, on the one hand, the oil industry, which requires large amounts of capital for installations liable to become obsolete in a relatively short time and which employs comparatively little labour, and, on the other hand, coal mines, where the capital required can be written off over a long period but where the labour cost is large, is equally important.

The oil refineries produce white and black oils, which are required for totally different markets. This distinction of refinery products made throughout this study is based essentially on physical criteria but, within broad limits, this corresponds to significant differences between the economic characteristics of the two groups of products.(1)

The distinguishing feature of white oils, and specifically motor spirit, is that they are employed in uses which cannot, except to a very limited extent, be served by any other product not related to petroleum - i.e. for road and air transport. By contrast, as indicated in Chapter III, there is technically great scope for substitution between different forms of energy in those consumption sectors of the general energy market where black oils can be used.

This means that except in times of shortage there is a tendency for the maximum price of black oils to be determined by the prices of competing fuels, whereas that of white oils (and lubricants) is determined only by competition with other white-oil producers.

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(1) The two criteria, the physical and the economic, do not of course produce clear-cut boundaries and the middle distillates (gas and diesel oils) and lubricating oils flow into each of the two markets.

White oils together with lubricants are responsible for a higher share of total revenue from oil refining than their share in output, measured in physical terms, and this is a most important factor affecting the market relationship between black oils and coal. The importance of black oil as a revenue earner must not, however, be under-estimated.

As already noted, black oils and white oils are necessarily the joint products of a unified refinery operation. This means that the supplies of either tend to be less sensitive to changes in prices, particularly in the short run, than would be the case were each produced independently. Therefore, in the short run the price of black oils will tend to find whatever level is needed to clear the market of the quantities available. However, in the longer term, some adjustment in the proportion of the various products produced, or in the output of the refineries would become necessary.

It follows that during a temporary glut, coal is not likely to gain relief at the expense of oil; on the contrary, oil is likely to press hard on coal.

The following figures for the United States give a striking illustration of the degree of flexibility which may be expected in the pricing of black oils. In 1932, No.6 fuel oil sold at only 67 per cent of the price of coal. By 1934 it had risen to 102 per cent, only to fall to 84 per cent in the following year. In 1937 it returned to 99 per cent, but fell to 81 per cent the next year. In the post-war period residual fuel oil prices reached 131 per cent of coal prices in 1948 (a year of shortage for all products) and fell to 80 per cent in 1949.(1)

This typical behaviour of black oils - relative output stability and price instability in the short run - likely in times of glut to enforce contractions of output in the coal industry with resulting unemployment, is an important problem because of its wider implications, which are far more serious than in the case of oil. A fall in refinery throughput does not mean unemployment of labour in the same way as does a reduction in mining output, since labour costs in oil refineries (based on United States experience) have been only 10 to

(1) Report of the Commission on Bunker "C" Fuel Oil of the National Petroleum Council, Washington, December 9, 1952, page 14.

15 per cent of the total whereas the labour cost in west European coal mines has amounted to over 60 per cent. Such a fall, however, places a heavy financial burden on the oil industry if refineries, in which large sums of money have been invested and which become comparatively rapidly obsolete, cut back production.

It seems probable, as shown below, that the future tendency will be to reduce, within the limits of the economic operation of refineries, the proportion of black oils produced. As is, however, pointed out in Chapter II the demands of the transport industry for white products is one of the main criteria which will determine the amount of black oils produced. The other criteria are technical factors: the type of crude oil being refined, the availability of suitable plant such as equipment for catalytic cracking, and the state of competition in the black oil market.

The data available on the economics of catalytic cracking are insufficient for any estimate to be given of the speed and extent to which west European refineries would, in normal circumstances, reduce the proportions of black oils in their output.

The scope for variation in the yield of fuel oil - and correspondingly of gasolines - which exists with modern techniques is illustrated by the fact that the proportion was 18.6 per cent in 1952 and 17.6 per cent in 1953 in the United States against 45 per cent in western Europe in 1952.(1)

While these figures give no direct indication of the possible short-run variations in the pattern of output, there is no reason to doubt the existence of a considerable measure of short-run flexibility, given some capacity in excess of normal requirements at certain stages of production, as is the case in other industries. It should, however, be noted that this cannot be a short-term solution, as cracking equipment is both slow to install and expensive.

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(1) Improvements in the quality of refined products as well as variations in the yield can be brought about by using secondary processes (e.g. thermal and catalytic reforming and cracking, polymerization, alkylation, hydrogenation and purification). Among these processes, reforming and cracking are the most important.
Cracking equipment has two main functions. One is to improve the quality of the products, mainly to increase the octane number of the motor-spirit; the other is to increase the production of white products and consequently lower the output of black products.

The extent of flexibility in the refining industry is in the final issue determined by the available equipment and it is understood that the west European industry is being progressively equipped with cracking facilities. This is of great importance as it does provide a technical basis on which a rational, general energy policy could be evolved.

The advantages of encouraging increased flexibility in the proportions of white and black oils produced in refineries suggest that, on grounds of public interest, there is a strong case for building up such facilities quickly. But even if, as predicted in Chapter II, the long-term outlook is one of general energy shortage, periodic gluts, such as the present, are bound to arise and it is at such times that the existence of a maximum flexibility is of particular value.

CHAPTER V

SUMMARY AND CONCLUSIONS OF THE STUDY

The petroleum products competing with coal are those commonly described as black oils. They consist of the more viscous products which remain when the white oils - mostly motor spirit - have been refined from crude oil. Broadly speaking, the white oils serve the inland, air and sea transport market, where, either because of the need to dispense with a separate heat conversion unit, or because of the importance of having a fuel where the calorie/weight ratio is high, there is, effectively speaking, no substitute and their use on a large scale has had a notable influence on the development of the present world economy. The black oils (except for diesel oil in certain uses) cannot serve this market and they find their uses in heat production in the general energy market and to some extent in petro-chemistry.

Penetration of Black Oils into the Energy Market

The penetration of black oils into the general energy market has so far been modest. Between 1937 and 1953, black oils increased their share in the total energy consumption of west European countries from 2 to 8 per cent. There is little reason for extrapolating such a trend to follow the same path as in the United States, where black oils accounted in 1953 for 21 per cent of total energy consumption. The proximity of sources of oil supply in the United States has certainly had an influence on this development. On the other hand there is no doubt that the increase in the use of black oils has been considerably retarded by the tremendous increase in the consumption of natural gas, which is also in the United States a source of indigenous supply and one with which Europe in comparison is poorly endowed.

The west European development appears to represent the combined results of three broad groups of factors - government policy, the general fuel shortage and comparative economic and technical advantages. It is however not easy to disentangle the separate influences of each of the factors.

The influence of governments has had mixed effects. On the one hand, it has been in the direction of checking the growth of black oil consumption, whether directly, by measures which have raised the price of black oils or, indirectly, through measures which have limited the growth of white oil consumption and therefore the production of black oils. It is doubtful in most cases whether this apparent discrimination resulted from deliberate policy; probably it has been mainly a question of fiscal convenience. In a few cases import duties on black oils have clearly been imposed with a view to promoting the development of home refineries and indigenous crude production. On the other hand, although governments have found the taxing of motor spirit a convenient means of extracting revenue, encouragement has been given to the oil companies, for strategic and balance of payment reasons, to erect refineries in western Europe; refineries that cannot operate without producing a substantial but variable proportion of black oils for which a market must be found.(1)

The fuel shortage, which has characterized most of the post-war period, has however clearly encouraged the use of black oils. Indeed, given the difficulty in raising its production from which the European coal industry continues to suffer, it is evident that but for the growth of black oil supplies during this period, when they filled an important gap, the whole course of west European economic development might have been significantly different.(2)

Government policy and the fuel shortage have in recent years been the major factors in influencing the trend towards black oil consumption, but the real area of competition, which is on a broad front, has been somewhat obscured by these factors. However, with the exception of shipping, where a high calorie/weight ratio is particularly important for space saving, there are few fuel-using sectors where the growth of black oil consumption has been dramatic and the picture is rather one of relatively small increases in consumption in a wide variety of uses.

