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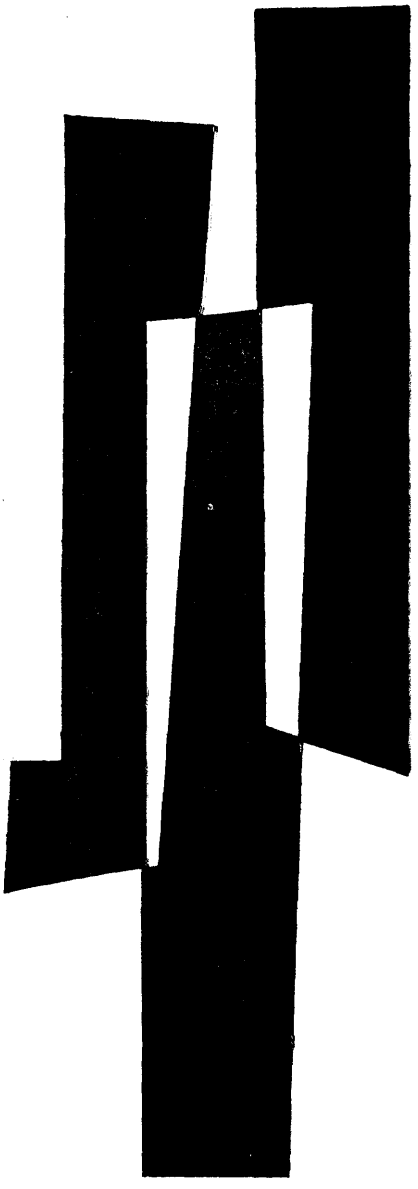

Review of the long-term energy outlook for the European Community

Recent developments, prospects for 1970, trends up till 1980

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REVIEW OF THE LONG-TERM ENERGY OUTLOOK FOR THE EUROPEAN COMMUNITY

Recent developments, prospects for 1970, trends up till 1980

Luxembourg, April 1966

FOREWORD

by P.-O. LAPIE, Member of the High Authority,
Chairman of the Inter-Executive Working Party on Energy

New features of the present study on the long-term energy outlook are, firstly, that it is not confined exclusively to the Europe of the Six but covers the wider field of the world energy economy, secondly, that it carries up to around 1980 the forecasts for the period 1970-75 worked out in 1960-62, and thirdly, that fuller account is taken than could be done in 1960 of the new element in the situation represented by Dutch natural gas, then only just beginning to be opened up, and a more accurate calculation offered of the probable share of nuclear power.

The basic underlying assumption and the method employed, however, are the same as before. The assumption is that of an expanding European economy. The method of forecasting is one which has done good service. Though known, it was little used at that time, and there was some doubt as to its suitability for this particular purpose. But, applied, subject to all possible safeguards and with the utmost caution observed in the interpretation of data and the allowing of margins of uncertainty, it produced forecasts which subsequently proved correct.

Nevertheless, there remain two major question-marks, both arising out of the quickening pace of discovery. The present study was on the point of completion when the strikes of gas in the North Sea and the signs of coming big technological changes in the use of nuclear power brought further alterations in the general picture of Europe's future energy situation. We therefore offer it simply as a contribution to thought on the subject, commenting on current developments and outlining the prospects for 1970 and trends up to 1980.

The great point which emerges from the study is Europe's future dependence on outside sources for its energy supplies. The extent of that dependence will vary according to the steps taken by the different countries to meet the situation and to the size of such energy resources as may be discovered within their territories. Rightly, the E.C.S.C. Council of Ministers has decided to commission a special investigation into the position as regards security of supply for Europe.

Coal, which did, unaided, afford it that security for over a century, is now, for various reasons, losing ground faster than we had foreseen. What were still regarded, when the previous study was drawn up, as coal's strongholds—the services sector, small industry, private households—are weakening steadily. It is open to question whether the thermal power-stations will continue as one of coal's big outlets when more and more of them are going over to oil. And that leaves the iron and steel industry—which incidentally consumes only one type of coal, coking coal. The present study is an effort to cover these considerations, whose grave implications of social hardship and difficult regional adjustment require long-term measures carefully thought out in advance.

If thanks to the opening-up of the new resources to which I have referred we achieve security of supply and cheaper indigenous Community energy, the already diminishing use being made of our coal could well shrink more drastically still.

On the other hand, the energy requirements of an expanding economy may by the closing years of the century have reached such proportions that all available fuels, including the oldest and most costly, will have to be thrown in to meet the staggering demand.

Like its predecessor, the present study is at pains not to suggest that events are bound to move in accordance with an inexorable destiny. On the contrary, it seeks by impartial analysis to cast light on what lies ahead in order to make it possible to influence developments. It is intended as an instrument to enable the industries, the Communities and the Governments to take appropriate action in time.

Action: the man of action is the man who refuses to be the plaything of supposedly "inevitable" forces, and acts. But he has to know what he is doing. To those at the head of European energy affairs, at grips with grave problems and working to resolve them, the Executives of E.C.S.C., E.E.C. and Euratom ask only to provide in this study the basis of technical data to serve as the foundation for their decisions.

CONTENTS

INTRODUCTION

The Study on the Long-term Energy Outlook for the European Community (referred to as the "Outlook" in this document) was originally written in 1961 and 1962, issued in preliminary form in December 1962 and published in its final, complete version in 1964. The authors feel that a review is now needed to include the most recent information on the subject and to allow for developments in the energy sector over the last four years. The opportunity will also be used to carry forecasts further into the future.

The term "review" clearly indicates the extension of an existing study and not a completely fresh report. The general concepts are the same, as far as possible comparable statistics are used and arguments which retain their full force are referred to rather than repeated.

There are three parts comprising:

- a short survey of recent developments;
- a study of conditions for balance in 1970;
- a brief review of supply and demand trends up to 1980.

Although the current position is systematically discussed in a detailed publication ("La Conjoncture énergétique de la Communauté") it was felt that a comparison of recent developments with the "Outlook" indicating where and how far the present situation can be regarded as temporary, might form a useful introduction to a study of medium and long terms prospects.

For the future, 1970 and 1980 should be regarded as landmarks only; we have no intention of trying to forecast exactly what will be happening then and will confine ourselves to discussing what the energy position may be like in a few years, in 1970 and later around 1980.

Two dates have been chosen because the problems to be faced and the means of dealing with them will be quite different. Production and consumption capacity in 1970 are determined by decisions which have already been taken to a very large extent and can only be slightly affected by additions or alterations; consequently, scope for action is limited to the economic conditions under which energy products are marketed. 1980 offers a much wider horizon, however, and action is possible in most directions. As will appear from this report, decisions to be taken in the near future will be quite different for the two dates; around 1970, the main concern will be to find outlets for coal but the longer-term problem will be optimum coverage of requirements.

The two dates must be considered together in order to prepare energy policy. Decisions aiming at a balance around 1970 will have long-term as well as immediate effects and steps must be taken here and now to ensure the desired pattern in 1980.

Finally, it must be made quite clear that this report merely sets out the results of technical and economic studies. Conclusions regarding policies are, or will be, reached in other documents.

CHAPTER I

RECENT DEVELOPMENTS

The Community energy market is at present characterised by a sharp increase in demand, abundant supplies and marked cost differences between the various sources of supply. Even allowing for Government restrictions, the supply pattern is being radically changed as a result.

Three outstanding features will be discussed in detail:

- Consumption of hydrocarbons has increased rapidly while Community coal has fallen back, both absolutely and relatively. In consequence, the share of imported energy in total supplies is rising.
- The main cause of this trend is the price differential between the various competing sources of energy, combined with the greater convenience of using liquid and gaseous fuels.
- The measures taken by a number of countries since 1958 to assist Community coal have radically distorted the relationship between the delivered-price and cost structures of the various forms of energy. Protection in the shape of import restrictions and internal taxes have so far been relatively effective against American coal but, in the case of petroleum products, have been gradually offset by differences between the untaxed prices for Community coal and those of oil products. This has led to further subsidies which have failed to prevent a steady deterioration in the financial position of Community pits.

Section 1

Changes in the pattern of energy consumption

As expected, the economic expansion of the Community has slowed down somewhat since 1960, with GNP rising by about 5% between 1960 and 1965 as compared with 5·5% over the previous ten years. *Total energy consumption* in the Community has nevertheless gone on rising by an average of about 5% per annum. Over the last five years demand has increased a little more quickly than was forecast in the "Outlook", with a difference of around 3·5% after correction of the relevant series of statistics. As appears from Table 1, the increase has not been regular, the very high consumption of 1962 and 1963 being due to the weather.

For at least ten years, and particularly since 1958, consumption of petroleum products have risen steeply, with far-reaching effects on the pattern of consumption. Over the last five years, the share of hydrocarbons (oil and natural gas) in the total has risen from 31% to 49%, while that of coal has dropped from 53% to 38%.

At the same time, imported energy's share in consumption has increased very sharply from 27% to 46%. While consumption has risen by 135 million m. tons h.c.e., Community energy output has fallen in absolute figures (alomost 15 million m. tons h.c.e.).

TABLE 1

Coverage of the Community's internal energy requirements

	'000,000 m. tons h.c.e.						% of total		
	1950	1960 (a)	1962	1963	1964	1965	1950	1960 (a)	1965
Total energy consumption	289	461	515	561	572	596	100	100	100
of which hard coal	213	245	249	254	237	224	74	53	38
brown coal	25	34	36	37	38	34	9	7	6
oil	30	126	175	207	240	270	10	28	45
natural gas	1	14	18	19	20	23	..	3	4
hydro, geothermal and nuclear energy(c)	20	42	37	44	37	45	7	9	7
Coverage by :									
a) Community energy	(257)	336				322	(89)	73	54
of which hard coal	(215)	236				201	(74)	51	34
b) Imported energy (b)	(32)	125				274	(11)	27	46

Source : High Authority energy balance-sheets.

General notes: 1) From 1964 onwards the statistics include consumption in West Berlin.
2) The figures do not include oil used in the manufacture of non-energy products.

Special notes: a) figures revised as compared with the "Outlook".
b) less energy exports.
c) including net imports.

In particular, outlets for Community coal have not increased but have rather tended to decline. Disposal difficulties which caused stocks to rise in 1958/59, were less in 1960 because the economy was running at a very high level. The problem was concealed by the very cold weather in 1962 and 1963 but reappeared in 1964 and became serious in 1965 when more than ten million metric tons were added to stocks during the year. Thus, despite coal production being cut from 234 million metric tons in 1960 to 218 million in 1965 (1), the full Community output was only disposed of when demand for energy was at a peak.

The main features of the last five years have, therefore, been the structural decline and cyclical vulnerability of Community coal, the rapid structural advance of petroleum products and their relative immunity to cyclical movements (at least as regards quantities) and a marked increase in imported energy's share of the market.

A more detailed picture is given by the figures for the main *consumer sectors* (Table 2 A).

(1) National statistics in million m. tons h.c.e. = 1960 - 229; 1965 - 211.

TABLE 2

A - Consumption by sectors

'000,000 m. tons h.c.e. (rounded figures)

	Total energy		Oil		Coal, Hard coal and coke	
	1960	1965	1960	1965	1960	1965
1. Iron and steel (1)	57	61	5	10	54	51
of which coke					(51)	(49)
2. Other industries (1)	91	115	32	69	39	25
3. Transport (1)	54	77	41	69	13	6.5
4. Domestic sector (1)	100	139	29	67	53	50,5
5. Electricity generation :						
of which hydro and nuclear power stations (5)	42	45	—	—	—	—
thermal power stations	75	107	6	24	46	55
6. Other energy producers and converters (1) (2)	37	44	13	28	36(4)	33(4)
7. Miscellaneous (1)	5	8	—	3	4	4
8. *Total internal consumption*	461	596	126	270	245	225

B - Overall balance sheet

'000,000 m. tons h.c.e.

1. Total internal consumption	461	596	126	270	245	225
2. Exports and bunkers	60	77	50	71	8	5.5
3. Non-energy products	11	27	11	26	—	—
4. Changes in stocks with converters and final consumers	— 0.4	— 1	—	—	— 0.4	— 1
5. Total disposals	531	699	187	367	253	230
6. Imports	201	387	176	350	18	29
7. Primary Community production	329	332	16	25	229	211
8. Changes in producers' stocks	— 6.5	+10.9	—	—	— 6.5	+11.5
9. Final difference (4)	+ 5	+ 8	+ 5	+ 8	—	— 1

Source: High Authority energy balance-sheet.

(1) Excluding electricity.

(2) Calculated as a remainder for total energy.

(3) Losses and coke ovens, gasworks' charges, own consumption of pits, coke ovens and gasworks.

(4) Line 9 = Line 6 + 7 – 5 – 8.

(5) Primary energy equivalent of hydro and nuclear electricity.

The amount of coal used directly for *rail transport* started to decline as long ago as 1952, when diesel and electric traction were introduced; this trend is still continuing rapidly in the Federal Republic of Germany but is partially offset by the use of coal to generate electricity.

There are two special points to note concerning *industries other than iron and steel.* Over the last few years energy savings have been less marked and demand has risen more than expected. At the same time, hydrocarbons which began to enter this sector in 1957/58 are continuing to do so very rapidly. They are now being used both to generate steam and to heat furnaces and are even extending to branches such as cement-making, traditionally one of coal's preserves. As a result, coal consumption has fallen particularly sharply in recent years, with a drop of one third in five years. The decline has even continued during "peak" periods of energy demand.

In the *iron and steel industry,* the outstanding feature is the stagnation of demand for coke since 1961, as the combined result of a slower increase in output and an unexpectedly rapid fall in blast-furnace input rates.

Energy requirements for the *consumer sector, services and small industry* are still rising rapidly with the growth of incomes and household expenditure over the last few years. The "Outlook's" assumption that demand would gradually be saturated does not appear to be proving accurate. In the case of coal there were wide fluctuations until 1964, reflecting temperature variations from year to year, but the average level of consumption was little affected; however, the estimates for 1965 suggest a decline which cannot be accounted for by cyclical factors and may mark the start of a new trend.

