COMMISSION OF THE EUROPEAN COMMUNITIES

Prospects of primary energy demand in the Community (1975 - 1980 - 1985)

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Contents

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General observations

1. *List of abbreviations*

GWh	Gigawatthour: 10^6 kWh
kcal	kilocalorie
kg ec	kilogramme coal equivalent (at 7 000 kcal)
kg ep	kilogramme oil equivalent (10 000 kcal)
kWh	kilowatthour
M t	million tonnes
M tec	million tonnes coal equivalent (at 7 000 kcal)
M tep	million tonnes oil equivalent (at 10 000 kcal)
MWe	electrical megawatt
PCS	higher calorific value
Tcal	teracalorie: 10^9 kcal
TWh	terawatthour: 10^9 kWh
u.a.	units of account (= $ 1 at the 1970 parity)

2. *Definition of energy sources and consumption sectors*

The definitions correspond to those given in the balance diagram presented at page P of ' Observations ' at the beginning of the 1971 ' Energy Statistics ' Year book of the OSCE (= BILEN) with the following reservations:

(a) The industrial sectors are grouped differently:

Prospects	*BILEN* (171)
Iron and steel	1710 Iron and steel
Chemical industry	1712 Chemical industry
	161 Final non-energy consumption - chemical industry
Other high energy consuming industries	1711 Non-ferrous metals
	1713 Non-metallic mineral products
	1718 Metal fabrications
Miscellaneous industries	1714 Extraction (excluding fuels)
	1715 Food products, etc.
	1716 Textiles, etc.
	1717 Paper, etc.
	1719 Other branches
Other non-energy uses	162 Final non-energy consumption - others

(b) Consumption of the energy sector and losses: this item, included in the total consumption of industrial sectors, includes the following items of the BILEN:

— 14 Consumption of the ' Energy ' sector

— 15 Losses in networks

— Losses in transformation (= difference between 13: Transformation and 2: Production of by-products).

(c) Internal consumption: for historical data, this item corresponds to the gross internal consumption (item 12 of BILEN), less the Statistical deviation (item 18).

(d) The ' Total requirements ' concept is specific to the present document. These requirements are obtained by the addition of the following items of BILEN:

— 12 Gross internal consumption

— 9 Exports to countries outside the Community

— 11 Bunkerage

3. *Units and conversion factors.*

(a) Units

The prospects are expressed in tec, the usual unit in the *Energy Statistics* and in the publications of the Commission regarding energy. However, Appendix 8 gives the principal data of the study expressed in tep, for information and to permit easier comparison with other publications.

(b) Conversion factors with a constant rate over the whole period covered by the forecast.

— coal and equivalents: 1 t = 1 tec (at 7 000 kcal per kg)

— lignite and equivalents: rates varying according to quality. The data have all been calculated on the basis of the coal equivalent.

— natural gas: 1 Tcal (PCS) = 131 tec
10^3 m^3 (8 400 kcal PCS) = 1.1. tec

— oil and equivalents: 1 t = 1.43 tec

— other products (and heat): 1 Tcal (PCI) = 143 tec

(c) Conversion factors with variable rates for the transformation of electricity into primary energy.

Electricity is converted on the basis of the average specific consumption of all conventional thermal power stations of the Community. The rate of conversion thus corresponds to the average quantity of fuel required to produce one kWh gross during each year of reference.

This method has been chosen in preference to that which consists in converting electricity according to the equivalent thermal efficiency obtained, because it renders more accurately the volume of primary energy requirements to be met.

The following rates have been used:

1970 1 kWh - 0.336 kg ec
1975 1 kWh - 0.323 kg ec
1980 1 kWh - 0.313 kg ec
1985 1 kWh - 0.307 kg ec

4. *Observations concerning the Tables and statistical data*

The totals given in the Tables may not agree with the algebraic sum of the data they cover, due to the rounding-off of the figures.

The numerical historical data originate from the *Energy Statistics* published by the Statistical Office of the European Communities. In some cases, when the final statistical information was not available at the time of the preparation of the document, estimates had to be made, which explains slight discrepancies.

CHAPTER I

INTRODUCTION

Section I - Purpose of the study

On three occasions already, the Executives of the European Communities have published studies on future energy requirements and the way they may be met.[1] These documents, by analysing the data on the energy market and their probable trends, were to provide a means of evaluation for the choice of economic policy measures aimed at achieving the most satisfactory conditions of supply.

The present study has similar objectives, as was stated by the Commission in its communication to the Council of December 1968 on a 'First attempt at an energy policy for the Community'.[2] It is all the more justified at the present time, as it would seem that a change is becoming apparent in the trends of supply conditions. Developing the tendencies brought to light by the 1961 'Study', the 'New Considerations' have stressed the problem of dependence on imported energy. They showed particularly the need to examine within a world-wide framework the future requirements of the Community, among which the demand for oil seemed already very heavy.

Since then, the economic background has changed : the increase in costs has, among other things, contributed to a worsening of the competitive position of coal mines within the Community, whilst oil was offered in abundance and at a practically stable cost, in nominal terms. Quite recently the conditions of supply for oil have taken a new aspect, the producing countries endeavouring to obtain compensation for the fall in revenue they had sustained during the last ten years.

It is therefore necessary to add to the assumption on which the previous investigations were based the new problems suggested by the events of the last few years. The present study, however, does not pretend to assert, any more than the previous study did, that the future will follow a particular course. Conscious of the uncertainty attached to any forecast, this study wishes, as the earlier ones did, to provide a basis for reflection on the different patterns which might arise in the future.

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1 *Study on the structure and the tendencies of the energy economy of the Community*, Luxembourg, n.d. (1957)
Study on long-term energy prospects in the European Community - first edition, Luxembourg, 1962; 2nd edition, 1964.
New considerations on the long-term energy prospects of the European Community - ECSC Bulletin, High Authority, No 61 Luxembourg, 1966.

2 See *Supplement to the European Communities Bulletin* No 12/68.

Furthermore, this new study was to take into account the broad lines of action outlined by the Commission in its 'First Attempt', and in particular serve as a common basis for more detailed work bearing on the different sources and forms of energy.

Section II - General concept

A — *Prospects for the Community*

Being intended to provide a framework of action for a Community policy, energy prospects are essentially related to the study of trends within the Community as a whole. Although they are based on an analysis of the main consumption in each of the Member States, they aim to give an overall view and as a result may not touch upon certain phenomena peculiar to certain countries or certain areas.[1]

The prospects will be limited to the framework of the Community of the Six. It was, in fact, not possible to present prospects of energy consumption for the candidate countries on bases which were harmonized with those already available for the present Member States. Rather than give an unclear image of the future requirements of the Community of the Ten, the Commission preferred to provide a detailed study of the prospects for the present Community, to which information will be added when the Community has been enlarged and the necessary data become available.[2]

B — *The time horizon*

The years 1975, 1980 and 1985 have been taken as points of reference, mainly because in a sector with a large inertia such as the energy sector, the future 5, 10 and 15 years ahead present different characteristics.[3]

Five years ahead, providing the basic economic assumptions are confirmed, only economic or climatic factors can cause a substantial distortion between forecasts and reality. The structures are only likely to undergo small modifications during such a period, whether it be in the consumer's field or the energy sector itself. For a large number of installations which make up these structures, a period of at least five years must elapse between the decision to invest and full commercial operation. Thus, most oil refineries, power stations and steel works, etc., the construction of which had been decided around 1970, will only begin to influence the energy balance appreciably during the period 1975-1980.

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1 Tables summarizing the prospects for each Member State are given in appendix 9.

2 Among the principal data which will modify the prospects of energy supply in the enlarged Community, the following should be noted, for example: the consumption rate of growth, lower in Great Britain than in the present Community, the coal resources of Great Britain, the natural gas and oil fields of the North Sea, the nuclear equipment of Great Britain. Some of these factors tend to reduce the dependence of the whole in relation to imports, but they will provide no fundamental change in the problems of energy supply.

3 The question could be asked whether the prospects, based on economic trends such as they were forecast in 1970, are realistic, taking into account the relative stagnation of the growth observed in 1971 and 1972. This problem will be examined later, when the economic assumptions are outlined. In any case, the years 1975, 1980 and 1985 have only a reference value, making it possible to specify the period when certain trends are to be expected. Thus, some of the technological changes likely to affect the energy balance for the year 1985 will occur between 1980 and 1990.

Ten years represent a reasonable delay for the diffusion of new processes in the field of production and conversion of energy, as in its utilization. Fixing this approximate length of time does not preclude the material possibility of developing an innovation in a shorter time. It only underlines at the global level of a national economy or of the Community the inevitable slowness for the positive adaptation (creation of new plant) and negative adaptation (depreciation of installations based on old processes) which result from the magnitude of investments in the energy sector.

It is therefore not before 1980 that, under normal conditions, profound changes may be observed in the structure ofenergy consumption. Beyond that date, however, some effort of imagination must be exercised in order to explore all the developments which may result from the penetration of new technologies, the contribution of new additional resources, or even from deliberate actions bearing on important masses.

Although figures are given generally for the three periods, the accent is put in some cases on the prospects for 1985, although these include a larger degree of uncertainty. In fact, only a long-term view can bring out the major problems which will be raised by the energy policy of the next few years.

C — *The approach*

Before indicating the method which has been followed or its range, it is useful to describe the global approach within which the prospects and the other related studies are comprised.

The energy demand of an economic whole is related to its structure and its growth. A group of assumptions relating to the evolution of the trends of these factors[1] makes it possible to establish the level of the future demand of the main sectors of consumption and of their total.

First it is necessary to establish whether it is possible to satisfy these requirements and under what conditions. For this purpose the potential offered by each source of energy will have to be examined, and this will depend on the amount of reserves and on the production, transport and transformation capacities which will be available. The estimation of the potential will also have to take into account the requirements of other countries or regions of the world which may compete with the Community on the markets for certain sources of energy.

The comparison of the demand with the potential supply will then lead to consideration of the costs of supply. These will have to include elements as varied as the actual technical costs, the structure of the markets, regulatory and financial intervention by public authorities, the security premium to be paid in order to obtain the guarantee for a sufficient and regular supply, the additional charges arising from the protection of the environment, etc.

[1] See section IV.

The price at which the demand may be satisfied will, in this way, be the subject of a first estimate. The consumer is, however, to some extent influenced by the level of prices. The first estimate of these may therefore cause either a change in the absolute amount of the demand, or a change in its distribution between the various forms of energy.

D — *Scope and validity of the prospects.*

The approach which has just been outlined justifies the use of the word 'prospects' in preference to 'forecasts'. No attempt is, in fact, made to assert that the energy demand will reach a given figure in 1980 or 1985, or that it will be met in a given way. Neither is it a question of fixing production objectives for the various sources of energies which the Community will require, nor of planning their utilization.

The figures given in this investigation do not therefore represent 'what will happen', nor 'what should happen', but simply 'what would happen if'. The validity of energy prospects is related to that of the economic assumption on which they are based.

This view assumes therefore that the context will not be upset by entirely unforeseeable events such as : a long-lasting economic crisis ; the appearance of major restrictions to international trade; a hardening of the attitude of oil-producing countries; armed conflict, etc. Events of this kind would, of course, render obsolete any forecast without, however, taking away from it the usefulness of providing a basis for the choice of measures which would have to be taken to ensure, under these circumstances, as satisfactory a supply as possible.

The presentation of bands has been deliberately avoided. Apart from the difficulty which would have resulted from the multiplicity of cases to be considered at the level of each country, we wished to avoid the false security offered by data of this kind. A central hypothesis, representative of the most likely trends, offers the advantage of bringing better to light the fundamental tendencies which might be expected. And it is rather at the level of the potential supply that the study of the possible variants appeared to be worth-while.

Section III - Methodology and plan of the study

Energy prospects have been worked out according to conventional methods in this field.[1]

The recent trends of the main features of the supply within the Community are recalled, first as an initial reference: this is the object of chapter II.

Then the energy requirements have been subdivided into large sectors of consumption, by drawing a distinction between industrial uses (iron and steel, chemical

[1] Only the broad outline of the method is given here. Later in the report the technical developments have also been restricted.

industry, other industries), transport uses and those of the so-called domestic sector.[1] For each of these sectors, an analysis of past trends has been made, country by country, which has made it possible to establish relationships with the most appropriate explanatory variables and to extrapolate them. Sometimes different solutions had to be adopted according to countries, for a given sector, due to structural peculiarities. The sum of the estimates by country has in each case been compared as a check with an overall estimate for the whole of the Community.

The results of these analyses have then been compared with a study of the mutations which appeared likely to influence the structure of the consumption: technological progress, changes in the way of living, new requirements of an economic or sociological character. The conclusions drawn from this double approach are presented in an appendix.

In chapter III these sectorial prospects are regrouped and compared with a global estimate, in order to evaluate the internal consumption. By adding the other requirements, evaluated separately, to this consumption, the amount of total requirements is obtained.

The total requirements present a higher degree of uncertainty than the estimates of internal consumption, although they are the determining factor in the last resort in weighing up the future problems associated with the supply of energy. It is, in fact, very difficult to define factors which explain in a satisfactory way the trends in stock and exports, headings which represent the difference between the two aggregates.

Section IV - Economic assumptions

A — *General characteristics*

The analysis of past trends brings to light the role which various economic parameters can play as explanatory variables of the growth in energy requirements.

For the future, it has been necessary to build up a coherent group of assumptions regarding the trends of these parameters and to reinstate them into a general framework which is described below.

The study is based on the assumption of an economic development similar to that which has prevailed during the last twenty years and which implies in particular the continuance of activities carried out in common by the Member States of the Community, as well as the achievement of common policies which seem, at present, likely to materialize during the next few years, for instance in the realm of economic and monetary union.

The assumptions adopted do not take into account the variations of the general economic climate and apply on the basis of normal water availability and tempera-

[2] For the definition of consumption sectors and the items of the global energy balance, see page 9.

ture. The sometimes considerable influence that these three factors may exercise on the consumption of energy should not be overlooked. Apart from the fact that, in the long term, it is not possible to consider the prospects as equivalent to forecasts, the existence of these factors of distortion prevents us making a direct comparison between the value expected for one year with an amount actually reached. With regard to the first of these uncertainties, it might be interesting to know what the consequences of the substantial slowing down of economic growth in 1971 might be on the trends expected for the period 1970 to 1975. Under present conditions, and taking into account the fact that average conditions were taken as a basis, it does not seem appropriate to consider the possibility of a greatly reduced growth over the next few years, as there is no reason to exclude the possibility of recovery, either during that period or in subsequent years.[1] By 1985, the final aiming point of the present prospects, the margin of error resulting from an overestimate of the growth over the period 1970-1975 does not differ much from those due to other factors of uncertainty.

In other words, the prospects, just as the economic assumption on which they are founded, have a central character, representing the most likely trends, even if they rest on the study of a range of possible solutions. As has already been indicated, the presentation of bands would have made it necessary to discuss a large number of cases without, however, reinforcing the clarity or the reliability of the whole.

The assumption adopted is still within the growth curve of the economic activities of the last twenty years, but rests on a slightly slower trend towards the end of the period. It is, in fact, reasonable to think that the growth of the GNP will not continue indefinitely at an exponential rate. In spite of this, the assumption of a high rate of growth throughout the next fifteen years might seem to be rather audacious. It is, however, justified, particularly as it is to be expected that a large portion of the future demand will be directed to imported energies. There are good reasons to believe that the market for these imported energies will not offer as much flexibility as in the past. In such a case it seems better to avoid the risk of underestimating the requirements, which would lead to certainly more serious consequences than those which might be due to an overestimate.

B — *The main variables*

Tables 1 and 2 give the main variables used for the estimates by country, as well as the result of their summation at the level of the Community.

It would have been desirable to have trend forecasts relating to the whole of the Community, for the whole of the period considered. The economic prospects on which the third programme of medium-term economic policy is founded[2] do not, unfortunately, go beyond 1975. For some large aggregates, forecasts from OECD,[3] which are compatible with the previous ones, are available up to 1980. For the remainder it has been necessary to make estimates.

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1 An analysis of the economic trends for Germany between 1965 and 1970 gives an example of the possibilities of recovery presented by a reversal of economic conditions.

2 See *OJ* No L 47 of 1.3.71.

3 OECD : *The growth in production 1960-1980* (Paris, December 1970).

It should be noted that in all countries the deviation between the rate of growth of the GNP and that of industrial production tends to fall. This trend expresses the assumption of an increase on the share of services within the GNP, which is confirmed in any case by the relative slowing down of the latter towards the end of the period.

The rates of growth appertaining to each country reflect the differences between their economic structures and particularly their degree of industrialization: already high in Germany, in Belgium and in Luxembourg, growing in France and particularly in Italy and in the Netherlands.

The trends of the active population follow the present demographic situation and its tendencies, (e.g. ageing of the population in Germany and in Belgium) as well as factors such as the level of female employment. In this respect, the prospect of a ceiling has been adopted for Germany, whilst an expansion is to be expected in the Netherlands. The apparent break in the trends of employment in Italy results in particular from the effects expected from the withdrawal of part of the female labour from agriculture, which is transferred towards other sectors only with a certain delay.

TABLE 1

Average annual rate of growth, in volume, of the main basic economic variables, in the countries of the Community.

(in %)

	Germany			Belgium			France		
	71-75	76-80	81-85	71-75	76-80	81-85	71-75	76-80	81-85
Gross national product [1]	4.5	4.6	4.2	4.8	4.6	4.2	5.7	5.9	5.3
Industrial production [2]	5.1	5.0	4.4	5.7	5.1	4.5	7.5	6.4	5.6
Total population [3]	0.5	0.2	0.2	0.4	0.1	0.1	0.9	0.6	0.6
Active population [2] [4] (% of the total population)	43.3	43.2	43.2	40.4	40.2	40.0	41.1	41.6	42.0
	Italy			Luxembourg			Netherlands		
	71-75	76-80	81-85	71-75	76-80	81-85	71-75	76-80	81-85
Gross national product [1]	6.0	6.1	5.5	3.5	3.5	3.2	4.6	4.4	4.0
Industrial production [2]	7.5	7.3	6.4	3.5	3.3	2.9	6.7	6.1	5.3
Total population [3]	0.8	0.7	0.7	0.5	0.5	0.5	1.0	1.1	1.1
Active population [2] [4] (% of the total population)	36.1	36.0	36.5	41.5	41.5	41.5	36.4	36.7	37.0

Sources :

1 1971-1975 : 3rd programme of medium-term economic policy
1976-1980 : OECD
1981-1985 : estimates

2 1971-1975 : 3rd programme of medium-term economic policy
1976-1985 : estimates

3 1971-1980 : OSCE *Social statistics*, No 4/1970 (except Luxembourg, for 1976-1980)
1981-1985 : estimates

4 Average value during the period.

TABLE 2

Economic variables for the Community (average annual rate of growth in volume)

(in %)

	1971 1975	1976 1980	1981 1985	1971 1985
Gross national product [1]	5.2	5.3	4.8	5.1
Private consumption [2]	5.1	5.2	4.6	5.0
Public consumption [2]	4.5	4.6	4.2	4.4
Gross fixed capital formation [2]	6.1	6.2	5.6	6.0
Industrial production [1]	6.5	6.4	5.7	6.2
Total population [1]	0.7	0.5	0.5	0.6
Active population [1] [3] (in % of the total population)	40.0	40.1	40.3	—

Sources :

1 See table 1

2 Beyond 1975 : estimates

3 Average value during the period.

CHAPTER II

ENERGY SUPPLY WITHIN THE COMMUNITY FROM 1960 to 1970

In endeavouring to outline the prospects for the demand for energy for the next fifteen years, it is necessary, in the first place, to be aware of the trends which have given the market its present aspect. This market, in fact, very largely conditions developments in the near future, on which will be resting the structures and the constraints existing at the start. It is only after five to ten years that the changes occurring within those structures will begin to have a significant influence.

Although long series cannot be ignored — series which have been used elsewhere for the preparation of demand forecasts — it seemed better here to restrict the examination to the period 1960-1970, which in some respects shows a change in the trends. This period has, in fact, shown an increase in the rate of growth in the requirements and a new supply pattern for energy: a great reduction in the relative importance of coal, the appearance of natural gas in large quantities, the progressive maturity of nuclear energy, and particularly the confirmation of the preponderance of oil which, at a relatively low price, has gained at the expense of other forms of energy in an increasing number of uses, and been able to meet the major part of the new requirements. Only lignite and hydraulic energy have not experienced large changes, although the role of the latter tends to become more and more specialized in the supply of peak electric power.

Section I - Trends of the energy demand during the years 1960 - 1970

A — *Outline of the trends*

With an average annual rate of 6.2 % the growth of energy consumption between 1960 and 1970 has been greater than that observed during the previous decade.

An analysis bearing on short periods, e.g. of five years, shows to what extent this rate is affected by overall economic variations. These are mentioned only to underline the gap which may appear between a long-term trend and influences of a temporary character (see Table 3).

TABLE 3

Average annual rate of growth of the internal consumption of energy

(in %)

1951-1955	1956-1960	1961-1965	1966-1970	1951-1960	1961-1970	1951-1970
5.4	3.6	5.9	6.4	4.5	6.2	5.3

One of the main features of recent consumption trends is the large increase in the requirements of the domestic sector. From 1960 to 1970 they have grown to an index of 215, whilst industrial consumption, particularly due to the reduction of the specific consumption of energy per unit produced, only reached the index 153, and the needs for transport reached the index 185.

Apart from the improvement in the standard of living of households (the domestic consumption has increased on the average by more than 5 % per year between 1960 and 1970), this increase in domestic requirements results from the important increase in the consumption for services and from the changes in the make-up of household appliances.

Within the industrial sector the weighting of the different branches tends to change and the consumption of the manufacturing industries calling for energy in various forms takes a relatively growing share at the expense of traditional branches, such as iron and steel, non-ferrous metals and even the chemical industry.

The rates of growth shown above for the various sectors of consumption concern the total final demand, that is the demand for fuel and electricity. If only the latter is considered even higher rates are reached, the rate of doubling every ten years of the total requirements (7.5 % per year on the average) being maintained in a fairly constant way. This explains the growing part taken by the consumption of primary energy of thermal power stations in the overall balance (18 % of the gross internal consumption in 1970, against 16 % in 1960).

B — *Forecasts and achievements*

Table 4 compares the amount and the distribution by sector of the primary energy demand in 1970 with the forecasts published by the Interexecutive Energy Group in 1962 and 1966.

This comparison attempt calls for an important reservation, which is due to the influence of the overall economic climate, which was particularly favourable, on the level of consumption for 1970. The forecasts or prospects should not be interpreted as a prediction of a spot situation but as an indication of the tendencies which will determine the trends around the year chosen as a point of reference.

TABLE 4

Long-term forecasts for the year 1970 and achievements: demand by sector [1]

(M tec)

Sectors	Study [2]	New considerations [3]	Achievements [1]
Industries [4] [5]	253	262	277
Transport [4]	102	103	102
Domestic [4]	133	171	210
Conventional thermal power stations	150	153	147
Primary electricity	62 } 212	54 } 207	47 } 194
Total needs in primary energy [5]	700	743	783

1 This table is presented in accordance with the pattern of requirements used in the studies mentioned in (2) and (3), a less developed pattern than the one which has been used for the preparation of the present prospects. The differences in the definition of the items of demand do not make it possible to compare the data from this table with the other elements of the present study.

2 The study on the long-term energy prospects of the European Community (first edition 1962 - second edition 1964)

3 New considerations on long-term energy prospects of the European Community (1966).

4 Only fuel requirements.

5 Excluding non-energy uses.

Taking this reservation into account, it will be seen that the 1962 forecasts were correct as far as transport was concerned, that they were confirmed within minus 10 % for industry (although a more detailed analysis shows that the underestimate concerned mainly industries other than iron and steel), and within a little less than + 10 % for electric power stations requirements (the main difference lies in the estimate for the supply of primary electricity). For these three items the deviations between the 1966 forecasts and the achievements were of the same signs but less pronounced.

Against this, it is clear that the increase in the requirements of the domestic sector has been greatly underestimated, in 1962 as well as in 1966, and this could be explained by the fact that the structural changes which occurred within this sector were not expected.

The standard of living has risen faster than expected, particularly due to the high overall economic climate at the end of the ten-year period. The demands for comfort have grown, and consumption has risen rapidly, without any increase in the weighting of energy within the domestic budget, and this, furthermore, in a period when in real terms the relative price for energy was falling. The 'consumer society' had also spread to energy. In addition, the domestic sector includes consumers other than households, and in particular administrative organizations and services (commerce, banks, etc.) whose demand for energy developed in a way which could not be expected from the economic assumptions available in 1960 and 1965.