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(1) The increase in the imports of crude oil into western Europe is shown in Table 15, while Table 16 shows the decrease in importance of the import of refined products and Table 19 the planned refinery figures for 1954.

(2) The increasing percentage use of black oils is shown in Table 17.

On the other hand, as regards technical aspects of the competition between coal and fuel oils, as outlined in Chapter III, it appears that the substitution of oil for coal has in some instances been encouraged by the inconsistency in qualities of coal supplied to consumers and the lack of co-ordination between the coal industry and the appliance manufacturers. In addition, it appears that further steps might be taken to encourage the economical gasification of coals, since gas has the same advantages as oil so far as convenience and easy regulation of temperature are concerned.

Trends in Black Oil Production

Black oils and white oils are the joint products of a unified refinery operation in which crude oils are treated and since, broadly speaking, white oils have no competitor within the market which they serve, it is not unnatural that they provide a major share of the total value of sales from oil refining and can therefore be regarded as the leading product which determines the level of refinery throughput. Although white oils are the leading product, the importance of black oils should not be minimized but, in the short run, the volume of black oils produced will be determined by the course of demand for white oils and the black oils will always be priced at a level at which they can be sold.

If this chain of causality could be regarded as inflexible it would lead to the conclusion that, in an important sense, coal has no defence against competition from black oils. It would lead also to the further conclusion that it would not be in the interests of west European countries to attempt to provide any defence. It is true that oil is, to all intents and purposes, a commodity for whose supply western Europe must rely on imports and that, since coal is an indigenous product, it would appear at first sight that, on balance of payment grounds, some limitation on the inroads into the market for coal would be justified. In fact, however, since white products have no substitute the import of crude oil is unavoidable and the fact that black oils are derived from an imported raw material is irrelevant.

Although this line of reasoning is basically true the relationship between the consumption of white products and the supply of black products is not so inflexible as it implies. In the first place, the proportion of white products

to residual fuel oil, which it is possible to derive from the processing of a given quantity of crude oil, can be varied within very broad limits. In the United States, for example, the average proportion of residual fuel oil in refinery output was in 1952 reduced to no more than 18.6 per cent, compared with a level of about 45 per cent in western Europe. In the second place, the picture is modified by the possibility of trade in both directions in both white and black products.

In practice the proportion of white to black oils produced will in the end depend on a combination of technical factors, plant availabilities and market conditions. How the market divides itself in future between coal and black oils depends on the general development of the energy market, the relative availability of supplies and, to a lesser extent, the trend of prices.

The Energy Position

An attempt is made in Chapter II to assess the energy position in 1963. This suggests that on the basis of a range of assumptions, the energy market is more likely to be characterized by a situation which is approximately in balance or by shortage, at any rate during certain periods, than by conditions of surplus.

On the basis of the lowest energy requirements, arising from the assumptions adopted, it would be necessary for the coal industry to maintain its present level of output, but if the highest set of assumptions is adopted then a very large increase in expansion over the next ten years, amounting to 25.7 per cent or an annual increase of 2.3 per cent would be necessary.

Even if the situation in the future is that the demand for energy tends to exceed the readily available supply there are likely to be periods - such as the present - when the reverse is the case. Such temporary gluts may occur, either because of fluctuations in the demand for energy - an even rate of expansion of industrial production is clearly improbable - or because the rate of increase in production of different forms of energy is also unlikely to be smooth.

In the short term black oils are likely to be marketed at prices which will clear the market of available supplies and this will be facilitated by the provision of dual-firing equipment. Other forms of energy such as hydro-electricity and natural gas have a low prime cost of production and once the

large capital expenditure required to harness them has been provided, and the equipment has been installed, it is unlikely that production will be voluntarily curtailed. It follows that the burden of making adjustments when temporary surpluses arise will, in the absence of any special action, fall mainly on coal which might be detrimental to the best long-term interests of the economies of western Europe.

At first sight the reasons for this may not be apparent, as coal and petroleum are sharply distinguished in their cost structure; in the coal industry, labour costs represent over 60 per cent of total costs whereas in petroleum refining the proportion is only 10 to 15 per cent, and the production and transport of crude oil are also capital-intensive activities. This means that the saving in total costs arising from a reduction in output is substantial in the coal industry but small in the oil industry. It might appear - from this narrow accounting point of view - that the coal industry might be able to face a temporary deficiency of demand more easily than the oil industry.

In fact, however, the situation is quite the reverse. A reduction of coal production would mean unemployment of labour and unless coal production in future is to be permanently reduced, a large expenditure on maintenance of non-producing mines would be necessary. In the oil industry some unemployment of capital might result but, although it is true that the effect on supplies of white oils of any restriction in the output of black oils must be taken into account, and there is no particular reason to suppose that a fall in demand for white oils would coincide with a condition of temporary glut in the general energy market, it would be possible, as already pointed out, to vary the proportions in which the two groups of petroleum products were produced so that a restriction in black oil output need, in principle, create no interference with the supply of white oils. The condition for securing such short-term flexibility in the pattern of refinery output is, of course, the existence of capacity in excess of normal needs, at some stages of production. Such a situation is, however, a normal feature of most industries in which different commodities are produced by means of common processes.

Consideration of the longer-term implications of a situation in which the main burden of temporary gluts is borne by the coal industry suggests that the effects to be expected are even more undesirable. The major difficulty in raising coal output in western Europe has been to obtain and keep enough labour in the coal mines under conditions of general full employment. If periodic unemployment or short-time working again became characteristic of the coal industry, the task of building up or retaining a labour force of adequate size would become all the more difficult. The effect would therefore be to exacerbate both the particular difficulties of the coal industry and any tendency towards a general energy shortage over the long term.

This suggests the need for some co-ordination of fuel policy so that the superior flexibility of black oil production may become a stabilizing rather than a destabilizing factor in the general energy market. Given such co-ordination, the further growth of dual-firing could be regarded as an unmixed blessing which it might well be found desirable to stimulate positively.

The putting into operation of a properly co-ordinated fuel policy, at any rate so far as western Europe is concerned, should be facilitated by the predominant role exercised in the oil industry by a few large companies as exemplified in Table 23.

A co-ordinated fuel policy would entail consideration of the use of the best and most rational type of energy for any given purpose; it would involve at least temporary burdens to be borne by both the coal and oil industries and the adoption of rational marketing policies, particularly in times of surplus. All this would safeguard the general long-term interests of both industries.

A 2-per cent fall in the demand for energy is at present equivalent to about 13 million tons of coal. Even if demand for white products fell at the same time, which can by no means be assumed, it is unrealistic to envisage that all of this contraction in output would be borne by black oils. The coal industry, if it is to be free from periodic threats to employment would have to increase its own flexibility by such means as the provision of increased stocking facilities, the financing of stocks and the putting into operation of underground development policies in times of low demand and by taking steps to ensure the rational utilization of those types of coal in free supply.

APPENDIX

SECTION I : THE SUPPLY OF COAL

1. Reserves of Hard Coal

Europe possesses enough coal to allow the present rate of mining to continue for a considerable time to come, as is shown by Table 11.

Table 11

Reserves and Output of Hard Coal in Europe in Selected Years

(in millions of metric tons)

Country	Probable reserves	Production			
		1937	1947	1952	1953
Belgium	3,000	30	24	30	30
France	12,000	44	45	55	53
Saar	8,000	13	10	16	16
Western Zones of Germany	67,000	138	71	123	124
Netherlands	4,000	14	10	13	12
United Kingdom	171,000	244	201	230	228
Other west European countries	15,000	6	17	18	19
Czechoslovakia	6,000	17	16	20	20
Poland	136,000	66	59	84	89
Other east European countries	2,000	5	4	6	6*
Total Europe	424,000	577	457	595	597

Sources (reserves): - World Power Conference, Washington, Statistical Yearbook No. 4, 1936 to 1946, and No. 6, 1948 to 1950.