Power stations form the last main sector, where two trends are to be noted :

- expansion of conventional thermal production, owing to the relative stagnation of hydro-generation and delays in getting nuclear production under way.
- increased outlets for coal (over 20% in 5 years for all power stations), in marked contrast to the trend in other sectors. Although the authorities in some countires have encouraged the use of coal, liquid fuels account for 23% of the total input of Community power stations, with wide variations from country to country (Italy 78%, Netherlands 41%, Belgium 28%, France 20% and Germany 9%).

Some conclusions now emerge regarding the validity of the general trends outlined in the "Outlook":

1. Some *energy* requirements were under-estimated (other industries, transport and domestic sector) and others over-estimated (iron and steel), The net result is a higher figure for total requirements.
2. Far from slowing down, the tendency for *coal* outlets to contract has become more marked. Apart from thermal power stations, all the main outlets have been affected in turn, leading to difficulties in disposing of Community coal output.

There are several reasons for these difficulties :

- stagnation of the demand for coke from the iron and steel industry since 1961;

- economic growth and the increase in energy requirements have been relatively slower in regions close to coalfiels than over the rest of the Community;
- differences between retail coal prices and those of competing products, and particularly petroleum products. Except in France and Italy, natural gas has so far had only a limited effect;
- at equal delivered price per calorie, many coal consumers have changed to other products for reasons of convenience or quality.

With the growing concentration of coal outlets on thermal power stations, the third factor - relative prices - will in future be by far the most important. Special attention should, therefore, be given to existing price and cost relationships.

Section 2

Changes in relative prices of energy products

As a result of the changing supply pattern outlined above, *oil prices* have increasingly become the reference prices for the whole Community energy market outside the iron and steel industry.

The rapidly expanding markets of the Community were the first to reflect the falling trend of world prices for petroleum products. Heavy fuel oil prices reached rock-bottom as long ago as 1960 (Table 3) and have stayed at much the same level ever since.

Prices for middle distillates have fallen by 20 to 30% since the spring of 1964, due to changes in supply conditions following the arrival of Libyan crude with a high gasoil yield, the equipment of refineries with units giving higher gasoil yiels and competition from the first deliveries of natural gas in the Netherlands.

Inland tariffs for natural gas in the Netherlands suggest prices of about $ 12 to 13 per ton h.c.e. for large industrial consumers and $ 20 to 23 per ton h.c.e. for domestic heating.

The current price situation can therefore be summarised as follows:

$ 11 to 15 per ton h.c.e., inclusive of all taxes, for heavy fuel oil and natural gas for industrial use, with differences in national tax accounting for the range. Except in France, the corresponding untaxed prices range from $ 8 to $ 10 per ton h.c.e.

$ 20 to 25 per ton h.c.e. for household fuels (except light fuel oil in Belgium where recent tax measures have raised the price to about $ 30 per ton h.c.e.).

TABLE 3

Trends in fuel-oil prices at a number of Community centres (1)

($ per metric ton)

Year Date (summer-autumn rates)	Price per m. ton of fuel oil			Price per m. ton h.c.e.	
	Including all taxes	Tax	Before tax	Including all taxes	Before tax
I. Heavy fuel oil (large industrial consumers)					
– Hamburg (delivered price) November 1960	17.0–20.0	6.0	11.0–14.0	11.9–14.0	7.7– 9.8
November 1964	19.0–21.0	7.7	11.3–12.3	13.3–14.0	7.9– 8.6
December 1965	20.0–21.0	7.7	12.3–13.3	14.0–14.7	8.6– 9.3
– Rotterdam (delivered price) November 1960	13.5–15.0	1.0	12.5–14.0	9.4–10.5	8.7– 9.8
November 1964	16.5–17.0	3.0	13.5–14.0	11.5–11.9	9.4– 9.8
December 1965	16.0–18.0	3.0	13.0–15.0	11.2–12.6	9.1–10.5
January 1966	18.0–20.0	5.0	13.0–15.0	12.6–14.0	9.1–10.5
– Antwerp (ex-refinery) November 1960	20.0–24.0	6.0	14.0–18.0	14.0–16.8	9.8–12.6
Nov mber 1964	16.0–17.0	4.5	11.5–12.5	11.2–11.9	8.0– 8.7
December 1965	15.5–16.5	4.5	11.0–12.0	10.8–11.5	7.7– 8.4
January 1966 (4)	15.5–16.5	4.5	11.0–12.0	10.8–11.5	7.7– 8.4
– Dunkirk - Le Havre (ex-refinery) November 1960	22.5–23.5	2.2	20.3–21.3	15.7–16.5	14.2–14.9
November 1964	19.0–20.5	2.2	16.8–18.3	13.3–14.3	11.7–12.8
December 1965	18.0–19.0	2.2	15.8–16.8	12.6–13.3	11.0–11.7
– Genoa (ex-refinery) November 1960	17.0–18.0	5.0	12.0–13.0	11.9–12.6	8.4– 9.1
November 1964	16.0–17.5	5.0	11.0–12.5	11.2–12.2	7.7– 8.7
December 1965	16.5–18.0	5.0	11.5–13.0	11.5–12.6	8.0– 9.1
II. Light fuel oil (delivered price) (domestic heating)					
– Hamburg November 1963	36.3–39.2	3.3	33.0–35.8	25.4–27.3	23.1–25.0
November 1964	28.2–31.1	3.3	24.9–27.8	19.7–21.7	17.4–19.4
December 1965	28.0–30.0	3.3	24.7–26.7	19.6–21.0	17.3–18.7
– Rotterdam November 1963	40.9	0–1.0	39.9–40.9	28,6	27.9–28.6
November 1964	28.0–31.0	0–1.0	27.0–31.0	19.5–21.7	18.9–21.7 (3)
December 1965	25.0–28.0	0–1.0	24.0–28.0	17.5–19.6	16.8–13.7
January 1966	26.0–29.0	0–1.0	25.0–29.0	18.2–20.3	17.5–20.3
– Antwerp November 1963	38.0–40.3	6.0	32.0–34.3	26.6–28.2	22.4–24.0
November 1964	31.0–33.0	5.5	25.5–27.5	21.7–23.1	17.8–19.2
December 1965	31.0–35.0	5.5	25.5–29.5	21.7–24.5	17.8–20.6
January 1966	42.0–46.0	16–17	26.0–29.0	29.4–32.2	18.2–20.3
– Dunkirk - Le Havre November 1963	40,3	3.5	36,8	28,2	25.7
November 1964	35.0–37.5	3.1	31.9–34.4	24.6–26.2	22.3–24.1
December 1965	32.0–35.0	3.1	28.9–31.9	22.4–24.5	20.2–22.3
– Milan November 1963	29,3	7.0	22.3	20.5	15.6
November 1964	29.0	7.2	21.8	20.3	15.2
(fluido) (2) December 1965	25.0–26.0	7.2	17.8–18.8	17.5–18.2	12.4–13.1

Source: "La conjoncture énergétique", several years.

(1) Real prices of fuel oils are not known for certain because of the rebates allowed. The above figures are based on incomplete data; they are not fully comparable, either from year to year or between countries and only represent general trends.

(2) Fuel fluido (3° – 5° Engler) is heavier than the household or light fuel oil used in the other countries.

(3) Private domestic use; the duty on oil for other uses was about $ 6 up till 1.1.66 and is now $ 10. Price is increased by the additional duty.

(4) Following the duty increase of 1.1.66.

Lastly, prices have varied less on the motor-spirit market which is difficult and costly to enter. Prices at the pump have fallen only slightly and are still adequate for the integrated companies which have been working this market for many years. On the other hand, much higher rebates have had to be offered on wholesale contracts.

In the case of *American coal*, the c.i.f. price for tonnages freighted on a single voyage has risen by about $ 1 since 1960 and, before customs duty, now stands at approximately $ 12.50 for steam coal and $ 14.50 for coking fines (Table 4). The trend for single voyages is not reflected, however, in the post for bulk cargoes carried by large vessels. This price has fallen below the spot rate and must be something like $ 13 for coking coal and $ 11 for steam coal. American coal, before duty, can therefore compete with heavy fuel oil (tax paid) in coastal areas but not inland because of the additional cost of transport.

TABLE 4

Price of American coal freighted on a single voyage basis

(Smalls and coking fines, $ per metric ton)

Year (autumn rate)	Price f.o.b.	Atlantic freight charge	Price c.i.f. A.R.A.
1960	9.60	3.51	13.11
1963	10.41	5.01	15.42
1964	10.41	3.76	14.17
1965	10.47	4.04	14.51

Schedule pithead prices for the Community coal industry vary from field to field as follows:

- $ 15 to 17 for industrial steam coal and coking fines
- $ 30 to 34 for anthracite (Belgium $ 42).

Because transport costs for coal are relatively high, price differences between Community coal and competing products rise sharply as distance from the coalfield increases. Alignment on competing rices is costly and is applied to limited tonnages only.

As will be seen in Section 3, absolute *cost* differences between the various forms of energy are much bigger than price differences, but cost *trends* continue to influence price movements. The price of heavy fuel oils has been kept down while light fuel prices have been cut by higher productivity throughout production and distribution.

Yields have also been substantially increased in several coalfields. The forecasts for Germany and Lorraine in the "Outlook" have been exceeded, but progress has slowed down considerably in the last year or so (Table 5 A). Wages have moved in a different direction, with an average rise of 6.5 to 8.5% per annum (1) over the last five years and the sharpest increases during the last two or three (Table 5 B). The combined effect of these changes has been a marked, general increase in pit production costs despite ihe fact that Governments have assumed responsibility for special social security payments. Over the five-year period, the rise exceeded 10% in the Federal Republic of Germany, 15% in Belgium, 25% in France and the Netherlands.

(1) These remarks refer to nominal wages. With the general price rise in the Community the increase in real wages has been much less.

TABLE 5

A. Trend in o.m.s. in the coalmines

Coalfield	O.m.s. kg. for kg.			Average annual increase 1960 - 1965	
	Actual		Estimate in 1965 Outlook"	Actual	"Outlook"
	1960	1965		%	
Ruhr	2,181	2,895	2,700	5.8	4.3
Saar	2,013	2,740	2,700	6.4	5.6
Campine	1,778	2,102	2,350	3.3	5.5
Southern Belgium	1,452	1,697	1,760	3.2	4.1
Nord/Pas-de-Calais	1,562	1,662	1,680	1.2	1.5
Lorraine	2,580	3,239	2,850	4.6	2.0
Dutch Limburg	1,833	2,253	2,240	4.2	4.1

B. Trend in average direct hourly wages
(underground and surface)

Country	Index 1960 = 100						Average annual increase 1960 - 1965		
	Actual				"Outlook" 1965		Actual	"Outlook"	
								%	
	1960	1963	1964	1965 (1)	(2)	(3)		(3)	(2)
Germany (Fed.Rep.)	100.0	128.0	135.7	149.3	122.9	144.9	8.1	4.2	7.7
Belgium	100.0	119.1	127.3	137.5	117.1	136.9	6.6	3.2	6.5
France	100.0	123.8	134.5	143.0	121.7	146.8	7.4	4.0	8.0
Netherlands	100.0	122.3	140.0	150.6	114.8	140.5	8.4	2.8	7.0

(1) Provisional.
(2) Estimates at constant general level of prices.
(3) Estimates allowing for changes in general level of prices.

C. Trend in companies' production costs

(Basis: national currency)

Country	1960	1961	1962	1963	1964	1965
Germany (Fed. Rep.)	100.0	103.1	103.1	104.3	106.2	112.8
Belgium	100.0	97.2	99.9	104.4	111.6	116.0
France	100.0	108.1	112.9	127.1 (1)	120.5	127.7
Netherlands	100.0	99.0	108.3	113.9	122.2	127.0

(a) Estimated.
(b) Including effects of strikes.

As a result, price cuts introduced some years ago by certain coalfields either could not be maintained or have only been continued with increased assistance.

To sum up:

- there is a widening gap between prices of Community coal and those of competing forms of energy, with the result that disposals fell off immediately after the "peak" demand of 1962 and 1963 disappeared;
- the collieries' financial position is becoming worse;
- further aid is needed if output is to be marketed.

Section 3

Effects of protection and subsidies

The changes described would have been swifter still if the authorities in coal-producing countries had not taken a whole series of measures which can be summarised as follows:

Imported coal :

- customs duty of 20 DM in the Federal Republic accompanied by a tariff quota of 6 million metric tons; different types of administrative measure in France, Belgium and the Netherlands.

Petroleum products :

- inland consumption taxes varying widely from country to country: $ 2.20 in France and $ 7.70 in the Federal Republic on heavy fuel oils;
- organisation of the market with publication of pricescales in France, although the latter's effect is reduced by removal of the prohibition on rebates;
- voluntary limitation of sales by oil companies in the Federal Republic, at the suggestion of the authorities.

Community coal :

- financial assistance to collieries mainly by a reduction of social security charges.

All these measures have radically distorted the relationship between the cost and price structures of the various forms of energy; Community coal is sold below cost while petroleum products and imported coal are marketed at prices higher than cost.

The consequences of these measures can be analysed from two standpoints; first, their direct *effectiveness* and secondly the *additional cost* so created *for the Community*.

Barriers to coal imports have been largely effective. The $ 5 per ton duty imposed by Germany has so far proved prohibitive. In 1965, for example, imports amounted to only 7,300,000 metric tons and did not exceed the tariff quota, allowing for military deliveries amounting to 1,500,000 metric tons. Imports have also been held down or cut to a very

low level by the regulations enforced in other countries (1), with 11 million metric tons (including 7 million of coking coal) for France and Benelux (5 and 6 million respectively). Only Italian imports are rising and are now running at 10,500,000 metric tons which are needed to meet the growing demand from the iron and steel industry and to offset lower Community deliveries for which price alignment would be too costly.

Restrictions on the import of coking coal have worked directly and exclusively to the advantage of Community coal but have raised the cost of supplies to the iron and steel industry. In the case of steam coal, petroleum products have probably shared the benefits of import quotas with Community coal.

The policy of taxing *oil fuels,* adopted for different reasons by each country, has not appreciably slowed down the substitution of oil for coal. The consumption tax has been offset by higher coal prices and lower untaxed prices for liquid fuels (particularly light fuel oils over the last few years).