Finally, the only difference between forecasts and achievements in the domestic sector occurs at the level of the total.

The fact should also be stressed that Table 4 does not include the energy allocated to non-energy uses, the demand for which has become considerable, representing 7 % of the internal consumption in 1970.

The subdivision of the demand by forms of energy is given in Table 5, which also compares forecasts and achievements for the year 1970.

TABLE 5

Long-term forecasts for the year 1970 and achievements: demand by source of primary energy [1]

	In M tec			In %		
	Study [2]	New Considerations [3]	Achievements [1]	Study [2]	New Considerations [3]	Achievements [1]
Lignite	32	38	33	5	5	4
Coal [4]	232-255	200-233	189	33-36	27-32	24
Oil [4]	330-306	398-365	447	48-45	54-49	57
Natural gas [4]	41-45	53	67	6	7	9
Primary electricity	62	54	47	7	7	6
Total [4]	700	743	783	100	100	100

[1], [2] and [3] : see notes [1] [2] and [3] of Table 4.
[4] Excluding non-energy uses.

With the same reservations of principle as in the previous table, this table shows that the regression of coal has been underestimated in the forecasts, and that these envisaged a much lower advance than has been achieved for oil and natural gas.

There were still too many uncertainties in 1960 on the future of coal mines within the Community to enable the role of coal to be correctly estimated, whilst the possibilities of expansion of hydrocarbons — which have exactly covered all the increase in consumption due to the exceptionally favourable overall economic climate of 1970 — could not be estimated in full.

The comparisons mentioned above confirm the indications of the previous chapter on the validity and the range of energy prospects.

The assumptions on which they rest imply a certain homogeneity in the economic trends. In reality, however, this homogeneity is not achieved on only one front, and the influence of the overall economic climate may introduce a bias, at least in appearance, in long-term trends.

As an element of reference for a framework of action, the prospects appear as an indication of the most likely trends, but it is quite clear that they should be re-examined periodically in order to take into account new and unforeseeable trends, particularly in the light of structural modifications.

Section II - The trends of the market for the different primary sources of energy

A — *Coal*

The falling trend of coal consumption has continued uninterruptedly during the period. Starting at 243 million tec in 1960, the gross internal consumption went through a maximum of 251 million tec in 1963[1] to fall gradually down to 189 million tec in 1970.

The coal consumption is concentrated in two main sectors. In iron and steel, where coal is used for specific purposes, Community production was faced to some extent with competition from imports from third countries. In power stations, coal is tending to recede in favour of other fuels. Energy policy measures, in both cases, help to maintain a certain flow of coal of indigenous origin.

Community coal production still covers the greatest part of consumption. Following a process of regression (227 million tec in 1960, 161 million tec in 1970, i.e. — 3.4 % per year on the average) it does not offer more than limited flexibility to meet the fluctuations of demand. These have, therefore, to be transferred to movements of stocks and to imports.

Efforts towards rationalization of production within the Community have been maintained in spite of increasing difficulties resulting from the rapid increase in costs. This has engendered a generalized increase in the selling prices and led, in some cases, to accelerating the programme for closing mines.

The substantial measures of support for the coal industry introduced by the Member States within the framework of Community decisions[2] have resulted in direct aid which rose from 82 million units of account in 1965 to 404 million units of account in 1970.

B — *Oil*

The greatest part of the increase in energy demand between 1960 and 1970 has been met by oil, as shown by Table 6. During the first five years the substitution effect for solid fuels came in addition to the growth effect, which resulted in an increase in oil consumption (+ 170 million tec between 1960 and 1965) which was greater than the increase for the whole of energy (+ 163 million tec). During the subsequent five years oil experienced a slightly lower increase than that of the whole (+ 275 million tec against + 298), which may be explained, in particular, by the slowing down of the substitution process in some applications, and by the rapid development of natural gas.

1 The high coal consumption in 1963 results particularly from abnormal climatic conditions.

2 Decisions of the ECSC 3/65 and 71/3, 1/67 and 70/1.

TABLE 6

Increase in demand for primary energy and oil - 1960-1965-1970

	Total requirements * (in M tce)			Share of oil in the total requirements for energy (%)		
	1960	1965	1970	1960	1965	1970
Energy	542	705	1003			
of which: Oil	204	375	650	38	54	65

* Gross internal consumption + exports + stocks.

As shown in Table 7, the structure of the consumption of petroleum products has gradually changed. First will be noticed the increasing share of products for non-energy utilization, which may be explained particularly by the rapid development of petro-chemistry. Then, the substantial decrease in petrol for motor vehicles, the share of which has become hardly greater than that of non-energy products. Lastly, the increasing importance of products used mainly as fuels (gas-diesel oil, heavy fuel oil, other products) which together rose from 71.9 % to 74.8 % of the total. The share of heavy oil tends, however, to decrease and this may be explained by the efforts made to reduce atmospheric pollution, and by research, on the part of refineries, for a better balance in the production as a function of the qualities of available crude oil.

TABLE 7

Structure of internal consumption of petroleum products - 1960-1970

(in %)

	1960	1970
Motor vehicle petrol	18.5	13.5
Gas-diesel oil *	31.0	36.5
Heavy fuel oil	34.6	32.5
Other products for energy use	6.6	5.9
Non-energy products	9.3	11.6
Total	100.0	100.0

* Including light fuel oil.

The supplies of crude oil necessary to cover this growing demand have not been lacking, particularly thanks to the increase in production at the world level. But on two occasions during the period serious threats have been directed at the Community's supplies, which almost entirely depend on imports from countries outside the Community. The first time, in 1967, the Middle-East crisis closed the Suez

Canal, the main route used for oil from the Persian Gulf. In spite of the temporary interruption of some supply lines it was possible to maintain a sufficient supply. At that time there was a flexibility in oil production and transport which made it possible to replace missing deliveries at short notice from other sources. In addition, the greater transport distance caused by closing the canal has resulted in an increase in costs which has, partially and gradually, been compensated by savings from the use of very large tankers.

The second crisis, of 1970-1971, appeared in a very different world context displaying a particularly high increase in demand and very narrow manœuvring margins in production as well as transport, in comparison with the situation in 1967. These circumstances have enabled the producing countries to wage with success a concerted action aimed at obtaining a substantial increase in taxes and payments made by foreign undertakings which were extracting the crude oil.

When analysing the effects of this situation on the world oil market, general economic factors should not be overlooked, particularly those concerning the costs of maritime transport. Furthermore, the recent increase in taxes and payments for oil extraction follow a long period of decrease, in real money terms, of the cost of crude oil for importers and refineries. Lastly, it may be the suddenness of the recent changes which has had more effect than their magnitude.

It should nevertheless be recognized that the world oil market has taken on a new appearance, characterized by the different relationships between the producing countries and the oil undertakings. Another new element which might make it possible to offset this in part is the opening-up of new oil-producing areas which, without replacing the dependence of Europe on its traditional suppliers in Africa and the Middle-East, contribute to diversifying the origin of supplies.

C — *Natural gas*

Until 1965, the production of natural gas was mainly limited to the North of Italy and the South-West of France; at Community level it constituted only a make-up source of energy. Subsequently, the opening up of the fields discovered in the Netherlands has permitted rapid growth of consumption and created suitable conditions for a European market at a time when an international natural gas market was developing.

Whilst in 1960 natural gas covered only 3 % of gross internal consumption, with 12 million tec, it reached 9 % in 1970 with 73 million tec. This increase (+ 20 % per year on the average) was achieved not only by covering new needs, but also by taking over from other energies, mainly coal and to some extent petroleum products. Its principal impact is in the domestic sector and in industry, but it is also penetrating, under certain conditions, into the thermal power station sector. Experience has shown that a very large market may be open to natural gas.

Apart from the known reserves within the Community, new availabilities become apparent from third countries, and the importation of a limited amount has already taken place.

D — *Nuclear energy*

The launching of nuclear energy has not taken place within the Community at the rate expected at the beginning of the 1960's. This is the result, first of all, of the continued relative fall of hydrocarbon prices, which has caused electricity producers to hesitate before committing themselves resolutely to nuclear energy. The additional investment cost resulting from technical and economic characteristics of nuclear plant is another brake. Lastly, the inevitable technical uncertainties met with in any new development reaching maturity are still affecting the reliability of nuclear power stations, and their insertion into the networks involves particular difficulties.

Experience has shown in the United States, however, that when the prospects of nuclear electricity costs in relation to conventional thermal electricity are favourable, the nuclear plant capacity may grow at a rapid rate, providing the necessary industrial infrastructure is available.

Section III - Energy in the economy of the Community

A — *The role of the energy sector in the economy*

The energy sector, which represents approximately 12 % of industrial productions, exercises important effects on the economy up-stream as well as down-stream.

It has, in particular, a large influence on other branches through its demand on investment assets, which exceed at the moment 6000 million units of account per year, reaching, from one year to another, between a quarter and a fifth of the capital needs of the whole of industry. Since 1967, however, a tendency to a reduction in the share of energy investment has been observed.

The share of the coal industry is decreasing regularly, whilst that of oil and gas extraction remains practically stable, as well as the share of the refining industry.[1] The largest amount of investment within the energy sector is carried out by the gas and electricity supply industries. The latter represents, in a fairly constant manner, about 60 % of the whole investment for energy, and it is likely that in future the high investment burden caused by the development of nuclear energy will tend to raise this percentage.

[1] This heading does not include investments in transport and distribution of petroleum products

TABLE 8

Investments in fixed assets of the energy sector

	1964	1965	1966	1967	1968	1969	1970
In millions of accounting units at current prices	4 800	4 700	5 100	5 400	5 200	5 400	6 200
In % of the total industrial investments	25.4	24.7	25.2	27.0	24.8	22.0	20.0
of which:							
Extraction of solid fuels	2.1	2.0	2.0	1.7	1.7	0.9	0.9
Extraction of oil and natural gas	1.3	1.3	1.5	1.3	1.5	1.2	1.2
Oil refining	4.0	3.8	4.1	5.1	4.4	4.4	3.7
Production and distribution of electricity	18.0	15.2	15.1	15.9	14.4	13.0	12.2
Production and distribution of gas		2.4	2.5	3.0	2.8	2.5	2.0

Source : SOEC

The investment charge included in the cost of energy delivered within the Community is not, however, limited to the amount shown above. There are also sums devoted to investments in third countries by undertakings contributing to the supply, for research, for instance, and for the production and transport of crude oil. The multiple destination of these investments, which also serve to supply other regions of the world, does not, however, make it possible to evaluate the share applicable to the requirements of the Community.

A large part of the energy industry investments concern products of a high technological content: the growth in energy requirements provides incentives to a number of industries from which it purchases products requiring more and more developed technologies. Furthermore, the energy sector, which employs approximately 1 150 000 persons, requires a labour force with very diversified qualifications and of a generally high level.

Intervening within economic circuits either as a production asset or as a consumption asset, in each case energy plays a double role. On the other hand its physical availability conditions the performance of a very large part of economic and social activities, and an interruption of supply could result in a considerable loss of social product. Furthermore, it constitutes a substantial cost element for certain industries (iron and steel, electro-chemistry, electro-metallurgy ....); for the others it is an indispensable means of production, even if its cost has less effect on competitiveness. As a private or collective consumption asset, its price is also of some importance for the level and the standard of living.

B — *The Community as largest importer of energy in the world.*

1. Energy imports

The *oil* production of the Community, of about 15 million t per year, brings only a small contribution towards covering requirements and is falling. Only imports make it possible to satisfy a growing demand for petroleum products. In ten years these imports have grown almost four-fold, which represents a mean annual increase of 14.1 %, i.e. a rate which is almost three times higher than that of the overall energy demand rate of growth.

TABLE 9

Total imports of coal from countries outside the Community

(M tep)

1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
109	126	143	167	198	230	260	280	317	360	406

Regarding *coal*, the more favourable conditions of supply in some countries outside the Community have made it possible, within certain limits, to cover part of the demand by imports at a cost below that of internal production. It should be noted, however, that, as opposed to oil, these imports have only slightly increased since 1960: they are influenced by the coal policies of the Member States, as well as by the economic trends of the iron and steel industry, principal buyer of imported coal. Altogether, the share of imports in the gross consumption of coal has risen from 7.5 % in 1960 to 15 % in 1970.

TABLE 10

Total imports of crude oil from countries outside the Community

(M tec)

1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
17.9	18.8	23.6	34.0	31.0	29.0	26.2	24.3	22.0	24.1	31.2

Regarding *lignite*, the Community production covers practically the whole consumption.[1] The same applies to *natural gas*, although measures taken recently to improve the importation of gas from countries outside the Community will increase future dependence on imports.

[1] Except for a small decreasing quantity of imported briquettes of lignite.

For *nuclear energy*, whose share in the balance has so far been very small, a different judgement should be given according to which of the different stages, from the extraction of the uranium ore to the manufacture or the reprocessing of the different types of fuel elements, is being considered.

Lastly, for *electrical energy*, one cannot speak of dependence, but of additional supplies, the imports from countries outside the Community being only one element in a group of exchanges related to the daily and seasonal fluctuations of the demand and to the structure of electrical installations in these countries and those of the Community. Account should also be taken of the shares which some undertakings in the Community own in some power stations (hydroelectric in particular) built jointly with undertakings of countries outside the Community.

2. The degree of energy dependence

Altogether the degree of energy dependence, which expresses in percentage terms the share of supplies originating in countries outside the Community in the total requirements, has grown in the years from 39 % to 66 %, the actual energy imports of the Community rising from 200 million tec to 650 million tec. The Community thus appears in the first rank of buyers on the world energy market, accounting for approximately 30 % of the whole of the world's imports. For crude oil alone, it leads with 406 million t in 1970, ahead of Japan (142 M t), EFTA (130 M t, 94 of which for Great Britain), and the United States (87 M t).

Graphs 1 to 3 present some data relating to energy exchanges with countries outside the Community.

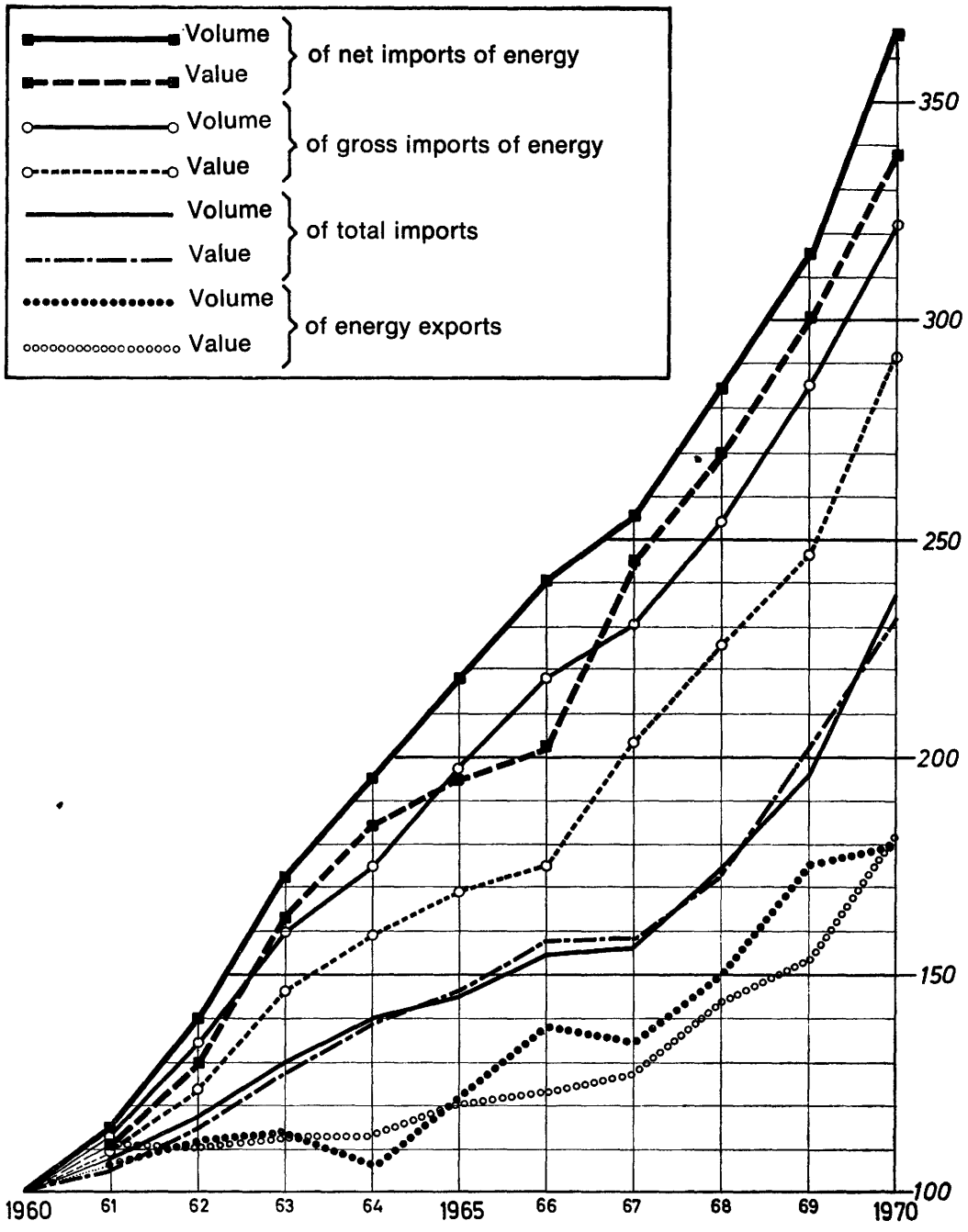
Indexes are given on graph 1 for the trends of total imports in the Community, its gross and net imports of energy, expressed each time in value and in volume, from 1960 to 1970. It is clearly shown that the growth of energy imports during the period has been larger than that for all imports.

However, whether we deal with gross imports or net imports of energy, the growth in volume has been greater than the growth in value. This trend shows the relative decrease of the prices for imported energy whilst for total imports the trend in value follows practically that in volume. During the years 1964 to 1966 the deviation between value and volume of energy imports increased due to the substantial reduction of average prices. In 1967 the Suez crisis brought a rise in the prices of imported energy; the average price then remained stable, to grow once more in 1970: these trends are illustrated by the quasi-parallelism of value and volume indexes from 1967 onwards.

In spite of the substantial increase in dependence on outside sources, the share of gross energy imports in the value of total imports has remained fairly stable, rising from 14 % in 1960 to 17 % in 1970 (see graph 2).

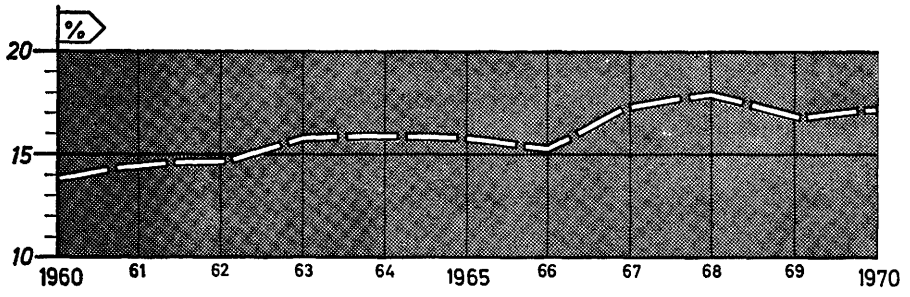
Energy exports have also increased but at a lower rate than imports. Whilst they represented in volume 22.5 % of gross energy imports in 1960, they have gradually fallen to 12.5 % in 1970, the trends in value being practically parallel (from 34.5 % to 21.0 %) (see graph 3).

TRENDS OF IMPORTS AND EXPORTS OF ENERGY AND OF TOTAL IMPORTS (Index 100 = 1960)



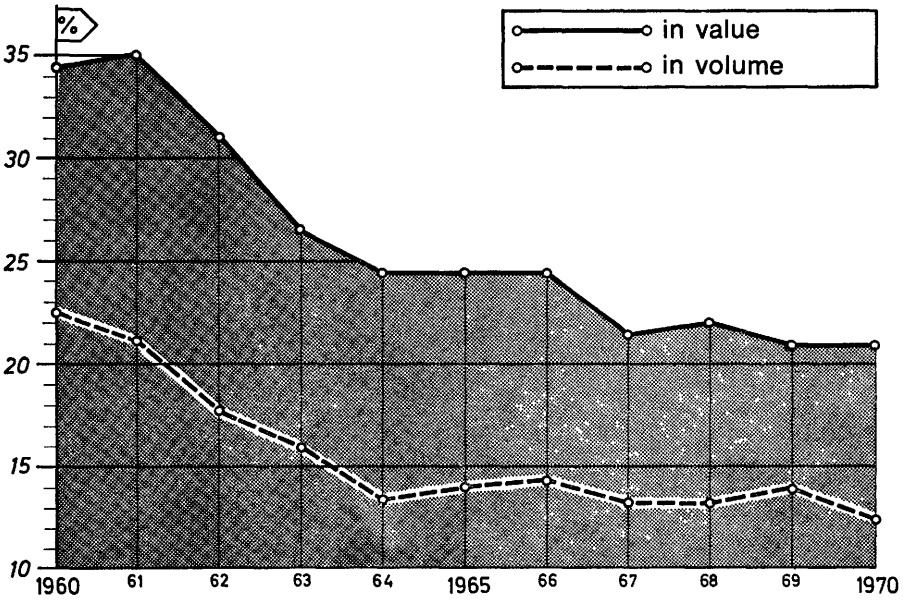
RATIO BETWEEN THE VALUE OF GROSS IMPORTS AND THE VALUE OF TOTAL IMPORTS

(2)



(3)

RATIO BETWEEN EXPORTS AND GROSS ENERGY IMPORTS



The growth of net energy imports, i.e. the growth of purchases needed to meet the internal requirements of the Community, has thus been greater than that of gross energy imports (see graph 1).

During the last decade, the energy dependence of the Community has therefore become more serious due to the increase in requirements and the smaller and smaller contribution of internal production towards satisfying them. In addition, although energy exports have increased, the compensation they provided for the importing position has appreciably dropped in importance.[1]

[1] To be complete, this brief analysis should take into account the structure of the energy industry within the Community, and particularly the role of multi-national undertakings in this sector, by studying the financial currents caused by the activities of these undertakings. This question, too complex to be examined here, has been examined within the framework of medium-term trends concerning hydrocarbons.

CHAPTER III

THE ENERGY DEMAND IN 1975-1980-1985

The prospects for the global demand for energy have been established on the basis of a comparison between the results of sectorial forecasts, the details of which are given in appendices, and those of a global approach. The subdivision of the demand into the different primary sources of energy is then outlined.

Section I - Internal consumption: sectorial approach

The different consumption sectors[1] have been grouped, as shown in graph 4, into three areas as follows: the *industrial sectors* including, apart from energy requirements from industries (iron and steel, chemical and other branches), their non-energy requirements, as well as their own consumption and the losses of energy supply industries; the *transport sector*, public and private; and a very mixed group referred to as the *domestic sector*. The data[2] deal with all the energy consumed (fuels + electricity), which explains that in a first stage of the argument power stations' requirements are not shown. These will be examined in section IV.