- Glückauf, Essen, Vol. 89, 1953, p. 595.

- B. Roga and L. Wnekowska : "Analiza Paliw Stalych", Warsaw, 1952, pp. 31 and 34.

In general the most easily accessible seams of coal, usually the thickest and the best in quality, have been worked first, with the result that the mines are now continually becoming deeper and the seams worked, thinner. In 1913 578 million tons were produced, the coal being of a better quality than at present. A high proportion of present output is obtained from pits more than forty years old. This applies in particular to the older fields - in the United Kingdom and the Ruhr and to some of those in France and Belgium. It is less true of the more recently developed mining areas; Silesia, Lorraine, Campine.

2. The Outlook for Production

Table 12 shows the trend of production and trade in hard coal for selected years from 1929 to 1953.

Table 12

European Production, Trade[a] and Available Supplies of Hard Coal in Selected Years

(in millions of metric tons)

	1929	1937	1947	1948	1949	1950	1951	1952	1953
United Kingdom[b]									
Production	262	244	201	213	219	220	226	230	228
Net exports to western Europe	45	30	1	8	11	11	7	11	12
Net exports to the rest of the world	16	11	-1	3	3	3	-	1	2
Available supplies	201	203	201	202	205	206	219	218	214
Other west European countries									
Production	252	245	177	197	225	234	249	255	254
Net imports from United Kingdom	45	30	1	8	11	11	7	11	12
Net imports from eastern Europe	10	10	7	13	12	11	10	7	7
Net imports from the rest of the world	-1	-2	34	17	10	1	25	21	8
Available supplies	306	283	219	235	258	257	291	294	281
Eastern Europe									
Production	93	88	79	92	96	101	106	110	115
Net exports to western Europe	10	10	7	13	12	11	10	7	7
Available supplies[c]	83	78	72	79	84	90	96	103	108
Total Europe									
Production	607	577	457	502	540	555	581	595	597
Net exports to rest of the world	17	13	-35	-14	-7	2	-25	-20	-6
Available supplies[a]	590	564	492	516	547	553	606	615	603

(a) Excluding bunkers.
(b) Excluding Northern Ireland.
(c) Including supplies to the USSR of approximately 8 to 9 million tons a year in the post-war years and small exports to overseas countries in the pre-war period.

In the main coal-producing countries of Europe, estimated future outputs range from an increase of more than a quarter to be achieved in five years' time in Poland, to a slight decline of output in the Netherlands. It is, of course, only to be expected that richer mining areas should expand faster than the less remunerative coalfields, where output may even drop. There might, however, be cause for anxiety if the United Kingdom, which produces more than one third of all European coal, did not plan to expand its output by more than a small fraction in the next five years. By its mere size, the British coal industry governs the future of European self-sufficiency in coal to a larger extent than any other country; it also has the best technical opportunities in western Europe for quick expansion at the lowest cost but, according to the Report and Accounts for 1952 of the National Coal Board, there will be for some time to come a shortage of planning staff.

The Polish seams are particularly suited for highly mechanized production. The target set for 1957 is 110 million tons, an increase of 21 million tons over 1953, and it is expected that this will be achieved mainly through increases in output per manshift.

The effect of the establishment of the European Coal and Steel Community has yet to be seen but it might well, in the coal-producing countries concerned, improve the situation by promoting higher output at lower cost.

Pit-head Stocks

The accumulation of pit-head stocks in France and Belgium shown in Table 13 is indicative of the present situation of easy supply conditions in the continental west European coal market. The same conditions do not apply in the United Kingdom. The situation in the Western Zones of Germany is reasonably well balanced as regards pit-head stocks, but at the end of 1953, 3.4 million tons of coke were in stock at coke ovens.

The situation has not improved in 1954 and at 30 June 1954 the provisional figures (in millions of metric tons) were:

Belgium	4.1
France	7.0
Western Zones of Germany (coke)	3.5

Table 13

Pithead stocks of Hard Coal in Selected West European Countries, 1950 to 1953

Country	Year	Stocks end of period (thousands of metric tons)	Annual production (millions of metric tons)	Ratio of Stocks to production (days)(a)
United Kingdom	1950	1,708	207(b)	2
	1951	1,453	215(b)	2
	1952	4,621	218(b)	6
	1953	1,909	216(b)	3
Western Zones of Germany	1950	407(c)	111	1
	1951	432(c)	119	1
	1952	465(c)	123	1
	1953	841(c)	124	2
France	1950	2,652	51	16
	1951	1,353	53	9
	1952	4,197	55	24
	1953	5,762	53	33
Belgium	1950	1,031	27	11
	1951	225	30	2
	1952	1,673	30	17
	1953	3,077	30	31
Saar	1950	190	15	4
	1951	68	16	1
	1952	460	16	9
	1953	536	16	10
Netherlands	1950	151	12	4
	1951	140	12	4
	1952	237	13	6
	1953	213	12	7

Source : Quarterly Bulletin of Coal Statistics for Europe, ECE, Geneva.

(a) Taking 300 days to a year
(b) Deep-mined only.
(c) Excluding low-grade fuel.

3. Trade in Coal

Coal production is nationalized in many European countries although there are notable exceptions, namely, Belgium, Western Germany and certain mines in the Netherlands. The main controls over west European continental production are now held by the High Authority of the European Coal and Steel Community.

On the other hand trade in coal largely remains in western Europe in the hands of private enterprise. The trade in several of the larger coal-consuming countries has, however, since the war, been subject in some way or another to governmental control. Most often this has taken the form of a limitation on trade margins imposed as part of a general policy for stabilizing living costs. In the United Kingdom additional restraints on trading activities have resulted from the control and allocation of supplies. In Sweden, on the other hand, a variant of this policy is that although there are no controls in force, the Price Control Board has the right to interfere if profit margins are likely to become too high.

One effect of this system has been that in the absence of competition traders have had no incentive to improve their sales methods. It should, of course, also be borne in mind that since the war and until recently the coal market has, with only some exceptions, been a seller's market so that limitation of supplies both in quality as well as in quantity has substantially contributed to this.

The structure of the coal trade has also hardly contributed to efficiency since in many countries there are a great number of traders very often handling quantities so small that there is no opportunity for specializing in the business. Thus in Belgium there are approximately 15,000 retailers selling annually some 7 million tons, an average of less than 500 tons per dealer. As a result they often have to combine coal trading with other business such as dealing in building materials or acting as transporters of general goods or even selling black oils.

4. The Price of European Coal

The present pit-head prices of coal in western Europe average US $14 a ton, except in the United Kingdom where the price is about $8.5 a ton; these prices, in some cases, leave only a small margin of profit to the producer.

Since the war coal prices have been controlled and generally kept low by the governments of producing countries, on the assumption that any increase would have a detrimental effect on costs throughout industry.

The fact that export prices may in some countries be higher than pit-head prices (by some US $2.1 in the United Kingdom, such difference varying with the quality of the coal exported) is not of great assistance to producers, owing to the small proportion of coal exported as compared with total production (8.9 per cent in 1952). The differences in west European pit-head prices arise mainly from variations in direct cost and, owing to the particular structure of the coal industry, the principal factor affecting these variations is the output per man-shift; nevertheless, dissimilarities in producing countries in general economic policies and in methods of charging the cost of social services, are also of importance. From 1951 to 1953, the output per manshift (underground) in Europe has varied as follows:

	1951	1953
	(In metric tons)	
Belgium	1,054	1,068
France	1,298	1,416
Saar	1,617	1,691
Western Zones of Germany	1,457	1,459
United Kingdom	1,632	1,630
Netherlands	1,729	1,567
Poland (1949)	1,830	..

This, to some extent, explains why pit-head prices in the United Kingdom are lower than elsewhere in western Europe and indicates that pit-head prices in Poland, other cost factors being taken as similar, can be presumed to be still lower.

Although output per manshift in the Netherlands was among the highest in western Europe indigenous production accounted for only 2.3 per cent of the total production of the countries shown above and its cost could therefore have had little if any influence on price formation in Europe.

