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ENERGY POLICY : PROBLEMS AND RESOURCES 1975-85

(submitted to the Council by the Commission)

Energy Policy: Problems and resources 1975-85

Contents

Abbreviations:

Mtce = million tonnes of coal equivalent (7,000 kilocalories per kg) = 7.10^{12} kcal

Mtpe = million tonnes oil equivalent (10,000 kilocalories per kg) = 10^{13} kcal

kg ce = kilogramme coal equivalent (7,000 kilocalories)

GWe = gigawatt of electricity = 10^{6} kw

Gcal = gigacalorie = 10^{6} kilocalories

INTRODUCTION

Energy policy is intended to create a situation in which consumers may obtain the primary energy they need, in the most favourable conditions as regards quantity, quality and price.

To do this it must take into account not only factors which are specific to the energy economy (developing patterns of demand, availability of the various types of energy, the economic and political conditions affecting the supply of energy from different sources, etc.) but also factors external to the energy market itself (for example, the maintenance of the economic and financial equilibrium, or the exigencies of foreign or domestic social policy).

In analysing these constraints and thus defining the extent to which freedom of action is possible, an idea emerges of the various combinations available for selection. Such is the purpose of the present document, based first on the study of demand prospects[1] and secondly on the studies of the future supply situation for the principal sources of primary energy[2]; it is a descriptive synthesis of the essential problems of energy policy which will be encountered between now and 1985. It seeks, moreover, to identify the available policy options and to evaluate the consequences of each. Thus it contains the basic reasoning underlying the guidelines proposed by the Commission in "Progress necessary in Community energy policy"[3].

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[1] Forecasts of primary energy demand in the Community, 1975-80-85 (Doc. XVII/153/72).

[2] Medium-Term Forecasts and Guidelines for the Oil Sector (Doc. XVII/134/72F), Medium-Term Forecasts and Guidelines for the Gas Sector (Doc. XVII/382/71F), Second Illustrative Nuclear Programme for the Community (Doc. XVII/341/71F).

[3] Doc. XVII/214/72F.

CHAPTER 1

PROSPECTS FOR ENERGY DEMAND

A. New features of the energy market

The main characteristics of the world energy market from 1960 to 1970 were ample availability and relatively low prices.

Oil was available in virtually unlimited quantities and at relatively low prices, and covered most of the new demand which arose. This was particularly true so far as the Community was concerned, which reaped the benefits of the active competition in the oil market. The result was that the price of oil was the level of reference for the prices of other types of energy with which it is likely to compete.

Natural gas, an indigenous and expanding source of energy supply, shared in the growth in energy demand, and even captured certain markets from oil products.

Community coal, hampered by higher production costs, continued to decline. There are sectors, electricity generation and coking, in which coal can still make a particularly important contribution to the fulfilment of energy requirements, but even in these sectors it has only been able to maintain its position by virtue of public financial support. Imported coal contributes only relatively modestly to the total volume of energy needs, but it is nevertheless of a certain importance to those who consume it, notably the steel industry.

The progress of nuclear energy was hindered both by the low price of "conventional" energy and by the inertia which affects the general adoption and application of new techniques.

Difficulties in the markets for certain types of energy have occurred from time to time during this period, caused by market forces or by political events. Examples of this were coking coal in 1969-70 and oil in 1967 and 1970-71. In general, however, the Community was able during the ten-year period to obtain its energy supplies under very favourable conditions.

Since 1970 the structure of the market has tended to change under the influence of a number of factors.

While petroleum has established a lasting domination of energy supplies, the conditions of supply are becoming more restrictive than in the past. World demand forecasts show that the Community will have to compete with other buyers - principally with two other great industrial powers: Japan and the United States - both in its dealings with traditional suppliers and in establishing supplies from new sources. Also, the oil-producing countries have become aware of the advantages they would gain in a sellers' market. By fiscal measures they have secured a proportion of the income from petroleum and are now seeking to intervene more directly in the management of their natural resources.

Thus all the indications are that the easy supply situation of the 60s has little chance of being maintained. It is therefore appropriate to examine the long-term trends of energy demand and supply and in doing so to consider the Community in the wider context of the international market. In this way it will be possible to define the problems which energy policy will have to resolve.

The year 1985 has been chosen as the "horizon" of the study, not as a firm date by which one would expect to see a definite situation, but rather as a point of reference for evaluating market conditions during the period 1980-90. This choice of "horizon" allows both the evolution of currently known factors and certain possible hypotheses on longer term structural changes to be taken into account[1].

B. Prospects for world energy demand in 1985

The Community already depends on imports for a high proportion of its energy supplies. Even more so than in the past, development of demand in the other economic zones of the world will in future be a constraint to be allowed for by energy policy.

Though the outlook for the evolution of energy needs varies according to the degree and type of economic development of each country, it is certain that demand, at the world level, will considerably increase in future.

The estimates which follow are necessarily based on less searching studies than those used for the determination of Community energy needs. In spite of their margins of uncertainty, they give a satisfactory idea - at least in their order of magnitude - of the problems of world energy supply which must be solved in the near future.