A — *The industrial sectors*

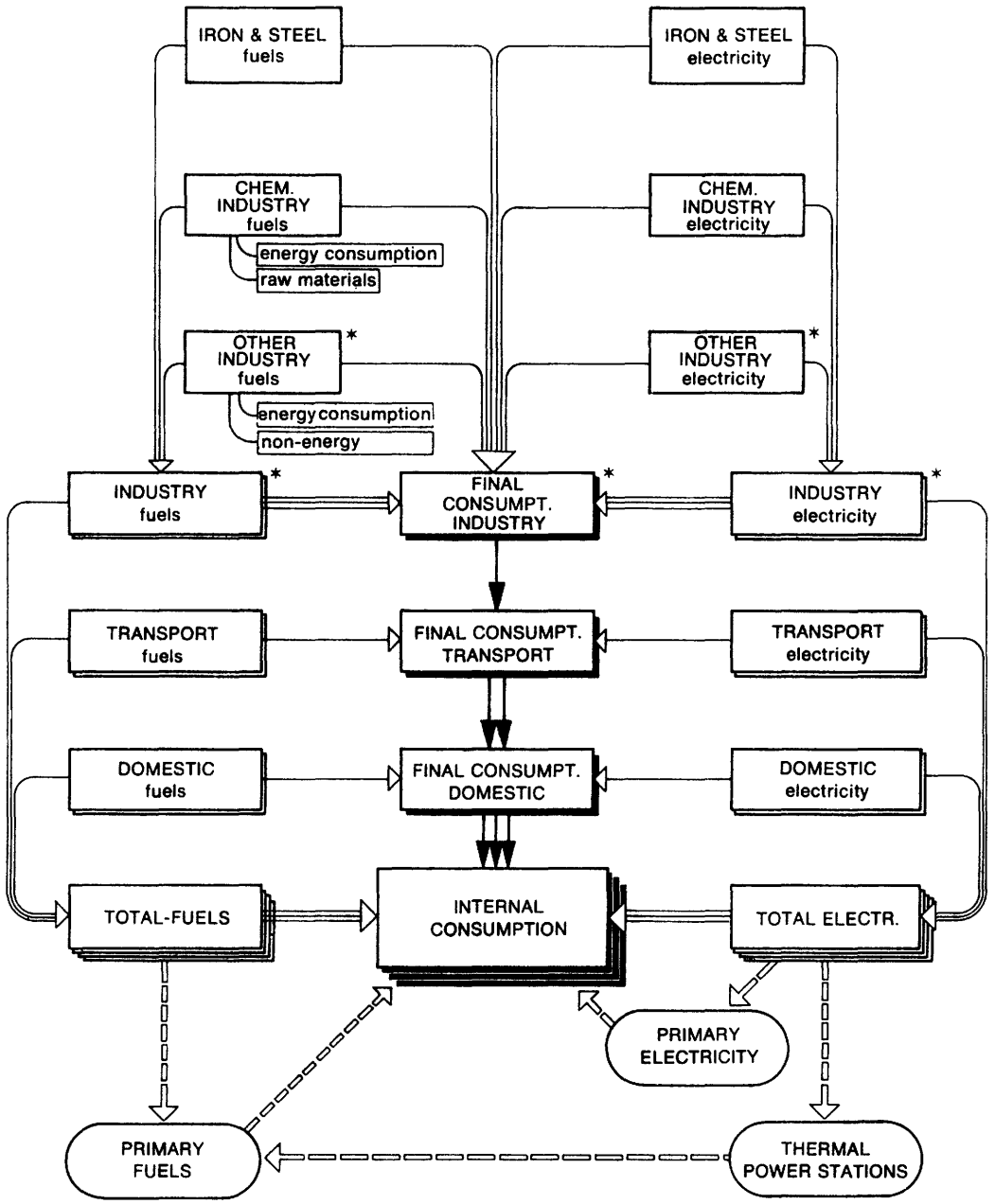
During the years 1960 to 1970 the industrial consumption of energy has increased by 5.5 % per year on the average, i.e. slightly less than the total internal consumption.

Table II shows the changes of structure which have taken place within the energy demand of industry (excluding energy supply industries). If the chemical industry is the branch whose consumption has had the greatest increase since 1960, the

1 General indications on the definitions adopted for each sector are given in the general observations, page 9. Where necessary, additional information is given in the Appendices devoted to the main sectors.

2 The data appearing in the tables of the text may present certain discrepancies with those in the Appendices, following conversions of data originally in tec and the rounding-off of certain figures, necessary to ensure the coherence of the whole.

REGROUPING DIAGRAM OF SECTORIAL FORECASTS FOR THE DEMAND FOR ENERGY (INTERNAL CONSUMPTION)



* Including consumption of energy sector and losses

'other industries with high energy consumption' and the 'miscellaneous industries' have grown more than iron and steel. The large increase of the non-energy uses, other than those of the chemical industry, should also be noted.

TABLE 11

Structure and recent trends of industrial consumption of energy - 1960-1970 [1]

Branches [2]	Volume in M tce		Distribution in %		Mean annual variations in % 1961/1970
	1960	1970	1960	1970	
Iron and Steel	68	89	31.1	23.1	+ 2.7
Chemical industry (energy uses and as raw material)	44	91	20.1	24.7	+ 7.6
Other industries with high energy consumption	52	94	23.7	25.2	+ 6.2
Miscellaneous industries	46	74	21.0	19.9	+ 5.0
Other non-energy uses	9	27	4.1	7.1	+ 11.5
Total for industrial uses	218	375	100	100	+ 5.5 [3]

1 Excluding energy supply industries.
2 For the definition of branches, see general observations, page 9.
3 + 4.4 % if excluding non-energy uses.

The trends will be differentiated within the industrial sector for the next 15 years as well.

Iron and steel[1] represents a relatively homogeneous branch, which rests on a well-tried technology, but in the long term it might be subject to important structural modifications. The energy forecasts for this sector up to 1975 rest on the general objectives for steel[2] which are based on fairly high growth assumptions. Although these objectives give certain indications for 1980, the prospects for that date and especially for 1985 are based particularly on a study of the possibilities offered by new technological developments. Several of these will be adopted by the iron and steel industry of the Community but, between now and 1985, it is not likely that they will modify to any great extent the structure of energy consumption; the latter will continue to be dominated by fuels and mainly by coke.

1 See Appendix 1
2 'Memorandum on the general objectives of the iron and steel industry of the Community for the years 1975-1980' - OJ No C 96 of 29.9.71.

TABLE 12

Energy consumption of the iron and steel industry - 1975-1985 Prospects

(M tec)

	1970	1975	1980	1985	Mean annual variations in % 1971-1985
Fuels	72	85	95	106	+ 2.6
Electricity	17	20	25	29	+ 3.6
Total	89	105	120	135	+ 2.9

The *chemical industry*[1] is an intensive energy consumption sector whose rate of growth will remain high in the future, mainly as a result of a continuous diversification of its production. Whilst the fuel consumption may grow at a lower rate than that of chemical production, the use of energy products as raw material in that sector is likely to experience a very high increase. The chemical industry is of particular interest in view of the fact that almost all its non-electrical requirements bear on hydrocarbons: petroleum products and natural gas.

TABLE 13

Energy consumption of the chemical industry - 1975-1985 Prospects

(M tec)

	1970	1975	1980	1985	Mean annual variations in % 1971-1985
Fuels	31	37	43	49	+ 3.1
Electricity	28	40	59	79	+ 7.2
Raw material	32	57	75	91	+ 7.2
Total	91	135	175	220	+ 6.1

Several of the branches included among the *other industries*[2] are characterized by the large part played by energy in their costs of production. That is the case, for instance, with the non-ferrous metals industry and that of non-metallic minerals. Their development is in part determined by different factors: competitiveness in relation to undertakings from countries outside the Community for the former (and in this connection the price of energy is of very great importance), and activity in the building industry for the latter. On the whole, the rate of growth of their energy requirements will remain fairly high.

1 See Appendix 2

2 See Appendix 3, A

TABLE 14

Energy consumption of other industries with high energy consumption - 1975-1985 prospects

(M tec)

	1970	1975	1980	1985	Mean annual variations in % 1971-1985
Fuels	65	87	117	159	+ 6.1
Electricity	29	39	53	71	+ 6.1
Total	94	125	170	230	+ 6.1

The *miscellaneous industries*[1] bring together branches whose trends follow many different influences and their energy consumption grows in a less regular way than that of other industries. For the future it is probable that these industries will still experience an important development which would double their consumption by 1985, in relation to 1970.

TABLE 15

Energy consumption of miscellaneous industries - 1975-1985 prospects

(M tec)

	1970	1975	1980	1985	Mean annual variations in % 1971-1985
Fuels	51	68	94	129	+ 6.3
Electricity	23	31	41	52	+ 5.6
Total	74	100	135	180	+ 6.1

The consumption of the *energy industries* and the *losses* due to the transformation and transport of energy have been evaluated as a function of the quantities of energy required to satisfy all the industrial consumers and others. This consumption is related to the structure of the means of meeting the requirements and takes into account the more or less elaborate character of the various energy products concerned. The consumption and losses amounted to 91 million tec in 1970; they will reach 170 million tec approximately towards 1985.

Energy consumption for non-energy uses, other than those as raw materials used by the industry, has been estimated on the basis of the probable trends of the requirements in tars, bituminous products and lubricants, taking into account their place in the range of products derived from crude-oil refining. The requirements for '*other non-energy uses*' are expected to rise from 26 M tec in 1970 to 64 M tec in 1985.

[1] See Appendix 3, B

These areas of consumption have been added to the amounts shown in Tables 12 to 15 to arrive at Table 16, which recapitulates all the forecasts relating to industrial sectors, whose consumption should rise from 465 to 1 012 million tec, i.e. a mean annual growth of 5.3 %.

TABLE 16

Energy consumption of industrial sectors [1] - 1975-1985 prospects

(M tec)

	1970	1975	1980	1985	Mean annual variations in % 1971-1985
Fuels	336	437	562	697	+ 5.0
Electricity	129	170	227	315	+ 6.1
Total	465	607	789	1012	+ 5.3

[1] Including use as raw material, consumption for non-energy uses, consumption of energy supply industries and losses.

B — *Transport*[1]

Although some factors lead to the belief that consumption by road transport may experience, in time, some slowing down in its rate of growth, the rate of development of the whole sector will be maintained at a fairly regular level during the whole period under consideration.

It should be stressed that long-term forecasts, in this sector, are effected by several uncertainties which may work in various directions. Thus, for instance, measures for the fight against pollution may reinforce the growth of motor fuel requirements if they are aimed at limiting certain emissions from road vehicles or increase electricity requirements if they aim at encouraging the development of certain methods of public transport.

TABLE 17

Energy consumption by transport - 1975-1985 prospects

(M tec)

	1970	1975	1980	1985	Mean annual variations in % 1971-1985
Fuels	102	131	167	220	+ 5.3
Electricity	6	6	7	8	+ 1.9
Total	108	137	174	228	+ 5.1

[1] See Appendix 4

C — *The domestic sector*[1]

The energy requirements of the domestic sector have increased, during the last twenty years, at a greater rate than that of the two sectors examined above. This growth reflects sociological changes which occurred during that period: rapid and generalized rise in the standard of living, development of tertiary activities, increase in the organization of public services etc... It is necessary, however, to take into account the fact that this sector includes groups of consumers of fairly diverse types: actual households, public administrations, commercial undertakings and small industry, agricultural undertakings, etc. From this mixture there arises an element of inaccuracy for future trends, but most of the indices lead to the belief that it will be in the direction of a continued high rate of growth.

For this sector, two variants of distribution between fuels and electricity have been considered for 1985. It is necessary to stress the considerable possibilities offered in this sector to electricity. The development of urban areas (new towns), with the greater demands it imposes regarding the way of life and the environment, will maintain a high rate of growth of the needs for electricity in the domestic sector. In the very long term, therefore beyond the period covered by the present prospects, the question will no doubt arise of a predominance of electricity over other fuels.

In order to avoid a multiplicity of assumptions, only the variant resting on a low rate of growth for electricity has been adopted for the estimation of total consumption of the different forms of energy presented in Table 18.

TABLE 18

Energy consumption of the domestic sector - 1975-1985 prospects

(M tec)

	1970	1975	1980	1985	Mean annual variations in % 1971-1985
Fuels	208	256	306	358	+ 3.7
Electricity	63	95	146	212	+ 8.4
Total	271	351	452	570	+ 5.1
Fuels	80 %	73 %	68 %	63 %	
Electricity	20 %	27 %	32 %	37 %	
Total	100 %	100 %	100 %	100 %	

[1] See Appendix 5

D — *Total consumption*

The sectorial prospects outlined above make it possible to estimate the amount of the internal energy consumption of the Community as 1095 million tec in 1975, 1 415 million tec in 1980 and 1 810 million tec in 1985. As shown in Table 19, these figures correspond to a mean annual growth of 5.2 %.

TABLE 19

Internal energy consumption in 1975-1985: distribution of sectorial prospects

(M tec)

	1970	1975	1980	1985	Mean annual variations in % 1971-1985
Industrial sectors *	465	607	789	1012	+ 5.3
Transport	108	137	174	228	+ 5.3
Domestic sector	271	351	452	570	+ 5.0
Total (rounded-off)	844	1095	1415	1810	

* Including non-energy uses, energy industries and losses.

Table 20 shows that the breakdown by main consumption sectors, which had been changed between 1950 and 1970 by the increasing share of the domestic sector (from 26 to 32 %), would remain fairly stable between now and 1985. Some possible changes in the rate of growth of each of the sectors,[1] without altering the total amount of consumption, might nevertheless alter this breakdown.

TABLE 20

Share of the main sectors in the internal consumption of energy

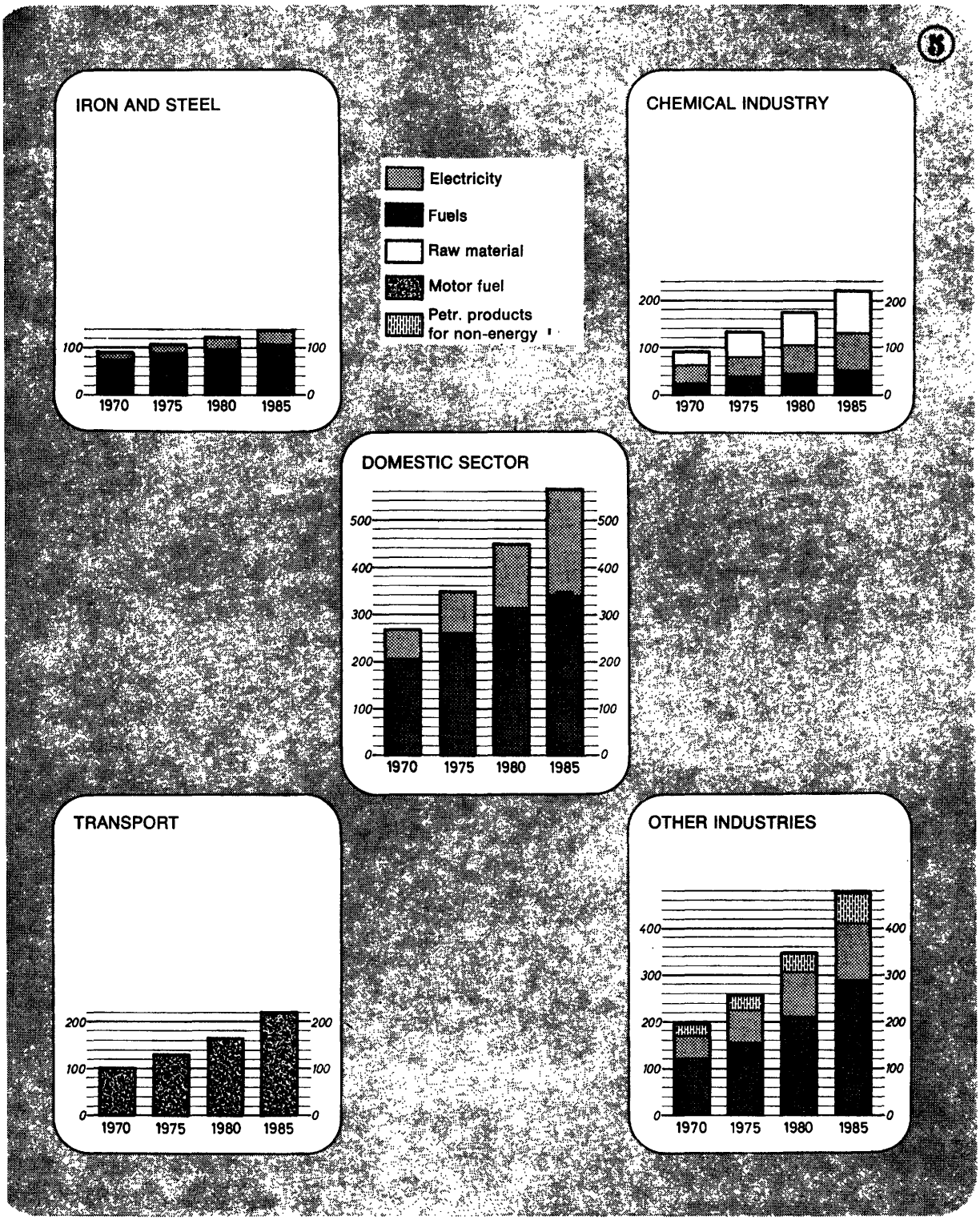
(in %)

	1970	1975	1980	1985
Industrial sectors [1]	55	55	56	56
Transport	13	13	12	12
Domestic sector	32	32	32	32
Total	100	100	100	100

1 Including non-energy uses, energy industries and losses.

1 ... due particularly to uncertainties which affect the evolution of employment, evolution of prices, etc.

ENERGY CONSUMPTION OF THE PRINCIPAL SECTORS (M tec)



[1] Part of the consumption for non-energy uses could be accounted for within other consumption sectors.

Section II - Internal consumption: global approach

The figures in Table 19 lead us to expect that the rate of approximately doubling of the energy consumption in 15 years will still continue during the subsequent period within the Community. It corresponds to a mean annual growth rate of around 5 %.

A — *Energy consumed per unit of product*

This prospect implies a certain increase in the consumption of energy per unit of GNP expressed in real money. Such an assumption seems possible with regard to the trends observed for the last 15 years within the Community. After falling from 2.40 tec in 1956 to 2.07 tec per 1 000 dollars of GNP in 1961 (expressed in real value at the 1963 rate), the quantity of energy required to obtain the same amount of national product has tended to rise since, to reach almost 2.25 tec in 1970.[1]

This overall trend is different, however, when considered country by country. Whilst in Italy and the Netherlands, countries of more recent industrialization, the quantity of energy consumed for a given amount of GNP grows in a regular manner, the same does not apply to the other Member States[2] where, after a large decrease until 1961, a certain stability prevailed until 1966, followed by an increase.[3] The general trend is therefore, for the time being, an increase in this ratio. For the future it seems that a number of factors, which may have contributed to causing a decrease or stability, will disappear and that we should expect a continuation of the growth of energy consumption per unit of GNP.[4] It is, of course, difficult to measure the respective effect of these factors and to place this effect in time, but they can at least be mentioned:

— The progress achieved in the efficiency of energy utilization, which has resulted in a fall in the consumption per unit.[5] Little by little, however, these possibilities of improvement become smaller, as has already been found for instance in thermal power stations or blast furnaces. But it is known that the contribution of conventional thermal power stations to the demand for primary energy has risen from 16 to 18 % between 1960 and 1970, and that it will go on rising until nuclear energy has taken over.

— The more or less abundant availability of energy, in relation to the contribution from other production factors, which manifests itself by the relative difference between prices at utilization. In this connection, it will be noted that the period

1 See Appendix 7

2 The case of Luxembourg, which presents too many peculiarities due to its size and the weighting of some sectors in the establishment of its GNP, is not considered.

3 Very clear in Germany and Belgium, but not so pronounced in France.

4 Or, which amounts to the same thing, a slight increase in the coefficient of elasticity Energy/GNP. This coefficient is the ratio between the relative growth of energy consumption and that of the GNP, for the same period, both expressed in percent.

5 It is in counting on the continuation of these trends that the Study on the energy prospects of the European Community foresaw in 1961 that the rate of elasticity Energy/GNP would remain at 0.9 during the period 1970-1980, whilst in fact it has already oscillated around 1.0 between 1960 and 1970.

previous to 1960 was characterized by fairly high prices for energy; since then, the trend towards full employment of labour and the low price of energy have led undertakings to introduce a greater degree of mechanization.

— The appearance of new uses for energy, for instance the use of hydrocarbons as raw material for the chemical industry, which has risen from 3 to 7 % of the internal consumption between 1960 and 1970.

— The rise in the standard of living, which entails an increase in non-industrial energy consumption: domestic households (from 27 to 32 %), services, motor fuel, etc.

Just as it is not possible to decide the precise role of each of these influences in the past, it is not possible to forecast their future repercussions with certainty. Nevertheless and taking into account the trend observed in other industrialized countries,[1] the assumption of a gradual increase in the consumption of energy per unit of GNP seems reasonable.

The prospects of available manpower show, in fact, that the incentive for mechanization in industry will remain at least as strong as in the past. It will assert itself more and more in the services branches. Without doubt, it should be taken as reasonable, for the next 15 years, to assume an increase in the average cost of energy. But there is nothing to show that this increase will be relatively greater than the increase in the cost of other production factors, and manpower in particular. Just as in the past, no doubt, energy will be the motive force behind economic growth, even if the conditions under which it will be offered should encourage consumers to increase their efforts towards using it in a more rational way.

Furthermore, the progress which can be achieved in the realm of efficiency will be continuously decreasing due to the technico-economic stresses to be met. For instance, the curve of the trends of specific consumption of thermal power stations already show the pattern of the limits facing conventional installations.[2]

It is also to be expected that the need to protect the environment will entail, for a given final consumption, a higher need for primary energy.

B — *Consumption of energy per inhabitant*

The trends in the average consumption of energy per inhabitant in the Community are found to lie between the forecast for Japan on the one hand, where a three-fold increase is expected in 15 years, and that of the United States on the other hand, where the increase will only be by half. Rising from 4.5 to 8.9 tec per inhabitant, it would approximately double in the Community, as show in Table 21.

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1 The trend of the coefficient of elasticity in the United States since 1955 presents fluctuation in the same direction as those observed in the Community, but of a lesser degree. In that country, the tendency towards a fall in the consumption of energy per unit of GNP observed since 1947 seems to have reversed since 1966.

2 In this connection it is interesting to mention the trend which is taking shape for large conventional units (beyond 600 MW), which is to design installations with less advanced characteristics resulting in an efficiency lower than that of power stations built earlier, but also in smaller investment per kW installed.

TABLE 21

Prospects for the consumption of energy per inhabitant - 1975-1985
(gross internal consumption)

(tec/inhabitant)

	1970	1975	1980	1985
Germany	5.5	6.8	8.4	10.5
Belgium	6.0	7.9	9.7	11.9
France	4.2	5.2	6.6	8.3
Italy	2.9	4.0	5.1	6.6
Netherlands	5.3	7.3	9.1	11.2
Luxembourg [1]	(19.6)	(22.4)	(24.7)	(27.1)
Community	4.5	5.7	7.1	8.9
Japan	3.7	6.2	8.8	11.3
United States	11.7	13.2	14.7	16.3

[1] In view of the structure of energy consumption in Luxembourg, where industrial uses are preponderant, the figures which concern that country are not comparable with the others.

By 1980 Japan would reach the average level which might be expected for the whole of the Community in 1985. However, without reaching the American level, the Community and Japan would see a reduction during the next 15 years in the relative difference between their average consumption per inhabitant and that of the United States.

Section III - Internal consumption and other requirements - total requirements

The quantities of energy intended for stocks, exports and certain military needs, security stocks or the increase of stocks with the consumer, initial charging of pipelines, etc.... are not included in the internal consumption, either because we are dealing with energy products actually consumed outside the frontiers of the Community or because the information covering these items is not published.

In an endeavour to determine the total and real amount of energy resources which should be available within the Community, it is also necessary to evaluate this demand, which has quite different characteristics from those of internal consumption, whilst stressing at the same time that the estimates concerning the two main items, i.e. exports and bunkering (stocks) include a high degree of uncertainty, due to the influence of factors external to the economy of the Community.

Overall, the total energy requirements have increased a little more rapidly than the internal consumption. Just as for the latter, petroleum products have experienced the greatest part of their growth during the last 20 years.

Between 1950 and 1970, the requirements for *bunkering* in the ports of the Community have increased very fast: they have sustained a threefold increase during the first decade and more than doubled during the second. This results from the combined action of determining factors which are, on the one hand, the important development of maritime traffic and more particularly of oil traffic and, on the other hand, the price of heavy oil and the policy followed by some countries of the Community regarding the provision of bunkering products.

For the future a certain reduction in the rate of growth of requirements seems probable. This estimate rests on the assumption that a certain rationalization will take place coupled with an improvement in efficiency in maritime transport and that oil transport by pipeline will be chosen in all cases where this will show itself technically and economically possible.

In 1950 *exports* towards countries outside the Community consisted of approximately two thirds in solid fuels and one third in petroleum products. Ten years later, petroleum products represented three-quarters of these exports. At present, they represent more than nine tenths of them. Exports of liquid fuels have also grown on the average by about 13 % per year from 1950 to 1970.[1]

The volume of exports of petroleum products depends to a great degree on the strategy of refining undertakings in the commercial field as well as on investment policy: this applies particularly to large international petroleum companies. From this point of view, a fairly important modification of the origin of crude oil processed within the Community, a change in the refining structure or the framework of commercial relations may affect the expected trends. The situation of the world markets for petroleum products also comes into play, as well as the commercial policy measures taken where necessary by importing countries.

The forecasts in this connection include therefore a great dale of uncertainty, and this explains the attitude adopted in limiting the forecasts to a cautious extrapolation.[2]

The *miscellaneous requirements* include mainly quantities intended for stocks. The steadiness of their growth is based on the assumption of an increase in emergency stocks related to the growth in internal consumption of petroleum products, assuming that the adoption of the measures raising the amount of stocks to be maintained within the Member Countries from 65 to 90 day's consumption is ratified.