The formation of the European Coal and Steel Community is a first attempt to co-ordinate investments and policies in the coal industry of continental western Europe, with the ultimate purpose of decreasing the cost of coal to the consumer.

The structure of coal prices has in the main followed the pre-war price pattern owing to the policies carried out by the governments of the producing

countries. This pattern, the outcome of market forces and a supply situation entirely different from the present, has become outmoded.

In addition the increases in prices, allowed from time to time by governments, have generally been more or less equally applied to all qualities, so that in view of the changed conditions the price relationship of one quality to another may now be irrational. However, owing to the recent easing of the market consumers are increasingly favouring certain qualities of coals and countries in growing numbers are adapting their prices to a more rational structure.

5. The Price of United States Coals

Coal can be brought from the United States in sufficient quantities and correct qualities to cover Europe's import needs whenever these arise. As a result of favourable geological conditions and a high degree of mechanization United States pit-head prices compare advantageously with west European prices. In addition, the coal industry in the United States has the advantage of a far greater production flexibility than European mines, as geological conditions in United States coalfields allow for extensive developments to be made at considerably less expense than in European mines and recruitment of technically-minded workmen for operating coal-mining machines is not such a problem in the United States as the recruitment of trained miners in Europe.

At present the f.o.b. price from the East Coast is US $7.50 per ton[1], which is slightly below the British pit-head price. The cost of ocean transport however, is heavy compared with the f.o.b. price. Moreover, in the last few years freight costs have fluctuated violently. They were as high as $15 per ton in 1951 and as low as $4 at the end of 1953. With freight costs at the lower limit United States coal delivered on the continent of Europe is cheaper than that of British exported coal. Thus the fluctuations in Atlantic freight rates influence the price level of coal in Europe, both in times of shortage and surplus.

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(1) The f.o.b. price of the qualities of coal imported recently in Europe might be $1 or so higher, but precise quotations are not available.

The purchase of United States coals, however expedient in times of dire shortage, involves a dollar expenditure which is by no means negligible; for the fiscal year, July 1951 to June 1952, this amounted to some US $600 millions for 28 million tons of coal.

The corresponding payment for the oil equivalent, 19 million tons at $30 a ton, would have meant a total of $570 million.(1) The actual dollar cost, however, might have been less. Even if the United States oil companies' possible expenditure in Europe was not taken into account, the freights paid in other currencies could have reduced the amount by 25 per cent(2) or to a total of $427 million.

More could be said on the dollar cost of coals imported from the United States: for instance, non-dollar vessels could be used for the transportation of these coals. But in times of dire coal shortage, which coincide with a high level of economic activity, carriers for coal may be harder to find, except at an inflated cost or by having recourse to the United States "moth-ball" fleet, as opposed to tankers, which are specialized vessels.

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(1) No possibility existed at that time of refining larger quantities of crude oil in European refineries.

(2) In 1952 25 per cent of the total landed cost of imported oil products from United States companies was paid in non-dollar currencies mainly for freights.

SECTION II: THE SUPPLY OF OIL

1. European Production of Oil

Europe has relatively small oil resources, as is apparent from Table 14. Its present estimated reserves are only 1 per cent and its production is not more than 2 per cent of the world totals. In 1952 Europe imported about 85 per cent of the oils used and it is unlikely that this percentage will fall.

This does not, however, apply to all European countries. Romania and Austria, and probably also Hungary, have exportable surpluses of oil. The Romanian oilfields, in particular, are producing more than was thought possible only a few years ago. The relatively low consumption of oil in eastern Europe has contributed to this area's oil surplus. While eastern Europe consumed in 1952 about sixteen per cent of all hard coal used in Europe the corresponding figure for oil was at the most 12 per cent.

Table 14

Proven World Reserves and Production of Crude Petroleum in Selected Years

(in millions of metric tons)

Area	Proven reserves end 1953	Production				
		1937	1947	1951	1952	1953
Western Europe (a)	78	0.5	0.9	2.6	3.1	3.7
of which W. Zones of Germany	55	0.5	0.6	1.4	1.8	2.2
Netherlands	14	-	0.2	0.7	0.7	0.8
Eastern Europe	97	7.7	5.5	8.6	12.4	13.2
of which Romania	54	7.2	3.8	5.5	8.6	9.1
Austria (b)	30	-	0.9	2.3	2.8	3.0
Total Europe	175	8.2	6.4	11.2	15.5	16.9
Rest of the world	20,039	276.5	409.2	581.7	605.8	637.3
of which United States	4,000	177.7	254.4	307.5	309.0	317.0
Middle East	10,938	15.8	42.3	97.3	105.5	121.6
USSR (c)	2,600	28.5	26.0	42.3	47.5	52.5
Total World	20,214	284.7	415.6	592.9	621.3	654.2

Sources: - Statistical Yearbook 1952, United Nations, New York.
- Monthly Bulletin of Statistics, United Nations, New York, April 1953.
- "Economic Survey of Europe in 1951", ECE, Geneva, 1952.
- "Economic Survey of Europe since the War", ECE, Geneva, 1953.
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- Szabad Nép, Budapest, 30 November 1952.
- Plan Odbudowy Gospodarczej Liczby Podstawowe, Warsaw, 1947, p. 47.
- Wiadomosci Statystyczne, Warsaw, No. 1, 1951.
- Supplement to Probleme Economice, Budapest, April 1948, p. 29.
- Informations Roumaines, Paris, 25 May 1952.
- Scanteia, Bucharest, 23 January 1953.

(a) Algeria and Morocco are included under western Europe.

(b) Virtually all crude-oil production and refining in Austria is controlled by USSR authorities. Source: Erdöl und Kohle, Hamburg, April 1954 (for reserves).

(c) Average of estimates of various sources: World Oil, Houston, United States, Vol. 136, 1953, page 265.

The above figures of oil reserves refer to proven reserves; i.e. those quantities of crude oil which are estimated to be recoverable from known oilfields by existing production methods and at the present cost level. They are nevertheless estimates and, as such, should be considered as an indication of magnitude of the reserves. They represent, however, only a fraction of actual possible world oil reserves, which have been estimated as 60,000 million tons(1), the accuracy of this figure being, of course, open to doubt.

In the United States, which has both by far the largest production and a rapidly increasing consumption, new discoveries of oil reserves are continually being made at a rate which, so far, has kept the supply outlook constant.

The Middle East, South America and the USSR are among the most promising oil-producing areas where proven reserves at present rate of production should last about a hundred years. Among other producing areas with good prospects are the Far East, where oil has recently been discovered in New Guinea, and Australia, while in South Sumatra and British Borneo oilfields are being rapidly developed; in Canada, important oilfields have been discovered in Alberta and large-scale prospecting for oil is taking place.

2. Imports of Crude Oil

Supplies of crude oil to west European refineries, divided according to sources of supply, are shown in Table 15 for selected years.

Table 15

Imports of Crude Oil by Western Europe in Selected Years

(in millions of metric tons and in percentages)

Sources of supply	1932	%	1937	%	1951	%	1952	%	1953	%
North America	0.4	12	2.1	20	0.3	0.6	0.2	0.3	0.3	0.4
Latin America	1.2	38	2.9	28	5.3	9.8	5.4	7.9	4.8	6.2
Middle East	1.2	38	4.5	44	47.9	89.0	62.8	91.6	72.2	93.0
Far East	0.2	6	0.4	4	0.3	0.6	-	-	0.1	0.1
Eastern Europe and USSR	0.2	6	0.4	4	-	-	0.2	0.2	0.2	0.3
Total	3.2	100	10.3	100	53.8	100	68.6	100	77.6	100

Sources: - United Nations Commodity Trade Statistics, 1951 and 1952, New York.
- National trade statistics.

(1) Average of two estimates in "The World's Oil Reserves", Petroleum Information Bureau, London, July 1953, page 2.

As can be seen from Table 15, Europe now relies almost entirely on imports of crude oil from the Middle East, while supplies from other sources have shrunk to only a minor fraction of the total tonnage imported.