The annual average rate of increase in world energy consumption from 1960 to 1970 was over 4.5%. From 1970 to 1985 the rate could be over 6%. The present world energy demand is some 16,000 million tcc.

[1] For the significance of medium- and long-term timescales in energy forecasts, see "Outlook for primary energy demand in the Community 1975-80-85" (Doc. XVII/153/72-F), p. 4.

Forecasts of world energy demand in 1985 ('000,000 tcc)

	Actual 1970					Forecasts 1985				
	Solid fuel	Liquid fuel	Natural gas	Primary elec.	Total energy	Solid fuel	Liquid fuel	Natural gas	Primary elec.	Total energy
Industrialized countries with free-market economies	1110	1910	820	280	4120	1100	4430	2050	1770	9350
Including										
EEC (10)	363	685	88	83	1219	255	1410	345	345	2355
US	480	1050	680	80	2290	670	1700	1130	700	4200
Japan	90	290	5	25	410	105	760	10	175	1050
Countries with planned and centralized economies	1180	445	325	65	2015	1870	1520	1150	260	4800
Developing countries	125	330	70	40	565	230	1100	250	220	1800
World	2415	2685	1215	385	6700	3200	7050	3450	2250	15950
(Total in '000,000 tpe)	1690	1880	850	270	4690	2240	4935	2415	1575	11165

The needs of industrialized countries with free-market economies will reach a little more than double the present levels in fifteen years. Most of them will be able only partially, and to a greater or lesser extent, to cover their needs from indigenous resources. They will therefore be buying increasing quantities in the world market.

This applies especially to oil (about 3,500 million tce will have to be imported), but for this fuel the present and future circumstances of the three principal economic zones (EEC, USA, Japan) exhibit differences which are worth emphasizing:

- while in the United States oil will become slightly less important proportionately (from 45 to 40%) over the next 15 years, the converse will apply in both the Community and Japan (from 55 to 60% and from 70 to 72%);

- in the structure of the consumption of oil products in the US, the supply of products for "motor fuel uses" is predominant (some 60%); refining is orientated towards meeting this demand (residual fuel oil represents only 13%) and has had no major difficulties in taking expensive crudes because of the high market value of the principal products. The situation is quite different in the Community and Japan, where fuel oils (heavy and light) for domestic and industrial heating purposes are the principal products (all fuel oils, 65% and 75% respectively); consequently, any increase in the price of the crude affects the price of these products and diminishes competitiveness in international markets.

In view of the foregoing, it would seem that the traditional clients (Europe and Japan) in the world oil market and the newcomers, the United States, probably requiring a quarter of their energy consumption from imported oil, may not be able to take the same attitude to the market in the future.

Countries with planned and centralized economies will consume in 1985 two and a half times as much energy as in 1970, and the structure of their consumption will probably undergo important changes.

Solid fuels now satisfy more than 55% of the need: in 1985, the same proportion will be covered by all the hydrocarbon fuels. This tendency towards a closer approach to the "industrialized free-market economy" structure will nevertheless leave a substantial margin for the expansion of solid fuels.

The increasing hydrocarbons requirement envisaged for these countries casts doubt on the generally accepted hypothesis of total self-sufficiency for this economic zone. Compelling considerations of a regional nature or of economic policy could incline these countries towards greater participation in world energy markets.

The consumption of energy in the developing countries will probably treble during the period 1970-85, but should still be less than one-eighth of world energy needs.

Fundamental structural differences exist among the developing countries as a whole, from one zone or one country to another, relative to the degree of economic development and to energy needs and resources or the lack of them. The increase in energy needs will not, therefore, be of a uniform nature in all developing countries and in each case the rate of increase will be determined in large measures by the expansion or otherwise of the development of the economy.

Although some of the countries in question possess the greater part of the world's energy resources, their own additional energy needs will have only a minor effect on availability of energy in the world market from now to 1985.

In spite of the higher rate of increase of energy needs in the developing countries, the margin which separates them from the industrialized countries is most unlikely to narrow to any great extent. In 1985, the average consumption of energy per head of population should be 10,900 kg ce in the industrialized countries, 3,300 kg ce in countries with planned economies, and 700 kg ce in developing countries. Thus more than half the world's population will be using only one-tenth of the available energy.

Whatever the uncertainties surrounding the development of energy demand in certain countries or in certain types of countries, and without understating the role of the other energy sources, it is clear that the problems of world energy supply during the next fifteen years will essentially concern hydrocarbon fuels, which have to cover two-thirds of the total needs.

C. The Community's energy needs[1]

Any estimate of future energy needs must be based on an assumption of economic growth. In this respect it seems reasonable to count on an average rate of growth in the Community comparable to that achieved over the last 20 years - about 5%. Essentially, this hypothesis is based on the prospect of an improvement in productivity, which, particularly in view of the foreseeable labour supply situation, can only be achieved by an increased degree of mechanization, which in turn implies increasing energy consumption. Certainly one should

[1] Doc. XVII/153/72, "Outlook for primary energy demand in the Community 1975-80-85" describes the methods by which energy demand has been estimated and gives detailed information for each sector of consumption.

not overlook the possibility of technical advances bringing about reductions in the specific consumption of fuels. However, apart from the fact that in certain sectors - for example, conventional power stations and blast furnaces - the possibilities for improving performance are growing progressively less, other factors will make for growth in energy demand - for example, the increase in consumption which may be expected to result from measures to protect the environment.