On the basis of the assumptions adopted, which are presented in Table 22, the total requirements of the Community will increase by about 5 % per year during the next 15 years, increasing therefore at a slightly lower rate than that of internal consumption. This seems to follow from a change in trends in relation to the years 1950 to 1970, arising from the moderate rates of growth adopted for all the requirements other than internal consumption.

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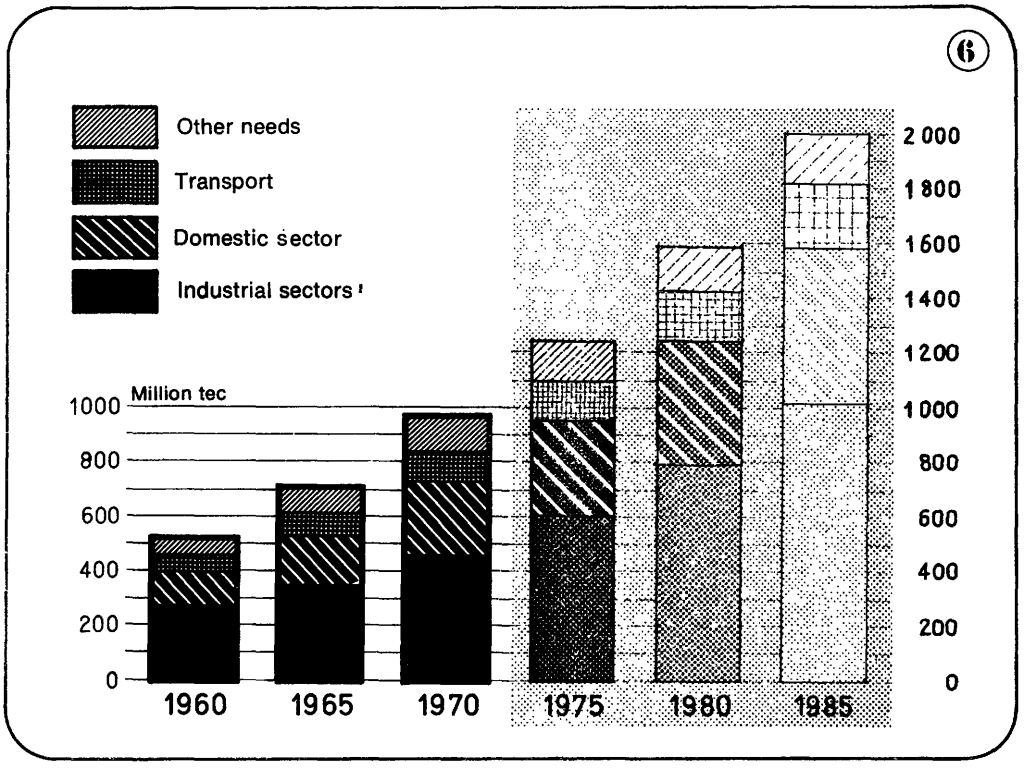
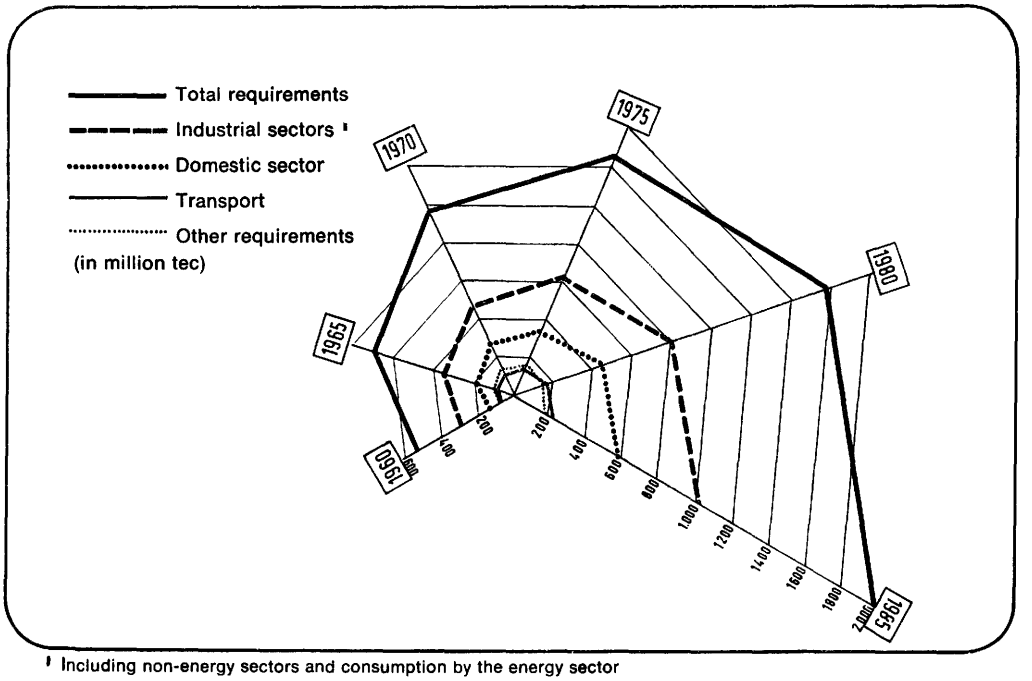
1 See chapter II, section III, B

2 For a more detailed analysis of exports of petroleum products see ' Medium term policy trends for oil '.

TOTAL ENERGY REQUIREMENTS OF THE COMMUNITY
1960-1970 Trends and 1975-1985 Prospects





[1] Including non-energy sectors and consumption by the energy sector

TABLE 22

Total energy requirements of the Community - 1975-1980-1985 prospects

(M tec)

	1970	1975	1980	1985	Mean annual variations in % 1971-1985
Internal consumption	844	1095	1415	1810	+ 5.2
Bunkering	37	50	60	69	+ 4.2
Exports	83	82	90	98	+ 1.1
Miscellaneous requirements*	9	13	15	18	+ 4.7
Total requirements	973	1240	1580	1995	+ 4.9

* Stocking by consumers or processing undertakings, military requirements, filling ' pipelines ', etc.... assuming that the emergency stocks of oil will be raised to 90 days from 1975 onwards.

Section IV - Distribution of the demand between the different primary sources of energy

The calculation of the prospects for the energy demand should make it possible to identify the problems raised by the supply of energy and, if necessary, provide a basis for the options which may have to be exercised as a result of these problems. It is not sufficient, therefore, to determine what global quantities of energy will be required in the long term. It is also necessary to try and find out which primary sources will be called upon to meet the demand, and under what conditions of cost and security of supply it might be satisfied.

An effort has therefore been made to outline the most likely distribution of the demand under present conditions. The investigation which follows is devoted mainly to internal consumption, without taking into account bunkering, exports and miscellaneous requirements.

A — *Final consumption of the sectors and requirements of electrical power stations*

Section I gave indications on the breakdown of the main consumers' demand between fuels and electricity.[1] Table 23 shows in detail how the final consumption of each sector would be directed to solid fuels, oil, gas and electricity.

For fuels, the breakdown is according to the trends which may be expected regarding the structure of the total of utilization appliances in service and the quantity of energy available from each source. The substitutions between fuels have been estimated between two limits: the first limit is an acceptable rate of plant conversion, and the other is that a reasonable difference between the relative prices of the different sources of energy should remain in line with the present pattern.

[1] Appendix 6 gives a recapitulation of the electricity consumption forecasts, as well as indications of the global assumptions adopted.

TABLE 23

Breakdown by fuels of the final energy consumption of the main sectors - 1975-1985 prospects (rounded-off)

(M tec)

	Solid fuels	Oil	Gas	Electricity + heat	Total	Solid fuels	Oil	Gas	Electricity + heat	Total
	1970					1975				
Industrial sectors	61	207	68	129	465	52	284	101	170	607
of which:										
Energy uses	(52)	(116)	(49)	(98)	(315)	(49)	(155)	(73)	(130)	(407)
Non-energy uses and raw material	(—)	(52)	(7)	(—)	(59)	(—)	(77)	(12)	(—)	(89)
energy industries and losses	(9)	(39)	(12)	(31)	(91)	(3)	(52)	(16)	(40)	(111)
Transport	2	100	0	6	108	—	131	—	6	137
Domestic sector	44	140	24	63	271	22	183	51	95	351
Internal consumption	107	447	92	198	844	74	598	152	211	1095
	1980					1985				
Industrial sectors	50	372	140	227	789	49	474	174	315	1012
of which:										
Energy uses	(48)	(202)	(104)	(178)	(532)	(48)	(262)	(132)	(245)	(687)
Non-energy uses and raw material	(—)	(100)	(16)	(—)	(116)	(—)	(135)	(20)	(—)	(155)
Energy industries and losses	(2)	(70)	(20)	(49)	(141)	(1)	(77)	(22)	(70)	(70)
Transport	(—)	167	—	7	174	—	220	—	8	228
Domestic sector	13	218	75	146	452	7	253	98	212	570
Internal consumption	63	757	215	380	1415	56	947	272	535	1810

As far as electricity is concerned, the assumption has been made of a falling long term real price which would bring its share to 30 % in internal consumption in 1985. This seems likely particularly in the light of the trends observed in countries outside the Community with a high degree of electrification.

To go from this distribution to a pattern of internal consumption of primary energy, it is necessary to examine the prospects of demand by electrical power stations.[1]

Assuming, for the sake of simplicity, that the power stations of the Community will cover the whole of the demand for electricity, it can be estimated that the quantities of primary energy necessary to satisfy the requirements of all these power stations would amount to 271 million tec in 1975, 380 in 1980 and about 535 in 1985.

The contribution of nuclear energy has been estimated on the basis of the Second Indicative Programme, which makes it possible to expect that its share will amount to 20 million tec in 1975, 75 in 1980 and 175 in 1985.[2]

Taking into account the very small increase in energy availability from hydroelectric or geothermal sources, the balance to be covered by conventional thermal power stations will rise from approximately 207 million tec in 1975 to 315 million tec in 1985.

The picture which will be presented by the supply from thermal power stations in 1975 may be approximately traced by considering existing installations or those under construction which will be in service at that date. Some uncertainties remain, however. Power stations burning at present a given fuel may be converted for the utilization of another source of energy in a very short time and unpredictably. It is also possible that some stations will be closed in addition to those already scheduled.

Lastly, factors of an economic nature may influence the working life of the various categories of power stations, as well as the operation of installations with dual fuel firing.

Table 24 shows the breakdown of the fuels consumed by power stations in 1975 on the basis of present knowledge. It also gives indications for 1980 and 1985 which are based on the following trends.[3]

From 1980, the maximum production based on lignite is probable, due in particular to the effect of nuclear generation at this time, which renders the opening-up of new fields uncertain. The possible development of lignite for purposes other than the production of electricity should also be borne in mind (pre-reduction of iron-ore, gasification).

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1 Appendix 6 gives a detailed Table of the production prospects for electricity.

2 See: Second Indicative Programme for Nuclear Energy, published in accordance with the requirements of article 40 of the Euratom Treaty. It is necessary, however, to mention that the programme does not make forecasts in the normal sense of the term, but fixes objectives. These can only be reached if the conditions defined in the programme are fulfilled and in particular if the actions proposed are actually implemented.

3 Appendix 2 of the ' Second indicative programme for nuclear energy ' gives more detailed indications on the pattern of the provision of electrical power stations.

The consumption of natural gas in electrical power stations will still increase after 1975, but at a lower rate. The volume of resources at present known within the Community is relatively small, and it is certain that these resources will find an easy outlet in domestic or industrial uses, giving a better return — for the producer as well as for the Community — than the production of electricity. This applies even more to gas imported from a country outside the Community.
Coal and oil will share the balance, amounting to about 170 million tec in 1980 and 215 million tec in 1985.

Regarding the consumption of coal, in the best possible conditions, stabilization may be envisaged at the level which will be reached in 1975, i.e. approximately 47 million tec. Taking into account the requirements for coking coal anticipated elsewhere, the trends of operational conditions of the mines within the Community do not make it possible to envisage an increase in the availability of steam coal of indigenous origin, but rather a fall. Part of this amount should therefore come from imports from countries outside the Community.

TABLE 24

Meeting the requirements of conventional thermal power stations in primary energy[1] - 1975-1980-1985 prospects

(M tec)

	1970	1975	1980	1985
Total requirements of electrical power stations in primary energy [1]	195	271	380	535
Conventional thermal power stations:				
— *Controlled* sector	34	44	49	51
— *Competitive* sector	117	163	210	262
i.e.:				
— natural gas	15	31	40	48
— coal	53	47	47	47
— petroleum products	49	85	123	167
Total	151	207	259	313

Source : Appendix 2 of the Second Indicative Programme for Nuclear Energy.

[1] Requirements for the satisfaction of gross internal consumption, i.e. including the consumption of auxiliaries and losses, not including the balance of exchanges with countries outside the Community. See more detailed table in appendix 6.

The balance to be covered by liquid fuels, i.e. 85 million tec (60 million tep) in 1985, corresponds to quantities of fuel oil which might reasonably be available, taking into account the overall demand for petroleum products.

B — *Outline make-up of the primary energy demand*

Table 25 gives the likely make-up of the gross internal consumption from the various primary energies. It has been prepared on the basis of the final consumption (Table 23), giving each primary source its share of electricity production according to Table 24. The trend from 1950 to 1970 is also shown as an element of comparison.

TABLE 25

Meeting the gross internal consumption of energy[1] - 1950-1985

	1950	1960	1970	1975	1980	1985
	Amounts in M tec					
Coal	210	243	189	158	147	137
Lignite	23	32	33	37	38	37
Oil	35	138	500	686	884	1119
Natural gas	1	12	73	150	225	295
Hydro-electric, geothermal and other energies[2]	31	39	45	44	46	47
Nuclear energy	—	0	4	20	75	175
Total (rounded-off)	300	464	844	1095	1415	1810
	Distribution in %					
Coal	70	52	22	14	10	7
Lignite	8	7	4	3	3	2
Oil	12	30	59	63	63	62
Natural gas	0	3	9	14	16	16
Hydro-electric, geothermal and other energies [2]	10	8	5	4	3	3
Nuclear energy	—	0	1	2	5	10
Total	100	100	100	100	100	100

1 Including primary energy converted in power stations.

2 For the years 1950 and 1970 this amount includes the balance of exchanges of electricity. ' Other ' energies are miscellaneous fuels (peat, wood, etc.) used in power stations.

In the future, whilst increasing slightly in absolute value, the share of hydro-electric energy will fall continuously due to the dearth of sites suitable for economic developments.

Nuclear energy, however, is expected to develop considerably. The number of nuclear stations for power generation at present under construction or on order shows that this source of energy has reached a place which will go on rising in the energy balance of the Community.

The fulfilment of the objectives of the Second Indicative Programme should by 1985 bring to 10 % the share of nuclear energy in meeting internal consumption.

Coal will be more and more restricted to specific outlets and to covering part of the thermal power station requirements. Its decrease could be relatively slower than during the period preceding 1970, but its share in the whole of the internal consumption would reach only 7 % by 1985. Fifteen years ahead, it is very difficult to distinguish, in this amount of coal requirements, how much will be covered by Community production and how much by imports. It is in any case probable that supplies coming from countries outside the Community will play an ever increasing part, due to the relative rise in the cost of indigenous production.

The demand for natural gas is likely to increase substantially whether in terms of internal production or of imports, and it should reach approximately 16 % of internal consumption by 1980 and then stabilize at that level.[1]

The combined growth (mainly from indigenous sources), i.e. nuclear energy and natural gas, will cover 40 % of the increase in internal consumption between 1970 and 1985.[2]

Petroleum products are therefore expected to satisfy the major part of the new requirements which will appear between now and 1985. However, contrary to what happened in the past, the rate of growth will tend to become equal to or lower than that of the total consumption. Their share of the internal consumption will probably reach a maximum towards the years 1975-1980, to stabilize at a level of around 63 %, only just above that of 1970.

If account is taken of bunkerage, exports and miscellaneous requirements, which are covered almost entirely by petroleum products, the share of oil in the total needs in 1985 will be around 65 % (63 % in 1970), amounting to 1 300 million tec (900 million tep).

It is these total requirements (see Table 26) which finally represent the amount to be taken into account in evaluating the magnitude of the future energy supply problems. Exports and bunkerage should, in fact, be satisfied in the same way as internal consumption, in order to ensure the good operation of the economy as a whole.

1 See ' Medium-term Orientation for gas '.

2 Comparison between the increase in the total gross internal consumption and the increase in the contribution of natural gas and nuclear energy:

(M tec)

	1970	1985	Increase 1970-1985
Natural gas	73	295	222
Nuclear energy	4	175	171
Total	77	470	393
Gross internal consumption (all primary energies)	844	1810	966

TABLE 26

Total primary energy requirements in the Community[1] - 1975-1985 Prospects

	in M tec				in %			
	1970	1975	1980	1985	1970	1975	1980	1985
Solid fuels	223	195	185	174	23	16	12	9
Oil	617	831	1049	1304	64	67	66	65
Natural gas	73	150	225	295	8	12	14	15
Primary electricity	50	64	121	222	5	5	8	11
Total requirements	973	1240	1580	1995	100	100	100	100

[1] A detailed table with equivalents in tep is given in appendix 8.

C — *Uses of a specific character and other uses*

The make-up presented in the above paragraph rests in particular on an estimate of the amounts for specific uses, i.e. consumption which, due to technical or economic constraints, can only be covered by one particular source of energy. On the other hand, this amount makes it possible to recognize the field where competition may exist between primary energies able to serve the same uses (essentially heating applications).

Taking into account the prospects of technological trends in the main industrial processes with an intensive energy consumption, it seems that certain sources of energy will retain most of their specific uses during the next 15 years. This applies above all to coke used in iron and steel manufacture.

For similar reasons, motor fuels used in road, air and river transport should be considered as an energy for specific use. The same applies to the internal consumption of energy industries and losses, as well as to availabilities of blast furnace and coke oven gas, which will be consumed in any case.

The first group of energies for specific or quasi-specific uses represented in 1970 a total of 225 M tec. It will rise to 275 M tec in 1975, 330 in 1980 and 383 in 1985.

Another category of consumption is, in practice, developing outside the market for competing energies. This relates to energies used for the production of electricity, the outlet for which is guaranted for various reasons. Geothermal energy and lignite offer economic advantages which place them at a price below that of competing conventional energies. The energy from nuclear power stations will be used in any case. Finally, hydro-electric power, the cost of which varies according to the characteristics of the site and the age of the installations, constitutes an essential factor in good technical and economic management of electrical networks.

This second group will rise from a volume of 73 M tec in 1970 to 96 in 1975, 157 in 1980 and 258 in 1985. These last two figures reflect, of course, the development of nuclear power according to the objectives of the Second Indicative Programme.

Having subtracted the two above-mentioned groups, the balance of the demand, in the field of alternative energies which amounted to approximately 65 % internal consumption in 1970, is likely to remain at that level between now and 1985.

TABLE 27

Uses of a specific character and field of alternative energies

(M tec)

	1970	1975	1980	1985
Internal consumption	844	1095	1415	1810
Uses of a specific character:				
— group (a) [1]	— 225	— 275	— 330	— 385
— group (b) [2]	— 73	— 96	— 157	— 258
Balance = field of theoretically possible substitutions	545	725	930	1165

[1] Consumption of coke in iron and steel manufacture, transport (except rail), consumption of energy industries, losses blast furnaces and coke oven gas.

[2] Geothermal, hydro-electric and nuclear energies; lignite consumed in power stations.

In reality, competition between alternative energies will not affect the whole of this amount, as it will be slowed down to some extent by the inertia of investments or by local or regional advantages which favour certain sources of energy. Various outside factors may also intervene, for instance measures taken to protect the environment, or even the structure of production undertakings, the structure of the world market, etc.

If reference is made to total requirements rather than to internal consumption, the absolute amount of the field of alternative fuels does not change. In fact the demand of bunkerage and exports, which make up the difference between the internal consumption and the total requirements, is of a quasi-specific character, even though it relates only to oil products.

D — *Indigenous energy and imported energy*

Table 28 presents an attempt at splitting up the energy demand between indigenous and imported energies.

TABLE 28

Share of indigenous and imported energies - Assumptions 1975-1985

(M tec)

	1970	1975	1980	1985
Internal consumption	844	1095	1415	1810
Share covered by indigenous production [1]	— 325	— 390	— 470	— 625
Balance to be covered by imports	519	705	945	1185
Share of imported energy in %	61 %	64 %	67 %	65 %
Total requirements [2]	974	1240	1580	1995
Share covered by indigenous production [1]	— 325	— 390	— 470	— 625
Balance to be covered by imports	649	850	1110	1370
Degree of energy dependence in %	67 %	69 %	70 %	69 %

[1] Amount presented as a working assumption.
[2] Internal consumption + exports + bunkering.

The many uncertainties which affect the amount of coal production in the Community as well as the amount of natural gas available, do not make it possible to consider these figures as anything more than a working assumption.

Coal, lignite and natural gas production within the Community has been estimated carefully, on the basis of trends and taking into account the plans and production objectives known so far and — as regards oil and natural gas — taking account only of the amount of proven reserves. Any new discoveries which may be made, particularly on the Continental Shelf, would increase the share of internal resources.

The estimate of the nuclear production of electricity is based on minimum objectives fixed by the Second Indicative Programme for Nuclear Energy.

An examination of the share of imported energies in meeting the requirements leads, however, to the conclusion that, whilst a reinforcement of the energy dependence of the present Community seems inevitable by 1980, a reversal of this trend could take place after that date.[1] This prospect of new trends rests essentially on the additional contribution of indigenous production which might be provided by nuclear energy.

From then on it might be hoped that the energy economy of the Community would take on a new aspect. But it should not be forgotten that the fact that this level might be reached only on the fulfilment of a number of conditions, particularly those implied by the achievement of the objectives of the Second Indicative Programme for Nuclear Energy.

[1] It is premature to put forward an estimated amount of the effects - no doubt favourable - that the resources of hydrocarbons from the North Sea might have on the degree of energy dependence in the future of the enlarged Community.

APPENDICES

Prospects for energy demand by the main sectors of consumption and detailed tables

INTRODUCTORY NOTE

As stated in chapter III, the preparation of long-term prospects for energy demand are founded on a double approach: first of all sectorial, and then global. The monographs which follow in appendices 1 to 6 give an outline of the main elements which have served as a basis for the first approach.

Apart from the analysis and the extrapolation of the trends observed in the past, studies of a prospective character have been carried out, bearing on the structural trends which may alter these tendencies in the future.

The structural changes take on a particular importance in the long term — 10 to 15 years — and it is often difficult to express their effects quantitatively. Often, when the period ending in 1980 and particularly that ending in 1985 come to be considered, it will only be possible to arrive at conclusions of limited range or of a highly conditional character.

The first two Appendices are devoted to iron and steel and the chemical industry. Intensive energy consumers, these two branches represent together about half the requirements of the industrial sector. Their consumptions follow particular technological characteristics which have been the subject of detailed examination. For the other industries covered by Appendix 3, a more rapid study had to be made, due to the large number of branches concerned and to greater uncertainties regarding structural mutations which affect the share of each branch within the whole as well as the manufacturing processes themselves.

The other sections study first the transport field (Appendix 4), then that fairly mixed group of consumers, the so-called 'domestic sector' (Appendix 5). Lastly, the prospects of electricity consumption are summarized in Appendix 6, which will enable the thermal power station requirements to be evaluated, this being an item of inevitably growing importance in the energy balance.

It should be stressed that the future trends of the various industrial sectors, which have been used as a basis in the Appendices, are only working assumptions.

They give a sufficient measure of probability, at least as an order of magnitude, to enable them to be used as indicators in ene.gy demand prospects, but they do not claim in any way to offer a strict forecast, valid in itself, of the growth of the sector. They can in particular show some differences in comparison with forecasts issued by other sources and which would meet different criteria (estimates of production capacities to be set up, market survey of products of the branch, etc.). It is necessary in this connection to recall the general reservations concerning the range of the present prospects which were expressed in Chapter I. In addition, the achieve-

ment of economic and monetary union could cause transfers of activities or change location prospects of new industries in a way which is at present not possible to foresee.

As in the text, the total of the data by country which are shown in the Tables may differ from the Community total, following the rounding-off of certain figures; the same applies to the data by form of energy, in relation to the totals.

Appendix 8 gives details of the total energy requirements for the Community, in tec as well as in tep. This latter information should render comparison easier with work from other sources which uses the tep or the kcal as a unit.