3. Imports of Refined Products

The different sources of supply of refined products are shown in Table 16.

Table 16

Imports of Refined Petroleum Products to Western Europe in Selected Years(a)

(in millions of metric tons)

Sources of supply	1932	1937	1951	1952	1953
North America	4.7	4.2	4.3	3.8	3.6
Latin America	1.9	3.6	9.9	7.8	8.2
Middle East	2.2	3.2	4.0	1.1	1.4
Far East	2.3	5.0	0.5	0.8	0.5
Eastern Europe and USSR	5.6	3.6	0.1	0.3	0.6
Total	16.7	19.6	18.8	13.8	14.3

Source: National trade statistics.

(a) Refined petroleum products include all products covered by code No. 313 of SITC, i.e. refined mineral oils, lubricants, waxes and petroleum coke.

Since the end of the last war imports from North America have consisted mainly of special products, such as aviation spirit and special kinds of lubricants, considered as economical to produce in Europe. West European refineries are now beginning to supply increasing quantities of special products and are, in some cases, even seeking export markets.

Regarding imports from other sources, it should be stressed that in practically all west European countries the market for oil is not confined to home-refined products and, therefore, oil companies are free to make their own arrangements with regard to sources of supply, at least in so far as dollar payments are not involved.

Before the war, supplies of refined petroleum products from eastern Europe represented 18 per cent of total imports; these are now reappearing on a very low, though increasing, scale on the west European market.

4. The Refining of Oil

Up to the beginning of this century crude oil was refined mainly for the purpose of extracting kerosine. The relative importance of other products increased only gradually and, as can be seen from Table 17, the importance of motor spirit consumption became considerable only about 1920. The importance of black oil and lubricant consumption has increased gradually over the last fifty years from 11 per cent to 68 per cent.

Table 17

Estimated Relative Importance of the Consumption of Major Oil Products by Percentage of Total World(a) Consumption in Selected Years

	1900	1910	1920	1930	1938	1951
Gasoline	3	7	25	38	32	25
Kerosine	86	72	23	9	7	7
Black oils	11	21	46	49	57	66
Lubricants			6	4	4	2
Total	100	100	100	100	100	100

Source: The Journal of Industrial Economics, Oxford, July 1953.

(a) Excluding the United States and the USSR.

It is only natural that crude oil refining should have started at the sources of supply; primitive methods were used and the yield in comparison with to-day's refining was low. The magnitude of consumption of oil in different consuming areas was not large enough to induce the building of refineries in those areas, especially as individually the patterns of consumption did not correspond to normal refinery output. It was not until the end of the nineteen-twenties that conditions became favourable enough to justify the erection of refineries in western Europe. At that time European governments also had a strong desire to locate refineries within their national boundaries.

In 1928 measures were taken in France to promote the establishment of, and to give protection to, a national refining industry. This was a complete reversal of the policy that had been followed since 1903. Belgium, Germany, Italy and Japan soon followed this example and, since the last war, have been joined by the United Kingdom, which earlier did not favour the idea of an indigenous refining industry.

It was mainly after the last war that the bulk of refineries was erected in western Europe. There were several reasons for this development. The European refining industry had virtually stood still during the war period in contrast with the continued expansion in the United States. There was an extreme and general shortage of fuels and, in spite of its efforts, the coal industry was not able to meet requirements. In such a situation the possibilities of finding new sources of energy were more or less confined to oil. Moreover European countries had an urgent desire to save hard currencies.

Up to 1952 this development could be regarded as a shift of the centre of gravity of refining from producing areas to consuming areas but since then, for most of the products, the capacity of European refineries has been more than sufficient to satisfy the entire needs of Europe itself and a further growth of refinery output will have to be disposed of either by exports or by increased home consumption. This might lead, at least temporarily, to a pressure to use oil instead of coal. On the other hand, ever since the last war warnings about over-expansion have been heard which have so far not proved warranted. The growth of refinery output capacity is shown in Table 18.

Table 18

Oil Consumption[(a)], Refinery Output and Capacity in the OEEC Countries

(in millions of metric tons)

Consumption and output		Motor spirit	Gas/diesel oil	Fuel oil	All products
1948/1949	Consumption	10.7	9.3	15.0	43.4
	Output	4.2	4.4	8.6	20.8
1951	Consumption	14.8	14.5	25.4	65.4
	Output	11.7	11.5	23.9	53.9
1952	Consumption	15.8	15.8	26.7	69.5
	Output	15.9	14.0	30.3	67.9
1954	Planned consumption	18.5	17.6	29.7	78.6
	Estimated output	23.0	17.5	33.4	86.2
	Potential output based on capacity, end of year	26.7	20.4	38.1	99.5

Sources: Second and Third Reports on Co-ordination of Oil Refinery Expansion in the OEEC Countries, OEEC, Paris, 1951 and 1953.

(a) Including bunker liftings, which for 1951 and 1952 represented on the average 15.4 and 31 per cent of the total consumption respectively of gas diesel oil and fuel oil.

The Middle East crudes, which are mostly used in west European refineries, yield with straight distillation some 20 to 22 per cent petrol, 18 to 20 per cent other distillates and 43 to 45 per cent residual fuel oil; in 1952 the output of the refineries of the OEEC countries was 23.5 per cent petrol, 20.5 per cent other distillates and 44.5 per cent fuel oil[(1)].

If available cracking capacity were used to transform as much heavy oil as possible into lighter qualities the output of fuel oil could be decreased from the present 44.5 per cent to about 33 per cent; this without taking into account the question of quality, which is a very intricate one.

(1) The situation in Western Germany is rather different: the yields of petrol are much higher and those of residual fuel oil much lower. This is the result of the availability of hydrogenation capacity dating from the pre-war and war years when the intention was to convert the highest quantity possible of indigenous crude into road-vehicle and aircraft fuel.

There is at present no price incentive for the refining industry to do this since, although fuel oil at present prices gives comparatively little profit, if lighter products (mostly petrol) and fuel oil are taken together the margin of total profit is substantial. Moreover, the demand for petrol is relatively low and can be met without resorting to cracking as regards quantity but not quality.

However, since the middle of 1953 there are indications of a growing tendency - substantiated by some plans - for west European refiners to increase the investment in cracking plants. This development is probably based on an assumption that the demand for transport fuels will increase rapidly.

5. The Location of Refineries

The location of refining capacity in western Europe is set out in Table 19. The reasons which determined the location of the refineries are difficult to appraise. Approximately 80 per cent of capacity will be located in the major coal producing countries and, out of the remaining 20 per cent, 17 per cent will be in Italy.

The main factor taken into account in locating refineries in western Europe was the existence of a steady internal market although the six major producers anticipate substantial oil exports. Intra-west European trade in oil is growing in importance, as will be seen from the following figures (in millions of metric tons):

1932	1.0
1937	1.1
1951	8.0
1952	11.5

Other factors were undoubtedly the availability of capital resources, of deep-water harbour and inland-water transport facilities, and the desirability of concentrating refining operations in areas close to consuming centres.

The map which follows shows the location of the refineries in western Europe as well as coalfields and industrial centres.