A further argument in favour of the adoption of a growth hypothesis is that it would be imprudent to base energy policy options on an assumption of a slower rate of economic growth than in the past; such a slowing-down would, in present conditions, be of a purely speculative nature.

It is in fact already certain that more than half of the energy requirement will have to be covered by imports. It is therefore best, while always bearing in mind the margins of uncertainty which beset all estimates of future demand, to avoid understating the quantities of energy which the Community will have to obtain in the world market.

On these bases energy demand should be expected to increase by 5.2% a year on average, a slightly less rapid rate of increase than was observed between 1960 and 1970 (+6.2%). The Community's total energy needs would increase in this way from 973 million tce in 1970 to 2,000 million tce (1,400 million tpe) in 1985; nine-tenths of this would be for internal consumption[1].

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[1] Total needs include exports and deliveries to bunkers as well as internal consumption. The estimates for these additional items, about 185 million tce (130 million tpe), are subject to a greater degree of uncertainty than the estimates of internal consumption. It is nevertheless desirable to take them into account in order to obtain an idea of the total quantities necessary for the internal working of an economic entity and for the maintenance of its external relations.

These forecasts should be considered in a long-term context since they do not take account of fluctuations in the business trend which will tend to be approximately self-cancelling. For example, one might reasonably suppose that the slackening of economic activity observed in 1971 and 1972 can be compensated by subsequent movements. The figure of 2,000 million tce therefore represents the probable magnitude of demand and makes it possible to outline the size and nature of the main energy supply problems of the Community towards 1985.

A certain proportion of energy needs may be called "specific" in the sense that, with present technology and because of the limitations and inertia of investment patterns, they can only be satisfied by a particular type or source of energy. To these needs should also be added those covered by certain energy types which are available in any case, whether because of technical considerations, because of the commercial conditions of supply, or because the development of the energy types in question will be brought about by exigencies of a technological nature.

The remaining portion of energy requirements, within which competition among different energy sources is possible, represents about 65% of total needs. Thus in 1985, 1,100-1,200 million tce (770-840 million tpe) would represent the quantity of Community demand for which competition could take place and also the principal potential sphere of influence for policy. This is really, however, a maximum figure because, even for this section of demand, there are factors of inertia which militate against complete fluidity of the market.

Competition among substitutable energy sources will be in conditions different from those experienced in the recent past, because the choice criteria applied by consumers, individually and collectively, will tend to change. The two traditional criteria of quality and price will continue to exercise a decisive influence but may become broader in scope.

To the concept of intrinsic quality of the product and of the service which it provides will be added that of its effects on the environment, and the criterion of the lowest possible price will also be increasingly seen in the same context. Moreover, the future commercial conditions of energy supply and new requirements for the protection of the environment will add urgency to the necessity of using energy in as rational a way as possible. Lastly, as "First Outlines" have already emphasized, equal weight must be attached to security of supply as an objective closely bound up with that of low cost.

CHAPTER 2

PROSPECTS FOR ENERGY AVAILABILITY

While it is possible to sketch the outlines of future energy demand in the Community, it is most difficult to study the commercial conditions which will apply to energy supply. Apart from the evolution of technical and economic factors, political situations which are difficult to foresee may also affect the conditions of supply.

The present study is limited to the main supply tendencies for the energy types which can compete in meeting the needs, described as "substitutable": oil, natural gas, coal and nuclear energy. These are also the energy sources whose supply problems must be examined in a world-wide context.

A. Oil[1]

The extensive world reserves of oil are generally considered to be sufficient to cover demand until nuclear power is able to take over completely from fossil fuels. However, much uncertainty surrounds the conditions under which oil will be made available to consumers, particularly in the Community, which will depend on imports for 95% of its crude oil requirements. Even if in future an increasing proportion of these imports comes from sources which are relatively close at hand (North Sea), the Community will still depend on remote supply sources for the greater part of its needs.

In 1970 and 1971 pronounced changes took place in the oil market. The pressure on both demand for crude and the freight market created conditions favourable to substantial price increases. The scope of these increases should not, however, be exaggerated in those cases

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[1] For a more detailed survey see "Medium-term forecasts and guidelines for the oil sector".

where their purpose was to compensate for monetary depreciation and the erosion of the producing countries' income. The agreements recently concluded between the producing countries and the major oil companies make it possible to forecast with some degree of precision the commercial conditions of crude oil supply up to 1975.