Appendix 9 gives Tables by country. Following the regroupings and adjustments which had to be made to ensure the coherence of the totals, the total of the data by country may sometimes differ from the figure adopted for the Community. These prospects by country are in some respects less reliable than the figures relating to the Community. They only have an indicative value and in particular cannot be considered as a judgment expressed by the Commission on the trends of the energy economy of each country.

APPENDIX I

THE IRON AND STEEL INDUSTRY

The energy consumption prospects in the iron and steel industry have been obtained by a fundamentally different approach for the period 1970-1975 and for the subsequent period.

The 'Memorandum on the general objectives of the iron and steel industry of the Community for the years 1975-1980'[1] has formed the basis for the 1975 estimates. Not only does it give quantitative data on the trends of the iron and steel industry of the Community, but it also includes precise choices and expresses a political will for this industry to resist foreign competition and retain its place in the world steel market.

In the more distant future, i.e. in 1980 and 1985, the estimates have, however, a more speculative character, and the steel production prospects used as a basis are only working assumptions.

A — *The 1975 outlook*

1. Steel production in 1975 — Structural modifications in the manufacturing processes

The production of steel in the Community required to cover internal consumption together with the export balance should, in 1975, be between 137 (mean assumption) and 148 million tonnes (high economy assumption).[2] The subdivision of these amounts by country is given in Table 1.

Taking into account the fact that the amounts reached in 1969 and 1970 resulted from a particularly favourable set of economic conditions and that the growth stopped in 1971, it seemed reasonable to take only the mean assumption as a basis, which may today be considered as a rather optimistic objective. The high economic condition assumption would assume, in fact, that a production increase of 35 % would take place between 1970 and 1975: such an increase, greater than the record of 27 % in 5 years observed between 1965 and 1970, seems unlikely under present conditions.

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1 OJ No C 96 of 29.9.71.

2 For the justification of these forecasts, see 'Memorandum on the general objectives of the iron and steel industry within the Community for the years 1975-1980', loc.cit. page 10 and following.

TABLE 1

Production of Steel and Cast Iron in the Community - 1975 Objectives (mean assumption)

	Steel			Cast Iron		
	1970 (M t)	1975 (M t)	Mean annual variations in %	1970 (M t)	1975 (M t)	Mean annual variations in %
Belgium	12.6	15.8	+ 4.6	11.0	14.5	+ 5.8
France	23.8	29.0	+ 4.0	19.1	23.4	+ 4.2
Germany	45.0	53.0	+ 3.3	33.6	41.4	+ 4.3
Italy	17.3	26.5	+ 8.9	8.4	12.9	+ 9.0
Luxembourg	5.5	5.7	+ 0.7	4.8	4.7	— 0.4
Netherlands	5.0	7.0	+ 7.0	3.6	5.6	+ 9.2
Community	109.2	137.0	+ 4.6	80.5	102.6	+ 5.0

Source : General Directorate of Industrial Affairs.

The production of steel by means of the open-hearth furnace and the Thomas converter will decline during the next few years, in favour of the oxygen and electric processes, which will represent together 85 % of the total (60 % in 1970).

Besides these changes, technological innovations as such will still only have very limited effects between now and 1975. This applies for instance, to processes using prereduction of ores, which by that time are not likely to exceed more than 2 % of the Community's production.

2. Fuel consumption: General

In the present state of technology, the major part (approximately 70 %) of the fuel consumption in the iron and steel industry is attributable to the blast furnace which, for a long time to come, will remain the basic process in this industry. But the specific consumption of fuel per tonne of cast iron produced in blast furnaces has fallen by approximately 20 % between 1960 and 1970 within the whole of the Community. This improvement of efficiency results mainly from the progress achieved in the preparation of charges and the use of richer ores, and from the replacement of some of the coke by fuel-oil and natural gas. These factors have led to a substantial reduction in the specific consumption of coke which, between 1960 and 1970, has fallen from 883 kg/t to 582 kg/t, resulting in an overall reduction in the specific fuel consumption for the whole of the iron and steel industry.

The structure of consumption has also changed, following the increasing use of hydrocarbons at the expense of solid fuels. The share of hydrocarbons in the net fuel consumption of the iron and steel industry of the Community has risen from 10 % in 1960 to 40 % in 1970.

The predominance of the blast furnace has led to the choice of the production of raw cast iron as the explanatory variable of net fuel consumption. The forecasts

shown in Tables 2 and 3 have been established by extrapolation of the global consumption on this basis, the subdivision among fuels being then obtained by estimating their respective contributions as far as possible by a chronological trend. It is, in fact, possible to count on the continuation of the trends observed at the present time, because the orientation of investment decisions shows that iron and steel production will continue to be based on the production of cast iron by means of the blast furnace for the next 5 years at least. Taking into account the depreciation period for investments, an important change in structure is not likely to take place before 1980.

Coke and manufactured gas are, therefore, likely to remain the most used fuels in the supply of energy to the iron and steel industry until 1975, in spite of the development of the use of hydrocarbons for uses outside the blast furnace as well as in the blast furnace itself.

TABLE 2

Total net fuel consumption [1] in the iron and steel industry
1975 forecasts by country

(M tec)

	1970	1975	Annual variations in %
Belgium	7.9	8.9	+ 2.4
France	17.1	19.2	+ 2.4
Germany	29.0	32.4	+ 2.2
Italy	9.1	14.7	+ 10.6
Luxembourg	4.1	4.1	—
Netherlands	3.3	4.9	+ 8.2
Community	70.5	84.2	+ 3.6

[1] See notes to Table 3: only quantities used for the final consumption of the iron and steel industry are included.

TABLE 3

Subdivision of net fuel consumption in the iron and steel industry
1975 forecasts by country

(M tec)

	Coal and Agglomerate	Coke [1]	Blast furnace gas [2]	Coke oven gas	Natural gas	Petrolum products	Total
Belgium	0.1	4.5	1.9	0.7	0.8	0.9	7.9
France	1.8	7.6	4.0	0.8	1.2	3.8	17.1
Germany	0.3	14.3	6.0	2.6	4.0	5.2	29.0
Italy	—	5.4	1.6	0.7	2.0	5.0	9.1
Luxembourg	—	1.5	1.3	—	—	1.3	4.1
Netherlands	—	1.9	0.2	0.3	1.2	1.3	3.3
Community	2.2	35.2	15.0	5.1	9.2	17.5	70.5

[1] Blast-furnace gas production excluded.

[2] Iron and steel industry consumption only, the quantities used by the power stations belonging to that industry being excluded.

3. Coke and fuel-oil requirements of blast furnaces [1]

It is expected that the consumption of furnace coke will fall from 582 kg per tonne of cast iron produced in 1970 to 500-520 kg in 1975. This trend will result from the important part that recently built blast furnaces will play among the plant in use, the modernization of some of the old installations, which will be converted for fuel or natural as injection, as well gas the increasing use of richer iron ores and and of better quality coke. Thus the production of 102.6 million tonnes of cast iron expected in 1975 for a mean economic assumption would require a gross total consumption of 57 million t of furnace coke, 5 million t of which would be for agglomeration and use by auxiliary services.[1] Table 4 shows details of these forecasts, which are based on an average value of the charge make-up of 510 kg.

TABLE 4

Furnace coke consumption in the iron and steel industry of the Community - 1975 forecasts.

(M tec)

	1970				1975 [1]			
	Blast furnaces [2]	Agglomeration & other uses	Total	Charge make-up (kg/t)	Blast furnaces [2]	Agglomeration & other uses	Total	Charge make-up (kg/t)
Belgium	6.4	0.6	7.1	586	6.6	0.7	7.3	515
France	12.0	1.1	13.1	629	12.8	0.6	13.4	545
Germany	18.7	2.4	21.1	559	20.5	2.6	23.3	495
Italy	4.4	0.6	5.0	524	6.9	0.8	7.7	470
Luxembourg	3.5	0.2	3.8	730	2.9	0.2	3.1	620
Netherlands	1.7	0.2	2.0	484	2.6	0.3	2.9	470
Community	46.8	5.1	51.9	582	52.3	5.2	57.5	510

Source : General Directorate of Industrial Affairs.

1 In order to simplify the presentation of the Tables, the average value of 510kg/t has been adopted for the charge make-up.

2 Including quantities transformed into blast furnace gas.

The present trend of the development of fuel oil injection into blast furnaces will continue during the next few years: from approximately 40 kg per tonne of cast iron in 1970, (i.e. 3 million tonnes for the whole of the Community) it will reach 50 kg/t in 1975 (i.e. 5 million tonnes altogether).

1 See ' Memorandum on general objectives ' page 43 and following.

2 In this Appendix 1, the coke requirements of consumers other than the iron and steel industry are not included, as these are included in the item ' solid fuels ' of each of the sectors investigated in the following Appendices.
For the requirements of these other users, it is possible to expect a continuation or even, due to the trend of prices, an acceleration of the replacement of coke by other forms of energy. The demand of sectors other than the iron and steel industry and exports may fall from 17 million t in 1970 to 13 million t in 1975. The total consumption of furnace coke for the Community will amount, therefore, to 71 million t in 1975, if the activities of the iron and steel industry reach the level expected in the assumption of mean economic conditions.

The use of fuel-oil in blast-furnaces would thus represent 40 % of the global consumption of fuel in the iron and steel industry. This level would only be exceeded if the ratio between the prices of coke and oil were to change in a way particularly favourable to the latter. The specific consumption of fuel-oil of 50 kg/t corresponds to a high assumption of 520 kg/t for the charge make-up of coke; if it were to rise to 70 kg/t or more, the lower assumption of 500 kg of coke per tonne would be more correct.

4. Coke production capacities and the supply of coking coal

The carbonization capacities of the Community amounted to 74.5 million t in terms of coke in 1971. From the plans at present known concerning new constructions and extensions of coke-ovens on the one hand, and decisions to close down such plant on the other hand, the capacities should amount to approximately 88 million t by 1975. This would be sufficient to cover the whole of the requirements of the iron and steel industry and of the other sectors,[1] even assuming favourable economic conditions (75 M t).

The production of coke to make it possible to cover the total requirements in medium economic conditions would require about 92 million tonnes of coal for the coke-ovens.

Two assumptions have been made for the allocation of this amount of coking coal between Community coal and imported coal. In the first, the supplies from countries outside the Community would be around 10.5 million tonnes, an amount which is close to the present level.[2] The other assumption is based on the probable trend of investments in coke-ovens. A large part of the new installations for coking are, in fact, planned by the iron and steel industry, whose share in the total capacity would rise from 31 to 45 %. These new coke-ovens would be mainly situated in coastal regions, which could lead to an increase in the volume of imported coking coal, up to maximum level of approximately 26 million tonnes.

These two import levels would be matched by sales of Community coal of between 66 and 90 million tonnes, according to the assumption which would be fulfilled in so far as the iron and steel activities and charge make-up are concerned.[3]

5. Electricity consumption

As opposed to what has been stated with regard to fuel consumption, the specific consumption of electricity by the iron and steel industry, has, in spite of some irregularities, increased between 1960 and 1970 by a little more than 1 % per year, from 391 kwh/t to 473 kwh/t. The increase in the specific consumption of agglomerates, the more general use of oxygen, the higher degree of elaboration and finishing of steels, as well as the development of mechanization, explain this trend.

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1 See page 6 note 1.

2 The 1969 figure (10 M t) has been taken as a basis for reference, in preference to that of 1970 (14 M t) which partly reflects the effects of a particularly favourable set of economic conditions.

3 See ' Memorandum on the general objectives... ', loc.cit. pages 44 to 46.

The influence of these factors is at present counteracted by the progress achieved in the equipment towards improving efficiencies. This is why the specific consumption of electricity seems to have reached a maximum for some years. Thus the trend of steel production has been adopted as the principal indicator of the variations in electricity consumption in the iron and steel industry in the medium term.

Table 5 has been drawn up by extrapolating a simple regression between electricity consumption and steel production. The electricity consumption of the iron and steel industry would thus amount to 5.5. % per year on the average for the mean economic assumption.

TABLE 5

Electricity consumption in the iron and steel industry - 1975 forecasts

TWh

	1970	1975	Annual variations in %
Belgium	4	6	+ 5.8
France	12	16	+ 6.1
Germany	20	24	+ 3.7
Italy	12	18	+ 8.5
Luxembourg	2	2	+ 1.2
Netherlands	2	2	+ 3.0
Community	52	68	+ 5.5

B — *The 1980 - 1985 outlook*

In the long term it is probable that the iron and steel industry of the Community will undergo important technological modifications. Many manufacturing processes likely to affect energy consumption directly are at present being investigated or are at the experimental stage. Within the next few years some of them will reach a sufficient degree of maturity to be introduced on an industrial scale and influence the structure of the global energy balance of the iron and steel industry from the years 1980 - 1985 onwards. Account should nevertheless be taken of the relative inertia which would result from the large amount of capital tied up in the present installations.

Several long term patterns may be discerned. The first would be characterized by new advances within proven technology (improvement of the charge, injection of 150 kg of fuel-oil or the equivalent in natural gas per tonne of cast iron and reduction of the coke charge make-up to 300 kg, use of super-oxygenated draught at a higher temperature) and by the generalized use of modern blast-furnaces, which will make it possible to bring the thermal balance of cast iron production from rich ores nearer to the technical limit. A second pattern corresponds to an iron and steel industry depending jointly on the injection of hydrocarbons and on the inclusion of partially reduced ores in the charge; this would enable a new step to be taken towards the reduction of the charge make-up and to lower it to 250 or even

200 kg of coke per tonne of cast iron. Lastly, the widespread adoption of the use of ores with a high rate of pre-reduction, either in the electric steel process or in the conventional blast-furnace cycle, creates the prospect of another future development: in this latter eventuality, the energy consumption of the iron and steel industry would undergo the greatest structural change. An additional variant would result, in the latter case, from the choice between imports of pre-reduced ores or their production within the Community.

1. The production of steel and cast iron

The 'Memorandum on the general objectives of the iron and steel industry of the Community for the years 1975-1980' only gives, for the year 1980, an overall indicative figure for the production of steel and cast iron within the Community.[1] For the requirements of the present study, these estimates have been subdivided by country and projected to 1985 on the basis of growth assumptions of industrial production[2] and by adopting as a further yardstick the data for the Community relating to 1980.

TABLE 6

Production of steel and cast iron
Working assumption for 1980 and 1985

(M t)

	Steel		Cast-iron	
	1980	1985	1980	1985
Belgium	20	25	15	16
France	35	40	28	30
Germany	61	67	47	49
Italy	34	40	20	22
Luxembourg	6	6	5	5
Netherlands	10	12	8	9
Community	165	190	121	130

For the whole of the Community these estimates show a growth of steel production of the order of 3.7 % for the period 1975-1980 and of 2.8 % for the period 1980-1985. Cast iron production, however, is to increase by 3.2 % between 1975 and 1980, and by 1.6 % between 1980 and 1985. This latter rate is explained by the probable growth of electric steel production and the reduction of the cast iron/steel ratio. The figures by country are working assumptions rather than forecasts, due to uncertainties affecting the structure of production and intra-community exchanges.

1 Loc. cit. page 34.
2 See chapter I, section IV.

2. Fuel consumption

The total fuel consumption in the iron and steel industry within the Community should reach 95 million tec in 1980 and 106 million tec in 1985. The reduction of the share of solid fuels will continue during that period, whilst a new large increase in the consumption of fuel-oil and natural gas is to take place.

These forecasts rest on a group of assumptions bearing on the production structure on the substitution of hydrocarbons for coke in the blast furnace and on the composition of the charge.

— With the reservations stated below concerning the development of electric steelmaking, it is assumed that the *production structure* will remain dominated by the processes depending on the blast-furnace.

— *The substitution of hydrocarbons for coke* in the blast furnace has been growing for a number of years at rates which differ according to countries. Fuel-oil or natural gas benefit from this substitution either separately or together, according to local conditions with regard to availabilities, relative prices and particularly taxation. These same factors will govern the choice in the future, whilst regulations for the fight against pollution will play a role which will, no doubt, tend to grow. Another aspect to be considered is that of the cost of electricity necessary to produce the oxygen required for the enrichment of the draught in the blast-furnaces where hydrocarbons are being injected.

— The utilization of *pre-reduced iron ores* could lead to a high acceleration in the reduction of the charge make-up, down to 200 - 250 kg of coke per tonne of cast iron by 1985. As stated earlier, the pre-reduced ores may be used directly in the electric steel works or introduced in the production cycle either at blast-furnace level or in the refining stage in the steel works.

  The loading of pre-reduced ores into the blast-furnaces (which might amount to as much as 50 % of the charge) or in the steel furnaces will inevitably develop due to the associated technical and economic advantages.

  Their use, associated with considerable development of the electric steel process, will depend on the level of prices which may be reached by electricity. The prospects in this connection are fairly favourable, considering the price reduction in real value achieved over the last 20 years.

  At the present time, no process makes it possible to obtain pre-reduced products at a competitive price in Europe, due to the relatively high price of the energy required for pre-reduction. However, many tests covering the whole range of fuels are being carried out with some success in several countries producing iron ore and possessing cheap energy resources (Canada, Mexico, Venezuela, Australia, etc.)[1]. In the present state of technology, pre-reduced products present the drawback of easily reoxidizing during transport, but remedies are being investigated and the difficulties to be solved should not be considered as insurmountable. We cannot therefore discount the future possibility of obtaining in Europe, on a fairly large scale, pre-reduced ores imported from other countries where there is cheap energy available.

[1] The world production capacity of pre-reduced products amounted to approximately 1 million t in 1970.

Tables 7 to 9 present the assumptions for the net consumption of fuel and the consumption of coke and hydrocarbons which have been adopted for 1980 and 1985.

The falling trend of the average make-up of coke will continue until 1985, when it might reach 370 kg/t, against 582 kg/t in 1970 and 500-520 kg/t in 1975. The increase in cast iron production will compensate for the reduction in specific consumption, and the coke requirements of the iron and steel industry will, therefore, not vary very much between the years 1970 and 1985 and will be around the 52 million tonnes mark in 1980 and 47 in 1985.[1]

The specific consumption of hydrocarbons will probably reach 100 kg/t in 1980 and 120 in 1985. The total consumption of fuel-oil and natural gas in blast furnaces would therefore treble between 1970 and 1985, rising from 5 to 16 million tep.

The total fuel requirements of the iron and steel industry will probably grow by 2.6 % on the average for the period 1970 - 1985 to reach 106 million tec.

TABLE 7

Net consumption * of fuel in the iron and steel industry
1980 and 1985 prospects per country

(M tec)

	Belgium	France	Germany	Italy	Luxembourg	Netherlands	Community
1970	8	17	29	9	4	3	71
1975	9	19	32	15	4	5	84
1980	10	21	35	19	4	6	95
1985	11	23	37	23	4	8	106

* See notes to Table 8.

TABLE 8

Distribution of net fuel consumption in the iron and steel industry of the Community
1980-1985 prospects

(M tec)

	Coal and Agglomerates	Coke [1]	Blast furnace gas [2]	Coke oven gas	Natural gas	Petrolum products	Total
1970	2	31	13	5	7	14	72
1975	2	35	15	5	9	18	84
1980	2	32	15	5	17	24	95
1985	1	32	14	5	26	27	106

1 Excluding blast furnace gas production.

2 Consumption of the iron and steel industry only, excluding quantities used by electric power stations belonging to that industry.

1 The coke requirements of consumers other than the iron and steel industry are included in the item ' solid fuels relating to each sector.

TABLE 9

Blast-furnace consumption and charge make-up of coke and hydro-carbons in the iron and steel industry of the Community - 1980 and 1985 prospects

	1970	1975	1980	1985
Coke				
Total consumption [1] (M t)	47	52	52	47
Charge make-up (kg/t)	582	510	430	370
Hydrocarbons				
Total consumption (M tep)	5	8	12	16
Charge make-up (kgep/t)	60	80	100	120

[1] Including quantities converted into blast-furnace gas. Quantities intended for agglomeration and other uses of the iron and steel industry, which may be estimated at 5 M t approximately, have not been included.

3. Electricity consumption

On the basis of the assumptions adopted, the consumption of electricity in the iron and steel industry of the Community will amount to 82 and 97 TWh in 1980 and 1985 respectively. The mean annual increase of 4 % between 1975 and 1980 and 3.5 % between 1980 and 1985 would be slightly greater than those of the steel production.

TABLE 10

Electricity consumption - 1980 and 1985 prospects

(TWh)

	1970	1975	1980	1985
Belgium	4	6	7	9
France	12	16	20	23
Germany	20	24	28	32
Italy	12	18	21	27
Luxembourg	2	2	2	2
Netherlands	2	2	3	4
Community	52	68	82	97

These figures, which may be considered as a minimum assumption, are within the overall assumption of the continuation of the present development of electric steel production, but it could be different if the steel preparation cycle using pre-reduced products in electric steel works became competitive with the conventional cycle of the blast-furnace and steel works using oxygen. The energy balance of the iron and steel industry would then be greatly modified between now and 1985 in its

overall volume as well as in the specific energy consumption, and the electricity consumption would be greater than the amounts shown in Table 10.

The application of strict regulations in the fight against pollution, which would generally entail a greater reliance on electricity, might lead to a similar result. These two eventualities have not been examined in greater detail here, but they should be borne in mind among the factors which may lead to a modification of the structure of the final consumption for industrial sectors as a whole.

APPENDIX 2

THE CHEMICAL INDUSTRY : ENERGY CONSUMPTION AND UTILIZATION AS A RAW MATERIAL

For many years the largest user of electricity (85 Twh in 1970, i.e. a little less than a third of all industrial consumption), the chemical industry[1] became in 1970 the principal industrial client of the energy branch, even ahead of the iron and steel industry, if its energy requirements are considered as a whole together with its consumption of energy as a raw material (altogether about 100 million tec).

There is practically no chemical process which can take place without energy, either as heat supplied for endothermal reactions, or as electricity for electrolysis and electro-heat, or else as other forms in various processes such as distillation, evaporation, cracking, etc.[2] The type and the magnitude of the requirements vary according to the products and their degree of processing, but considered as a whole, the chemical industry is an intensive consumer of energy, for which the energy factor represents an important cost of production. In addition, it uses large quantities of energy products as a raw material: in the past is was mainly coal, but for the last 10 to 20 years coal has been progressively replaced by hydrocarbons.

The development prospects of the chemical industry could, in principle, be determined by studying the future demand for its principal products of important intermediaries in order to determine the amount of production within the Community required to meet internal demand and exports. This analytical method would have the advantage of giving detailed information for the different branches of the chemical industry.

A macro-economic approach, based on the volume indices of production, may nevertheless be considered as sufficient for a forecast study of energy consumption, particularly as it is less exposed to the risk of error resulting from the uncertainty of the basic information.

It has, therefore, seemed more appropriate to use the analysis of the past trends of the chemical industry in relation to industrial production—the latter being considered as a satisfactory indicator of economic growth — in order to determine in this way what might be the development of production in the chemical industry. The expan-

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1 As indicated in the General Observations, ' chemical industry ' is intended to cover here the activities of branches 25 and 26 of NACE.

2 The importance of the conversion of fuels in electric power stations belonging to the chemical industry must also be mentioned (approximately 8 million tec for the whole of the Community in 1970). The primary enrgy consumed by these power stations does not figure under the ' chemical industry ' heading of the energy balance, but is shown with the requirements of other thermal power stations.

sion of this industry, while retaining its own dynamic nature, will be more and more closely related to general economic development, as there is practically no branch of economic activity which can do without the products of that industry. The role of the chemical industry as a supplier of intermediate goods or final consumption goods is in many cases equal to or even greater than that of the iron and steel industry.[1]

Table 1 presents growth assumptions of chemical industry production, which have been established by applying a trend coefficient for the chemical industry to the rate of growth of industrial production.[2] A medium-term coefficient has been applied for the period 1971-1975, and a long-term coefficient for the following ten years.[3] In some cases these rates have been corrected in the light of a qualitative evaluation of factors likely to influence the trends of the chemical industry.

It should be stressed that these rates apply to a long term prospect. In a sector like the chemical industry, which is fairly sensitive to the effects of economic conditions, the short-term trends may reveal fairly sudden reductions or accelerations, but they do not present an obstacle to the maintenance of the long term trend.

TABLE 1

1970-1985 Prospects of trends in the chemical industry
Working assumptions

Annual variations in %

	1971-1975	1976-1980	1981-1985
Belgium	8.0	8.0	7.0
France	10.0	8.0	7.0
Germany	7.0	6.0	6.0
Italy	10.0	8.5	8.0
Netherlands	13.0	11.0	11.0
Community	9.0	7.0	7.0

In general, and especially when a longer term is being considered, the assumption for the whole of the Community presented in Table 1 offers a greater degree of probability than that of the assumption by country. This is particularly true for a sector such as the chemical industry, the recent growth of which has been rapid and in which product and process innovations are numerous and may entail profound structural changes. In addition, some transfers may take place between countries without affecting the overall growth. Whilst the assumptions by country may be compared in a generally satisfactory way with those presented in various specialized studies, they should only be accepted with the reservations mentioned in the introductory note preceding the Appendices.