The position of the oil industry has been affected by changed market conditions reflecting the influence of institutional patterns on the intensity of competition. Cuts in costs at the various stages after production have kept the fall in profit margins within reasonable limits for the major integrated companies despite lower ex-refinery nett backs (2). These margins still appear to be fairly satisfactory except on the most depressed markets but the same does not apply to all the small and medium-sized companies which generally have a lower ex-refinery nett back and frequently do not buy their crude at cost. With the exception of the few companies which have managed to acquire very cheap sources of crude (mainly in Libya), profit margins often seem too low to finance expansion and sometimes even to guarantee survival.

Finally, distortions in taxation policy for the various petroleum products have inevitably given rise to difficulties.

In Germany, for example, the lower rate of duty on light fuel oils than on heavy types has created so large a demand for the former that substantial imports have been necessary to meet it. Conversely, the very high Italian duty on gas oil has so far prevented its being used as fuel and has resulted in the accumulation of surpluses.

As external and internal protection have proved increasingly ineffectual, at least in the case of petroleum products, the authorities have substantially increased their *financial assistance* to the coalmining industry.

By the terms of High Authority Decision No. 3/65, taken in implementation of the Protocol of April 21, 1964, financial aid given by Member States as compensation for "abnormally heavy" social security charges arising from changes in the colliery labour force are controlled at Community level. This decision also sanctions the payment of subsidies for rationalising collieries and adjusting the rate at which they are closed down, taking due account of regional and social considerations.

(1) Except during periods of temporary shortage, as in 1963.

(2) Ex-refinery nett back realisation is calculated by using untaxed ex-refinery price and the share of the various products in refinery output in order to determine gross revenue per ton of crude after processing at the refinery. Ex-refinery nett backs which vary with country, region and quality of crude, as well as with the operating company, are analysed in the annex on oil supply conditions.

Information from Governments shows that in 1965 compensation for "abnormally heavy" charges amounted to $4.20 per ton mixed in the Federal Republic of Germany, $4.70 in France, $5.40 in Belgium and $0.85 in the Netherlands.

Subsidies per ton mined ran at $0.40 in the Federal Republic and, $0.80 in France and Belgium.

Financial assistance is growing and spreading in the Community, while differences in the amount paid per ton in the various countries are narrowing.

Two comments may help to point the significance of these data:

- the figures quoted relate to action taken under the terms of High Authority Decision No. 3/65. Other payments, varying from country to country, are also made; they include financial assistance to some customers (to encourage the construction of thermal power stations and district heating plant) and certain Community coal hauliers, as well as payments to municipalities where miners live.
- it is clear that a substantial fraction of the charges at present met by the authorities are likely to continue for some time *after* production is stopped, because they relate to past and not current production. Closures would merely prevent *fresh* charges of this kind from being created by the engagement of new miners. Responsibility for past events will, of course, have to be accepted.

TABLE 6

Trends in financial measures to assist the coalmining industry under the terms of Decision No. 3/65

	$ per ton mined (2)	
	1960 (1)	1965
Compensation for abnormally heavy social security charges		
Germany (Fed. Rep.)	1.9	4.2
Belgium	3.1	5.4
France	1.0	4.7
Netherlands	.	0.8
Subsidies		
Germany (Fed. Rep.)	0.2	0.4
Belgium	0.5	0.8
France	0.1	0.8
Netherlands	.	.

(1) Estimated.
(2) Converted to $ at constant exchange rates.
$1 = 4DM
50B. Frs.
4.937Fr. Frs.
3.62florins

This increase in assistance has failed to check the deterioration of the collieries' financial situation, but the position varies quite considerably from firm to firm not only because of differences in winning conditions but also because losses on coalmining are offset in widely varying measure by profits from the same firm's other activities or by transfers from financially-linked companies.

Lastly, in 1965, as in 1964, the collieries' cash position was adversely affected by storage charges, particularly in the Federal Republic.

To sum up, the financial difficulties of Community collieries are increasing despite protection, more Government assistance and opportunities for offsetting losses in certain cases. With output at its present level, there is no immediate prospect of any substantial or lasting improvement.

The final point to consider, is *the effect* which energy policy measures over the last few years have had on the *rest of the economy*. One obvious consequence is higher energy prices for the consumer, who pays at least 4 dollars more per ton h.c.e. for his fuel at the point of production or import than he would if imported energy could be sold in unlimited quantity and without extra taxes. A less obvious, but more serious consequence is the cost which the community has to pay for channelling the factors of production to activities (coalmining) where, because of unfavourable geological conditions, their economic utility is markedly less than it would be in other sectors whose exports would cover the cost of additional energy imports. Coal could be imported at 12 dollars per ton h.c.e. and fuel oil could be obtained even more cheaply; in practice, tens of millions of tons of coal are mined at a cost of more than 19 dollars per ton on the basis of full costs and probably 2 to 3 dollars less on the basis of partial costs (1).

(1) A partial-cost calculation is made only for pits scheduled for closure. In such cases partial costs include only current operating costs with preparatory work, equipment and maintenance cut to a minimum.

CHAPTER II

CONDITIONS FOR A BALANCED SITUATION IN 1970

Trends from now until 1970 will in all probability confirm those observed over the last few years, with the cost of imported energy remaining stable and that of Community coal continuing to rise. In spite of a fairly big increase in requirements, Community coal will lose a substantial part of its market in the industrial and the domestic sector; at the same time, thermal power stations will only take more coal and thus partly offset the loss of other outlets, if sales to this market are backed by special financial assistance.

Section 1

Overall economic context

The survey carried out by the Working Group on Medium-term Economic Prospects, largely on the basis of studies made in member states, suggests that growth should continue over the period 1966 to 1970. The rate of expansion is likely to be slower than between 1950 and 1960 but similar to that of the last five years. Little additional labour is now available, but prospects for an increase in individual productivity were considered to be fairly good.

Thus, Community GIP[1]) is expected to rise by an average of 4·3% per annum from 1965 to 1970, with the rate slightly higher in Italy, France and the Netherlands and lower in the other countries.

The Group's studies also show that this rate of growth will not be easy to achieve. It calls for vigorous investment and full employment of the whole available active population, which means that it will be difficult to keep the general price level approximately stable, as it must be if the balance of payments is to be in equilibrium. Measures to release manpower and reduce production costs are therefore vital for expansion and the corresponding improvement of living standards.

Section 2

Probable demand for energy

In the *iron and steel industry*, the sharp drop in unit coke consumption at blast furnaces is likely to slacken somewhat over the next few years, but even so blast-furnace input rates can be expected to fall by a further 15% or so, from 700 kg. in 1965 to about 600 kg. in 1970. The iron and steel industry will continue to expand less rapidly than the economy as a whole; the General Objectives for Steel estimate that steel production may

[1]) Gross Internal Product.

rise from 85 million metric tons in 1965 to something like 95 million in 1970. The quantity of coke consumed by the industry (including sintering) would then remain around the present figure of 50 million metric tons. However, the construction of new plant to work rich ores near the coast will mean some transfer of the iron and steel industry at the expense of centres near to the coalfields.

TABLE 7

Internal energy consumption and upper and lower limits for coal outlets in the Community

('000,000 metric tons h.c.e.)

	Total energy '000,000 m. tons h.c.e.		Coal			
			'000,000 m. tons h.c.e.		% of total disposals	
	1965	1970	1965	1970	1965	1970
1. Iron and steel[1])	61	66	51	51	22	26–22
of which coke			(49)	(50)		
2. Other industries[1])	115	144	25	15–22	11	7–9
3. Transport[1])	77	109	6.5	3	3	1
4. Household sector[1])	139	165	50.5	35–45	22	18–19
5. Power stations						
of which hydro and nuclear	45	54	—	—	—	—
conventional thermal	107	153	55	65,5–79	24	33–35
6. Other producers and converters of energy[1])	44	52	33	26–29	14	13–12
7. Miscellaneous	8		4		2	
8. Total internal consumption	596	743	225	195.5–229		
9. Exports to third countries and bunkers	77		5.5	4	2	2
10. Non-energy products and changes in stocks held by converters and final consumers	26	—	—1			
11. Total disposals (Community and imported energy)	699		230	199.5–233	100	100

[1]) Excluding electricity – see also notes to Table 2 in Chapter 1.

Two points are to be noted concerning *other industries:*

- *a slower increase in the use of fuels;* the wave of technical innovations introduced between 1950 and 1960 is now becoming spent. While industrial production is expected to rise by a little over 5% per annum, the corresponding increase in fuel requirements is put at about 4·5%.
- *continued substitution between fuels.* Even when costs per thermal unit are the same, hydrocarbons have a very marked advantage for certain users such as the glass and pottery industries, which stopped using coal many years ago, and a less, but real,

advantage for other purposes, such as steam generation and the heating of cement ovens. With relative fuel prices as they are, the present division does not produce a balanced situation. Even if comparative prices remain stable, the drop in industrial consumption of hard coal and coke must therefore be expected to continue, from 39 million m. tons h.c.e. in 1960, to 25 million in 1965 and something between 15 and 22 million in 1970. The lower limit assumes a continuation of the trend observed over the past few years, while the upper limit would require a very marked slackening of the process of substitution, which would appear highly unlikely if relative prices remain unchanged.

On the basis of recent experience, the "Outlook's" estimate for the future requirements of the *household sector* has been raised. As living standards rise, consumers are installing more space and water-heating plant with no sign of demand becoming saturated. This being so, requirements may increase by almost 20% from 1965 to 1970. Consumption of liquid and gaseous fuels is rising sharply but there was no absolute drop in solid fuel consumption until 1964. On the other hand, the big decline recorded in 1965 suggests that convenience, combined with lower prices, will be of increasing importance in future, despite the fact that reluctance to convert plant is greatest in the household sector. Sales of natural gas are also destined to increase substantially in this sector, but consumers' behaviour in five years' time is difficult to forecast accurately. A range of 35 to 45 million m. tons h.c.e. is therefore suggested for 1970 for coal and coke together, as against 51 million at present, but the situation will have to be closely followed. There seems little likelihood, however, that the trend will be materially affected by a movement of relative prices in favour of coal; a slight slowing down is the most that can be expected.

Transport consumption will continue to rise quickly, with almost exclusive concentration on petroleum products.

Electricity sonsumption will increase rapidly, slightly more than doubling every ten years. Between 1965 and 1970, the main supply feature is the moderate rise in output from hydro power stations and those burning blast-furnace gas and brown coal; out of a total production increase of 180 TWh, these sources will provide only 30 TWh. Allowing for higher nuclear production (20 to 25 TWh), coal, fuel oil and gas will thus have to supply a further 125 TWh. Keen competition between fuels is now bound to develop in this sector. The margin where fuels can be shifted will be provided by the new power stations on the one hand and the alternative-fuel plant already in service on the other.

Assuming no large-scale conversion of existing plant, investment projects suggest that coal may supply something between 66 and 79 million m. tons h.c.e. and fuel oil between 56 and 43 million m. tons. The upper figure for coal disposals cannot be reached without further major support measures. Furthermore, the existence and commissioning of alternative-fuel plant introduce a substantial margin of uncertainty into these estimates. Existing plant of this kind, burning coal and one other fuel, represent a production capacity of about 10 TWh in the Federal Republic, 10 TWh in Belgium, 3 in France and 5 in the Netherlands, with a total fuel consumption of 10 million m. tons h.c.e. Any large-scale conversion of these plants would affect the lower limit but it is not easy to give a figure because many of the plants are not 100% interchangeable.

Overall, internal energy consumption should rise by 25% while coal consumption (Community and imported) could be anything up to 30 million n. tons less than in 1965.

These estimates for coal consumption are at present under consideration by several bodies and are therefore liable to slight modification. The overall adjustment is more likely to be downwards, particularly from the upper limit we have quoted.

Section 3

Energy supply prospects

The energy supply position in 1970 will depend on decisions already taken or in hand, which will affect quantities, and on the trend of production cost elements, concerning which assumptions can be made. The adjustment of supply to demand is discussed in the paragraphs which follow.

a) *Community coal*

Many decisions have been announced during the last few months, concerning production prospects for 1970.

In France, the Government's Fifth Plan puts output at around 48-49 million metric tons, indicating that while this is a "firm" target "it may nevertheless have to be revised in the middle of the period".

In Belgium, the Directoire charbonnier has recommended that the Government should cut production back to 15-16 million metric tons in 1970.

The Netherlands Government has announced that output must be expected to drop below the present figure of 11 million metric tons, with a reduction of about 30% by 1971-1972, according to the rate at which reconversion can proceed.

By the terms of the German rationalisation law, undertakings were required to declare their closure plans by 31st October 1964 in order to qualify for assistance. Allowing for announced closures and the counter-effect of using available capacity more fully at pits which are to remain open, companies' "anticipated" production can be put at 132 million m. tons h.c.e. More recently, however, much lower figures have been quoted, dropping to 115 million m. tons h.c.e. even before 1970.

In Italy, production may reach 1 million m. tons with the power station built in Sardinia in full operation.

The High Authority has only fragmentary information on cost trends, but some general conclusions are possible. There is still ample scope for improving yields, but present mining methods will have to be radically altered in some cases. Over the next five years, the increase seems unlikely to exceed 20% (even this figure will be difficult to achieve in some coalfields). Wages, on the other hand, are bound to rise at least as quickly as national output per hour worked, at a rate of some 5% in real terms (i.e. at constant general price level); nominal wages may rise a little more quickly, as they have over the last few years.

Even assuming fuller use of capacities at pits which are to remain open, nominal costs are therefore likely to rise by at least 3% annually, to give a total increase of 15% between 1965 and 1970, with variations from pit to pit. On the other hand, the calculation for mines due for closure should only take account of partial costs[1]) which are always lower than full costs, again with considerable variations from pit to pit.

b) *Oil*

The growth of production capacities combined with the size of reserves suggests that world supplies will continue to be plentiful. As hitherto, the Community will have a very flexible supply pattern, based on substantial refinery capacity and an active external trade. With this flexible arrangement, wide seasonal variations in demand can be covered.

As regards price trends, detailed analysis suggests that FOB costs of crude are unlikely to change; on the other hand, as newcomers consolidate and the fiscal advantages which some of them are reported to enjoy, especially in Libya, are eliminated, prices should show a slightly firmer tendency on the worst depressed markets, and margins should improve. Untaxed prices of heavy fuel oil at coastal refineries may therefore level off around $11·50 to 13·50 per metric ton ($8 to 9·50 per m. ton h.c.e.). After a very steep drop in recent years, prices of medium distillates may remain fairly steady.