The average delivered cost[1] of a North African crude increased from $11/tonne at the beginning of 1970 to $18/tonne at the end of 1971. This increase stems solely from the application of new tax liabilities, $7/tonne more for the Mediterranean basin and $3.5/tonne for the Persian Gulf. Up to 1975, expected increases should, taking into account the recent devaluation of the US dollar[2], amount to $3/tonne for Mediterranean and $2.5/tonne for Middle East crude. These cost increases will be reflected in prices, particularly of light and heavy fuel oil which are price reference points for other forms of energy. Heavy fuel oil is generally quoted $3-4/tonne below the crude price.

Trend of supply cost of a Saudi-Arabian crude 1970-75 (example)

$/tonne

	Before Teheran-Tripoli	After Teheran-Tripoli	1975
Produced cost including levies and taxes	$7.5/t	$11/t	$13.5/t
Transport to Rotterdam and companies' profits	$9.3/t	$9.3/t	$9.3/t
Total	$17/t ($12/tce)	$20/t ($14/tce)	$23/t ($16/tce)

As far as transport costs are concerned, medium-term prospects are relatively favourable; so long as available capacity exceeds demand, only modest increases may be expected. In the longer term, it is difficult to

[1] Excluding companies' profit margins.

[2] Geneva agreement, February 1972.

predict the conditions which will apply to the transportation of the 3,000 million tonnes of oil which will be exported in 1985; there is no reason, however, to expect substantial increases in freight rates while economies of scale can still be achieved.

Nevertheless, beyond 1975 uncertainty surrounds many of the factors affecting oil costs, and a number of potentially inflationary elements can be discerned:

- the development of higher-production-cost deposits could lead to eventual cost increases;
- the policy of producing countries, which for many years was aimed at increasing profit by increasing the volume of sales, may in some cases shift the main emphasis to increasing proceeds per unit. The producing counties are exercising a growing degree of control over their petroleum resources, either directly or by fiscal measures, in order to exert an upward pressure on prices, particularly in view of the strengthening world demand;
- the quantities of oil available are closely linked to the flow of investment funds to exploration, which can only intensify as demand increases. Whether within the present business structure or in the context of greater participation by producing countries, the maintenance of low-cost diversified oil resources depends on the maintenance of sufficient investment capability.

Other factors could tend to balance the effect of those mentioned above:

- the interests of the various producing regions will not necessarily coincide; economic or other necessities peculiar to some of them could contribute to the maintenance of a degree of competition between crudes of different origins;
- diversification of supply sources will reduce the importance of certain producing regions. From this point of view the discovery of new resources, including the North Sea fields, will attract particular attention.

The known resources in the North Sea do not justify the hope that they might make a major contribution to the needs of the Community of Six. In the enlarged Community, however, they will have a favourable effect on the balance of oil imports. In any case, they will tend to reduce the demand on other producing regions.

In this respect it should be noted that Japan, like the Community, depends entirely on imports for her oil requirements, which could reach 500-600 million tonnes in 1985. The United States, until recently self-sufficient, will import increasing quantities of oil, and some forecasts put the imported proportion of US consumption at 30-50% from 1980 onwards. It is the Middle East, the principal present and future supplier of the Community, which will also be called upon to supply a large proportion of the needs of those other two zones of consumption.

These various contradictory factors are sufficient indication of the long-term uncertainties attaching to the cost of crude oil supplies.

B. Natural gas[1]

If natural gas were available in sufficient quantities it could cover almost one-third of energy needs. However, from the known reserves in the territory of the Community or on the Continental Shelf, availability in 1985 cannot be expected to exceed 240,000 million m^3 [2].

Increasing quantities of gas will have to be imported in excess of indigenous availability to meet demand. On present information these imports could reach 23,000 million m^3 a year before 1980.

Natural gas is a relatively rare form of energy which costs less to produce than crude oil; its price tends to come into line with those of oil products which it can replace (principally medium and light fuel oils).

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[1] See "Medium-term forecasts and guidelines for Community gas supplies".

[2] At 8,400 kcal per m^3.

In general, free-at-frontier prices of imported gas are higher than those of indigenous gas. This applies particularly to liquified gas, which needs a high degree of supporting capital investment and involves a complex technology. Transportation by pipeline is simpler but also requires large amounts of capital.

As an indication, prices in long-term contracts were as follows in 1970 (in $ per tce):

- Dutch gas (free at frontier)	9.1/11.2
- North African gas (cif plus regasification)	11.9/14
- USSR gas (free at frontier)	9.8/11.6.

The outlook for Community production beyond 1980 depends on the size of any new discoveries which are made, particularly on the Continental Shelf.

So far as imports are concerned, the considerable reserves in North Africa, the USSR and the Middle East offer possibilities for major expansion. The international natural gas market does not escape the effects of some of the difficulties which affect the oil market, due in particular to the increasing demand trends which are emerging. As in the case of oil, Japan and the United States will be seeking to buy gas from some of the main potential suppliers of the Community.

Already a rising trend in natural gas prices can be observed. For Dutch gas, representing over half of the Community's internal production, the price link with fuel oil has recently been reinforced. The most recent contracts for Algerian LNG, covering gas deliveries starting between 1975 and 1980, have been concluded at fob prices which are about one-third above present levels. Taking into account the increasing costs of methane tankers, the delivered price is thus increased by $2.8-4.9 per tce.