Table 19

1954 Planned Capacity and Operation of Refineries and Consumption Forecasts for Western Europe

(in thousands of metric tons)

Countries[a]	Planned capacity (distillation)	Planned operation (crude input)	Consumption
Belgium	5,640	4,500	3,850
Denmark	38	28	2,249[b]
France	26,880	22,111	14,589
Western Zones of Germany	11,320	9,748[c]	7,655
Italy	18,320	13,857[d]	7,655
Netherlands	10,300	11,295	4,603
Norway	50	45	2,356
Portugal	1,190	645	1,080
Sweden	1,920	1,800	5,680
Switzerland	200	200	1,414
Turkey	330	..	948
United Kingdom	29,940	29,774	22,882
Total	106,038	94,003	74,961

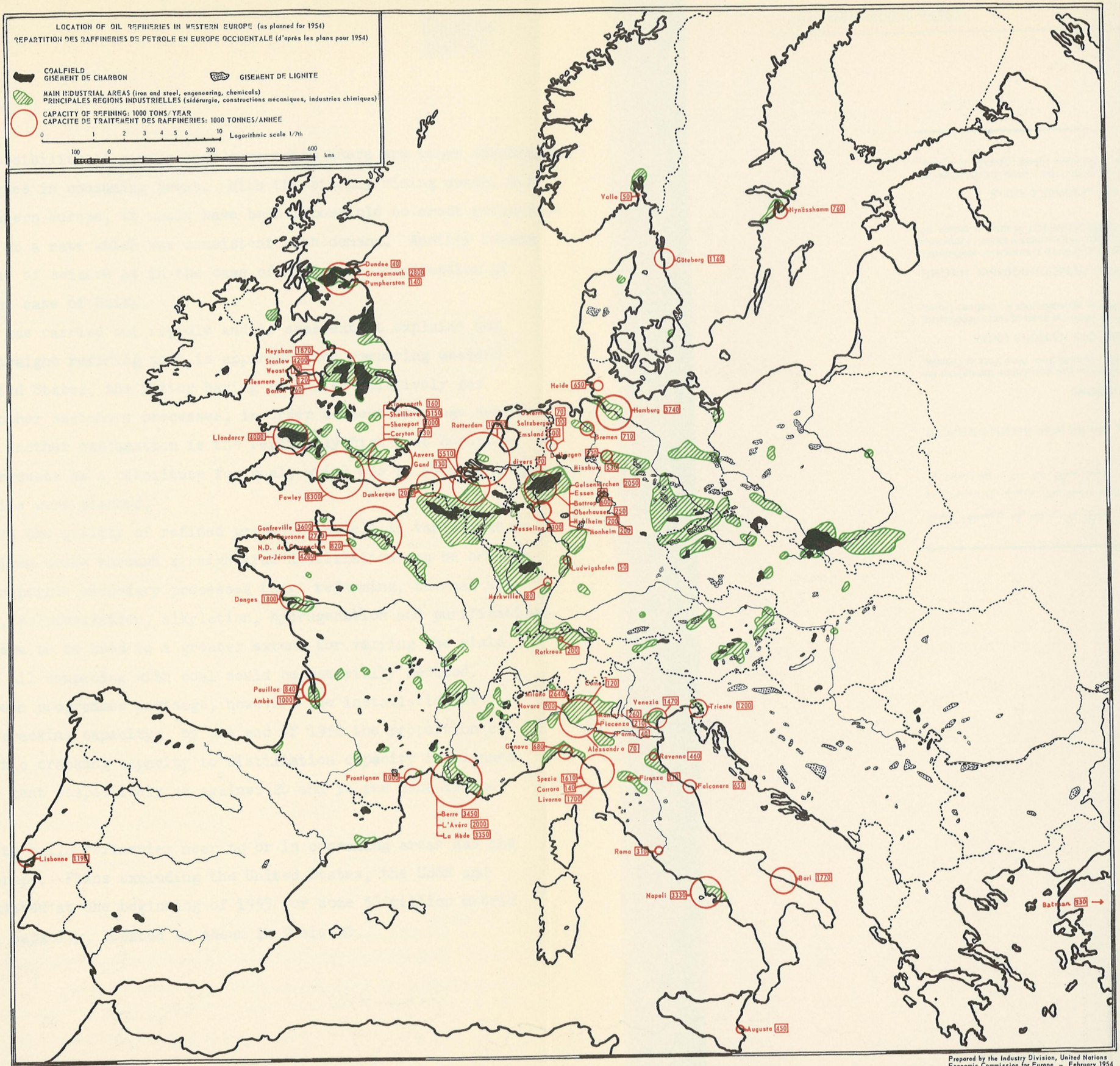
Source: Third report on Co-ordination of Oil Refinery Expansion in the OEEC Countries, Paris, June 1953.

(a) Austria's refineries are all within the USSR Zone. The production in 1952 estimated by the Austrian Oil Industry Association shows an output of 2.8 million tons.

(b) France intends to supply most of the needs of its overseas territories, either directly or through a switching operation; thus the amount of indigenous needs covered by French refineries will actually be larger than that shown in the table which relates only to France's own inland consumption and bunkers.

(c) Thirty per cent of the Italian refining capacity must legally be held as a reserve. Part of the refining capacity is built for the sole purpose of exporting to the adjacent Mediterranean area - Greece, Turkey and the Near East.

(d) The crude input figure is planned on the assumption that part of the cracking installation will be used for "topping", i.e. removing lighter fractions of crudes.



Préparé par la Division de l'Industrie,
Commission Economique pour l'Europe des Nations Unies – Février 1954

Prepared by the Industry Division, United Nations
Economic Commission for Europe – February 1954

Besides the possibility of saving hard currencies there are other advantages in erecting refineries in consuming areas. With the steeply rising demand for oil products in western Europe, it would have been impossible to erect refineries in the Middle East at a rate which was consistent with demand. Another reason was undoubtedly fear of seizure as in the case of Abadan or interruption of operations as in the case of Haifa.

The expansion was carried out rapidly and to some extent explains the preponderance of straight refining that is apparent when comparing western Europe and the United States, the latter having installed relatively far more cracking and other secondary processes, in order to meet the huge demand for motor spirit. Another explanation is the relatively high west European demand for black products as a substitute for coal, which was in short supply when these refineries were planned.

Improvements in the quality of refined products as well as variations in the yield from a given crude through straight-run distillation can be brought about by using appropriate secondary processes (e.g. reforming, thermal and catalytic cracking, polymerization, alkylation, hydrogenation and purification).

If cracking were to be used to a greater extent for varying the yield, the amount of fuel oil competing with coal could be materially reduced. Present west European programmes envisage, however, the installation of relatively little cracking capacity; by the end of 1954 the proportion of thermal and catalytic cracking capacity to distillation capacity is planned to be 4 and 14 per cent respectively as against 20 and 34 per cent in the United States.

The tendency to build refineries near to or in consuming areas has not been limited to Europe. Plans excluding the United States, the USSR and eastern Europe, existed at the beginning of 1953 for some 50 million metric tons of additional capacity, located as shown in Table 20.

Table 20

1954 Planned Increased in Refining Capacity: Excluding the United States, the USSR and Eastern Europe

(in thousands of metric tons of distillation capacity)

	Existing capacity 1 January 1954	New plants	Extensions
Oil-Producing/Exporting areas:			
Middle East	51,000(a)	6,320	1,000
Aden (AIOC)		5,000	
Iraq, Dourak (Government)		1,000	
Lebanon, Sidon (Caltex)		320	
Egypt, Suez (Government)		-	1,000
Mexico and Carribean Area	73,800	1,250	9,550
Peru	1,900		450
Far East	11,400		100
Sub-total		7,570	11,100
Total	138,100	18,670	
Oil-consuming/importing areas:			
European area	94,000	3,750	5,700
South America (Argentina, Brazil, Chile, Uruguay)	11,000	8,400	1,650
Eastern Hemisphere (excluding Europe)	7,000		
South Africa		750	
Far East:			
India		3,750	
Philippines		650	
Australia		5,950	
Sub-total		23,250	7,350
Total	112,000	30,600	
Grand Total	250,100	49,270	

Source: Petroleum Press Service, London, February 1954.

(a) Including 27 million tons for Abadan and Haifa.

It will be observed from Table 20 that only 38 per cent of additional capacity is to be located in oil-producing areas, the refining capacity of which had already decreased from 75 per cent in 1948 to 55 per cent of the estimated world capacity in 1954. Planned expansion for western Europe amounts to about 9.5 million tons out of the 49.3 million tons for the countries shown in Table 20.

Developments outside Europe may tend to impede the sales of surpluses from west European refineries, which in recent years have been as follows (in millions of metric tons):

Year	North America	Latin America	Middle East	Far East	Africa	Unspecified	Total
1951	-	0.1	1.3	0.4	2.2	2.4	6.4
1952	0.2	0.2	3.2	1.8	3.2	2.2	10.8
Source: National trade statistics.							