With a capacity of some 400 million metric tons, operated at much the same rate as in 1965 (about 85% of capacity at the end of the year) refinery output is estimated at 340 million metric tons of finished products, from which 35 million tons of non-energy products have to be deducted. The coastal refineries will continue to be the most important and may export up to 35 million metric tons, to which over 20 million have to be added for bunkers, to give a total of almost 60 million metric tons. Against this, imports of finished products are likely to remain substantial. In all, therefore, some 260 million metric tons, representing almost 375 million m. tons h.c.e. should be available for the internal market (including refineries' own consumption).

Regional imbalances between supply and demand of refined products, caused by the construction of inland refineries over the last few years should be less marked. In the immediate future, no new inland refining areas are likely to be established and activity should be confined to extending those recently constructed.

c) *Imported coal*

The cost of purchasing American coal should remain amlost steady until 1970, with possible slight rises on FOB prices offset by increased use of large vessels. The price should be around $13-13·50 for coking coals and $11-11·50 for 7,500 kcal steam coal.

d) *Other sources of energy*

Production of brown coal and hydro- and nuclear electricity will be limited, with their total contribution rising from 74 million m. tons h.c.e. in 1965 to 88 million in 1970.

[1]) Partial costs are defined at the end of Chapter I.

As already explained, this would mean a total of about 375 million m. tons h.c.e. of oil reaching the market. Coal's remaining share would amount to 743 – 145 – 375 = 223 million metric tons h.c.e.[1]). It will be seen, therefore, that anticipated refinery capacities are consistent with coal disposals (imported and Community coal) nearer the upper limit of the range 200 to 233 million tons h.c.e.[1]). There is, however, a margin of uncertainty regarding imports of refined products, to the extent that these are not controlled. Finally, total coal disposals have to be shared between Community sources and imports.

In the light of this problem of quantities, it remains to consider what scope there is for action to create conditions which will favour the marketing of a *Community coal output* nearer the estimated upper limit for the various countries (something like 190 million tons or 185 million m. tons h.c.e.).

This calls for a review by sectors.

As regards the *iron and steel industry*, where total outlets will not vary much, the question is whether the Governments will maintain protection against American coal, with the consequent cost increase for an industry already known to be in difficulties on world markets, or whether they will favour a cut in prices of coke for the iron and steel industry; in the latter case, special aid will be needed to maintain Community coal disposals.

Disposals to *other industries* will be low and a big drop in relative prices would be needed to gain at most a few million tons.

Measures to limit imports of steam coal might perhaps check the drop in Community coal sales, but might at the same time assist fuel oil to some extent.

The drop in disposals to the *household sector*, due partly to psychological factors, cannot be reversed and might at best be slowed down by a change of a few dollars per m. ton h.c.e. in relative prices.

Furthermore, some sales are declining or will decline very quickly in regions whose energy supply pattern is being changed completely. This applies, for example, to parts of the Netherlands, Belgium, Germany and Northern France which will be supplied with natural gas for the first time. It is already the case in Southern Germany where the construction of refineries has been followed by spectacular price reductions, which could cut disposals from the Ruhr by as much as fifteen million m. tons h.c.e.

Overall, changes in relative prices are unlikely to have any appreciable effect on falling sales to other industries and the household sector. The difference between the upper and lower limits is, therefore, due much more to uncertainty concerning the rate at which plant will be converted than to any possibility of influencing the market.

The situation is rather different in the case of *thermal power stations*, where a limited number of large consumers have to be supplied. With the exception of pit power stations, they only burn coal if the price per calorie is such that the cost of generating electricity,

[1]) Clearly, the figures quoted apply only if the economic situation, water run-off and weather conditions are all average. In boom conditions, accompanied by cold weather and low run-off, disposals might well increase temporarily by several million metric tons; but no production programme can be based on the hope of a dry summer or a cold winter...

including capital charges, is no higher than with other fuels. They have a wide choice because of the amount of new thermal plant to be commissioned in the years to come, the availability of plant burning more than one type of fuel and the possibility of modifying plant to burn a cheaper fuel. In these circumstances, inertia can hardly be relied on to maintain coal sales, but conversely, any measure enabling producers to operate at the same cost with either coal or another fuel will help to maintain or open outlets for Community coal. The margin for deliberate action in this sector is therefore a little over 10 million m. tons h.c.e.

The foregoing considerations suggest that measures to aid Community coal sales over the next few years should differ appreciably from present policies. Because outlets vary, assistance has so far taken the form of financial aid, more or less geared to output, combined with taxes to raise the retail price of competing fuels to the consumer. As disposals are likely in future to be concentrated on the iron and steel industry and thermal power stations, which offer the sole hope of increased sales, it might be possible to reduce taxes and customs barriers on competing types of energy, while deliberately assisting disposals of Community coal to coke ovens and power stations; specific measures of this kind would be particularly effective in helping coal sales and would reduce the cost of energy to all users. These suggestions should be read in conjunction with the "Outlook", since they stress the importance of enabling the consumer to share the benefits of low energy prices and at the same time clearly specifiy the type of assistance needed by Community coal to ensure reliable supplies and a regular pattern of production and employment at the collieries.

Section 5

Problems of the oil industry

As already noted, with the possibility of a firmer price trend on the most depressed markets, the margins earned by the big integrated companies should be adequate to finance the industry's expansion and maintain the effort to diversify exploration. On the other hand, the position of some Community companies may raise a number of problems. With wide variations from company to company and country to country, these firms cannot make such big economies of scale and often have higher crude costs, either because their fields are less advantageous[1]) or because they buy from other producers. Finally, they are often handicapped by the institutions and taxation systems with which they have to deal. In particular, the fiscal systems of the Anglo-Saxon countries reduce the effect of an increase in taxes in the producing countries but Community companies generally have no such advantages.

The growth of the Community's oil industry, stemming grom oil's rising share in energy supplies, would be fostered by the promotion of economies of scale, high capacity-utilisation rates and encouragement to exploration in the Community and elsewhere.

[1]) Except those with access to the Libyan oilfields.

Section 6

Community energy balance-sheet

An energy balance-sheet for the Community in 1970 can now be sketched (Table 8):

- the lower limit for Community coal represents estimated potential disposals if present aid policies are continued;
- the upper limit represents potential disposals if inertia is strong among industrial and domestic users and Governments step up their aid, particularly for sales to the iron and steel industry and thermal power stations.

The present figure for imported coal has not been raised much except in the case of Italy; it would, however, have to be increased substantially if restrictions on the entry of American coal were lowered with no change in the current tax on fuel oil.

The limits for oil follow from those for coal.

Breakdown of the coverage of Community internal requirements shows that the share going to imported energy should increase from 46% in 1965 to 51% if Community coal disposals amount to almost 200 million m. tons h.c.e. and 55% with disposals of 170 million.

This calculation narrows the range quoted in the "Outlook" (Table 58) and increases oil's share in the coverage of requirements. The rise of some 60 million m. tons h.c.e. for oil is the result of three corrections:

- higher estimate for *total energy requirements* and attribution of the difference to hydrocarbons;
- adoption of the lower figure given in the "Outlook" for *imported coal*, because of the protective measures in force;
- the much narrower range for estimated sales of *Community coal*.

TABLE 8

Coverage of the Community's internal energy requirements in 1965 and 1970

'000,000 metric tons h.c.e.

	Community origin		Net imports[1]		Total	
	1945	1970	1965	1970	1965	1970
Hard coal	201[2]	168—198	23	32—35	224	200—233
Brown coal	32	36	2	2	34	38
Oil	25	28	245	370—337	270	398—365
Natural gas	22	47	(0.5)	6	23	53
Hydro and geothermal power	40	41	3	2	43	43
Nuclear energy	2	11	—	—	2	11
Total	322	331—361	274	412—382	596	743

(as % of total requirements)

Hard coal	34	23—24	4	4—5	38	27—32
Brown coal	5	5	0.5	—	6	5
Oil	4	4	41	50—45	45	54—49
Natural gas	4	6	—	1	4	7
Hydro and geothermal power	7	6	0.5	—	7	6
Nuclear energy	—	1	—	—	—	1
Total	54	45—49	46	55—51	100	100

[1]) Less exports: for coal 6 in 1965, 4 in 1970. See table 7.
[2]) Tonnages put to stock must be taken into account to calculate production.

CHAPTER III

ASPECTS OF A BALANCED SITUATION AROUND 1980

The Community and world economic background to any long-term view of energy problems contains many elements of uncertainty, but there is reason to suppose that growth will continue to be fairly rapid and estimates of energy demand are based on this assumption.

Production potential resulting from decisions already taken or virtually certain to be so will supply only a fraction of these requirements. Ways and means of covering future demand must therefore be considered. Even with rapidly-increasing production of natural gas and nuclear energy in the Community, substantial imports will still be needed, so that the supply position can only be considered properly in a world context.

Section 1

Future energy requirements

A – *Community energy requirements*

Forecasts of economic growth beyond 1970 have so far been isolated and rather incomplete, and have not given such a full and reasoned assessment as for the next five years. There are, however, several grounds for believing that output per man will go on rising fairly quickly:

- research activities will continue to expand and realisation of the need to remove obstacles to progress should help to expedite the introduction of new processes and the expension of new types of product;
- even with existing techniques there is scope for a substantial increase in average productivity. Productivity and efficiency still vary widely both between branches and between firms in the same branch. Consequently, in certain countries at least, quite a large part of the active population can still be transferred from low-productivity to high-productivity jobs; it may also be hoped that less efficient firms in a particular branch will tend to align themselves on the most efficient;
- lastly, the removal of obstacles to the movement of goods, capital and workers in the Common Market and the progressive application of common policies should lead to more efficient use of the factors of production and should gradually help us to catch up on the United States, where average output per man is almost twice as high as in the Community.

Allowing for these points and the fact that the economically active population will rise very little in Germany and by 0·5 to 1% per annum in the other countries, it has been

assumed that over the decade 1970 - 1980 the annual increase in Community gross internal product will be much the same as between now and 1970. Industrial production should continue to rise much more rapidly, particularly in the least industrialised countries of the Community.

a) By 1970, the Community *iron and steel industry* will still be a long way from absorbing the full reduction in blast-furnace fuel rates (particularly for coke) made possible by lighter burdens resulting from the use of rich ores, preparation of the burden, the use of large plant, the injection of solid, liquid or gaseous fuels instead of coke and higher blast speeds and temperatures. As plant must be modernised if the Community iron and steel industry is to continue competing with the newcomers to world markets, these technical improvements are likely to be widely adopted. The expected outcome is a drop of 25 to 30% on the blast furnace fuel rate of 730 kg. coke equivalent attained in 1965; the proportions of coke and other fuels will obviously depend on their prices and will differ from region to region; at Community level a figure of about 480 to 500 kg. of coke can be forecast as compared with 700 kg. in 1965.

Iron and steel production will rise but almost certainly less than between 1950 and 1960.

If these assumptions are correct, total coke consumption (including tonnages used for sintering and other purposes) should remain substantially unchanged.

b) Studies of likely technical developments in *industries* which use large quantities of energy have shown that the period 1950 - 1960 was rather exceptional. In the space of a few years, many technical improvements, including some dating back a number of years, were introduced, with a resultant sharp drop in unit consumption over the ten-year period followed by a slower decline. Prospects for the future appear much less promising. The possibility of a further wave of technical advances in energy consumption over the next 10 or 15 years cannot of course be excluded; but, in the light of fresh data, it seemed reasonable to raise the forecasts for 1970 and beyond and to assume that unit fuel consumption would fall only moderately between 1965 and 1980 (about 1·5% per annum as against 3·1% recorded from 1950 to 1960 for all industries other than iron and steel).

Assuming an annual increase of slightly over 5% in industrial production, the fuel consumption of industries other than iron and steel should therefore rise by 4% per annum, to about 205 million m. tons h.c.e. by 1980. Unless there is a dramatic change in relative prices, the drop in coal consumption already discussed will continue, so that around 1980 solid fuels may be covering only a small fraction of requirements; on the other hand, with the quantities mentioned as likely to be available, natural gas may be supplying 30% or more.

c) Forecasting is most difficult for the *household sector*. Fuel consumption per capita (760 kg. in the Community in 1965) is still far less than in the United States (1,870 kg. in 1963). However, the increase has not slowed down over the last few years, which suggests that the "Outlook" was a little premature in forecasting gradual saturation. The figure has therefore been increased to 220 million m. tons h.c.e. in 1980.

The breakdown between fuels will depend not only on comparative prices but also on the weight which consumers attach to convenience. As living standards rise this

factor will gain in importance; it would therefore seem reasonable to assume a steep drop in solid fuel consumption accompanied by a sharp increase for gas, which may cover almost 40% of requirements.

d) As more and more vehicles come on to the road, demand for *motor spirit* should continue to rise rapidly, and may more than double to reach 165 million m. tons h.c.e. by 1980.

e) With the expectation of swift technical progress in industry and increasing sales of domestic appliances, *demand for electricity* may well increase almost as quickly as over the last fifteen years. More specifically, other industries' requirements should be multiplied by 2·8 in 15 years while domestic demand will rise fourfold to give an overall increase of 290%, raising gross total consumption from 416 TWh in 1965 to over 1,200 by 1980. Expansion on this scale will, however, only be achieved if the relative drop in electricity prices as compared with the general price level can be maintained.

Another point of interest is that households' share in electricity consumption should advance from 26% in 1965 to 35% in 1980, with appreciable effects on the breakdown of earnings between high and low voltage sales and a bigger proportion of investments for the distribution side of the electricity sector.

f) The productive efficiency of *thermal power stations* burning fossil fuels may be expected to improve still further but possibilities in this direction are decreasing. Average consumption per gross kWh should thus drop from 2,820 kcal in 1960 to 2,530 in 1965 and 2,235 in 1980.

g) The Community's overall *energy requirements* are expected to almost double in fifteen years (+ 90%) from 596 million m. tons h.c.e. in 1965 to around 1,130 million in 1980. The average annual increase of 4·4% is thus very slightly higher than the figure

TABLE 9

Community internal energy consumption by sectors 1965 – 1980

	'000,000 m. tons h.c.e.		% of total		Average annual increase
	1965	1980	1965	1980	
1. Iron and steel[1])	61	74	10	7	1.3%
of which coke	(49)	(51)	(8)	(5)	
2. Other industries[1])	115	205	19	18	3.9%
3. Transport[1])	77	164	13	15	5.2%
4. Household sector[1])	139	220	24	19	3.1%
5. Power stations	152	386	25	34	6.4%
6. Other energy producers and converters[1])	44	81	8	7	3.0%
7. Miscellaneous[1])	8		1		
8. Total internal consumption	596	1.130	100	100	4.4%

[1]) Excluding electricity. See also notes to Table 2 in Chapter I.

suggested in the "Outlook" for the period 1960 - 1975. As indicated in the same document, the requirements of transport (15%) and power stations (34%) will account for virtually half the Community's energy consumption. The rapid growth of requirements assumed in this report is in fact due to the steep increase in demand from these two sectors.[1])

B – *World energy requirements*

The Community's energy problems in 1980 can only be analysed in a world context because hydrocarbons will inevitably have to be imported to cover most of its requirements.