1 Cf. *The economic influence of the price of energy*
(Report of a group of independent experts) EEC, Studies collection, Economy and Finance Series, No 4, Brussels 1966, pages 46 to 56.

2 See chapter I, section IV.

3 The coefficients have been established by calculating the ratio between the average annual percentage increase of the chemical industry and that of industry in general during the period 1964-1970 (medium term) and for the period 1958-1970 (long term).

A — *Fuel consumption for energy purposes*

For the period 1970-1985 it is estimated that the fuel consumption of the chemical industry within the Community will rise from 30.6 million tec in 1970 to 49.2 million tec in 1985, i.e. an average rate of 3.5 % per year approximately, very much lower than the progress of world-wide chemical production. This difference, similar to that observed in all industrial sectors, results from the technical progress which has made it possible and will still make it possible to reduce the specific consumption — and, no doubt, even more than in other branches of industry — of energy per unit produced.

Coal and coke consumption will continue to fall slowly, in the face of competition from hydrocarbons, falling from 4.5 million tec in 1970 to 4.2 million tec in 1985, i.e. respectively 18 and 8.5 % of the total consumption of the branch.

The substitution of hydrocarbons for solid fuels will, therefore, only develop to a limited extent. Against this, oil and natural gas will cover practically all the new requirements, although it is difficult to evaluate the respective positions of these two sources of energy.

Taking into account the specific advantages of natural gas (combustion characteristics, security of supply, smaller pollution effects, etc ....), the latter should experience rapid progress in the chemical industry, either from resources situated within the Community or on the basis of imports from countries outside it, and gain ground on petroleum products. It would then meet 26 % of the requirements of the sector in 1975 and 33 % in 1985.

Oil will nevertheless remain the leading supplier, rising from 22 million tec in 1975 to 28 million in 1985, but its relative share would fall slightly from 60 % in 1975 to 57 % in 1985 (see Table 3).

TABLE 2

Total fuel consumption in the chemical industry - 1975-1980-1985 prospects by country.

(M tec)

	Belgium	France	Germany	Italy	Luxembourg	Netherlands	Community
1970	2.1	6.0	10.7	8.4	0.1	3.2	30.5
1975	2.2	7.8	11.9	10.1	0.1	4.4	36.5
1980	2.4	9.3	13.2	12.5	0.2	5.4	43.0
1985[1]	3.0	11.0	14.0	15.0	0.2	6.0	49.0

[1] Rounded-off.

TABLE 3

Fuel consumption pattern in the chemical industry of the Community - 1975-1980-1985 prospects

M tec

	Coal and coke	Petroleum products	Natural gas	Other fuels	Total
1970	4.5	17.4	7.2	1.4	30.5
1975	4.4	21.5	9.5	1.1	36.5
1980 [1]	4.0	25.0	13.0	1.0	43.0
1985 [1]	4.0	18.0	16.0	0.5	49.0

[1] Rounded-off.

B — *Electricity consumption*

The consumption of electricity by the chemical industry has risen from 42.5 to 85.5 thousand million kWh between 1960 and 1970, i.e. an average increase of over 7 % per year. Electro-chemistry, electro-heat and the compression of gas use very large quantities of electricity, and the manufacture of certain products is possible only if electricity is available at a low price. In order to get away, at least partially, from this constraint, in as much as the price of the kWh is relatively high, a continuous research effort is endeavouring to substitute thermal or purely chemical processe, for electro-chemical processes, which should be theoretically possible in many cases. In fact, the processes complement each other rather than compete with each others and the consumption of electricity by the chemical industry will probably increase, at least until 1980, at about the same rate as that observed in the past. Extrapolation shows a similar trend, although slightly lower for the period 1980-1985, but it is clear that all kinds of uncertainties become greater and greater as the horizon of the forecasts recedes.

According to Table 4, the consumption of electricity by the chemical industry should amount to 133, 195 and 269 TWh in 1975, 1980 and 1985 respectively. This forecast is based for Germany, France and Italy on the maintenance of an elasticity between electricity consumption and chemical production of less than unity. In Belgium, however, the recent development of their modern chemical industry has entailed an accelerated consumption of electricity which will be maintained for some time but will not continue right up to 1985, by which time the structure of the Belgian chemical industry will probably have drawn closer to that of other European chemical industries. For the Netherlands, in the absence of adequate statistical bases, the forecasts have been established by extrapolation of an exponential trend.

TABLE 4

Electricity consumption in the chemical industry - 1975-1980-1985 forecast

TWh

	1970	1975	1980 (1)	1985 (1)
Belgium	4.9	8.4	13.0	21.0
France	19.0	41.1	70.0	98.0
Germany	36.9	47.5	58.0	71.0
Italy	17.3	24.6	34.0	46.0
Luxembourg	0.1	0.1	0.1	0.1
Netherlands	7.3	11.2	19.0	32.0
Community [1]	85.5	133.0	195.0	269.0

[1] Rounded-off.

C — *The consumption of energy as a raw material*

The rate of development of petro-chemicals during the last few years has been higher than that of any other industrial sector. This growth has already entailed a substantial increase in the consumption of petroleum products, particularly of naphtha

and natural gas, which should continue during the next few years, as shown in Table 5.

Among petro-chemical products, plastic materials should first be mentioned; they should experience a fairly sustained growth. Another sector which is experiencing expanding demand is that of products for textile uses: already, synthetic fibres cover one third of the consumption of fibres, and their share will increase further, the acrylics and polyesters appearing among those which should experience the highest progression.

The growth of the production of these items within the Community will, however be dependent on economic conditions in the textile industry and competition from other producers in the world, which shows signs of being very keen in the next few years.

The rate of growth of the production of synthetic rubbers will also be high, particularly in view of the inadequate production of natural rubber in relation to requirements. In the United States, the share of synthetic rubber in the total consumption of rubber reaches about 80 %; within the Community, where this proportion is only around 60 %, the trend is towards an increase. Carbon black and other additives for the manufacture of rubber will experience the same phenomenon of growth.

Other branches of the petro-chemical industry, such as the manufacture of colouring materials, auxiliaries and additives for plastic materials, adhesives, solvents, etc., will be influenced by the expansion of the products mentioned above.

The future growth of nitrogen fertilizers seems likely to be smaller. On the world scale, several investment plans in the early sixties were based on estimates of a growth of demand which did not eventually materialize, resulting in over-investment which has given rise to very stiff competition and a substantial reduction in prices.

The division of consumption between petroleum products and natural gas is fairly difficult to foresee, as it depends, at the same time, on the conditions of availability of each of these raw materials and the technical advantages which their use may present in various manufactures. If the first factor is full of uncertainties, the second is equally so, due to possible technological progress which could modify the demand for raw materials fairly rapidly in certain branches of the petro-chemical industry.

TABLE 5

Consumption of energy as a raw material in the chemical industry - 1975-1980-1985 prospects (Community)

	Petroleum products [1]		Natural gas		Total
	M tec	M tec	10^3 Tcal	M tec	M tec
1970	19	27	57	8	35
1975	32	45	92	12	57
1980	41	59	120	16	75
1985	50	71	150	20	91

[1] Net consumption, i.e. excluding the quantities returned to refining.

Taking all these reservations into account, Table 5 presents an assumed distribution which maintains constant the relative share of oil and natural gas in the supply of raw materials to the chemical industry, reaching 71 and 20 million tec respectively in 1985.

New investments in the chemical industry will be located less and less in accordance with national considerations but will tend to regroup in the regions of the Community which offer most advantages for the development of this activity (port infrastructure, proximity of refining centres, natural gas supply, etc.). In addition, the multi-national character of a large number of chemical firms enables them to select the most favourable sites over a very large geographical area. For these various reasons, a breakdown of consumption of the petro-chemical industry by country would not be very significant.

APPENDIX 3

OTHER INDUSTRIAL BRANCHES

In the fairly heterogenous group represented by the industries other than iron and steel and chemicals, a general distinction may be made on the basis of two criteria: the dynamic nature of the growth of the energy consumption of the various branches, and the relative importance of the volume of this consumption in total industrial consumption. This leads to a regrouping into two sub-groups. The first, so-called 'other intensive energy-consuming industries', includes the non-ferrous metals industry, the non-metallic mineral products industry and metal fabrications. The other sub-group, that of 'miscellaneous industries' groups together all the other branches. The prospects worked out for the energy requirements of these different industrial sub-sectors are based on the trends established for the whole of the period 1971-1985. However, the level of consumption in 1975 and 1980 has been determined: these points of reference, fixed in relation to average growth for the whole period, are presented as a guide, and the values have been rounded-off to the nearest million tec. Any calculation of the mean annual growth per five-year period is therefore liable to show irregularities which fundamentally do not exist, only the rates of growth established over the period of 15 years being significant.

TABLE 1

Structure and recent trends of the consumption of energy in the industrial branches of the Community

	Volume in M tec		Distribution in %		Mean annual variations in %
	1960	1970	1960	1970	1960-1970
Iron and steel	67.9	86.4	31.1	23.1	+ 2.5
Chemical industry (energy uses and raw material)	43.9	92.5	20.1	24.7	+ 7.7
Other large energy-consuming industries	51.8	94.2	23.7	25.2	+ 6.2
Miscellaneous industries	45.7	74.4	21.0	19.9	+ 5.0
Other non-energy uses [1]	8.9	26.4	4.1	7.1	+ 11.5
Total for industrial uses	218.3	373.9	100	100	+ 5.5 [2]

[1] + 4.4 %, if non-energy uses are excluded.

[2] Bituminous products, tars, lubricants, etc.

Table 1 shows that if the chemical industry is the industrial sector whose energy consumption has increased most since 1960, the 'other large energy-consuming industries, and 'the miscellaneous industries' have progressed more than iron and steel. The very large increase of non-energy uses other than those of the chemical industry should also be noted.

A — *Other large energy-consuming industries*

The group of other large-energy consuming industries had used 52 million tec in 1960: ten years later their requirements rose to 94 million tec, showing a mean progression of 6.2 % per year. This rate, which is very high in comparison with the 4.4. % achieved in the same period for the whole of industry (excluding non-energy uses), will probably be maintained up to 1985. It is, in fact, to be expected that the growth of the various branches grouped under this heading will remain fairly similar to that of the last ten years.

As for all the other consumer sectors, the years 1960 to 1965 were marked within these industries by a clear regression of solid fuels (— 7 % / year) and by a large growth of petroleum products (+ 16 % / year). Between 1965 - 1970 it has been possible to see an accelerated development of natural gas consumption (+ 19 % / year). Finally, for the whole of the period 1960-1970 the growth in electrical energy requirements has asserted itself with regularity (+ 5.2 % / year).

TABLE 2

Trends in energy requirements of other large energy-consuming industries within the Community

M tec

	Achievements			Prospects			Mean annual variations in %	
	1960	1965	1970	1975	1980	1985	1961-1970	1971-1985
Solid fuels	17.3	12.5	8.8	3	1	—	— 6.5	—
Petroleum products	13.4	28.6	45.2	60	77	102	+ 12.9	+ 5.6
Gas (natural + manufactured)	3.6	4.7	11.3	24	39	57	+ 12.1	+ 11.4
Electricity (+ heat)[1]	17.5	21.9	28.9	39	53	71	+ 5.2	+ 6.2
Total	51.8	67.7	94.2	126	170	230	+ 6.2	+ 6.1

[1] The item ' heat ' includes purchases of steam

In 1985, electricity is likely to cover the same share of energy consumption as in 1970, i.e. 30 %. Against this, natural gas would double its contribution to meeting these requirements: 12 % in 1970, it will probably reach 25 % of the total in 1985. Petroleum products should provide the rest after the practically complete disappearance of solid fuels (see Table 2). For the various branches, the trends should be as follows:

1. Non-ferrous metals

Since 1960, the energy consumption of non-ferrous metals has been increasing by 5 % per year on the average. This consumption is characterized by the preponderance of electricity, which represented 60 % of the requirements in 1960, but which shows a diminishing trend (57 % in 1970). In 1970, solid fuels covered 11 % of consumption, petroleum products 26 % and natural gas 5 %. The latter should experience a rapid growth of its share due to the specific advantages it offers for this branch of industry.

TABLE 3

Trend of energy consumption of the non-ferrous metals industry within the Community

M tec

	Achievements			Prospects			Mean annual variations in %	
	1960	1965	1970	1975	1980	1985	1961-1970	1971-1985
Fuels	3.2	4.5	6.3	8	11	16	+ 7.0	+ 6.4
Electricity (+ heat)[1]	5.9	6.8	8.5	11	14	17	+ 3.7	+ 4.7
Total energy	9.1	11.3	14.8	19	25	33	+ 5.0	+ 5.5

[1] See Table 2.

The non-ferrous metals industry has developed in the countries of the Community as a result of particular circumstances, especially in accordance with deliberate measures of industrial and regional policy. The availability of cheap electricity has, for instance, permitted the setting up of an aluminium industry in certain regions of the Community.

For the future it is possible that the energy consumption of the branch will continue to grow according to past trends, i.e. at a rate of 5 to 5.5. % per year on the average. The growth of electricity demand (approximately 4.7 %) would not be so rapid as that of the total consumption, and its share could fall to 50 % towards 1985, due in particular to the possible expansion of natural gas, which might then cover 15 to 20 % of requirements.

The future of this branch could, however, be influenced by the industrialization policy of its suppliers of raw materials. In so far as the availability of cheap energy is concerned, the ore-producing countries might decide to develop their activities downstream from extraction, and the European non-ferrous metals industries would have to adapt themselves to this new situation.

The demand of the non-ferrous metals industry represents at the moment a little less than 2 % of the total internal consumption of the Community. This position should not change much in the future.

2. Non-metallic minerals

The industries assembled under the heading of 'non-metallic minerals' [1] have experienced on the whole a fairly rapid growth of their energy consumption: + 5.6 % from 1960 to 1970. Allied, for obvious reasons, to the construction industries, the activities of these branches vary significantly with the fluctuations of the economic climate.

In the space of ten years, the structure of the energy demand by these branches has been completely changed. In 1960, solid fuels provided close to half the requirements, and petroleum products about a third. At the present time, solid fuels represent only 10 % of the energy consumption, whilst the petroleum products provide 60 %.

TABLE 4

Trend of the energy consumption of the 'Non-metallic minerals' industry within the Community

M tec

	Achievements			Prospects			Mean annual variations in %	
	1960	1965	1970	1975	1980	1985	1961-1970	1971-1985
Fuels	21.9	27.0	37.6	50	67	89	+ 5.5	+ 5.9
Electricity (+ heat)$_1$	4 2	5.7	7.4	10	13	18	+ 5.8	+ 6.1
Total	26.1	32.7	45.0	60	80	107	+ 5.6	+ 5.9

[1] See Table 2

The construction industry, the driving force behind the non-metallic minerals industries, is a branch whose long term development is assured. Certainly it is very sensitive to the uncertainties of the economic climate. Its growth, however, is related to the rise in the standard of living, to the development of infrastructures and industrial investments. These various elements justify the adoption of a fairly high assumption for the average growth of energy requirements for the non-metallic minerals industries, and an average rate of 6 % per year has been adopted.

50 % of the supply would be assured by petroleum products, 30 % by natural gas, and the rest by electricity and perhaps small quantities of coal.

3. Metal fabrication

The metal construction industry has experienced a very large expansion during the past ten years, and the average rate of growth of its energy consumption exceeds 7.5 % per year. Most of the development has been met by petroleum products

[1] In particular : tiles, bricks, ceramics, cement, lime, plaster, glass.

(1960-1970: + 13.5 % / year) and more recently by natural gas (1965-1970: + 14 % / year). Nevertheless, the very regular growth of electricity consumption should be stressed (1960-1970: + 6 % / year).

TABLE 5

Trends of energy consumption in the metal fabrication industry within the Community

M tec

	Achievements			Prospects			Mean annual variations in %	
	1960	1965	1970	1975	1980	1985	1961-1970	1971-1985
Fuels	9.3	14.3	21.4	29	39	54	+ 8.7	+ 6.4
Electricity (+ heat)[1]	7.3	9.4	13.0	18	26	36	+ 5.9	+ 7.0
Total energy	16.6	23.7	34.4	47	65	90	+ 7.6	+ 6.6

[1] See Table 2.

The growth of the metal construction industries will be differentiated according to sectors, but globally fairly high. The requirements will grow at 6 to 7 % per year, on the average, and the branch could represent 5 % of the internal consumption by 1985.

B. Miscellaneous industries[1]

The group of 'miscellaneous industries' has undergone interesting changes of behaviour during the last decade. From 1960 to 1965, the rate of development (+ 3.5%) of the consumption of energy by these branches was substantially slower than that of all industrial sectors (+ 4.1 %). Between 1965 and 1970, however, the rate of growth has greatly increased (+ 6.6 %) and has easily outstripped the average rate of increase of energy consumption for all industries.

It is difficult to express an opinion on the reasons for these trends, as they cover factors which are specific to very different industries. It might, nevertheless, be stated that a large number of 'miscellaneous industries' are related to some extent to service activities or produce goods for general consumption. The recent development of services and the growth of private consumption might therefore explain, to some extent at least, this acceleration.

In the same way as for other industrial sectors, the structure of consumption has undergone great changes over the last ten years. In 1960, solid fuels, petroleum products and electricity each covered 30 % of the energy consumption. At present, electricity has retained its share unchanged, whilst petroleum products meet more than half the requirements.

[1] This very heterogeneous group includes for instance the food and catering industries, drink industries, tobacco, textile industry, leather industry, the clothing industry, etc.

TABLE 6

Trends of energy requirements in ' miscellaneous industries ' within the Community

M tec

	Achievements			Prospects			Mean annual variations in %	
	1960	1965	1970	1975	1980	1985	1961-1970	1971-1985
Solid fuels	14.8	8.5	3.8	1	—	—	— 12.7	—
Petroleum products	13.7	25.3	41.1	54	75	101	+ 11.6	+ 6.2
Gas (natural + manufactured)	2.8	2.8	6.6	13	19	28	+ 9.0	+ 10.1
Electricity (+ heat)[1]	14.4	17.6	22.9	31	41	52	+ 4.8	+ 5.6
Total	45.7	54.2	74.4	99	135	181	+ 5.0	+ 6.1

[1] See Table 2

During the next 15 years, the development of energy consumption by these branches should continue at an annual rate of about 6 %, near the average rate of the 5 last years. In 1985, about 30 % of requirements should be met by electricity. Hydrocarbons, which should cover the other energy requirements, would consist of approximately 25 % natural gas and 75 % petroleum products.

TABLE 7

Recapitulation of the needs of ' other industries ' 1975-1985 forecasts.

	1970	1975	1980	1985	1971-1985[1]
Solid fuels	13	4	1	—	—
Petroleum products	86	114	152	203	+ 5.9
Gas (natural + manufactured)	18	37	58	85	+ 10.9
Electricity	52	70	94	123	+ 5.9
Total	169	225	305	411	+ 6.1

[1] Mean annual variation in %.

APPENDIX 4

TRANSPORT

A — *Road transport*

In present circumstances, the question arises whether the trends of road transport within the Community will continue as in the past, or whether it will be affected by new features. The following forecasts have, therefore, been established with caution: they show the most likely trend pattern, but there is nothing to prevent a drift on the high side or on the low side, according to the options taken by public authorities, particularly regarding the environment, infrastructure, etc.

The breakdown of different motor fuels might differ from the figures given below if one type or another of engine were to benefit from important technical progress, or if taxation were to upset the relative position of petrol and diesel fuel, but such eventualities cannot be foreseen at present. If they did occur, they would, in any case, have only a small influence on the total requirements of petroleum products for transport, as they would mainly result in a transfer from petrol to diesel or vice-versa.

1. Petrol consumption

Petrol consumption depends on several factors among which are: the ownership level of the motor car among the population, the average horse-power of the vehicles, the average distance travelled, etc.

The ratio of the number of vehicles to population within the Community was, in 1970, approximately 200 vehicles per 1 000 inhabitants, whilst it reached nearly 430 in the United States. Without taking the number of cars licensed in America as a model (the context is different to that of Europe as far as the economic, sociological and geographical background is concerned). it can be foreseen that the number of private cars in circulation will still increase steadily for many years, as it did between 1961 and 1970: an increase of the order or 50 % between now and 1985 seems quite conceivable.

The growing trend for the average power of vehicles to increase could continue, which would reinforce the growth in fuel demand.

The average distance travelled by each car annually is another factor to be considered, and the relationship between the trends in the number of cars in use and petrol

consumption gives a general idea of this. In this connection, in Italy and in the Netherlands, where the development of motor transport is more recent, the number of cars has risen much more rapidly than the petrol consumption. Against this, in France and in Germany, where the use of the motor car has been longer established, petrol consumption has risen at almost exactly the same rate as the number of cars. In Belgium the number of cars in use is at an intermediate position with a petrol consumption slightly below the rise in numbers of cars. It may be tempting to conclude that the purchase of the car is made first for reasons of social prestige and imitation, its utilization then developing only gradually.

It is also possible to speculate whether these two phases (the Italo-Netherlands phase and the Franco-German phase) might not be followed by a third, during which the number of cars in use, whilst increasing less rapidly, would consume more on the average, under the effect of rising incomes and increased leisure time, as well as other factors such as the improvement of the road system (for instance the construction of a motorway network) and the falling tendency of the real price of petrol. Finally, the growing density of traffic and the slowing down of traffic movement might also result in an increased consumption.

If past experience is anything to go by, it must be admitted that the forecasts of the number of cars in use have generally been clearly below reality and that they have underestimated the major role played by the thirst for motoring. 'Motoring is clearly a social desire. The product of many individual and independent desires, this social desire is much more constant than the expression of agreed majority desires which may be made from time to time through political channels. It may be relied upon for forecasting purposes. People wish and will continue to wish to acquire cars and to use them. As far as acquiring them is concerned, the gradual rise of incomes will give them the means; but as for using them, that is another matter'.[1]

Certain factors, however, may slow down the development of motor fuel consumption. Some result from the conditions of this development, others from external causes.

In the countries which have at present reached a high rate of motorization, such as the United States or Sweden, the wide spread of housing has exercised a favourable effect. In the Community, where the population density already leads to high traffic density, the territorial factor may have an opposite effect.

Account must also be taken of possible action from the public authorities with a view to eliminating or reducing the nuisance directly attributable to transport (occupation of space and equipment, noise, pollution, etc.) and to arresting the tendency towards a growing concentration of population and economic activities within built-up areas that are already too dense, as well as to favouring the development of underdeveloped regions or those in decline. Transport would then become increasingly one of the effective means of intervention in favour of the environment and the development of the territory in the widest sense, and the policies on these would preferably satisfy demands of a social character rather than the requirements of private consumption.

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1 Bertrand de Jouvenel: *L'art de la conjecture* (Editions du Rocher, Monaco 1964).

If this trend were to be confirmed, the public authorities would have, in particular, to intervene in order to promote effectively the public transport facilities within built-up areas and connecting with them (train, tramway, underground), and according to the effort made this could have consequences, the extent of which cannot be foreseen at the present time, on the development of petrol consumption in towns.

Measures for the protection of the environment might also stimulate research and development on new modes of vehicle propulsion offering lesser nuisance effects. Thus, for example, the electric car could revolutionize the structure of energy consumption by transport, particularly in towns. It does not seem, however, that such an upheaval should be taken into consideration in a forecast covering a period of 15 years, even if firm expectations can be built up on the development of this technique. Account should, in fact, be taken of the delaying effect resulting from the need to depreciate or to modify the production resources of the motor industry, as well as those for refining and distributing petroleum products, and a fairly long delay will take place before the electric car reaches a sufficient number likely to have an important effect on petrol consumption.

These various and conflicting influences will, no doubt, lead to the maintenance of present trends in petrol consumption, which would then grow fairly steadily in time, at least during the next ten years. This consumption would thus reach 54 million tonnes in 1975 and 81 million tonnes in 1985, against 41 million tonnes in 1970; the average increase in relation to the last mentioned year would be 5.5 % up to 1975 and would fall to 4 % during the period 1975-1985. (see Table 1).