The figures shown in Table 20 clearly illustrate the difficulty which western Europe will have in maintaining or increasing its present level of export. The tendency is more and more for those countries developing industrially to build their own refineries and to import crude oil from the producing centres which are also increasing their on-the-spot refinery facilities.

6. The Dollar Cost of Imported Oil and of Imported Coal (1)

The dollar cost of imported oil comprises mainly dollar payments to United States companies and the expenditures in dollars of other oil companies. The share of United States companies in the estimated value of oil imports of western Europe has decreased from 54 per cent for the year 1948/1949 to 42 per cent for the year 1952/1953; the corresponding percentages in tonnages (48 and 37 per cent respectively) are lower, owing to the high proportion of refined products included in imports from United States sources.

The landed dollar value of these imports does not, however, represent the dollar outlay; for instance, in 1952, this amounted to only $580 million out of a total value of $1,100 million, or 53 per cent, the difference being accounted

(1) "Economic Survey of Europe since the War", ECE, Geneva, 1953.

for by expenses of United States oil companies in western Europe and related territories as well as freights payable in non-dollar currencies. There is no figure available for net dollar outlays by other oil companies but the dollar content of these oil sales has been estimated at 30 per cent,(1) which puts such payments at between $275 and 300 millions annually. This may appear considerable but it should not be forgotten that the suspension of operations at Abadan has eliminated dollar returns on sales to United States companies from that source and that, so far, these returns have not been compensated by the increased operations in other parts of the Middle East, where rights are shared with United States companies.

Expenses in dollars incurred by west European Oil Companies in Venezuela are not balanced by sales in dollars or hard currency.

Dollar payments for west European imports of oils for the period April 1948 to December 1952 amounted to $3,000 millions, out of which $1,700 millions have been financed by ECA and MSA (this excludes dollar payments by European oil companies).

Since December 1952, however, western Europe has had to find dollars for these payments without outside assistance. This dollar drain has been reduced by agreements with United States oil companies to limit dollar payments so far as practicable. As a long-term measure further progress can be made in reducing the dollar drain if the United States companies continue to increase their purchases of oil equipment, supplies, technical services etc., in Europe and dependent territories.

7. Ownership of the Oil Industry

Ownership in the oil industry is mainly concentrated in the hands of a few large private companies. Few governments exercise a direct control over oil companies in western Europe or in other parts of the world, except in eastern Europe where the industry, like all others, is nationalized. The United Kingdom Government owns a 56 per cent interest in the Anglo-Iranian Oil Company, although it does not interfere with the commercial operations of this company in peace time.

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(1) Petroleum Press Service, London, November 1952, p.377.

The French Government has an interest in the Iraq Petroleum Company, through the Compagnie Française des Pétroles,(1) and in the refining industry, through the Compagnie Française de Raffinage, affiliated to the former.

The interest of United States, United Kingdom, Dutch and other companies in crude-oil production is shown in Table 21, which relates to 1952.

(1) The financial participation in this company is as follows:

	Per cent
D'Arcy Exploration (Anglo-Iranian Oil Company)	23.75
Anglo-Saxon Oil Company (Royal Dutch Shell Group)	23.75
Near East Development Group (Standard Oil of New Jersey 50% Socony-Vacuum 50%)	23.75
Compagnie Française des Pétroles (35% French State)	23.75
Gulbenkian	5.0
Total	100.0

Table 21

World Crude Oil[(a)] Production 1952:
Breakdown by Ownership

(in thousands of metric tons)

Location	United Kingdom and Netherlands		United States		Others		Total	
	Tonnage	%	Tonnage	%	Tonnage	%	Tonnage	%
North America	16,320	4.8	320,340	94.1	3,900	1.1	340,560	100
Latin America	36,870	30.4	67,440	55.6	16,940	14.0	121,250	100
Middle East	32,020	30.4	66,160	62.9	7,070	6.7	105,250	100
Far East	10,460	71.2	3,940	26.8	300	2.0	14,700	100
Western Europe:								
Western Zones of Germany	100		300		1,360		1,760	
Netherlands	360		360		-		720	
Others	60		-		580		640	
Total western Europe	520	16.7	660	21.2	1,940	62.1	3,120	100
Grand total	96,190	16.4	458,540	78.4	30,150	5.2	584,880	100
USSR and eastern Europe	-		-		55,500		55,500	
Total world	96,190	15.0	458,540	71.6	85,650	13.4	640,380	100

Source: The Petroleum Times, London, 4 September 1953.

(a) Including natural gasoline.

It will be seen from Table 21 that United States oil companies control 71,6 per cent of the world production of crude oil, British and Dutch interests 15 per cent and others only 13.4 per cent, of which the USSR and east European countries own 8.2 per cent. In the Middle East, the proportions have altered since 1951, when oil production in Iran dwindled to almost nothing.

The question of transport is of primary interest to the oil industry. Table 22 shows the ownership, by flag, as between oil companies and independently owned tankers.

Table 22

Analysis of Tanker Ownership by Flag

(in thousands of metric tons dead-weight, as at 31 December 1952)

Flag	Owned by oil companies	Independently owned	Total[(a)]
United States	4,644	2,295	6,939
Panama	1,359	1,747	3,106
Honduras	-	221	221
Others	498	221	719
Total Western Hemisphere	6,501	4,484	10,985
United Kingdom	4,470	1,509	5,979
Norway	120	4,589	4,709
France	590	703	1,293
Netherlands	750	136	886
Others	297	2,906	3,203
Total ECA countries	6,227	9,843	16,070
Liberia	440	870	1,310
Japan	64	575	639
Others	34	182	216
Total[(a)] World	13,266	15,954	29,220

Source: "Tankers Galore", The Economist, London, 1 August 1953.

(a) Excluding Government-owned tankers and vessels of less than 2,000 tons dead-weight.

The tonnage directly owned by the oil companies accounts for more than 45 per cent of the total. The independently-owned tonnages are to a great extent chartered on a long-term basis. Parts of the Norwegian and Greek tanker fleets form an exception to this rule. They provide a "buffer" service to all companies, which enables the companies to retain their fleet at levels where they normally can be fully used, while the marginal tonnage is available in times of pressure. Recently there has been a trend for independents to increase their share of the tanker fleet.

Pipe-lines also form part of bulk transport and these have been built from the Middle East to the Mediterranean in order to reduce costs of transportation from the Persian Gulf. Actually, the gain to oil transporters loading at pipe-ends results mainly in shorter voyages for their tankers, the charge for the piping of crudes being only slightly below the corresponding freight charge. These pipe-lines all belong to the big oil companies.

In the refining industry of western Europe United States companies own 24.5 per cent and the big oil companies control 68.8 per cent. A breakdown by control of west European refineries is shown in Table 23. The United States companies operating as refiners in western Europe are Standard Oil of New Jersey, Socony-Vacuum, Standard Oil of California and Texas Oil Company, the latter two operating together as Caltex.

Table 23

The Control of West European Refinery Capacity based on Planned Figures for 1954

(in thousands of metric tons of distillation capacity)

	United States companies	Royal Dutch Shell Group	Anglo-Iranian Oil Co.	Other private companies	State controlled	Total
Belgium	1,180	130	2,970(a)	1,360		5,640
Denmark	38	-	-	-	-	38
France	7,020	7,030(b)	4,000	1,880	6,950	26,880
W. Zones of Germany	2,110	1,100	1,240	6,780	-	11,230
Italy	4,730(c)	1,610		7,040	4,940(d)	18,320
Netherlands	1,550	8,750	-	-	-	10,300
Norway	50	-	-	-	-	50
Portugal	-	-	-	1,190(e)	-	1,190
Sweden	-	-	-	1,920	-	1,920
Switzerland	-	-	-	200	-	200
Turkey	-	-	-	-	330	330
United Kingdom	9,230(f)	9,220	10,940	550	-	29,940
Total	25,908	27,840	19,150	20,920	12,220	106,038
Percentage	24.5	26.2	18.1	19.7	11.5	100

Sources:- Oil and Petroleum Year Book (Third Report), London 1951.
- OEEC Third Report, Paris, 1953.