The trend of world demand has therefore deliberately been estimated on the assumption of rapid world economic expansion, with a steep rise in energy requirements (Table 10).

In 1960, Community demand accounted for about 10% of world energy requirements amounting to 4,400 million m. tons h.c.e. The industrialised countries of the free world (Western Europe, North America and Japan) absorbed 2,500 million or almost 60% of all world energy. The developing countries took only about 10%.

With economic expansion in the free world running at 4 to 5% per annum, energy requirements should rise by about 4·5% annually, to reach 7,000 million m. tons h.c.e. by 1980, including 5,600 million in the highly-developed areas.

The forecast is least reliable for the developing countries. With the suggested figure, consumption per head would still be very low in 1980 but there would be a fairly rapid increase over the next fifteen years (6% per annum). A vigorous upsurge of economic activitiy in the least advanced countries – of which there is unfortunately no sign at present – might produce a bigger demand; for payments reasons, however, these requirements could probably only be covered if national production were high; the figures now proposed are therefore consistent with the production data given later in Table 16.

Although information for the Communist countries is very incomplete, demand is likely to go on increasing more rapidly than in the free world, as in recent years.

On the basis of these assumptions, world requirements should increase by about 4·7% annually as against 5·1% from 1953 to 1963, thus reaching 6,800 million m. tons h.c.e. in 1970 and 10,900 million in 1980.

These estimates largely confirm the figures produced by the Energy Committee of O.E.C.D., but indicate a smaller rise in Japan.

Despite increased demand from the developing countries and the Communist states, the industrialised countries of the free world will still account for over 50% of world consumption in 1980, with 10% going to the Community and almost 30% to North America.

[1]) *Global* extrapolations linking economic expansion and energy consumption tend to give lower figures (cf. Annex 1).

TABLE 10

Total energy requirements: 1960 – 1970 – 1980

('000,000 m. tons h.c.e.)

	Apparent internal consumption			Rate of increase (% per annum)		Total energy requirements (internal consumption and bunkers)			% of total requirements	
	1960	1970	1980	1953–1963	1960–1980	1960	1970	1980	1960	1980
1. Western Europe	810	1,245	1,835	+ 4.2	+ 4.2	845	1,300	1,920	19	18
of which Community	430	715	1.100	+ 5.5	+ 4.8	445	745	1,150	10	10
2. North America	1,555	2,240	3,130	+ 3.0	+ 3.6	1,580	2,270	3,170	36	29
of which United States	1,455	2,075	2,870	+ 2.8	+ 3.5	1,475	2,100	2,900	34	27
3. Japan	110	250	500	+ 8.6	+ 7.8	115	275	540	3	5
4. Total (1+2+3)	2,475	3,735	5,465	+ 3.7	+ 4.0	2,540	3,845	5,630	58	52
5. Latin America	140	270	520	+ 7.7	+ 6.8	155	295	555	4	5
6. Africa	70	100	165	+ 4.6	+ 4.4	75	110	180	2	2
7. Middle East	30	65	130	+ 9.5	+ 7.6	50	95	190	1	2
8. South and South-East Asia	110	200	360	+ 7.9	+ 6.1	115	210	380	3	3
9. Oceania	45	75	120	+ 4.1	+ 5.1	50	80	130	1	1
10. Total developing regions (5–9)	395	710	1,295	+ 6.9	+ 6.1	445	790	1,435	11	13
11. Total free world (4–9)	2,870	4,445	6,760	+ 4.0	+ 4.4	2,985	4,635	7,065	69	65
12. Communist countries	1,365	2,175	3,835	+ 8.3	+ 5.3	1,365	2.175	3,835	31	35
of which Soviet Union	605	1.100	1.790	+ 5.6	+ 5.6	605	1,100	1,790	14	16
13. Whole world	4,235	6,620	10,595	+ 5.1	+ 4.7	4,350	6,810	10,900	100	100

Source: UN, World Energy Supplies except for the Community (High Authority statistics). The statistics for hydro power have been adapted to UN formulas, with the result that the Community figures differ slightly from those in other tables.

Section 2

Community production

a) *Natural gas*

Even on a cautious estimate, natural gas will be making a big contribution to Community energy supplies by 1980.

Proved and probable reserves at present exceed 2 billion cubic metres,[1]) of which 1.8 billion have recently been discovered in the Northern Netherlands and Germany; geological conditions are so good in these areas that, on the basis of what is already known, the experts can count on on-shore reserves of at least 2½ billion cubic metres

in 1980. With favourable reports from the North Sea and further probable sources in France and Italy, the Community's natural gas reserves should reach at least 3 billion cubic metres in 1980. Assuming that the fields in the north of the Community will be worked for 25 to 30 years and the other fields more quickly, Community output can be put at 110,000 million to 130,000 million cubic metres.

A further 10,000 million to 15,000 million cubic metres (with a net calorific value of 8,200 kcal/m^3) are likely to be imported from North Africa. This is a modest estimate in relation to the reserves available in that part of the world (over 2 billion cubic metres); it is based on the higher cost of transport by tanker and the problems involved in building pipe-lines to Europe.

In all, therefore, the Community should have 120,000 million to 140,000 million m^3, or 130 to 160 million m. tons h.c.e. by 1980.

b) *Oil*

Discoveries within the Community have so far been relatively small, with proved reserves of slightly more than 300 million tons and a 1965 output of about 16 million tons, representing 75% of total West European production. Although several deposits are worth working because of their size and location, present geological knowledge does not suggest any major increase in reserves. The exploration of certain off-shore areas might produce discoveries of greater value, but there is no means of knowing in advance whether they will find oil associated as usual with natural gas or natural gas alone, because deposits differ according to their source and the way in which the original organic matter has been transformed.

Within the range of 35 million to 50 million tons suggested for Western Europe in 1980, Community oil production is forecast at between 25 million and 40 million tons of crude (approximately 30 to 50 million m. tons h.c.e.).

c) *Nuclear energy*

Prospects for increased use of nuclear energy in the Community are discussed in detail in documents recently issued by the Euratom Commission.

The "First Indicative Programme for the European Atomic Energy Community" suggests installed nuclear capacity of at least 40,000 MWe as the target for 1980. This minimum figure was regarded as extremely cautious by the various authorities concerned when they met at Venice and Stresa in April and May 1965, and this view was more generally confirmed when the Economic and Social Committee gave its opinion on February 24, 1966.

Meanwhile, programmes and intentions announced by most member Governments indicate a capacity of almost 60,000 MWe for the Community as a whole in 1980.

Annual production of nuclear electricity should be between 280,000 million kWh and about 400,000 million kWh, according to whether installed capacity is 40,000 MWe or almost 60,000 MWe.

These forecasts are based on the immediate ability of nuclear energy to compete with electricity generated at large thermal power stations used to cover the base load.

According to the previous version of the "Outlook", nuclear power stations with tested reactors which can be put into service around 1970 should be able to compete with conventional power stations burning fossil fuel costing 10 to 12 units of account per ton h.c.e. delivered to the power station. It will be recalled that the margin between these two figures was due to differences in interest rates from country to country (approximately 8, 10 and 13%) and in the annual plant utilisation periods used for purposes of calculation (6,000 and 7,000 hours).

Recent trends, confirmed by construction tenders in both the Community and the United States, suggest that these figures should be revised and that, at the high annual loads which may be expected[1]) from 1970 onwards, the threshold of competition will lie somewhere between 8 and 9 units of account and will certainly continue to fall beyond that date.

The so-called "advanced converter" reactors now in course of development will use a bigger proportion of the uranium's or thorium's fissile energy. The most promising models are the heavy-water and gas-graphite reactors. Cautious estimates indicate that the cost advantage of power stations equipped with this type of reactor over stations burning fossil fuels will be greater than that of stations with industrially-proved reactors.

Finally, major efforts are being concentrated on research and development work on fast-neutron breeder reactors in the Community, the United States, the United Kingdom and the Soviet Union. When ready they can be expected to make a vital contribution to solving the problem of fossil-fuel supplies; they will also be an excellent proposition from the economic standpoint. It is still too early to suggest with any certainty when these reactors will be ready for industrial production but the time now appears to be nearer than could be expected a few years ago, when it was put at 1980 to 1985.

On the subject of nuclear fuel supplies, Euratom has estimated the Community's uranium requirements on the basis of production running at 28 TWh in 1970, 280 in 1980 and 2,400 in the year 2,000. Two of the development models considered merit special attention: model I uses only proved reactors over the whole period while model IV uses advanced converters for the transition from proved reactors to fast breeders which should come into service in 1980 and should account for over half total capacity by the end of the century. The Community's uranium requirements would then be as follows, expressed in thousands of metric tons of natural uranium metal:

Period	*Model*	
	I	IV
1970 – 1979	64	54
1980 – 1989	176	122
1990 – 1999	412	156
Total	652	332

[1]) The planned output of 280 TWh in 1980 represents about 25% of total electricity production. This percentage should be set against the proportion of total annual consumption covered by the 7,000-hour load, which member countries' individual curves for 1964 put at about half the total. Failing any far-reaching changes in the pattern of electricity consumption, particularly as regards the relative importance of heavy consuming industries, experience over the past fifteen years gives no reason to think that the sahpe of the above curves will change significantly. It may be assumed, therefore, that in 1980 nuclear electricity will be generated by power stations running for 7,000 hours a year.

Reserves workable at a price not exceeding that normally used for estimating costs per kWh i.e. \$8 to 10 per lb. U_3O_8 were estimated as follows on 1st January 1964 in thousands of metric tons of uranium metal.

	Proved reserves	*Announced potential additional reserves*
United States	122	200
Canada	160	180
South Africa	112	–
Community	31	24
Other countries	55	12
Whole of free world	480	416

Allowing for the fact that world requirements may be four or five times greater than the Community's, it will be seen that known reserves will be exhausted by about 1985 and announced potential reserves by the end of the century. However, potential reserves workable at a price between \$10 and \$20 per lb. U_3O_8 are much bigger than the quantities workable at less than \$10. In Europe, for example, ores workable in this price range are known to include the Swedish shales containing some 700,000 metric tons of uranium.

Other points to be borne in mind include :

- because of the present uranium price of about \$4 to \$5 per lb. exploration has almost been brought to a halt:
- in order to cover uranium requirements which are bound to increase rapidly, prospecting should be resumed immediately; this will certainly bring to light substantial reserves workable at prices similar to the quoted figures of \$8 to 10 per lb. of U_3O_8;
- the price of uranium has relatively little influence on costs per kWh; whether enriched or not, natural uranium accounts for less than 10% of the cost per kWh generated at proved nuclear power stations. Thus, dearer sources of supply can be used without appreciably reducing the competitive advantage of nuclear power stations.

Lastly, nuclear energy can be regarded as a Community source from the standpoint of security of supplies, despite the fact that most of the uranium will be imported. The nuclear fuel required to produce a given amount of electricity already costs four to five times less than fossil fuel, and this advantage will become greater as techniques improve. Moreover, uranium does not come from the same countries as the fossil fuel, oil, which the Community imports in the greatest quantity. Again, uranium is easy and cheap to store. Quite apart from the fact that reactors can work independently from fresh supplies, it would cost far less to set up reserves for nuclear power stations than to provide equivalent reserves for conventional thermal power stations.

d) *Community coal*

There is still considerable scope for improving yields from pits already in use, but this will involve radical changes in the mining methods used at present. Concentration will be the main aim and will in many cases only be effective if steps are taken to combine two

This table calls for the following comments:

- the figures for brown coal and hydro power are fairly certain;
- the figures for natural gas represent a somewhat cautious estimate: the fairly narrow range allows for the possibility of offshore discoveries;
- the figure for nuclear energy is derived from estimates made by the Euratom Commission itself; its achievement depends on the adoption and firm implementation of the policy outlined by the Commission;
- the very wide range quoted for Community coal production is merely intended to show how dependence on imports is affected by coal production; if output drops to 100 million metric tons, which would still exceed the strictly competitive nucleus for 1980, dependence on outside sources, expressed as the proportion of imports in total consumption, exceeds 60%. To keep dependence below 50%, either the figures for other types of energy would have to be raised or Community coal output would have to remain around the figure of 185 million m. tons h.c.e. set as the target for 1970 by the High Authority. This would be extremely costly.

In any event, large tonnages will have to be imported, which means that close consideration will have to be given to world energy supply conditions around 1980.

Section 3

External supplies

The Community's ability to import energy can only be assessed after first considering the general coverage of world energy requirements in fifteen years' time. We shall therefore briefly discuss the world energy balance-sheet around 1980 before examining first the physical and economic conditions of oil and American coal production and secondly the factors governing trends in world energy prices.

A — *World energy balance-sheet*

Tables 12 A to D which appear later are not claimed to be forecasts, but represent possible alternatives showing the main features and principal magnitudes of the world balance-sheet.

A single set of figures has been used for requirements; they have already been given and are based on the assumption that the world economy will expand fairly quickly. For production, however, we must consider several variants corresponding to different concepts of energy policy in the United States and Europe; the main differences relate to oil production in the United States, energy production in Europe, the amount of American coal required and oil production in Africa.

a) *North American oil supplies*

At the moment, imports of oil to the United States are of course severely restricted by quota, as the Americans try to supply almost all their energy from domestic sources.