These prices are comparable to the 1975 oil price levels which will result from the Teheran and Tripoli agreements.

In present circumstances there is thus every reason to believe that prices of natural gas will continue to be influenced by those of the oil products which it can replace. One cannot rule out the possibility of natural gas prices being forced above this parity if demand should significantly exceed availability.

C. Coal

The contraction of Community coal production will no doubt be at a slower rate than that which would be dictated by the underlying economics of supply alone; it will be mainly determined by the political decisions which are taken on production.

Taking into account coking coal requirements and the decline in the consumption of steam coal, and on the basis of present price levels (average revenue of the coal industry in 1971: app. $20 per tce; price of fuel oil net of tax: $12-14 per tce), the hypothesis can be advanced that coal production in 1985 will not significantly exceed 100 million tonnes. This hypothesis is based on prospects of rationalization and productivity improvements on the one hand and increasing costs on the other, these factors tending to neutralize each other.

The Community coal industry would in the first instance ensure the satisfaction of coking coal requirements[1]. Quantities of steam coal produced alongside this product could be sold to power stations if they were offered at competitive prices and assuming the availability of the necessary coal-fired or dual-fired capacity. On this point it should be noted that the Community coal's contribution to the flexibility of

[1] Coking coal is a special case to the extent that it covers specific requirements outside the field of competition among energy types. The commercial conditions for imports are therefore not dealt with here.

power station supply patterns is limited by the structure of the equipment.

Taking into account the decisive role of fuel oil prices, coal imported at similar price levels could play an increasing part in covering power station requirements. This could happen provided that imported coal meets the quality criteria which will result from the need to protect the environment, and that sufficient price stability is offered to compensate for diminished flexibility of utilization.

However, the possibility of increased imports of steam coal acting as a price regulator should not be overstated. Even if in certain cases favourable production and transportation costs secure a competitive position for steam coal in the Community's coastal power stations, the price of oil per calorie remains the rule for fixing the price of imported coal. Nevertheless, should the delivered price of imported coal fall below the price of fuel oil to the consumer, the former will have a restraining influence on the latter.

World trade in steam coal has until now been relatively limited, but will tend to increase because of the exploitation of new reserves, notably in Australia, Canada, South Africa and Poland. The expansion of supplies depends on the creation of mining, land transport and port capacities. It is difficult to give any indications concerning the prices at which these coals might be offered.

The volume of world coal reserves might make it possible to obtain larger quantities of imported steam coal than the 30-40 million tce which represent a reasonable hypothesis for 1985. However, a significant increase in steam coal imports could not be attained without price increases. Moreover, if a higher level of imports were required in 1985 the necessary action would have to be taken at relatively short notice.

D. Nuclear Energy[1]

Nuclear energy can reduce the dependence of the Community on imported fossil fuels, particularly oil. It is thus not only a diversification factor capable of increasing security of energy supply; it can also exert pressure on the prices of competing energy types since it will henceforth always, at the load diagram base, be the cheapest means of generating electricity.

From the point of view of security of supply uranium has certain advantages in that it can be treated as an indigenous energy source, although Community reserves, while not negligible, are scarcely extensive. Uranium reserves are widely distributed throughout the world; deposits are abundant and generally located in regions where continuity of supply is sufficiently assured. Uranium's energy potential per unit of weight is considerable, reducing transport problems and costs and facilitating storage.

At present, world availability of natural uranium far exceeds demand, and between now and 1985 there should be no problem in obtaining supplies sufficient for Community requirements.

The Community is at present entirely dependent on imports, and in practice on a single source, for its supplies of enriched uranium. Although the short-term availability prospects are satisfactory, this will not apply beyond the present decade. A comparison of cumulative world requirements with the cumulative production from enrichment plants now working or planned - mainly in North America - shows that after a period around 1980 production will be insufficient to meet demand.

A solution to this problem will have to be found before 1974 so that utilities ordering nuclear power stations for the time in question can be assured of sufficient fuel supplies. The creation of an enrichment

[1] See "Second illustrative nuclear programme".

capacity within the Community would make a fundamental contribution to achieving the objectives envisaged for nuclear production, and would allow Community industry to carry on all activities associated with the fuel cycle.

Until about 1980 supplies of plutonium will be limited, but thereafter progressively larger quantities will be obtainable, which could be recycled in light-water reactors and reduce the requirement for enriched uranium, provided that non-member countries with energy shortages do not bid for Community plutonium and divert it from this application.

Electricity can already be produced from nuclear energy at a lower cost than from a conventional thermal station working in comparable conditions. Unlike electricity generated from fossil fuels, however, most of the cost of nuclear electricity is due to capital investment. In the longer term, the experience acquired by European construction concerns should bring about a relative reduction in capital costs; however, if the reduction is to be significant, it is necessary to achieve both a greater degree of standardization in the range of reactor types offered, and to spread the orders for each type more, since the effects of series production are enhanced by widening the market.