2. Consumption of diesel oil

The growth of the number of lorries (in France and in Germany, for instance, 2.5 and 3.5 % respectively between 1958 and 1968) is not sufficient to explain the increase in diesel consumption, which seems to depend more on the structure and the utilization of the number of commercial vehicles than on the growth of the number in use.[1] Thus, the trends in the average weight of lorries and the progressive conversion to diesel propulsion of the lighter vehicles, after the conversion of heavy vehicles, have had important results. During the last few years, another growth factor for consumption, in spite of the slower growth of the number of vehicles in use, has been the more rational economic outlook of undertakings which used to own their own fleets of lorries but have disposed of them, preferring to rely more on the services of transport contractors or on hired vehicles. This attitude could only improve the overall economics of all vehicles in use and has affected in turn the consumption of diesel oil in a way which was proportionately greater than what might have appeared from the trends in the number of commercial vehicles.

The effect of all these factors determines trends which are very regular and the extrapolation of which gives for 1975 and 1985 a consumption of 21 million and 30 million tonnes respectively, against 17 million tonnes in 1970. The rate of increase would thus be for the 1971-1985 period approximately 4 % per year, clearly below that observed during the period 1961-1970.

[1] The consumption of diesel oil by private cars is of significance only in Germany.

TABLE 1

Consumption of petroleum products in the road transport sector - 1975-1980-1985 prospects

M tep

	1970			1975			1980 [1]			1985 [1]		
	Petrol	Diesel Oil	Total	Petrol	Diesel Oil	Total	Petrol	Diesel Oil	Total	Petrol	Diesel Oil	Total
Belgium	2.2	1.0	3.2	2.5	1.6	4.1	3	2	5	4	2	6
France	11.9	4.5	16.4	15.1	5.5	20.6	19	7	26	22	8	30
Germany	15.7	6.5	22.2	20.1	7.6	27.7	25	9	34	30	10	40
Italy	9.2	4.1	13.3	12.7	4.8	17.5	16	6	22	19	7	26
Luxembourg [2]	0.0	0.0	0.1	0.0	0.0	0.1	0	0	0	0	0	0
Netherlands	3.0	1.0	4.0	3.9	1.2	5.1	5	1.5	6	6	2	8
Community [3]	42	17	59	54	21	75	68	25	93	81	29	110

1 Breakdown by country and by motor fuel, for 1980 and 1985, presents a degree of probability rather less than the global figure relating to the whole of the Community.
2 0 = amount below 0.5 M tep.
3 Total rounded-off

Some factors which concern the very future of road transport and cannot be expressed in figures, should be mentioned in view of the importance of their possible effect on consumption and the uncertainties attached to them. These are, for instance, decisions which public authorities might take to improve the operation of railways or to arrest the deterioration of the road network caused by certain categories of vehicles, to increase road safety, etc. The magnitude of the financial means to be introduced for the maintenance and development of the road network and the importance of the problems of urban development which are raised by this development may also result in a certain slowing down, in the same way as the concern to limit the effects of pollution by road traffic: the considerations expressed on the subject of the consumption of petrol are equally applicable here.

B — *Air transport*

Since 1945 the energy consumption of air transport has increased in quite a spectacular way: 12 to 14 % per year on the average. Cargo transport alone is growing by 25 % per year. This expansion will still continue with the development of large capacity aircraft, the introduction of supersonic flights and the generally wider utilization of air transport.

Without detailed data and forecasts on the expansion of traffic in European airports, the consumption prospects for aviation fuel have been established on a global basis, assuming that the expansion will continue at the same rate. Experts foresee a growth in traffic at the main airports of the Community from now until 1985 that will be higher than the world average, and this applies particularly to those which already occupy an important place in international transport, such as Paris, Frankfurt or Rome. On the basis of these indications and of the experience acquired during previous investigations in which the forecasts have always been below archieve ments, the following rates of increase have been adopted: 15 % for Germany, 7 % for Belgium, 13 % for France and Italy and 8 % for the Netherlands. These rates are all higher than those experienced during the period 1961-1970, but on the assumption of a high growth in civil aviation they do not seem to be unrealistic.

The demand by air transport would double approximately every 5 years, rising from 6 million tonnes of aviation fuel in 1970 to 12 in 1975, 21 in 1980 and 40 in 1985 (see Table 2).

TABLE 2

Consumption of petroleum products in air transport - 1975-1985 prospects

M tep

	1970	1975	1980 [1]	1985 [1]
Belgium	0.4	0.5	0.7	1
France	1.5	3.1	5.7	11
Germany	2.0	4.0	8.0	16
Italy	1.5	2.8	5.2	10
Luxembourg	0.0	—	—	—
Netherlands	0.7	1.1	1.6	2
Community [2]	6	12	21	40

[1] See note [1] to Table 1.

[2] Total rounded-off.

C — *Rail transport*

The measures for the rationalization of rail transport equipment (replacement of steam locomotives by diesel and electric units) have resulted in a reduction or at least a stagnation in the global consumption of energy by railways during the last 15 to 20 years, which will probably be continued for some time to come.

Subsequently, the effects of this rationalization factor, as well as those of the slow growth of traffic, will be superseded by other influences which could cause a new increase in energy requirements. This applies, for instance, to the creation of high speed lines which can compete with other means of transport, particularly on medium distances, the development of new techniques (containers, turbotrain, tracked hovercraft), or even the effects of policies tending to favour the railways in view of its advantages over road transport as far as the environment is concerned.

TABLE 3

Consumption of petroleum products and electricity by rail transport within the Community 1975-1985 prospects

Petroleum products (M tep)				Electricity (TWh)			
1970	1975	1980	1985	1970	1975	1980	1985
1.6	2.0	2.3	2.6	18	21	24	27

As shown in Table 3, the consumption of petroleum products will rise from 1.6 to 2.6 million tonnes between 1970 and 1985, and that of electricity from 18 to 27 TWh. The Table does not show data relating to the consumption of coal (2.2. million t in 1970), as it will practically vanish by 1975.

D — *River transport*

The river transport sector includes a fairly mixed group of consumers (inland waterway navigation, coastal traffic, pleasure cruising, port installations) the trends of which follow different influences.

However, the preponderant share taken by inland waterway navigation in the total makes it possible to select the trends of this category as fairly representative of the whole. For this purpose, the basis adopted is the forecast of traffic prepared for 1975 by the European Conference of Transport Ministers,[1] by extrapolating the trend for the following period.

[1] European Conference of Transport Ministers. 15th annual report and resolutions of the Council of Ministers - Year 1968.

Altogether, the consumption of petroleum products for river transport would rise from 2 to 3 million tonnes between 1970 and 1985.

TABLE 4

Consumption of petroleum products in river transport within the Community 1975-1985 prospects

M tep

1970	1975	1980	1985
2.2	2.3	2.7	3.0

Table 5 recapitulates the prospects for requirements of petroleum products for the whole of transport, which would rise from 99 to 220 million tec in 15 years, i.e. an average increase of 5.5. % per year approximately, compared with 9.5 % during the period 1960-1970.

If uncertainties remain regarding the share of each category of transport in the total, the latter offers a greater degree of probability due to the transfers of traffic which may occur from one sector to another.

TABLE 5

Recapitulation of consumption forecasts of petroleum products in transport

M tep

Transport	1970	1975	1980	1985
Road	59	75	93	110
Air	6	12	21	40
Rail	2	2	2	3
River	2	2	3	3
Total in M tep	69	91	119	156
Total in M tec [1]	99	131	167	220

[1] Amount calculated on the basis of data relating to each country, added sector by sector.
Due to the rounding-off of the figures expressed in tonnes of petroleum products, the conversion of the total in M tep of the Table into M tec would give a slightly different and less accurate result.

APPENDIX 5

A — *General considerations*

The classification 'domestic sector' is comprised of several categories of consumers presenting very different characteristics. For some, energy is a consumption good, either in a private capacity (consumption by households) or on a collective basis (public administration). For others, energy is a factor of production, either in a generating process for goods (small industry, agriculture, fisheries) or in carrying out a service (light industry, commerce, insurance, banks, etc.).

In addition, within these various sub-sectors, energy is used for different ends and in different forms.

Except in particular cases, analysis of the different categories or the different uses grouped within the domestic sector comes up against great difficulties, due to the lack of sufficiently detailed and reliable statistical data. For households, for instance, it is necessary to consider that the consumption of solid and liquid fuels is equal to the amount delivered, as it is not possible to identify the movement of private stocks. As it is impossible to rely on surveys, it is often necessary to evaluate by substraction the amount of consumption by this sector and leave a certain margin for qualitative corrections.

Apart from these imperfections of a statistical order, the mixed nature of the domestic sector makes it equally difficult to detect parameters which govern its trends. Among the factors exercising an influence on the demand of domestic households, the levels of household income, changes in the standard of living, comfort requirements, the ratio between the cost of appliances and the cost of the energy consumed, etc., all have to be taken into account. The demands of fisheries, agriculture, services and light industry are greatly dependent on economic activity but in different ways.

It has therefore been necessary to proceed with great prudence with the study of consumption prospects in the domestic sector, relying at the same time on global evaluations and on analyses of the trends of domestic household requirements in the different member countries.

B — *Trends observed*

With an annual average rate of 6.5 % (greater than that for total energy consumption), the domestic sector is one of those whose demand has experienced the most rapid

increase between 1950 and 1970. The acceleration has been even greater during the last 10 years, amounting to 8 % .

An examination of the position of each form of energy makes it clear, however, that this increase has been accompanied by great changes (see Table 1).

TABLE 1

Consumption of energy by the domestic sector within the Community: 1950-1970

	M tec		Distribution %		Mean annual variations in %	
	1950	1970	1950	1970	1951-1960	1961-1970
Solid fuels	52	42	70	16	+ 1.9	— 3.9
Liquid fuels	4	141	5	52	+ 21.5	+ 17.5
Gas fuels	4	23	5	8	+ 4.1	+ 13.9
Total fuels	60	206	80	76	+ 4.9	+ 7.8
Electricity	15	63	20	24	+ 5.7	+ 9.3
Total	75	269	100	100	+ 5.1	+ 8.1

The consumption of solid fuels has slowly diminished, but in a fairly constant manner: from a dominating position (70 % in 1950) they have declined to a secondary role (16 % in 1970) although in absolute figures they have fallen only by a relatively small amount. However petroleum products have developed very rapidly, rising from 5 % to half the total. Since 1960, gas has experienced a growth apparently smaller than that of oil, but it has been accompanied by important structural changes, with natural gas developing rapidly at the expense of manufactured gas.

Finally, electricity increased its share due mainly to the continuous extension of its specific uses (motive power) but in part also its penetration into the competitive field (space heating).

C — *Changes in structure*

1. General

In 1968, the last year for which sufficiently detailed statistics are available on consumption in the domestic sector, the requirements of households represented 67 % of the total, 60 % of which were for heating and cooking, 6 % for agriculture and fisheries, and 27 % for commerce, light industry and services.

TABLE 2

Structure of domestic sector consumption within the Community in 1968 [1]

(in %)

	Solid fuels	Liquid fuels	Gaseous fuels	Total fuels	Electricity	Total energy
Household:						
— Space heating, cooking	19	29	6	54	6	60
— Lighting, power	—	—	—	—	7	7
Agriculture, fisheries	—	4	—	4	2	6
Commerce, light industry, services	3	14	1	18	9	27
Total	22	47	7	76	24	100

[1] The year 1968 is the most recent year offering a statistical basis for a breakdown by use.

Being sensitive to climatic conditions, the energy consumption of *households* grows parallel to the improvement of the standard of living. This may reveal itself not only in additional comfort, the generator of additional requirements of energy, but also in a certain waste of energy which results from a greater ease of utilization and of sufficient availability at low cost. Under these conditions a saturation of household requirements seems difficult to foresee. The requirements for lighting and for motive power will, in fact, always tend to develop. As far as space-heating requirements are concerned, the appearance of air conditioning will once again push back the possible threshold of saturation.

Electric space-heating presents many advantages. It eliminates the problems of storage and maintenance, simplifies distribution and rationalises consumption. It offers a great flexibility of utilization. But one of its essential qualities is that it does not cause any direct atmospheric pollution. This may become a determining factor for its expansion, in so far as increasing attention might be devoted to the fight against nuisance.

Air conditioning has almost the same qualities, because it also consumes mainly electricity. Its advantages mean that it will be used not only in private applications but also in collective applications (services and administrations). In relation to space heating it offers the special feature of not displacing or replacing any previous consumption. It therefore creates entirely new requirements.

The more or less rapid development of these two applications will depend to a large extent on their cost. They may, however, develop even in cases where a competitive problem arises, because the degree of comfort they offer justifies a higher cost.

A slowing down or even a stabilization of the growth of energy requirements for *agricultural production, fisheries, small commerce and light industry* seems probable. Competitive production units will be more and more rationalized, and this will cause a rise in the unit consumption of energy. But the effects of this trend would be to a large extent compensated by the disappearance of marginal units under the pressure of ever greater competition.

Furthermore, the important development of energy requirements of *administrations* and *services* will continue, whether it be the growth of present applications (for instance, public lighting) or entirely new applications, among which electronics and the mechanization of administrative operations occupy an important part. The development of collective requirements (for instance, leisure and cultural centres) and the structural growth of the share of services in the Gross Industrial Product will only reinforce this trend.

2. National peculiarities

Perhaps even more than for other sectors, the domestic consumption of energy is greatly influenced by regional factors: climate, type and density of housing, structure of economic activities, effect of regulations, etc. The propects mentioned above should therefore be treated separately, at least at the level of member countries.

In *Germany*, gas and electricity will experience a very large expansion. Following efforts made by producers to develop this application, domestic heating by electricity may represent up to half the household requirements in electricity towards 1985. In the same period, gas consumption should grow four-fold, heating applications absorbing approximately 90 % of the quantity used in the domestic sector, as long as its relative price advantage is maintained. In addition to the increase in the gas and electricity market, the continued development of household heating requirements and the important extension of services will still leave growth possibilities for petroleum products. The irreversible fall in solid fuel requirements will accelerate further during the coming decade, the efforts for commercial promotion not being able to fill the relative price gap in comparison with other forms of energy.

If, in *France* the share of space-heating consumption tends to diminish central heating will, nevertheless, remain the main source of domestic consumption. Thus, it is probable that in 1985 oil will continue to occupy the greater part of the market. Two factors may, however, modify this structure: the development of collective gas-fired boiler houses, and the 'all-electric' systems; in 1985, 20 to 30 % of new domestic premises may be so equipped. For applications other than space-heating, the trend towards an increased use of electricity is clearly apparent.

In *Italy* the growth of the domestic energy requirements will also bear on gas and electricity. The domestic market foı petroleum products will undergo a radical modification of structure following the measures taken to fight air pollution in towns. Residual fuel oil which had provided the greater part of the increase in heating requirements will only develop, from now on, at a very low rate, being replaced by diesel-oil for heating and liquid fuel oil. These will experience such a growth that they will cover 35 % of all the requirements of the domestic sector by 1985, compared with only 6 % in 1968.

In the *Netherlands*, natural gas will account for almost all the increase in consumption. Petroleum products will be practically stabilized between 1975 and 1980, and coal will have disappeared. The development of electric space heating could not be established in this country before 1985, except in special circumstances.

In *Belgium*, if the price ratios between gas and electricity remain unchanged, there should not be any spectacular development in space heating, at least up to 1980.

Except on the assumption that severe regulations to fight pollution have to be applied, petroleum products will still greatly increase.

D — *Prospects*

1. Total consumption

Table 3 presents the probable breakdown of requirements in the domestic sector in 1985 by uses and forms of energy.

TABLE 3

Structure of the domestic sector consumption within the Community in 1985.

(in %

	Solid fuels	Liquid fuels	Gaseous fuels	Total fuels	Electricity	Total energy
Households:						
— space heating and cooking	1	29 — 25	12 — 16	42	7	49
— lighting, power	—	—	—	—	10	10
Agriculture, fisheries	—	4 — 4	—	4	4	8
Commerce, light industry, services	—	12 — 11	5	17 — 21	16 — 17	33
Total	1	45 — 40	17 — 21	63 — 62	37 — 38	100

The share of households, which was 67 % in 1968, would fall to around 60 % in favour of commercial uses, light industry and services.

The breakdown by form of energy presents a double set of variants:

— the first postulates two competing situations between liquid and gaseous fuels;

— the second tends to underline the substitutions which could take place between all fuels (more particularly petroleum products) and electricity.

The prospects by country appear as follows. In Germany, gas and electricity together will cover more than 50 % of the requirements of the sector by 1985: they could even provide 60 % of these requirements if their relative price or measures of a general character favour such a development. On the basis of similar assumptions, gas and electricity together would represent 35 % to 55 % of domestic consumption in France and Italy. In Belgium and in Luxembourg, petroleum products should retain their share of approximately 50 % in the satisfaction of the requirements of the domestic sector until 1985, whilst in the Netherlands this share would be reduced to less than 25 % of the total. In this latter country natural gas alone would provide half the domestic consumption.

The highest growth would be in Italy, followed by the Netherlands and Germany (6.6 %, 5.3 % and 4.9 %: see Table 4). For the whole of the Community the energy consumption of the domestic sector will rise by 5 % per year, on the average, between now and 1985.

TABLE 4

Energy consumption of the domestic sector in the countries of the Community - 1968-1985

	M tec		Breakdown in %		Mean annual variations in %
	1970	1985	1970	1985	
Belgium	18	35	7	6	4.5
France	67	132	25	23	4.6
Germany	115	235	43	42	4.9
Italy	42	110	15	19	6.6
Luxembourg	1	2	0	0	—
Netherlands	26	56	10	10	5.3
Community	269	570	100	100	5.1

The decline of solid fuels will be continued at an accelerated rate, and they will represent only a very small part of consumption at the end of the period.

The growth of petroleum products will be maintained, but at a clearly smaller rate than in the past, due to the gradual disappearance of the possibilities of substitution and also to the competition of natural gas and subsequently of electricity in the coverage of new requirements. As opposed to what has happened during the last ten years, the rate of growth for petroleum products will be below the average rate for the whole of the domestic sector.

Gas will experience its greatest development during the next five years: It will double its contribution to the satisfaction of domestic requirements. Beyond 1975, the trend will depend essentially on the volume of natural gas which may be made available to the consumer and on the relative price of this fuel.

Table 5 presents quantitative prospects, taking into account the combination of the two alternative sets of assumptions mentioned above, for 1980 and 1985. It is noted that the consumption of an increasing amount of electricity and gas (caused either by the trends of price ratios or by measures encouraging the use of these two forms of energy) will lower the share of petroleum products in this total from 45 to 40 % in 1985. However, in order not to underestimate the requirements for liquid fuel, only the first assumption was adopted when preparing the global balance presented in Chapter III.

2. Consumption per inhabitant

The prospects outlined above correspond approximately, at the level of the Community, to a doubling of consumption per inhabitant in the domestic sector,[1] which would rise from 1425 kg ec in 1970 to 2 800 kg ec in 1985. The respective position

[1] Not to be confused with the consumption per inhabitant in the household sub-sector alone or domestic households. For reasons given previously, it is not possible to calculate the latter on a comparable basis for all countries and for all sources of energy. The same reasons prevent comparison of these data with those related to countries outside the Community.

TABLE 5

Consumption of energy by the domestic sector - 1975-1980-1985 prospects [1]

	M tec				Distribution in %				Mean annual variation in %		
	1970	1975	1980	1985	1970	1975	1980	1985	1971-1975	1976-1980	1981-1985
Fuels:											
— solid	42	22	13	7	16	6	3	1	— 8.4	— 9.9	— 11.6
— liquid	141	183	218/208	252/228	52	52	48/46	45/40	+ 4.6	+ 3.6/+ 2.6	+ 3.0/+ 1.9
— gaseous	23	51	75/85	98/118	9	15	17/19	17/21	+ 19,7	+ 8.0/+ 10.8	+ 5.5/+ 6.8
Total	206	256	306	358/353	77	73	68	63/62	+ 4.8	+ 3.6	+ 3.2/+ 2.9
Electricity	63	95	146	212/217	23	27	32	37/38	+ 6.7	+ 9.0	+ 7.7/+ 8.3
Total	269	351	452	570	100	100	100	100	+ 5.3	+ 5.2	+ 4.8

[1] The alternatives presented for 1980 and 1985 combine two sets of assumptions :
— the first set of assumptions allows for competition between gas and petroleum products within the total for fuels
— the second set proposes a possible substitution between fuels (mainly liquid) and electricity.

of each country in relation to this Community average would remain practically the same, Luxembourg remaining in the lead with 4 100 kg ec per inhabitant, followed by Germany, the Netherlands and Belgium (3 780, 3 690 and 3 440), France and Italy being below the average level (2 400 and 1 820). It is, however, in these latter countries that the mean annual increase would be highest during the period 1970-1981, at 5.9 % against 4.6 % for the Community as a whole.

TABLE 6

Energy consumption per inhabitant in the domestic sector [1]

(kg ec per inhabitant)

	1970	1985
Belgium	1860	3440
France	1325	2390
Germany [1]	1900	3775
Italy	775	1820
Luxembourg	2310	4100
Netherlands	1995	3690
Community	1425	2800

[1] Including the ' others not specified elsewhere ' consumption.

APPENDIX 6

THE ELECTRICITY DEMAND [1]

The preceding Appendices have investigated the final energy demand of the main sectors of consumption. This demand relates in part to primary energy, but mainly to secondary energy: particularly coke, refined petroleum products and electricity. Whilst it was possible to obtain the grand total of the fuel requirements and, where appropriate, of motor fuels, a separate estimate has been made each time for electricity. This method of treatment results from the particular character of electricity, which is generally intended for specific uses, and the demand for which seems to change in part according to laws different from those which govern other energy requirements.

The overall total electricity requirements are necessary to determine the demand for primary energy by the power stations and to estimate the distribution of internal consumption between different sources of energy[2]. Although the power stations form only a transitional item in the energy balance, they deserve particular attention, due to the magnitude of their requirements and of their concentration in a relatively small number of consumption units. Furthermore, for conventional thermal power stations there is a possibility of calling upon different fuels or to exploit the competition between them (multi-fuel power stations) which may possibly give rise to substitutions between sources of energy.

From 1950 to 1970, the consumption of electricity has increased at an average rate of 8.1 % per year, with however a certain slowing-down during the last ten years (7.5 %). It is in the domestic sector that the increase has been the highest (almost 11 %), which has raised its share of the total from one fifth to about one third.

Industrial consumption has increased more slowly, and its share has remained practically stationary, around half the total. The share of the other sectors has diminished, although their consumption has experienced a three-fold increase in 20 years.

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1 The 'Second Indicative Programme for Nuclear Energy' provides more detailed data on future trends of the demand and of the production of electricity: see Appendix II of that document.

2 See chapter IV, section I A, and graphs 4.

TABLE 1

Gross internal consumption of electricity - 1960-1970 trends

	TWh			Mean annual variations in %	Breakdown in %	
	1950	1960	1970	1951-1970	1950	1970
Industry	62.5	152.3	291.9	+ 8.0	50	49
including:						
iron and steel	(10.7)	(28.6)	(52.0)	+ 8.2	(9)	(9)
chemicals		(42.5)	(83.5)			(14)
other industries	(51.8)	(81.2)	(156.4)	+ 8.0	(41)	(26)
Transport	6.2	12.0	19.0	+ 5.8	5	3
Domestic sector	23.9	65.5	185.0	+ 10.8	19	31
Energy sector [1]	32.1	57.8	97.1	+ 5.7	26	17
Total internal consumption	124.7	287.6	593.0	+ 8.1	100	100

[1] Including losses and pumped storage energy

Table 2 summarizes the prospects for electricity in each sector which appear in appendices 1 to 5, as well as an estimate of the consumption of the energy sector industries (including transformation, transmission and distribution losses and pumped storage energy).

TABLE 2

Gross internal consumption of electricity - summary of sectorial prospects 1975-1985

	TWh				Mean annual variations in %
	1970	1975	1980	1985	1971-1985
Industry	292	400	565	795	+ 6.9
including:					
iron and steel	(52)	(68)	(82)	(97)	+ 4.2
chemicals	(84)	(133)	(195)	(269)	+ 8.1
other industries	(156)	(200)	(288)	(429)	+ 7.0
Transport	19	21	24	27	+ 2.4
Domestic sector	185	295	465	690	+ 9.2
Energy sector [1]	97	124	156	228	+ 5.9
Total internal consumption	593	840	1210	1740	+ 7.5

[1] Including losses and pumped storage energy

It seems therefore that the rate of growth for the next 15 years will be around 7.5 % which implies an approximate doubling of consumption in ten years.

This assumption fits in with the trend of recent developments and takes particular account of the maintenance of the falling trend of the price of electricity in real terms. It presents an average character which compensates the acceleration or deceleration factors which might become apparent in certain sectors.

On these bases and taking into account a slower improvement of the specific consumption of power stations than in the past,[1] the total amount of primary energy required by the power stations to satisfy the gross internal consumption in 1975, 1980 and 1985 may be estimated at 270, 380 and 535 million tec.