Current policy aims at covering the growth of requirements by discovering fresh reserves on a sufficient scale to maintain a constant ratio between proved reserves (genuine strategic reserves) and production. On this basis, imports may increase absolutely but not relatively. Exploration costs are tending to rise in the United States and, failing any major change in American oil legislation, will continue to do so as increasing American demand calls for bigger and bigger annual discoveries.

For example, if the United States wish to raise annual output from 436 to 660 million tons and still have a reserves/production ratio of 12 in 1980, they will have to discover 11,700 million tons of recoverable reserves from 1965 to 1980, as compared with actual discoveries amounting to 6,800 million tons between 1950 and 1965.

A cost ceiling is however imposed by the cost of extracting oil from bituminous sands and shales, which appears to be about $3 to 5 above that of producing oil at the moment but is likely to drop substantially over a period.

Exploration may also be supplemented by work in Canada, whose oil economy is linked with that of the United States.

The amount of exploration required to fulfil American policy is nevertheless likely to create major problems and the possibility of a change in policy to allow larger imports cannot be ruled out.

Two alternatives were therefore considered. First, it was assumed that the United States and Canada would increase their national production regardless of higher costs and would import mainly from the Western hemisphere. The second hypothesis was that North American production would rise more slowly, in which case production in South America, and more particularly Venezuela, would increase and some oil would be imported from the Eastern hemisphere.

The margin between the two alternatives was put at 100 million tons of oil for the United States and 50 million for Canada. There seemed no reason to take a higher figure, because of the United States' strategic interest in maintaining large internal supplies and their ability to carry higher costs with over 60% of all oil products consumed in the form of motor fuels. The lower production figure is based substantially on the quantity required for automotive purposes.

b) *Indigenous production in Western Europe*

The upper and lower energy alternatives for *Western Europe* are largely a reflection of different production forecasts for coal (maximum 410 million m. tons of brown coal). For nuclear energy the assumptions include the margin given in Table 11 for the Community and national or OECD forecasts for other countries. Finally, for natural gas the margin of 50 million m. tons h.c.e. (including 30 million in the Community) is intended purely as a guide and is largely due to uncertainty concerning the results of off-shore exploration.

c) *Imports of American coal*

The third alternative is concerned with whether Western Europe and Japan import larger or smaller quantities of American coal.

Taking low exports, it was assumed that sales of American coal to Europe would rise only slightly, with a bigger increase in disposals to Japan and Latin America. On this basis, net exports from North America are put at 65 million m. tons h.c.e.

Taking high exports, it was assumed that American coal would cover one third of Western Europe's requirements of coking coal (35 million m. tons) and 20% of requirements for power stations (80 million m. tons). With increased disposals to Japan also the total reaches 175 million m. tons[1]), which is well below the availabilities of 300 million m. tons h.c.e. estimated by the OECD.

d) *Oil production in Africa*

This will depend to a large extent on the amount of exploration undertaken in Africa by the industrialised countries. The high estimate for production is based on the effort to diversify these countries' sources of supply.

If all these hypotheses were taken in pairs, too many variants would have to be considered. Two of special interest have therefore been selected.

The first variant (alternative I) assumes high production in the industrialised countries, substantial diversification in sources of crude oil and high imports of American coal to Europe and Japan.

On this assumption, however, heavy exports of American coal would replace some domestic coal production in Europe and Japan. A downward correction is therefore necessary.

The second variant (alternative 2) combines low production in North America and Europe with low imports of American coal. This means that industrialised regions would import large quantities of hydrocarbons, particularly from the Middle East.

Lastly, for both variants, we assumed the Communist countries to be self-sufficient and allowed for no exports to the Western countries. We did so because of uncertainty concerning the extent of future trade with the Eastern countries and even whether it would show a surplus of imports or exports.

Alternatives 1 and 2 can now be summarised as follows:

First alternative	Second alternative
1. *General policy concept*	1. *General policy concept*
Policy of security at high-cost for the industrialised regions, based on internal production and diversification of oil imports.	Heavy imports of oil from the Middle East, where exploration is cheaper, but security problems are more difficult.

[1]) As coal is exported from the United States to Canada the figures for the former are: lower alternative: 85; higher alternative: 195.

First alternative	Second alternative
2. *Main features*	2. *Main features*
a) high oil production in North America.	a) low oil production in North America.
b) high American coal exports.	b) low American coal exports.
c) high internal production in Europe.	c) low internal production in Europe.
d) less adjustment (60 million m. tons h.c.e.) affecting either b) or c).	d) low hydrocarbon production in Africa.
e) high hydrocarbon production in Africa.	e) Communist world self-sufficient.
f) Communist world self-sufficient.	

These alternatives are only two examples. In both cases the margin between estimates is the combined result of:

1) *uncertainty concerning technical and economic conditions* on the world energy market in fifteen years' time. Oil exploration problems are typical sources of uncertainty in this respect;
2) the direction that *Government policy may take in third countries*, for example as regards opening the American oil market;
3) *the direction of Community economic policy*, for example as regards coal or nuclear energy.

All these factors are unlikely to act simultaneously at maximum force in the same direction. In our estimated figures, therefore, the margin between the two alternatives is not carried to its theoretical limit.

As they stand, these balance sheets indicate a few basic energy trends over the years to come:

- *a shortage of energy* in the industrialised countries, particularly Western Europe and Japan. The deficit will be at least, 1,000 million m. tons h.c.e. in the former and 450 million in the latter by 1980.
- *imports of Middle East crude oil* in either case. Under the first alternative only 1,300 million m. tons h.c.e. (1,000 million tons of crude oil) would be needed as against 340 million in 1960. Under the second, the figure would be more than 1,900 million m. tons h.c.e. (almost 1,500 million tons of crude oil).

In both cases, the result is also affected by our assumption that the Communist bloc will be self-sufficient. If there is a general increase in international trade with this part of the world and sufficient quantities continue to be available for export from Eastern countries, imports from the Middle East might be cut by 10 to 15% because oil would be imported from the Communist area.

TABLE 12

Outline world energy balance-sheet 1960 - 1970 - 1980

A. – 1960

('000,000 m. tons h.c.e.; rounded figures)

Area	Total requirements (internal consumption + bunkers)	Production	Balance Production-total requirement
I. *Areas of heavy consumption*			
1. *Western Europe*	845	545	— 300
of which hard and brown coal	520	480	— 40
oil	280	20	— 260
of which total Community[1])	445	300	— 145
hard and brown coal	280	260	— 20
oil	140	15	— 125
2. *North America*	1.580	1.440	— 140
of which hard and brown coal	380	400	+ 20
oil	670	510	— 160
of which total United States	1.475	1.365	— 110
hard and brown coal	360	390	+ 30
oil	615	475	— 140
3. *Japan*	115	60	— 55
of which hard and brown coal	60	50	— 10
oil	45		— 45
Total areas of heavy consumption (1 + 2 + 3)	2,540	2,045	— 495
II. *Developing areas*			
4. *Middle East*	50	350	+ 300
of which oil	40	340	+ 300
5. *Latin America*	155	290	+ 135
of which oil	120	255	+ 135
6. Other non-Communist areas	240	200	— 40
of which oil	90	55	— 35
7. of which *Africa*	75	65	— 10
oil	30	20	— 10
Total developing areas (4 + 5 + 6)	445	840	+ 395
III. *Total free world*	2,985	2,885	— 100
IV. *Communist world*	1,365	1,410	+ 45
of which Soviet Union	605	—	+ 45
V. *Whole world*	4,350	4,295	— 55

Source of statistics: UN World Energy Supplies except for Community. Oil production figures are converted to h.c.e. on the basis 1 ton of crude oil = 1.3 tons of coal.

[1]) After conversion of hydro power according to the UN formula of 0.125 kg. h.c.e. per kWh.

Outline world energy balance-sheet 1960 – 1970 – 1980

B. – 1970

('000,000 m. tons h.c.e.: rounded figures)

Area	Total requirements (internal consumption + bunkers)	Production	Balance Production-total requirements
I. *Areas of heavy consumption*			
1. *Western Europe*	1300	555/590	— 745/— 710
of which hard and brown coal	455/490	400/435	— 55
oil	725/690	35	— 690/— 655
of which Community	745	310/335	— 435/— 410
hard and brown coal	240/270	210/235	— 30/— 35
oil	425/395	25	— 400/— 370
2. *North America*	2270	2080	— 190
of which hard coal for internal requirements	515	515	—
hard coal for export	—	45	+ 45
oil	955	720	— 235
natural gas	745	745	—
of which *United States*	2100	1920	— 180
hard coal for internal requirements	490	490	—
hard coal for export		60	+ 60
oil	865	650	— 215
natural gas	705	680	— 25
3. *Japan*	275	70	— 205
of which hard and brown coal	80	55	— 25
oil	180	2	— 180
Total areas of heavy consumption (1 + 2 + 3)	3845	2705/2740	— 1140/— 1105
II. *Developing areas*			
4. *Middle East*	95	960/925	+ 865/+ 830
of which oil	80	940/905	+ 860/+ 825 (1)
5. *Latin America*	295	435	+ 140
of which oil	205	355	+ 150
6. Other non-Communist areas	400	535	+ 135
of which oil	195	325	+ 130
7. of which *Africa*	110	320	+ 210
oil	50	260	+ 210
Total developing areas (4 + 5 + 6)	790	1930/1895	+ 1140/+ 1105
III. *Total free world* (I + II)	4635	4535	—
IV. *Communist world*			
of which Soviet Union	2175		
V. *Whole world*	6810		

(a) Calculated as a remainder. This figure would be reduced by any increase in production in the non-Communist areas and any net imports from the Communist countries.

Outline world energy balance-sheet 1960 – 1970 – 1980

C. – 1980

First alternative – Low imports from Middle East

('000,000 m. tons h.c.e.; rounded figures)

Area	Total requirements (internal consumption + bunkers)	Production	Balance Production-total requirements
I. *Areas of heavy consumption*			
1. *Western Europe*	1,920	945	— 975
of which hard and brown coal		435	
oil	1,675	65	— 975
natural gas		200	
of which *Community*	1,150	560	— 510
hard and brown coal		225	
oil	1,005	50	— 590
natural gas		140	
2. *North America*	3,170	3,145	— 25
of which hard coal for internal requirements	725	725	—
hard coal for export	—	175	+ 175
oil	1,255	1,055	— 200
natural gas	985	985	—
of which *United States*	2,900	2,790	— 110
hard coal for internal requirements	695	695	—
hard coal for export	—	195	+ 195
oil	1,125	860	— 265
natural gas	910	870	— 40
3. *Japan*	540	100	— 440
of which hard and brown coal	100	55	— 45
oil	400	3	— 395
4. Adjustment to allow for effect of American coal on domestic production in Europe and Japan		— 60	— 60
Total areas of heavy consumption (1 + 2 + 3 + 4) - 4)	5.630	4.130	— 1.500
II. *Developing areas*			
5. *Middle East*	190	1,385	+ 1,195
of which oil	160	1,345 (a)	+ 1,185 (a)
6. *Latin America*	555	580	25
of which oil	405	445	+ 40
7. Other non-Communist areas	690	970	+ 280
of which oil	355	640	+ 285
8. *Africa*	180	625	+ 445
of which oil	75	520	+ 445
Total developing areas (5 + 6 + 7)	1,435	2,935	+ 1,500
III. *Total free world* (1 + II)	7,065	7,065	—
IV. *Communist world* of which Soviet Union	(3,835)		
V. *Whole world*	10,900		

(a) Calculated as a remainder. See note to Table 12 B.

Outline world energy balance-sheet 1960 – 1970 – 1980

D. – 1980

Second alternative - High imports from Middle East

(en millions de tec; chiffres arrondis)

Area	Total requirements (internal consumption + bunkers)	Production	Balance Production-total requirements
I. *Areas of heavy consumption*			
1. *Western Europe*	1,920	690	— 1,230
of which hard and brown coal		300	
oil	1,710	45	— 1,230
natural gas		135	
of which *Community*	1,150	400	— 750
hard and brown coal		140	
oil	1,040	30	— 750
natural gas		120	
2. *North America*	3,170	2,840	— 330
of which hard coal for hard coal for export	725	725	—
internal requirements	—	65	+ 65
oil	1,255	860	— 395
natural gas	985	985	—
of which *United States*	2,900	2,550	— 350
hard coal for internal requirements	695	695	—
hard coal for export		85	+ 85
oil	1,125	730	— 395
natural gas	910	870	— 40
3. *Japan*	540	80	— 460
of which hard and brown coal	70	35	— 35
oil	430	3	— 425
Total areas of heavy consumption (1 + 2 + 3)	5,630	3,610	— 2,020
II. *Developing areas*			
4. *Middle East*	190	1,975	+ 1,785
of which oil	160	1,935 (a)	+ 1,775 (a)
5. *Latin America*	555	670	+ 115
of which oil	405	535	+ 130
6. Other non-Communist areas	690	810	+ 120
of which oil	355	480	+ 125
7. *Africa*	180	490	+ 310
of which oil	75	390	+ 315
Total developing areas (4 + 5 + 6)	1,435	3,455	+ 2,020
III. *Total free world* (I + II)	7,065	7,065	—
IV. *Communist world* of which Soviet Union	(3,835)		
V. *Whole world*	10,900		

(a) Calculated as a remainder. See note to Table 12 B.

B — *Conditions of American coal production*

The most recent trends and studies confirm and strengthen the conclusions sketched in the "Outlook". While output is likely to rise slightly, real costs will tend tc fall and reserves of steam coal at least will remain plentiful.

In the pits, the potential increase in output may well be enough to offset higher wages in real terms; allowing for a slight increase in other costs, pithead prices can be expected to remain steady over the next fifteen years, even with an average increase in production.

As regards transport costs, the present trend is towards lower rail freight rates for deliveries of coal to thermal power stations, because of competition from other sources of energy and other means of transport (coal pipelines, high-voltage power lines); these lower rates are the result of rationalisation (full train loads etc.) and are a practical example of the substantial cuts in costs which have been forecast by experts for many years. There is no reason why these methods should not be applied to the transport of coal for export, if sufficient quantities are carried with sufficient regularity. Over the next fifteen years, it should certainly be possible to save $1.50 on the present rate of $4.50.

Lastly, on the Atlantic run, the rise in average cargo capacity should more than offset other factors which are liable to increase costs.