Investment decisions taken up to the present time have determined the nuclear capacity which will be in service towards 1977 if all the stations which have been planned are set up and working at that time. Thereafter, the scale of application of nuclear energy[1] should increase to a level of 130 GWe in 1985. Taking into account the stations which will be operational by 1977, a total of 150 GWe could

[1] This scale of application corresponds to the increase in the total number of power stations which are termed "competitive", i.e., for which investment choices are based on the costs (including investment) of the different energy types available. Excluded from this "competitive" range are hydroelectric stations, "peak-lopping" stations and stations using fuels with special characteristics (lignite, derived gases, etc.).

therefore be based on nuclear capacity in 1985.

In view of the forseeable pattern of development, the second illustrative programme has set a target of a minimum installed capacity of 100 GWe by 1985.

The Community's industrial capacity is such that this amount can be considerably exceeded, since even at this stage the components manufacturers' production capacity is far from being absorbed. A margin of flexibility therefore exists which would permit the industry to respond to any speeding-up of the nuclear plant construction programme.

CHAPTER 3

PROBLEMS OF ENERGY POLICY

A. Structure of demand

The prospects for the development of demand as described in Chapter 1 suggest a pattern for the future division of the market between the different kinds of primary energy. This pattern appears likely in view of the structural changes which will take place in the main sectors of consumption. It is based on the assumption that the lowest average cost will be sought in the competitive sector, having regard to the rigidities and restrictions affecting certain sectors of demand. It is also assumed that the relationships between the prices of the different competing forms of energy will not change radically from what they are at present.

In 1985, total needs[1] (2,000 million tce) will be met as follows: 2% by lignite, 7% by coal, 11% by electricity, 15% by natural gas and 65% by oil.

Breakdown of demand by source of energy (1970-85)

	Actuals 1970			Prospects 1985		
	'000,000 tce	%	'000,000 tpe	'000,000 tce	%	'000,000 tpe
Coal	199	20	139	137	7	96
Lignite	34	3	24	37	2	26
Natural gas	73	8	51	295	15	207
Hydroelectric energy	46	5	32	47	2	33
Nuclear energy	4	-	3	175	9	123
Oil	617	64	432	1304	65	912
TOTAL NEEDS	973	100	681	1995	100	1397

[1] The demand for energy for purposes other than electricity generation and as a source material will rise to 155 million tce in 1985 and is included in total energy needs.

A conservative estimate of the relative position of indigenous fuel in this set-up suggests that the Community's degree of dependence on energy supplies will continue to rise over the next ten years and will have increased from 67% in 1970 to 70% in 1980. No change in this trend can be hoped for until around 1985, when, through the attainment of the target set for nuclear energy by the "Second Illustrative Programme", the degree of dependence may begin to diminish.

While stress must be laid on the risks inherent in depending on external sources for energy supplies, autarchy must be ruled out as an objective for energy policy. For energy, as for all other forms of economic activity, the Community can only plan its policies in terms of an expansion of international trade. The only restrictions that can be imposed on this policy are those dictated by considerations of security, necessitated to a greater or a lesser extent by external circumstances as observed at the present time.

B. Oil: the key element in supplies

Even in the field in which different sources of energy are competing, the market has only limited flexibility. The labour force and the equipment in use in each energy sector impose limits on the short-term changes that can be made.

This characteristic seems likely to persist in the foreseeable future. An increase in the cost of oil supplies will not, therefore, entail a corresponding decrease in consumption and, whatever happens, this source of energy will probably still have to meet more than half the total energy needs between now and 1985 and at 900 million tons of crude oil (65% of total energy requirements) will still be the most prominent feature of energy supplies to the Community at that date.

All the same, it should be emphasized that, in spite of the considerable increase in the volume of demand, this situation will

itself constitute an improvement, or at least a levelling-out, in comparison with the situation in the next five to ten years, which looks like being a period which will have to be weathered before the Community can gradually break free from its excessive dependence on imported oil. This stabilization will be based, firstly on oil supplies from "reliable" areas, and then on the relative amount of natural gas produced within the Community or imported from non-member countries. These imports, whilst not reducing dependence on outside sources, will have the advantage of spreading the risks involved. The other factor of stabilization will be nuclear energy, which will not start to make its weight felt until after 1980.

For the Community, therefore, the basic energy policy question to be solved between now and 1985 is that of coming through this period of transition, i.e., obtaining its supplies of oil on the best terms possible, since in any event oil will have to cover the greater part of the Community's energy needs.

Thus, without minimizing the importance of particular problems in the other fields of energy, or of the policies necessary to solve these problems, it seems clear that oil policy is the key issue as regards energy policy in the Community. In the following pages the problems relating to other sources of energy will therefore only be considered to the extent that they have a bearing on the oil question.

C. Two possible lines of development in the oil market

In view of the uncertainties affecting oil supply conditions, consideration must be given to the situations to which different patterns of development may lead. The many hypotheses that can be built up on the basis of the factors at work can be reduced in practical terms to two cases; on one hand, a stable market with a certain surplus of availabilities and, on the other hand, a market in

which prices will rise appreciably as supplies become short.