Table 3 shows how requirements will be broken down among the various sources of primary energy. It has been prepared from Appendix II 'Structure of the production of electricity' of the Second Indicative Nuclear Programme.

TABLE 3

Satisfaction of the primary energy requirements of power stations [1] - 1975-1980-1985 forecasts

(M tec)

	1970	1975	1980	1985
Total primary energy requirements [1]	195	271	380	535
Primary production	**44**	**64**	**121**	**222**
including:				
— hydro-electric	39	43	45	48
— and geothermal nuclear	5	21	76	174
Convention thermal	**151**	**207**	**259**	**313**
including:				
— *privileged* (lignite, manufactured gas and other)	34	44	49	51
— *competitive*	**117**	**163**	**210**	**262**
i.e.				
natural gas	15	31	40	48
coal	53	47	47	47
petroleum products	49	85	123	167

[1] Requirements for satisfying gross internal consumption, i.e. including the consumption of auxiliaries and losses, but excluding balance of exchanges with countries outside the Community.

[1] On the conversion factors, see ' General Observations ', page VI.

APPENDIX 7

Consumption of energy per unit of GNP

Tec per 1000 [1]

Year	B	F	G	I	N	EEC [2]	USA
1955	3.09	1.91	3.12	1.42	2.32	2.36	2.69
1956	3.10	1.95	3.08	1.51	2.49	2.40	2.75
1957	3.04	1.90	2.98	1.51	2.39	2.33	2.71
1958	2.78	1.82	2.74	1.46	2.35	2.20	2.73
1959	2.81	1.77	2.60	1.46	2.35	2.14	2.68
1960	2.73	1.75	2.47	1.58	2.40	2.10	2.74
1961	2.69	1.72	2.40	1.59	2.38	2.07	2.72
1962	2.82	1.72	2.47	1.69	2.53	2.11	2.67
1963	2.92	1.79	2.58	1.81	2.71	2.22	2.71
1964	2.73	1.75	2.49	1.87	2.57	2.18	2.68
1965	2.73	1.73	2.43	1.97	2.65	2.16	2.66
1966	2.61	1.67	2.37	2.05	2.69	2.13	2.64
1967	2.69	1.69	2.40	2.08	2.75	2.19	2.68
1968	2.91	1.71	2.43	2.10	2.87	2.20	2.60
1969	2.97	1.72	2.44	2.15	2.98	2.23	2.71
1970	3.00	1.73	2.48	2.23	3.20	2.24	2.86

[1] At the 1963 rate of exchange.

[2] Luxembourg included. Due to the strong influence of economic circumstances relating to iron and steel on energy consumption in that country, the large variations shown by the E/GNP ratio are not very significant in terms of a long-term trend.

APPENDIX 8

Long term energy consumption prospects within the Community

		Energy consumptions Total	M tec					M tep					Energy consumptions Total
			Coal	Lignite	Oil	Gas	Electricity [1]	Coal	Lignite	Oil	Gas	Electricity [1]	
1970 (actual)	Industrial sectors [2]	465	60	2	207	67	129	42	1	145	47	90	325
	Transport sector	108	2	0	100	0	6	1	0	70	0	4	75
	Domestic sector	271	37	7	140	24	63	26	5	98	17	44	190
	Primary energy equivalent												
	Electric power stations	(p.m.)	+ 52	+ 24	+ 50	+ 23	— 149	+ 36	+ 17	+ 35	+ 16	— 104	(p.m.)
	Manufactured gas	(p.m.)	+ 38	—	+ 3	— 41	—	+ 27	—	+ 2	— 29	—	(p.m.)
	Internal consumption	844	189	33	500	73	49	132	23	350	51	34	590
	Bunkering, export, others	129	10	1	117	0	1	7	1	82	0	1	91
	Total requirements	973	199	34	617	73	50	139	24	432	51	35	681
1975	Industrial sectors [2]	607	51	1	284	101	170	36	1	199	70	119	425
	Transport sector	137	—	—	131	—	6	—	—	92	—	4	96
	Domestic sector	351	18	4	183	51	95	13	3	127	36	67	246
	Primary energy equivalent												
	Electric power stations	(p.m.)	+ 47	+ 32	+ 88	+ 40	— 207	+ 33	+ 22	+ 62	+ 28	— 145	(p.m.)
	Manufactured gas	(p.m.)	+ 42	—	—	— 42	—	+ 29	—	—	— 29	—	(p.m.)
	Internal consumption	1 095	158	37	686	150	64	111	26	480	105	45	767
	Bunkering, export, others	145	—	—	145	—	—	—	—	101	—	—	101
	Total requirements	1 240	158	37	831	150	64	111	26	581	105	45	868

[1] + heat and ' other primary products '.

[2] Industry + non-energy uses + consumption of energy sectors.

APPENDIX 8 (continued)

Long term energy consumption prospects within the Community

		Energy consumptions Total	M tec					M tep					Energy consumptions Total
			Coal	Lignite	Oil	Gas	Electricity [1]	Coal	Lignite	Oil	Gas	Electricity [1]	
1980	Industrial sectors [2]	789	49	1	372	140	227	34	1	260	98	159	552
	Transport sector	174	—	—	167	—	7	—	—	117	—	5	122
	Domestic sector	452	12	1	218	75	146	8	1	153	53	102	317
	Primary energy equivalent												
	Electric power stations	(p.m.)	+ 47	+ 36	+ 127	+ 49	— 259	+ 33	+ 25	+ 89	+ 34	— 181	(p.m.)
	Manufactured gas	(p.m.)	+ 39	—	—	— 39	—	+ 27	—	—	— 27	—	(p.m.)
	Internal consumption	1 415	147	38	884	225	121	102	27	619	158	85	991
	Bunkering, export, others	165	—	—	165	—	—	—	—	115	—	—	115
	Total requirements	1 580	147	38	1 049	225	121	102	27	734	158	85	1 106
1985	Industrial sectors [2]	1 012	48	1	474	174	315	33	1	331	122	221	708
	Transport sector	228	—	—	220	—	8	—	—	154	—	6	160
	Domestic sector	570	7	—	253	98	212	5	—	177	69	148	399
	Primary energy equivalent												
	Electric power stations	(p.m.)	+ 47	+ 36	+ 172	+ 58	— 313	+ 33	+ 25	+ 120	+ 41	— 219	(p.m.)
	Manufactured gas	(p.m.)	+ 35	—	—	— 35	—	+ 25	—	—	— 25	—	(p.m.)
	Internal consumption	1 810	137	37	1 119	295	222	96	26	782	207	156	1 267
	Bunkering, export, others	185	—	—	185	—	—	—	—	130	—	—	130
	Total requirements	1 995	137	37	1 304	295	222	96	26	912	207	156	1 397

[1] + heat and ' other primary products '.

[2] Industry + non-energy uses + consumption of energy sectors.

APPENDIX 9 a

Long term energy consumption prospects for Germany

		Energy consumptions Total	10^6 tec					Mean annual variations 1970-1985					Energy consumptions Total
			Coal	Lignite	Oil	Gas	Electricity [1]	Coal	Lignite	Oil	Gas	Electricity [1]	
1970 (actual)	Industrial sectors [2]	177,3											
	Transport sector	40,3											
	Domestic sector	116,9											
	Primary energy equivalent												
	Electric power stations	(75,8)											
	Manufactured gas	(21,0)											
	Internal consumption	334,5	97,1	30,5	177,6	18,1	11,2						
	Bunkering, export, others	53,0											
	Total requirements	387,5	126,3	31,4	198,0	18,4	13,4						
1975	Industrial sectors [2]	220	22	1	97	34	66						
	Transport sector	50	—	—	47	—	3						
	Domestic sector	148	9	4	74	14	47						
	Primary energy equivalent												
	Electric power stations	(p.m.)	+ 34	+ 30	+ 20	+ 14	— 98						
	Manufactured gas	(p.m.)	+ 19	—	—	— 19	—						
	Internal consumption	418	84	35	238	43	18						
	Bunkering, export, others	40	15	—	25	—	—						
	Total requirements	458	99	35	263	43	18						

[1] + heat and ' other primary products '.

[2] Industry + non-energy uses + consumption of energy sectors.

APPENDIX 9 a (continued)

Long term energy consumption prospects for Germany

		Energy consumptions Total	10^6 tec					Mean annual variations 1970-1985					Energy consumptions Total
			Coal	Lignite	Oil	Gas	Electricity [1]	Coal	Lignite	Oil	Gas	Electricity [1]	
1980	Industrial sectors [2]	266	20	1	121	41	83						
	Transport sector	64	—	—	61	—	3						
	Domestic sector	190	7	1	84	23	75						
	Primary energy equivalent												
	Electric power stations	(p.m.)	+ 33	+ 34	+ 30	+ 19	— 116						
	Manufactured gas	(p.m.)	+ 17	—	—	— 17	—						
	Internal consumption	520	77	36	296	66	45						
	Bunkering, export, others	40	13	—	27	—	—						
	Total requirements	560	90	36	323	66	45						
1985	Industrial sectors [2]	331	20	1	150	49	111						
	Transport sector	84	—	—	80	—	4						
	Domestic sector	235	5	—	91	29	110						
	Primary energy equivalent												
	Electric power stations	(p.m.)	+ 33	+ 34	+ 45	+ 23	— 135						
	Manufactured gas	(p.m.)	+ 14	—	—	— 14	—						
	Internal consumption	650	72	35	366	87	90	— 2,0	+ 0,9	+ 4,9	+ 11,1	+ 14,9	+ 4,5
	Bunkering, export, others	39	10	—	29	—	—						
	Total requirements	689	82	35	395	87	90	— 2,8	+ 0,7	+ 4,7	+ 10,9	+ 13,6	+ 3,9

[1] + heat and ' other primary products '.

[2] Industry + non-energy uses + consumption of energy sectors.

APPENDIX 9 b

Long term energy consumption prospects for Belgium

		Energy consumptions Total	10^6 tec					Mean annual variations 1970-1985					Energy consumptions Total
			Coal	Lignite	Oil	Gas	Electricity [1]	Coal	Lignite	Oil	Gas	Electricity [1]	
1970 (actual)	Industrial sectors [2]	34,1											
	Transport sector	6,1											
	Domestic sector	18,0											
	Primary energy equivalent												
	Electric power stations	(10,4)											
	Manufactured gas	(4,4)											
	Internal consumption	58,2	19,1	—	33,9	4,9	0,3						
	Bunkering, export, others	19,0											
	Total requirements	77,2	20,6	—	51,0	5,0	0,6						
1975	Industrial sectors [2]	46	5	—	21	10	10						
	Transport sector	8	—	—	8	—	—						
	Domestic sector	23	3	—	12	3	5						
	Primary energy equivalent												
	Electric power stations	(p.m.)	+ 3	—	+ 6	+ 4	— 13						
	Manufactured gas	(p.m.)	+ 5	—	—	— 5	—						
	Internal consumption	77	16	—	47	12	2						
	Bunkering, export, others	21	1	—	20	—	—						
	Total requirements	98	17	—	67	12	2						

[1] + heat and ' other primary products '.

[2] Industry + non-energy uses + consumption of energy sectors.

APPENDIX 9 b (continued)

Long term energy consumption prospects for Belgium

		Energy consumptions Total	10^6 tec					Mean annual variations 1970-1985					Energy consumptions Total
			Coal	Lignite	Oil	Gas	Electricity [1]	Coal	Lignite	Oil	Gas	Electricity [1]	
1980	Industrial sectors [2]	59	4	—	28	13	14						
	Transport sector	10	—	—	10	—	—						
	Domestic sector	29	1	—	16	5	7						
	Primary energy equivalent												
	Electric power stations	(p.m.)	+ 3	—	+ 8	+ 4	— 15						
	Manufactured gas	(p.m.)	+ 4	—	—	— 4	—						
	Internal consumption	98	12	—	62	18	6						
	Bunkering, export, others	22	—	—	22	—	—						
	Total requirements	120	12	—	84	18	6						
1985	Industrial sectors [2]	73	4	—	34	16	19						
	Transport sector	13	—	—	13	—	—						
	Domestic sector	35	—	—	19	7	9						
	Primary energy equivalent												
	Electric power stations	(p.m.)	+ 3	—	+ 9	+ 4	— 16						
	Manufactured gas	(p.m.)	+ 4	—	—	— 4	—						
	Internal consumption	121	11	—	75	23	12	— 3,6	—	+ 5,4	+ 10,9	—	+ 5,0
	Bunkering, export, others	25	—	—	25	—	—						
	Total requirements	146	11	—	100	23	12	—	—	+ 4,6	—	—	+ 4,4

1 + heat and ' other primary products '.

2 Industry + non-energy uses + consumption of energy sectors.

APPENDIX 9 c

Long term energy consumption prospects for France

		Energy consumptions Total	10^6 tec					Mean annual variations 1970-1985					Energy consumptions Total
			Coal	Lignite	Oil	Gas	Electricity [1]	Coal	Lignite	Oil	Gas	Electricity [1]	
1970 (actual)	Industrial sectors [2]	115,7											
	Transport sector	29,2											
	Domestic sector	67,1											
	Primary energy equivalent												
	Electric power stations	(26,7)											
	Manufactured gas	(9,5)											
	Internal consumption	212,0	50,4	1,6	127,9	12,0	20,1						
	Bunkering, export, others	30,3											
	Total requirements	242,3	52,9	1,7	153,9	12,0	21,7						
1975	Industrial sectors [2]	150	13	—	78	19	40						
	Transport sector	37	—	—	35	—	2						
	Domestic sector	85	5	—	49	11	20						
	Primary energy equivalent												
	Electric power stations	(p.m.)	+ 7	+ 1	+ 27	+ 5	— 40						
	Manufactured gas	(p.m.)	+ 9	—	—	— 9	—						
	Internal consumption	272	34	1	189	26	22						
	Bunkering, export, others	31	1	—	30	—	—						
	Total requirements	303	35	1	219	26	22						

[1] + heat and ' other primary products '.

[2] Industry + non-energy uses + consumption of energy sectors.

APPENDIX 9 c (continued)

Long term energy consumption prospects for France

		Energy consumptions Total	10^6 tec					Mean annual variations 1970-1985					Energy consumptions Total
			Coal	Lignite	Oil	Gas	Electricity [1]	Coal	Lignite	Oil	Gas	Electricity [1]	
1980	Industrial sectors [2]	203	13	—	105	29	56						
	Transport sector	47	—	—	45	—	2						
	Domestic sector	105	4	—	58	13	30						
	Primary energy equivalent												
	Electric power stations	(p.m.)	+ 8	+ 1	+ 36	+ 6	— 51						
	Manufactured gas	(p.m.)	+ 9	—	—	— 9	—						
	Internal consumption	355	34	1	244	39	37						
	Bunkering, export, others	32	—	—	32	—	—						
	Total requirements	387	34	1	276	39	37						
1985	Industrial sectors [2]	267	10	—	142	36	79						
	Transport sector	61	—	—	59	—	2						
	Domestic sector	132	2	—	68	17	45						
	Primary energy equivalent												
	Electric power stations	(p.m.)	+ 8	+ 1	+ 47	+ 7	— 63						
	Manufactured gas	(p.m.)	+ 8	—	—	— 8	—						
	Internal consumption	460	28	1	316	52	63	— 3,8	— 3,1	+ 6,2	+ 10,3	+ 7,9	+ 5,3
	Bunkering, export, others	36	—	—	36	—	—						
	Total requirements	496	28	1	352	52	63			+ 5,7			+ 4,9

[1] + heat and ' other primary products '.

[2] Industry + non-energy uses + consumption of energy sectors.

APPENDIX 9 d

Long term energy consumption prospects for Italy

		Energy consumptions Total	10^6 tec					Mean annual variations 1970-1985					Energy consumptions Total
			Coal	Lignite	Oil	Gas	Electricity [1]	Coal	Lignite	Oil	Gas	Electricity [1]	
1970 (actual)	Industrial sectors [2]	97,8											
	Transport sector	23,8											
	Domestic sector	42,2											
	Primary energy equivalent												
	Electric power stations	(22,0)											
	Manufactured gas	(3,5)											
	Internal consumption	163,8	12,0	0,6	119,2	15,4	16,5						
	Bunkering, export, others	49,0											
	Total requirements	212,8	12,8	0,7	167,2	15,4	16,8						
1975	Industrial sectors [2]	133	7	—	67	20	39						
	Transport sector	31	—	—	30	—	1						
	Domestic sector	60	1	—	36	7	16						
	Primary energy equivalent												
	Electric power stations	(p.m.)	+ 2	+ 1	+ 31	+ 3	— 37						
	Manufactured gas	(p.m.)	+ 5	—	—	— 5	—						
	Internal consumption	224	15	1	164	25	19						
	Bunkering, export, others	55	—	—	55	—	—						
	Total requirements	279	15	1	219	25	19						

[1] + heat and ' other primary products '.

[2] Industry + non-energy uses + consumption of energy sectors.

APPENDIX 9 d (continued)

Long term energy consumption prospects for Italy

		Energy consumptions Total	10^6 tec					Mean annual variations 1970-1985					Energy consumptions Total
			Coal	Lignite	Oil	Gas	Electricity [1]	Coal	Lignite	Oil	Gas	Electricity [1]	
1980	Industrial sectors [2]	180	7	—	88	28	57						
	Transport sector	37	—	—	36	—	1						
	Domestic sector	83	—	—	47	12	24						
	Primary energy equivalent												
	Electric power stations	(p.m.)	+ 3	+ 1	+ 47	+ 3	— 54						
	Manufactured gas	(p.m.)	+ 5	—	—	— 5	—						
	Internal consumption	300	15	1	218	38	28						
	Bunkering, export, others	64	—	—	64	—	—						
	Total requirements	364	15	1	282	38	28						
1985	Industrial sectors [2]	240	7	—	116	35	32						
	Transport sector	49	—	—	48	—	1						
	Domestic sector	110	—	—	60	17	33						
	Primary energy equivalent												
	Electric power stations	(p.m.)	+ 3	+ 1	+ 63	+ 3	— 70						
	Manufactured gas	(p.m.)	+ 5	—	—	— 5	—						
	Internal consumption	399	15	1	287	50	46	+ 1,5		+ 6,0	+ 8,2	+ 7,1	+ 6,1
	Bunkering, export, others	71	—	—	71	—	—						
	Total requirements	470	15	1	358	50	46			+ 5,2			+ 5,4

[1] + heat and ' other primary products '.

[2] Industry + non-energy uses + consumption of energy sectors.

APPENDIX 9 e

Long term energy consumption prospects for Luxembourg

		Energy consumptions Total	10^6 tec					Mean annual variations 1970-1985					Energy consumptions Total
			Coal	Lignite	Oil	Gas	Electricity [1]	Coal	Lignite	Oil	Gas	Electricity [1]	
1960 (actual)	Industrial sectors [2]	5,56											
	Transport sector	0,28											
	Domestic sector	0,79											
	Primary energy equivalent												
	Electric power stations	(0,58)											
	Manufactured gas	(1,89)											
	Internal consumption	6,63	3,83	—	1,94	—	0,77						
	Bunkering, export, others	0,49											
	Total requirements	7,12	3,92	—	1,98	—	1,14						
1975	Industrial sectors [2]	6,5	2,3	—	1,1	1,5	1,6						
	Transport sector	0,3	—	—	0,3	—	—						
	Domestic sector	1,0	—	—	0,6	0,1	0,3						
	Primary energy equivalent												
	Electric power stations	(p.m.)	—	—	+ 0,9	+ 0,5	— 1,4						
	Manufactured gas	(p.m.)	+ 1,8	—	—	— 1,8	—						
	Internal consumption	7,8	4,1	—	2,9	0,3	0,5						
	Bunkering, export, others	0,5	—	—	—	—	0,5						
	Total requirements	8,3	4,1	—	2,9	0,3	1,0						

[1] + heat and ' other primary products '.
Industry + non-energy uses + consumption of energy sectors.

APPENDIX 9 e (continued)

Long term energy consumption prospects for Luxembourg

		Energy consumptions Total	10^6 tec					Mean annual variations 1970-1985					Energy consumptions Total
			Coal	Lignite	Oil	Gas	Electricity [1]	Coal	Lignite	Oil	Gas	Electricity [1]	
1980	Industrial sectors [2]	7,2	1,5	—	2,0	1,8	1,9						
	Transport sector	0,4	—	—	0,3	—	0,1						
	Domestic sector	1,2	—	—	0,7	0,1	0,4						
	Primary energy equivalent												
	Electric power stations	(p.m.)	—	—	+ 1,1	+ 0,3	— 1,4						
	Manufactured gas	(p.m.)	+ 1,3	—	—	— 1,3	—						
	Internal consumption	8,8	2,8	—	4,1	0,9	1,0						
	Bunkering, export, others	0,5	—	—	—	—	0,5						
	Total requirements	9,3	2,8	—	4,1	0,9	1,5						
1985	Industrial sectors [2]	7,8	1,0	—	2,6	1,9	2,3						
	Transport sector	0,6	—	—	0,5	—	0,1						
	Domestic sector	1,5	—	—	0,9	0,1	0,5						
	Primary energy equivalent												
	Electric power stations	(p.m.)	—	—	+ 1,3	+ 0,2	— 1,5						
	Manufactured gas	(p.m.)	+ 1,1	—	—	— 1,1	—						
	Internal consumption	9,9	2,1	—	5,3	1,1	1,4	— 3,8	—	+ 7,1	—	+ 4,7	+ 2,7
	Bunkering, export, others	0,6	—	—	—	—	0,6						
	Total requirements	10,5	2,1	—	5,3	1,1	2,0	—	—	—	—	+ 4,1	+ 2,6

[1] + heat and ' other primary products '.

[2] Industry + non-energy uses + consumption of energy sectors.

APPENDIX 9 f

Long term energy consumption prospects for the Netherlands

		Energy consumptions Total	10^6 tec					Mean annual variations 1970-1985					Energy consumptions Total
			Coal	Lignite	Oil	Gas	Electricity [1]	Coal	Lignite	Oil	Gas	Electricity [1]	
1970 (actual)	Industrial sectors [2]	34,9											
	Transport sector	8,5											
	Domestic sector	26,0											
	Primary energy equivalent												
	Electric power stations	(13,7)											
	Manufactured gas	(1,1)											
	Internal consumption	69,1	7,3	—	39,5	22,5	—						
	Bunkering, export, others	76,6											
	Total requirements	145,9	10,4	—	100,2	34,9	0,4						
1975	Industrial sectors [2]	53	2	—	22	18	11						
	Transport sector	12	—	—	12	—	—						
	Domestic sector	34	—	—	11	16	7						
	Primary energy equivalent												
	Electric power stations	(p.m.)	—	—	+ 5	+ 12	— 17						
	Manufactured gas	(p.m.)	+ 1	—	—	— 1	—						
	Internal consumption	99	3	—	50	45	1						
	Bunkering, export, others	99	—	—	69	30	—						
	Total requirements	198	3	—	119	75	1						

[1] + heat and ' other primary products '.

[2] Industry + non-energy uses + consumption of energy sectors.

APPENDIX 9 f (continued)

Long term energy consumption prospects for the Netherlands

		Energy consumptions Total	10^6 tec					Mean annual variations 1970-1985					Energy consumptions Total
			Coal	Lignite	Oil	Gas	Electricity [1]	Coal	Lignite	Oil	Gas	Electricity [1]	
1980	Industrial sectors [2]	72	2	—	28	26	16						
	Transport sector	15	—	—	15	—	—						
	Domestic sector	44	—	—	12	22	10						
	Primary energy equivalent												
	Electric power stations	(p.m.)	—	—	+ 5	+ 18	— 22						
	Manufactured gas	(p.m.)	+ 1	—	—	— 1	—						
	Internal consumption	131	3	—	60	65	4						
	Bunkering, export, others	105	—	—	73	32	—						
	Total requirements	236	3	—	133	97	4						
1985	Industrial sectors [2]	95	2	—	34	37	22						
	Transport sector	19	—	—	19	—	—						
	Domestic sector	56	—	—	14	28	14						
	Primary energy equivalent												
	Electric power stations	(p.m.)	—	—	+ 7	+ 20	— 27						
	Manufactured gas	(p.m.)	+ 1	—	—	— 1	—						
	Internal consumption	170	3	—	74	84	9	— 5,7	—	+ 4,3	+ 9,2	—	+ 6,2
	Bunkering, export, others	110	—	—	75	35	—						
	Total requirements	280	3	—	149	119	9			+ 2,7	+ 8,5		+ 4,4

1 + heat and ' other primary products '.

2 Industry + non-energy uses + consumption of energy sectors.

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