Thus, the real cost in real terms of coal delivered to Europe in 1980 should be similar to the figures for 1970 i.e. $13 to 13.50 for mixed coking coal and $11 to 11.50 for 7,500 kcal. steam coal[1]). This forecast is something like 10% lower than the figures suggested in the "Outlook", but will only be fulfilled if output rises moderately and steadily. On the other hand, an increase of the magnitude required for the first alternative is hardly likely to be achieved without any rise in costs. Output would, in fact, have to increase from 400 million m. tons h.c.e. in 1960 to 900 million (almost 1,000 million short tons) and the American coalmining industry is unlikely to be able to double its production without temporary bottlenecks and higher costs.

C — *Oil supply conditions*

Price formation mechanisms for oil products are highly complex. Quite apart from having to deal with joint products, there are other factors connected with the industry's varied structure and institutional changes, in both producing and consuming countries.

As a result, no precise forecast can be made for 1980 on the many questions here involved; at best, conditional replies can be suggested allowing for the trend of certain objective data and, more particularly, policy decisions which may or may not be taken in due course.

To limit the margin of uncertainty affecting long-term forecasts, the following points are better dealt with separately:

— the trend of cost elements which should be covered by the nett realisation of crude oil;

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[1]) When comparing with Community coal, it should be borne in mind that American coal often has a higher calorific value per ton.

– the principal factors likely to influence price formation and thus profit margins[1]).

This sub-section is exclusively concerned with the trend in various expense categories; prices are dealt with in the next section.

At any given time, the untaxed nett realisation of oil should be sufficient to cover a set of expenses made up as follows:

a) – all expenditure on exploration and the production of crude oil, comprising:
  – current operating costs;
  – the expenditure on exploring and developing deposits;

b) – production taxes;

c) – the full cost of transport, refining and distribution;

d) – a group of expenses comprising :
  – profits tax in the countries in which the head office and all subsidiaries are registered;
  – dividends to shareholders.

The above breakdown is not quite the same as that normally used in firms' accounts which show operating costs, tax and amortisation and then work out the profit margin. The whole depreciation provision is used, together with surplus profits after dividend and income from foreign loans, to finance the industry's capital expenditure. The concept of amortisation raises no complicated problems for operations after the production stage (group c), which are analysed in accordance with the standard accounting procedure outlined in annex 4; but expenditure on production and exploration has been included as such to avoid the complicated calculation of amortisation for these cost elements (group a) and to show clearly the effect of their uncertain trend.

a) *Expenditure on crude oil exploration and production*

Current operating costs

Current operating costs for crude oil vary from field to field and over a period. Taking figures for regions, the present average ranges from less than 50 cents per metric ton in the Middle East to about 2 dollars in North Africa.

A fair number of experts believe that, for a number of reasons, average production costs in the Eastern hemisphere should remain relatively steady over the next 15 to 20 years.

In the Middle East, with its enormous proved reserves, consequent high reserves/production ratios and characteristic production curves (very slight decline in output per

[1]) The profit margin is very difficult to determine because it is a joint result of the price situation on all markets, which itself depends on the amount of competition, and of cost trends. It therefore varies appreciably both over a period and from company to company, according to size, degree of integration, breakdown of production and markets. In practice, very little is known concerning profit margins and the present analysis merely seeks to indicate the supply factors which may affect the trend of total expenses over the next fifteen years.

well over the period under review at least wholly offset by technical advances), exploitation of the main deposits seems likely to go on supplying a very large part of the demand for crude.

In Africa, where deposits are smaller, the effect of lower production on average operating costs is likely to be negligible because new discoveries will be opened up.

The extension of offshore prospecting and development may however help to raise costs in these regions, although the amount of the increase should be cut by rapid technical progress with this form of working.

The introduction of secondary recovery processes may also increase this group of costs but the effect should not be great unless exploration fails to fulfil the high hopes of discoveries in these areas. In the opposite, and more likely, circumstance, the use of this process will be confined to fields where it can compete with primary production.

Expenditure on exploring and developing deposits

Questions to be considered include first of all the trend of world reserves because, while short and medium-term supply is determined largely by existing production capacity, the position will depend on reserves in the longer run. The world distribution of proved reserves, which are the only ones for which semi-official figures are available (Table 13), suggests that supplies will be much more plentiful in the Eastern than the Western Hemisphere. However, in assessing the consequences of this disparity, account must be taken of the meaning of "proved" reserves and the way in which they are calculated.

Proved reserves are hydrocarbons which can be recovered from known deposits under the technological and economic conditions ruling at the time of estimating. Assessment of a deposit's reserves depends basically on its size, productivity per well and recovery rate, which only become known as the field is developed and brought into production. Proved reserves are, therefore, revised upwards from time to time and the annual average increase is more the result of revised estimates and extensions of deposits than of fresh discoveries.

The constitution of proved reserves, forming the safety margin for future supplies, involves very substantial capital outlay which ceases to be justified above a certain figure, varying with the cost of exploration in different parts of the world.

It will, therefore, be understood why for almost 40 years the American oil industry has been satisfied with a fairly low annual reserves/production ratio (from 10 to 15, which is sufficient for 7 to 10 years production allowing for the growth of demand), particularly as exploration costs are very high and rising mainly for historical and institutional resaons.

Table 13 also shows that, by these criteria, the reserves/production ratio is abnormally high in the Middle East. This can be attributed to the discovery of exceptionally large and cheap reserves. Furthermore, the "proving" of 27,000 million metric tons form 1950 to 1965 is due less to fresh discoveries – the 7 deposits containing most of the 28,400 million tons of reserves recorded in the Middle East by the end of 1964 were discovered before

1950—than to higher revised estimates of known and partly explored deposits. These revised estimates, which are standard practice in the oil industry, have been especially instrumental in raising delcared Middle East reserves. It is not surprising, therefore, that the reserves/production ratio has been falling quickly in the Middle East for a number of years, as revised estimates and new discoveries represent only three to four times annual production which is rising continuously.

TABLE 13

Breakdown by areas of reserves on 1st January 1965 and gross increase 1950—1965

	Reserves on 1.1.1965 (thousand million m.tons)	(%)	Years of production at current rates	Gross increase in reserves 1950—1965 (thousand million m.tons)
U.S.A.	5.0	10.7	11.7	6.8
Canada	0.9	1.9	22.5	1.1
Venezuela	2.4	5.2	13.5	3.–
Rest of South America	1.2	2.6	21.3	1.5
Total Western Hemisphere	9.5	20.4	13.5	12.4
Western Europe	0.4	0.9	20.–	0.5
Africa	2.5	5.4	32.9	2.7
Middle East	28.4	61.1	73.4	27.–
Asia-Australia	1.6	3.4	50.3	1.7
Total Eastern Hemisphere	32.9	70.8	63.9	31.9
Total free world	42.4	91.2	34.9	44.3
Soviet Union, Eastern Europe, China	4.1	8.8	16.6	5.3
World total	46.5	100	31.8	49.6

The problem is, therefore, to determine the conditions in which the necessary technical measures will be taken to ensure that the 1980 reserves will be sufficient to cover a given number of years of future production.

It is here interesting to compare the reserves discovered from 1950 to 1965 with those which must be found between 1965 and 1980 to guarantee a reserves/production ratio of 15 to 20, which is roughly the figure considered as economically sound by the oil companies.

Table 14, relating to the free world, shows the reserves which must be discovered to meet two different targets, namely, 12 in the United States, 25 in the Middle East and 20 elsewhere, or 12 in the United States and 15 elsewhere.

TABLE 14

Volume of reserves to be discovered between 1965 and 1980 to reach certain targets for the reserves/production ratio

	Production ('000,000 m. tons)			Gross increase in reserves 1950–1965 (thousand million m.	Volume to be discovered[4] (thousand million m. tons)			
	1965	1980			Target A		Target B	
		(1)	(2)		(1)	(2)	(1)	(2)
United States	436	660	560	6.8	11.7	9.7	11.7	9.7
Canada	41	150	100	1.1	3.6	2.2	2.9	1.7
Venezuela	180	220	280	3.–	5.2	6.9	4.1	5.5
Rest of Western Hemisphere	59	120	120	1.5	2.6	2.6	2.–	2.–
Total Western Hemisphere	716	1 150	1 060	12.4	23.1	21.4	20.7	18.9
Western Europe	21	50	30	0.5	1.2	0.6	0.9	0.5
Africa	102	400	300	2.7	9.5	6.7	7.5	5.2
Middle East[3]	425	1 035	1 490	27.–	9.2	24.2	0.0	9.2
Asia-Australia	33	90	70	1.7	1.2	0.6	0.8	0.3
Total Eastern Hemisphere	581	1.575	1 890	31.9	21.1	32.1	9.9	15.2
Total free world	1 297	2 725	2 950	44.3	44.2	53.5	29.9	34.1

[1]) = high estimate of production in the industrialised countries.
[2]) = high estimate of production in the Middle East.
Targets: Maintenance of the following ratios between reserves and current production

	A	B
United States	12 years	12 years
Middle East	25 years	15 years
Other areas	20 years	15 years

[3]) The production figures for the Middle East have been obtained as balancing items.
[4]) "Volume to be discovered" means not only reserves from new discoveries but also increases arising from revised estimates, extensions and improved recovery rates.

For each of the above "discovery" targets, the two production alternatives discussed earlier in the world balance sheet have been taken into account.

This table can be summarised as follows:

	Reserves discovered from 1950 to 1965	Reserves to be discovered between 1965 and 1980			
		A		B	
		1	2	1	2
United States	6.8	11.7	9.7	11.7	9.7
Rest of Western Hemisphere	5.6	11.4	11.7	9.0	9.2
Middle East	27	9.2	24.2	0	9.2
Rest of Eastern Hemisphere	4.9	11.9	7.9	9.2	6.0
Total free world	44.3	44.2	53.5	29.9	34.1

It will be seen that reserves which must be discovered by 1980 range from one and a half to two and a half times the quantity discovered during the past fifteen years in the world excluding the United States and the Middle East, and from 1.4 to 1.7 times the amount discovered during the same period in the United States. For the Eastern Hemisphere, the volume to be discovered for target A, outside the Middle East, is between 1.6 and 2.4 times the figure for 1950 to 1965. This multiplication factor is roughly the same as the increase in oil consumption in the Eastern Hemisphere from one period to the other.

Considering next how maintenance of the proposed reserves/production ratios will affect the cost of exploration and development, a distinction must first be made between these two items, of which the former is much more likely to increase than the latter. In practice, however, it is often difficult to isolate research investment from outlay on development, as the boundary between the two activities is ill-defined and separate estimates of expenditure are not available. As an example, however, this analysis concludes with the results of an experimental breakdown of investment between exploration and development in the Middle East where the problem is specially important because the enormous reserves discovered in the area remain largely undeveloped.

No accurate calculation of this kind can be made for the whole world but the main magnitudes can be worked out from the data available.

Table 15, covering the period 1950–1965, gives an estimate, for major regions, of sums invested in exploration and development, the gross increase in reserves and investment per metric ton of proved reserves.[1])

TABLE 15

Estimated investment in exploration and development
Figures for the period 1950 – 1965

	Total investment $ thousand million	Gross increase in reserves thousand million m.tons	Investment per ton discovered $	Investment per ton produced $
United States	56	6.8	8.2	9.5
Rest of Western Hemisphere	15.1	5.6	2.7	4.9
Western Hemisphere	71.1	12.4	5.7	7.9
Middle East	3.2	27	0.12	0.93
Rest of Eastern Hemisphere	6.9	4.9	1.4	7.5
Eastern Hemisphere	10.1	31.9	0.32	2.3
Total free world	51.2	44.3	1.8	6.1
World, except United States	25.2	37.5	0.67	3.4

[1]) In some cases, the figure obtained by dividing investment for exploration and development by reserves discovered during a given period may be significant. This would appear to be the case for the whole of the United States, but the same magnitude may lead to mistakes in other regions. This is so, for example, for the Middle East where major revised estimates of reserves were made between 1950 and 1965 but the deposits in question were only very partially developed. In this case, therefore, a calculation distinguishing between exploration and development expenses is essential.

Investment per *ton discovered* clearly varies widely from region to region, from something like $8 in the United States to a minimal figure in the Middle East and an average of $2 for the rest of the world.

In order to keep the reserves/production ratio constant when production is rising, more than one fresh ton of reserves must be found for every ton extracted, with the value of the multiplying factor increasing when the reserves/production ratio and/or the rate of increase in production are rising. Over the last fifteen years, investment in exploration and development for every ton extracted was about $6 for the whole of the world and $3.50 excluding the United States.

For the future, the main factor of uncertainty is the trend of investment in exploration and development in the various areas of the world.

If investment per *ton discovered* remains constant, the required discoveries shown above would reduce investment per *ton produced* by about $1.50 under the dearer. A 1 alternative, both for the whole world without the United States and for the Eastern Hemisphere alone.

If, on the other hand, a substantial rise in investment per *ton discovered* is assumed for all regions – $11 in the United States, $1 in the Middle East and $4 in the rest of the world – total investment would be multiplied by 2.8 and investment per *ton produced* would rise by $1 for the whole world, for the world except the United States and for the Eastern Hemisphere. Companies' profit margins would be affected accordingly.

These assumptions of rising unit investments may appear to be close to the upper limit of the possible range, since any estimate of future investment in the Middle East based on a calculation which differentiates between exploration and development expenses does not give quite the same results as those quoted above. The estimate of future costs in the Middle East is based on two assumptions:

- maintenance of unit investments at the same level as during the reference period;
- unit investments increased twofold for development and tenfold for exploration. In practice, doubling unit investment for development when production curves are falling would mean an almost threefold increase in the number of wells in active production. The expert view is that this would be impossible for the main Middle East deposits during the period under review.

Total investments in exploration and development are expressed per *ton produced.* As production will expand more slowly over the coming years (6·2% and 8·4% as against 12%), investment per *ton produced:*

- will be lower than during the reference period if unit investment is maintained at the previous figures of 40 cents per m. ton or 30 cents per m. ton, depending on the estimate of production;
- will increase very moderately if unit investment rises by 10 cents, or 60 cents, per metric ton.