1. First case: a stable market

The first case to be considered is that in which competition continues between oil from different sources as at present. The price of oil would follow approximately the same lines as the general movement of world prices, with adjustments, where necessary, to increases in costs and allowance for the relative depreciation of the royalties and taxes levied by the producer countries.

In these circumstances the price of crude oil in 1985 could be in line with the trend triggered off by the Teheran and Tripoli agreements. In view of the foreseeable increases in costs, the relationship between the prices of other forms of energy and those of competing oil products would be of the same order as they are at present and oil would maintain its role as a guide to average energy prices.

Demand would break down in accordance with the scheme shown above, which in particular would lead to the achievement of the nuclear energy target of 100 GWe installed capacity in 1985, the persistence of a certain contraction in the Community coal industry - which nevertheless would be unable to do without government subsidies - and a moderate increase in imports of coal from non-member countries. The exploitation of present known reserves of natural gas in the Community would have levelled off and the only imports would be those under contracts and declarations of intent which have been concluded at the time of writing.

It has been suggested above that oil would retain its leading part in determining the level of prices of competitive forms of energy, which would show variations from the price of oil of the same order that they do now. The general scheme of prices would therefore follow the same pattern as oil, namely one of moderate increases. However, if one

takes the price of oil as a constant in order to calculate the average supply cost it seems that the price structure in 1985 might be more favourable than in 1970, through a decline in the proportion of coal and the increasing importance of nuclear energy.

2. Second case: large increases in oil prices

Another possibility is one in which factors making for rigidities in the availability of oil supplies become preponderant, leading to sharper price rises. This would be the case, for example, if production were deliberately restricted or if investment in oil prospecting were not maintained at an adequate level.

Such an escalation in prices could profoundly modify the structure of energy demand in the Community if it reached the stage of changing the relationship between the price of oil and the costs of competing forms of energy:

(a) at the worst, oil consumption would be concentrated mainly on specific uses, i.e., for motor fuel and for certain applications as a raw material. Consumption of liquid fuels would be limited roughly to the amount inevitably produced as a by-product of refining the oil used for such specific purposes. The volume and structure of demand for crude oil would therefore be appreciably different from the first case we discussed;

(b) prospects for the development of nuclear energy would be more favourable. It might meet a larger proportion of electricity demand and even be extended to other uses;

(c) some reserves of natural gas in the Community which are at present considered not commercially exploitable might become exploitable and the search for hydrocarbons in the Community (including the new member states' territories and the Continental Shelf) would be stimulated. Imports of gas from non-member countries might reach

a very high level; even natural gas located in remote regions would have a lower delivered price than the oil reference price.

(d) the competitiveness of the Community coal industry would be improved, and the additional revenue which it would obtain would make at least part, if not all, production and sales subsidies unnecessary but would not lighten its charges incurred in the past. In this context production would not be much more than 100 million tons, but it would remain to be seen whether inevitable increases in the costs of production would not cancel out the increases in revenue. In any case a coal output of the same order as at present could not be maintained without subsidizing a proportion of coal production;

(e) demand for coal from non-member countries could expand markedly. Account must be taken of the relatively long period required for supplies to become available and of the price increases which would be bound to result, particularly in a situation in which the new aspect of the oil market might give rise to a world shortage of energy.

There are limits, however, to possible increases in the price of oil.

On the one hand, North America possesses substantial reserves of bituminous shales and sands from which considerable quantities of oil could be obtained. The cost of exploiting these shales and sands is about twice (per ton of oil produced) the present price of Middle East crude delivered US. This figure sets a ceiling which oil prices could not exceed, at least for that element of consumption where there is no substitute for oil, i.e., motor fuels and the minimum quantity of products involved in refining.

Furthermore, the possibility of recourse to imports of steam coal sets another limit to rises in oil prices. Steam coal is already available in some Community countries at prices lower than those of fuel oil, including taxes.

These two potential competitors (oil from shale and sands, and steam coal) would not have an immediate restraining effect on the rise in oil prices. Time would be required to make the investments needed to create an adequate supply.

But if the possibility of a sharp increase in oil prices linked with diminished flexibility of supply were to become real, it is certain that oil consumption would rapidly cease to expand and might even decrease to a large extent after a few years as large consumers changed to other sources of energy. Such a development would not be in the interests of either the consuming or the producing countries. The former would be obliged to pay more for energy that they cannot do without. The latter would risk losing a large part of their market and thus depriving themselves, perhaps once and for all, of the financial resources they most need to launch their economic development.

D. Restrictions on security of supply

Even if the second possibility considered has some exaggerated characteristics, it underlines the risks inherent in changes that are taking place in the structure of the world oil market. If competition between oil from different sources were no longer to be possible, powerful disturbances could affect the whole energy market, if not the world economy.

There are good reasons for hoping that these structural changes will take place in an ordered way without entailing such serious consequences. But there are reasons for concern until a genuine long-term stability is

achieved, because the changes thataare taking place involve the danger of tensions in varying degrees that might even result in the temporary interruption of some supplies. Some of or all the oil suppliers might be tempted by economic conditions to make and inforce fresh demands.