(a) Fifty per cent owned by Anglo-Iranian and 50 per cent by Petrofina.

(b) Forty per cent of Shell Berre owned by the French Company "Produits Chimiques et Raffineries de Berre".

(c) The two SARPOM refineries are owned jointly by Caltex and Fiat.

(d) IRON refinery (1,470 tons) is owned by AGIP (State-owned agency) and the Anglo-Iranian Oil Company 51 per cent and 49 per cent respectively. The two Stanic refineries (3,470 tons) are owned on a 50/50 basis by the Standard Oil Company of New Jersey and ANIC (State-controlled agency).

(e) One-third State-owned.

(f) The Vacuum Refinery (930 tons) belongs to Sacony-Vacuum and Powell-Duffryn on a 50/50 basis.

The final stage in the oil industry, the distribution of finished products, is mainly carried out by distributing companies set up and owned by the big companies. In addition to owning the distribution facilities (practically the whole stock of rail and road tankers as well as most of the storage capacity) these companies often have highly developed technical services which assist and guide customers in the use of their products. Some of them also sell oil equipment or are associated with engineering companies dealing with these products.

SECTION III - GOVERNMENT POLICIES TOWARDS OIL

In the early 'thirties, governments began to encourage the growth of national refining industries and France, Belgium, Germany and Italy took steps to enable their local refiners to compete on as equal a footing as possible with Mexican Gulf imported products. This protection was in the form of a preferential tariff for home-refined products, designed to cover (i) the cost of crude oil transportation; (ii) the higher processing costs per ton resulting from the smaller size of the refining units, which had to be adapted to the size of the market; (iii) the cost of crude oil storage necessary to minimize the danger of interruption of operations.

Since the war other motives have appeared, the most important of which has been the need to save dollars.

A detailed review of west European policies on oil would have to be the subject of a separate study, but the following comments give a general policy indication.

(a) Importing countries, such as the Scandinavian countries, Switzerland and Portugal, have in the main treated coal and oil on an equal footing, except on occasions when their trade relations have been involved.

Curtailment of oil consumption, whenever enforced, has been the result of dollar import restrictions. As more oil from non-dollar sources has become available consumers have been left free to decide which they prefer, coal or oil, and the question has become substantially a price issue.

(b) Italy is neither a coal producer nor an oil producer but in the early 'thirties took steps towards building a national refining industry. The size of the industry, which is now considerably in excess of the country's needs, was increased by a law, passed in 1932 and still valid, calling for a reserve capacity equal to 30 per cent of the capacity normally operated.

Furthermore, on account of the country's pattern of requirements which calls for a greater proportion of fuel oils than straight distillation of crude can produce, the erection of refineries freed from customs duties has been developed.

The Italian refining operations may be summarized as follows:

(i) Refineries working for inland and bunker consumption are allocated a tonnage of crude sufficient to provide for the country's light product requirements. This limitation in throughput prevents the refineries putting out all the fuel oil that the indigenous market could absorb.

(ii) Refineries freed from customs duties concentrate on the export of light products; however they operate in such a way as to be able to meet, within economic limits, the balance of the country's requirements of fuel oil. Until recently fuel oil had still to be imported but at present there is a surplus, not only of light products, but also of fuel oil, while a continuous shortage of middle products (gas/diesel oil) prevails. Pressure is being brought upon governmental authorities to approve projects for the development of the export of light products and increased output of middle products; this is of urgent necessity to the Italian economy. Consequently, the Italian refining industry is less likely to increase its output than to vary the pattern of production of different products. This is particularly so since the development of national resources in natural gas has taken spectacular strides forward in the course of the last three years, which has affected home consumption of fuel oil.

(c) Before the last war the United Kingdom took no steps towards building up an indigenous refining industry and has at no time adopted a special fiscal policy in favour of the refining industry. The fact that it has now become the most important oil-refining country in Europe arises mainly from the geographical position of the country in relation to north-west European markets as well as from the necessity to save dollars by importing crude oil from non-dollar areas rather than refined products from dollar areas; the closure of Abadan hastened rather than initiated the movement. This policy incidentally has resulted in an increase in the country's exports of processed products and in an improvement of the balance of its oil trade, which is however believed still to be in dollar deficit.

The import of refined products in 1952 amounted to only 25 per cent of inland consumption (which has doubled since the war) and consisted mainly of products which had been considered until recently uneconomical to produce at home, while exports represented 28 per cent of inland consumption figures. The exports of refined products during 1953 were worth £76.9 million, of which £39 million was accounted for by gas/diesel oil and fuel oil. The value of coal exports for the same period amounted to £70.8 million.

(d) In 1928 France initiated the development of a refining industry by granting its national refineries guarantees of market stability, in addition to preferential tariffs, but at the same time allowed the import of certain tonnages of refined products in order to prevent home refiners from monopolizing the market.

The tariffs based on fixed values were at the outset substantial but owing to successive devaluations of the currency in effect they have been progressively reduced. These were revised at the end of 1947 and fixed at the following percentages of a token c.i.f. value[1] for refined products:

	Per cent
Gasoline, white spirit, kerosene, lubricants	18
Gas oil, light fuel oil	10
Heavy fuel oil	3

In May 1951 and in April 1952 these import duties were reduced but, owing to corresponding increases in internal taxes, the price to the consumer remained practically unchanged.

Import duties are at present as follows:

	Per cent
Lubricants	15
Gasoline, white spirit, kerosene	10
Gas oils, light fuel oil	5
Heavy fuel oil	3

In the course of the year 1950 competition between liquid fuels and coal grew considerably and, under governmental auspices, an agreement was reached between interested parties which in effect limited the tonnages of fuel oil put on the market. Soon afterwards in 1951 the revival of economic activity rendered this agreement pointless but, since 1952, renewed competition between liquid fuels and coal has led to the imposition of a special tax of 750 French francs per ton on liquid fuels.

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(1) The token c.i.f. value of refined products is calculated in accordance with certain rules by a Commission composed of refiners and importers in equal number and is related to the average c.i.f. prices for imported refined products as recorded in the preceding month.

Finally, heavy taxation of gas oil restricts its use for heating, this the more so since compulsory blending with a fraction of heavy fuel prevents gas oil from being used in small heating plants.

(e) Western Zones of Germany. Before the war Germany's oil requirements were for the most part met by the import of finished products. After the war, however, as a result of changes in supply conditions, Western Germany went over to the import of crude oils which are processed along with home-produced crude. In June 1953 the oil taxation system was adjusted to meet the changed supply position, recourse having previously been had to various temporary expedients.

During the pre-war period the sole function of the oil taxation system was to protect the refining industry when it was processing home-produced crude oil. Over and above that, the level of customs duties was dictated by general revenue considerations. Under the new legislation customs duties are purely protective, whereas the fiscal interests are covered by the oil tax.

Since imported crude oils pay duty prior to refining, there is a draw-back system providing for the refunding of the duty paid on crude oil processed in Western Germany into products that would not have paid duty had they been imported in their finished state; e.g. bitumen and petroleum coke. A similar system applies to products the import duty on which is lower than that on crude oil, e.g. fuel oil, where the duty amounts to DM 15 per ton when the oil is used directly for heating purposes, as against DM 25 per ton when it is used in coking plants.

Recently, mineral oil residues, converted into gas by means of a chemical process, were freed from duty and tax.

(f) Benelux countries. The protection offered to the Benelux refiners has been based on a similar principle to that applied in the case of France, i.e. higher tariffs on refined products imported as such than on refined products produced in indigenous refineries and in the Belgo-Luxembourg Union the duty levied on imported refined products is higher than in the Netherlands. Nevertheless, as regards the Belgian consumer, petroleum products in Belgium are taxed at a lower rate (4.5 per thousand) than other sources of energy (4.5 per cent).

However under the terms of the customs union between the three countries, excise duties and other inland taxation have to be equalized and this has already been partially implemented.