A further comment is required on this point. The argument is based on the average for the period 1965 – 1980, which is, in fact, characterised by a progressive fall in the reser-

ves/production ratio. It may, therefore, be helpful to consider what the position is likely to be at the end of the period. Assuming that production will continue to follow the rising pattern anticipated for the closing years of the period; expenditure per ton produced will probably be from $1 to $1.50 higher than the calculated average for the period.

b) *Fiscal charges on production*

There have recently been a series of developments which cannot easily be summarised into a single trend. A number of outstanding features may be noted, however;

- keen competition between producing countries and high world production have prevented any substantial increase and have even induced some producing countries to accept a lower rate of tax per ton. Taxes have remained fairly steady in Venezuela, but the Middle East agreement on expensing of royalties has resulted in a rise of 30 cents per m. ton, with an increase of about $1 per ton in some new contracts;
- most new contracts reflect the producing countries' desire to take part in the exploitation of their oil resources, on terms and conditions which vary widely from country to country.

Only a very moderate rise in fiscal charges is to be expected over the next few years but any estimate of longer-term trends must take account of all factors affecting the world energy market. This point will be considered later.

c) *Total cost of transport, refining and distribution*

The expected slackening of the growth of demand in many parts of the world will reduce expansion investment per ton consumed, the unit investment being unchanged. This trend will certainly affect investment in transport, refining and distribution, where less self-financing may be required, as more capital is available from outside sources.

Sea transport. Recent trends in this sector confirm the analysis in the "Outlook". The composition of the fleet is changing more quickly than anticipated; new vessels coming into service are all big, so that average tanker size is increasing and will continue to do so; a rise from 27,000 tons dwt in 1964 to 38,000 tons in 1970 is expected and the trend will continue.

Over the next fifteen years, therefore, the cost of sea transport is likely to fall by between 50 cents and $1 on average for traffic concerning the Community.

Refining. Technical advances in the refining industry have allowed a substantial cut in the figures quoted in the "Outlook" with no change in capacity. Depending on the crude used, the cost per ton for topping and reforming only, lies between $3 and $4 for a new 4-million ton refinery (average in the Community). Further increases in unit capacity and continued technical progress will save at least 50 cents over about ten years (on the most likely assumption that the pattern of refining will be little changed).

Inland transport and distribution. Similarly, advances in inland transport and increases in quantities distributed will keep distribution costs steady or even allow a slight reduction.

In all, the cost of transport, refining and distribution may drop by $1 to $2 per metric ton of crude.

d) *Overheads and profits tax*

Overheads and technical research expenses per ton should not vary much.

Taxes on profits and distributed dividends will largely depend on the market trends discussed hereafter but the rate per ton may well remain fairly close to the level of the last few years.

Recapitulation. On the basis of the foregoing analysis of the various elements of expenditure, the overall position per ton of crude used can now be summarised. It can be concluded with some certainty that items accounting for more than two thirds of the untaxed realisation on crude delivered to consumers in the Community will show no change or will be reduced. Against this, uncertainty regarding geological conditions may lead to an increase in investment per ton produced, affecting margins by an amount of $2 to $3 by the end of the period.

Policies and market conditions are other sources of uncertainty which are discussed in the next section.

Section 4

Prices and market balance

In proceeding from this cost analysis to a price analysis, two major obstacles are encountered:

- production costs vary widely from region to region;
- with the relatively small number of producers there may be opportunities for exploiting monopolistic positions, with a wide margin between costs and prices.

No attempt will therefore be made to forecast price levels fifteen years hence but merely to outline the main elements likely to affect the formation of prices. In this context, it is most instructive to consider price trends over the last decade.

a) *Price trends over the last ten years*

For almost ten years prices of petroleum products have been falling steadily except on the North American market. This movement, which has been particularly marked in Europe, derives from fundamental changes in the pattern of world supplies, substantial cuts in costs and intensified competition, following changes in the structure of the industry and in the world political climate.

Lower costs are due partly to considerable technical advances at all stages of the industry, and particularly in sea transport and refining where bigger size has been mainly responsible for savings; they are due to a much greater extent to the opening up of enormous deposits of crude which can be worked very cheaply. The Middle East is of course

primarily concerned, but increasing discoveries in Africa have also played an important part; because of their geographical location and the fiscal advantages sometimes existing during the initial stages of operation, some African deposits have proved cheaper than the Middle East as a source of supplies for Europe.

These cost reductions would not have been reflected in prices if sharper competition had not changed the structure of the industry. The Middle East's extraordinary oil wealth had, of course, been known for many years but had been very strictly controlled by a few big companies. During the fifties, therefore, the European price structure was still geared to supplies from the United States, when imports were really being switched to Caribbean and, preponderantly, Middle Eastern sources of supply. The effects of increased competition only appeared slowly, following changes in American and British holdings after the second World War (1947), the entry of American independents into the Iranian consortium in 1954, the granting of concessions to more companies in Venezuela, the development of Community companies and the resumption of oil exports from Russia.

Yet the very keen competition which has developed, mainly since 1958, on the markets for both crude and finished products, is not solely due to more companies having entered the market; it is aldo, if not mainly, due to differences between the various companies, chiefly as regards the relationship between reserves (or potential production) and outlets. Some companies have used a very strong financial position or, in certain cases, differential rents as a basis for major efforts to extend their outlets or increase production. One result has been a sharp drop in prices on rapidly expanding markets, particularly in Europe where the increase in oil consumption was favoured by rapid economic growth and very active substitution. The second objective has produced very keen competition to obtain new concessions, both in established areas such as the Middle East, where exploration is limited by the size of existing concessions and in new, but very promising regions, such as Africa. The producing countries which gained their independence after the second World War, have profited from these circumstances to increase their revenues and their direct holdings in the industry when new contracts were negotiated or old ones revised. The consequent cut in margins has been a major stimulus towards rationalisation and technical improvements designed to bring down the costs discussed earlier.

The recent and present situation is therefore characterised by:

- over-supply;
- further geographical diversification of exploration.

The rather vague but very common expression "over-supply" in fact means that certain fiels could be developed without any marked rise in costs and that their output could be substituted more cheaply for oil from deposits which are producing but relatively dear to operate.

Again, even while the figures for Middle East reserves were rising by several thousand million tons every year, fresh projects were being launched. Oil companies already operating in the Middle East were joined by new undertakings in exploring other territories and developing fields which were in some cases less remunerative. Despite the reductions which have taken place, current prices seem to offer scope for such activities, which are

sometimes encouraged by deliberate Government action to diversify sources of supply and partly financed by equalisation between areas within the same company. In other words, the present level of prices still ensures a wide enough margin to attract capital for development outside the richest fields. As a result, a substantial differential profit is earned on Middle East oil.

These factors explain why, despite over-supply, exploration and production are continuing simultaneously in regions with very different costs.

At the same time, the price cuts recorded over the last ten years or so can be attributed to a number of factors working together:

- the known existence of vast deposits in the Middle East which are very cheap to operate;
- competition due to companies' unequal possession of oil reserves and distribution networks for refined products;
- emergence of the rapidly growing European market for energy, which the established suppliers, mainly of coal, have been unable to satisfy.

b) *Prospective price trends*

What probability is there of a further reversal of the situation?

In order to answer this question we must first consider how lasting the factors which have brought prices down since 1958 are likely to be.

Future developments will depend primarily on the outcome of the race between increasing oil consumption throughout the world and the growth of proved recoverable reserves. Supplies will remain plentiful if fresh, cheap reserves are discovered on a large scale over the next fifteen years and revised estimates of Middle East deposits continue to rise at the same rate as hitherto; but this possibility cannot be used as a basis for an energy policy and it would be wiser to assume a gradual return to a position where reserves are sufficient for 20 to 25 years production. Such a ratio will not impair future supplies but, by the industry's standards, will in itself no longer be liable to intensify competition which will henceforth depend more on the number of producers and the structure of the industry.

Reference must also be made to changes in demand over the next ten years or so. The replacement of coal by oil will continue in the years to come. By about 1975, oil will have been adopted wherever it can be used to advantage by the iron and steel industry, industry as a whole, the household sector and transport, not only in the Community but throughout the world. It will also have taken the place of solid fuels in the generation of manufactured gas wherever local supplies of natural gas are insufficient to cover the demand for gaseous fuels.[1]) By then, the demand for oil will no longer be growing as quickly as it is at present under the stimulus of substitution; expansion will be slower and will be governed mainly by economic growth and the rise in living standards. Reverse

[1]) Hydrocarbons will also predominate in the production of peak gas supplies, wherever a regular supply cannot be ensured by underground storage and non-continuous contracts.

substitution in the sectors named could only be started if prices changed radically against oil; power stations are the only sector where competition is likely to be affected fairly appreciably by prices.

The main features of the energy balance-sheet for 1980 are therefore the predominance of petroleum products in covering demand, with a share of at least 50% both for the Community and the whole of the free world, and the very narrow margin available on other forms of energy;

- by 1980, planned nuclear production should be covering from 8 to 11% of Community requirements. The high estimate is 35 million m. tons h.c.e. above the lower limit and allows for a major scientific and technical effort; it is unlikely that much more oil could be saved by stepping up these efforts, since the margin for the whole world cannot exceed about one hundred million m. tons h.c.e.;
- the margin on American coal is significant, amounting to 100 million and at most 200 million m. tons. This figure is small compared with an oil production running at 3,500 million m. tons h.c.e., but much more substantial at European level, where it represents 10 to 20% of import requirements. However, if oil prices rise, Europe will not be the only customer for this coal, unless deliveries are guaranteed under firm, long-term contracts negotiated well in advance;
- the margin on European coal production is around 100 to 150 million metric tons, at very high cost for the last twenty or so million (as pointed out on page 59, the whole of this margin cannot be added to the previous one);
- intensified exploration within the Community may reduce the need for imports.

On the second of the two alternatives considered, half of all the oil produced by the free world and almost 90% of supplies to the world oil market come from the Middle East. The shares for the first alternative (two-fifths and four-fifths) are lower but still very substantial. The dominance of a few countries in this part of the world, together with the relatively small number of companies in the market – even though they vary greatly as regards reserves, distribution networks and financial resources in general – certainly does not favour the spontaneous maintenance of competitive conditions which would ensure a price trend not very different from that of costs.

A well-balanced situation in world energy with prices moving in the same direction as costs must therefore be sought through a continuous series of both institutional and policy measures and directed to points in the market liable to be upset by disturbing factors.

CONCLUSION

In general, the preceding analysis confirms, and even strengthens in certain respects, the conclusions set out in the "Outlook" for the period reviewed. Despite rapidly growing requirements, both within the Community and elsewhere, plentiful supplies of energy products (oil and coal) throughout the world and keen competition between companies supplying the market should in the next five to ten years prevent the untaxed price of imported energy from rising much above the present level unless unforeseen snags arise. As the gap widens between the cost of Community coal and the price of competing products, the Community coal industry will have growing difficulty in disposing of its output unless fresh measures are taken. The longer-term prospects are more uncertain; as the time limit is pushed further into the future, our knowledge and information become less reliable and complications appear regarding the trend of the energy market itself. There are a number of potential sources of cost increases, particularly in connection with exploration for oil; with imports playing a growing part, maintenance of the present price/cost relationship will largely depend on the energy and general economic policies of the Community and the world in general.

At least half of the Community's requirements will be covered by imports and certain risks affecting oil supplies cannot be wholly disregarded. First, certain producing regions may be affected by political unrest leading to the partial or total stoppage of deliveries; again, producers may put up prices artificially, a development which is rendered less unlikely by the fact that half of all supplies for the world, excluding the Communist countries will consist of oil obtained from a few parts of the globe with widely differing costs and marketed by a limited number of companies.

Immediate consideration should therefore be given to ways and means of reducing the future risk to Community supplies as regards both quantity and, more important, prices. The exact pattern of such measures cannot be fixed once and for all because their cost depends on a number of geological and economic imponderables; it will therefore need to be reviewed from time to time with the systematic aim of finding the cheapest form of insurance against future risks without any loss of effectiveness.

The chief means of action are an increase in stocks, a permanent increase in output from the most reliable sources, continuously available production capacity and sufficient diversification of sources to spread the risk.

These measures are not equally easy to apply or equally effective for all sources of energy, as appears from a number of documents recently issued by the Community institutions.

Coal production[1]) might be kept above the quantity that can be marketed economically; but, as no substantial increase in the price of imported products is likely over the next few years, current difficulties in disposing of Community coal will probably become worse. Output cannot, in any case, be maintained at the present level; production cutbacks and pit closures have already been approved or are planned in all member countries.

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[1]) Cf. High Authority memorandum on coal production targets for 1970 and coal policy.

But for an increase in Government financial aid, the reduction would have to be very substantial; over the next few years, therefore, consideration should be given to cutting back production and capacities in conjunction with more effective measures to promote sales. In the coalmining areas, the number of men working in the pits will decline quickly, and in some cases very quickly, every year, as the combined result of higher productivity and lower output. The rate at which production declines will therefore largely depend on the speed at which effective measures are taken to retrain redundant workers and redevelop the economies of the areas affected.

As fresh information on long-term prospects becomes available in a few years' time, coal production trends will have to be reviewed, as also the part that coal imports from third countries can play in the various consumer sector of the Community.

In the nuclear sector[1]), consideration might be given to Government incentives for electricity producers to ensure that the present target for nuclear power production in 1980 is reached or even exceeded and to encourage fresh exploration for uranium ore; a suitable storage policy should also be considered.

In the case of oil[2]), temporary crises could be met by the constitution of sufficient stocks but this would not be a complete or adequate solution for a prolonged crisis. A partial answer to this problem might be to keep some production capacity constantly available for immediate use if certain supplies were seriously disrupted and at the same time to diversify sources of supply enough to spread the risk more widely. Arising from the last point, consideration might be given to an economically-justified expansion of Community production, and particularly to more intensive exploration for hydrocarbons within the Community, in areas with the most promising geological structure. At the same time, Community companies might be encouraged to step up exploration in other parts of the world.

It must be emphasized, however, that oil is a world market commodity and important for both producing countries and the industrialised countries which are their customers; such measures will therefore only be effective if applied within an the overall of international economic relations and if sufficient competition can be maintained between the companies operating on the oil market. All these questions will have to be examined with countries outside the Community, which face the same problems, with the aim of context harmonizing the objectives and the appropriate means of action.

[1]) Cf. First indicative programme for the European Atomic Energy Community.
[2]) Cf. The Commission's first note to the Council on Community policy for oil and natural gas.

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