We are therefore confronted with two aspects of the problem presented by security of supply, as regards not only oil but also other forms of imported energy.

On the one hand, with a market less flexible than in the past, efforts must be made to invest it with more flexibility so as to ensure long-term supply conditions which are favourable from the point of view of both price and stability while paying due regard to the legitimate interests of the countries possessing the resources to kindle the demand. It is therefore necessary to act in such a way that in 1985 the situation will resemble as closely as possible the first case examined in the preceding paragraph (C 1.).

Furthermore, it is necessary to guarantee regular and sufficient supplies whatever the structure of the market. Various measures can be put in hand to reduce the risk of interruptions in supply or to limit their effects: diversification of sources of supply, the creation of emergency stocks, keeping reserves of production and transport facilities, etc. Arrangements need to be made on these lines which will operate permanently as long as the market is seen not to be sufficiently stable. The expenses involved must be considered as a part of the costs of imported energy and must be adjusted in proportion to the risks involved.

CHAPTER 4

THE MEANS OF ACTION

Long-term security of supply could be improved by various means, among which policy choices will have to be made.

- Under any circumstances, more rational utilization of energy would make it possible to reduce demand and thus avoid accentuating the pressure on the market which will result from the growth in world needs. However, for several categories of use, technical constraints severely limit the improvements which can be made. Moreover, there is the problem of deciding what measures can be taken to encourage more rational use of energy without impeding the consumer's ability to obtain the fuel which best suits his own needs.

- Primary energy stockpiling not only provides a remedy for the direct effects of temporary interruptions in petroleum supply, but can also, to a certain extent, contribute to a longer-term easing of the situation. The existence of substantial stocks would make it possible, for example, to accept deliverately and for a fairly long period the severance of certain channels of supply in the event of highly disadvantageous price conditions suddenly being attached to them. The underground storage of a further month's consumption would cost $0.2-0.3 per tonne of oil consumed, a fairly modest cost compared with the price increases which could be expected.

  However, some time would elapse before stocks could be built up appreciably above the 90 days' consumption objective which the Commission proposes for 1975, partly because of the substantial investment required and partly because of the need to try to obtain the necessary quantities of oil under favourable conditions.

- The diversification of sources of supply increases both short- and long-term security, the former by increasing the number of options available, the latter by reducing the danger that individual producers might succeed in dominating the market.

  In this context, North Sea oil production, although relatively modest on present information (100-150 million tonnes a year towards 1985) will appreciably increase the proportion of "reliable" oil within the total supplies.

- The level of Community coal production for "thermal" applications will depend essentially on the extent of which support is provided by public authorities, taking into account expected increases in costs, particularly wages. Clear guidelines in this sphere would allow consumers, and in particular the electricity producers, to adapt their plant and fuel supply policies accordingly. But short of a complete reversal of the price relationship with the reference fuel - precisely the situation which it is sought to avoid - it is not to be expected that present levels of production will be maintained in the long term. Having regard to its special characteristics, coal production would make only a limited contribution to long-term security of supply for power stations.

- Imports of steam coal have so far been limited in quantity. World reserves are very large and several countries are potentially in a position to export coal to Europe, but transport costs will prevent these coals from being competitive with oil and natural gas

- There is always the possibility that this situation might change with the development of new production and transport equipment in the producing countries, and provided that increases in production and transport costs do not match the rate at which oil prices rise

With an appropriate policy, the use of additional quantities of imported steam coal in power stations would reduce demand for oil.

- Community natural gas production will certainly contribute to reduce dependence on oil, but in future a policy more attuned to resource conservation will become necessary and, all other things being equal, only a limited increase can be expected in the rate of extraction from known indigenous reserves. What can be extracted from the North Sea is mostly likely to be used by the new members of the Community. But, looking further ahead, an increase in exploration in the Community might perhaps produce an increase in the contribution of natural gas from internal sources. Large quantities of natural gas are available in the Soviet Union, North Africa and the Middle East. Community importers have already contracted supplies from the first two of these regions, which over the next few years will also be supplying gas to even more distant destinations, such as Japan and the United States.

  The procurement of increased supplies from these external sources would require considerable capital investment in processing and transport equipment (liquefaction installations, tankers, pipelines, etc.).

  Replacement of oil by natural gas from non-member countries would doubtless not reduce dependence on imported energy, but it would afford the advantage of greater diversification of supply sources.

- The nuclear industry's objective for 1985 is an installed power station capacity of 100 GWe. Achieving a substantially higher figure would make it possible to reduce, as early as 1980, fuel oil requirements for electricity production.

This speeding-up of the nuclear equipment programme would have an effect that would subsequently mean an even more rapid reduction in oil requirements.

In any case, the rate of development of nuclear energy will depend on the extent to which certain conditions are satisfied:

- liberalization of markets, restructuring of the construction industry and harmonization of standards and of construction specifications;

- speeding the procedure for authorizing the construction and use of plants;

- reserving sites, strengthening the links for the pooling of reserves;

- guarantees of availability of fuel, particularly enriched uranium, present plans for the supply of which are based on the minimum objective mentioned above.