COMMISSION OF THE EUROPEAN COMMUNITIES

Medium-term prospects and guidelines in the Community gas sector

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I - INTRODUCTION

In its memorandum submitted to the Council on 18 December 1968 on 'First Guidelines for a Community Energy Policy', the Commission proposed in particular to establish medium-term forecasts and guidelines for each type of energy at regular intervals.

These medium-term forecasts and guidelines comprise a detailed analysis in each energy sector of the trend of supply and demand and also of the general supply structure. In this connection the Commission thought it advisable to set out a summary of the main government measures affecting the operation of the gas industry in the various Member States, and also of certain structures and practices in this industry.

The parts of the memorandum relating to these measures, structures and practices are, however, without prejudice to any questions which might arise regarding compatibility with the provisions of the Treaty.

The aim of this analysis is to highlight the problems which crop up in this sector and the possible difficulties involved for the supply of energy as a whole.

Gas supply has in the past few years undergone a radical change of structure. This change, not yet complete, was mainly brought about by the spectacular development of natural gas.

Three main aspects stand out:

(i) the gradual closing down of local or regional plants producing manufactured gas, now totally achieved in some areas of the Community and their connection to a rapidly growing network of gas pipelines;

(ii) the simultaneous transition from manufactured gas (from solid, liquid or gaseous fuels) to natural gas;

(iii) the gradual replacement of the old gas supply structures which were strictly confined to national or regional boundaries, by a European and even extra-European transport network.

The following analysis will principally deal with natural gas, because this is the type which already covers the greater part of the Community's gas requirements, and all further growth of the gas supply system will be met with natural gas exclusively.

It is in the interest of the Community that the consumption of natural gas should increase since:

(i) the natural-gas extraction, transport and distribution installations hardly affect the environment;

(ii) the use of natural gas as a fuel contributes in particular to the solution of the problems of air and water pollution, particularly in built-up areas;

(iii) the supply of natural gas should be regarded as reliable and price-stabilizing. Natural gas, because it is dependent on pipelines, makes long-term contracts possible, thus ensuring great security of supply. Furthermore, these contracts enable long-term energy supply programmes to be set up; and given the rapid growth of natural gas contribution to the overall energy supply, these contracts can increase their stabilizing role at the general energy price level.

In addition to natural gas, gases from other sources will also be dealt with. Their importance is continually decreasing but nevertheless, in the foreseeable future, considerable quantities of gases, the inevitable products of other industries (particularly coking gas), will need to find a market.

As regards industrial and household gas supplies, the major factors, apart from natural gas reserves and gas production, are the complex system of gas transport, storage and distribution. A special chapter will therefore deal with this sector.

In order to ensure that the rapidly growing demand for gas is met, it has been necessary in recent years to invest considerable sums which account for a major part of the cost of supply. On the basis of the information available on the industry's investment projects, an attempt will be made to outline the future investment trends.

The cost of gas supply is influenced by various forms of taxation, from royalties which must be paid at the production stage to municipal consumption taxes. An analysis will be made of the tax systems in Member States and of the problems attached thereto.

The gas prices policy varies widely in the different Member States, ranging from price-fixing by the State to free competition on the market. The transparency of gas prices is for the most part ensured in those categories of consumption covered by tariffs, but in the heavy user sector (industry and power plants) it is very limited. From the available data, an attempt will be made to present a picture of the gas-price situation.

The structures in the gas sector are very varied from one member country to another. The last chapter will deal with the main characteristics of the different structures and the resulting problems.

II - NATURAL GAS - THE SUPPLY

1. General aspects

Natural gas consists mainly of non-associated gas; associated gas, a by-product of oil extraction, is only found in small proportions in the Community. By comparison with these, the other natural gases such as pit gas and sewer gas are only of relatively minor importance.

The availability of natural gas depends on the rate of exploitation of the proven workable reserves and on the delivery contracts concluded by the producers with the transport and distribution undertakings and occasionally with certain end consumers. In order to have an idea of the natural gas availabilities, the reserves of natural gas in the Community must first be taken into account; nevertheless, in the future account will also have to be taken of the reserves in non-member countries which are often available for export. A certain number of long-term import contracts have already been concluded with non-member countries. It is likely that these imports will be stepped up, either by increasing the quantities provided for in the existing contracts of by concluding new contracts.

2. Gas resources in the Community

As regards the proven reserves in the Community, the figures given vary slightly. This is due in part to the fact that the terminology used to define the reserves differs from one country or undertaking to another. In addition, the estimates of reserves have a greater or lesser degree of probability, and only by working the field is it possible to determine with increasing certainty the available quantities it holds.

In the Community, acid gas, or natural gas containing hydrogen sulphide, forms only about 10 % of the proven reserves. This relatively low figure is explained by the fact that the main field, at Groningen, contains no sulphur. If this field is not included, the proportion of acid gas in the rest of Community deposits is about 50 %.

At 31 December 1971, the proven and probable recoverable reserves in the Community total approximately 3 200 $\times$ 10^9 m^3. The possible reserves evaluated by analogy with findings at other deposits should also be mentioned; they are now estimated at 335-435 $\times$ 10^9 m^3.

(a) *The Netherlands*

The last known figures for the level of reserves in the Netherlands were provided by the Dutch Minister for Economic Affairs in October 1971.

The total recoverable reserves amount to 2 457 $\times$ 10^9 m^3, of which 2 076 $\times$ 10^9 m^3 are proven and 381 $\times$ 10^9 m^3 are probable. The greater part of the Dutch gas reserves are in the Groningen field, an unusually large one, even on a world scale, with reserves estimated at 2 108 $\times$ 10^9 m^3 (of which 1 924 $\times$ 10^9 m^3 are considered as proven and 184 $\times$ 10^9 m^3 as probable). The other deposits contain 349 $\times$ 10^9 m^3 of which 15 $\times$ 10^9 are considered as proven and 198 $\times$ 10^9 as probable.

These overall figures comprise the known reserves in the North Sea, but as yet there are no official figures for the quantities contained in the deposits discovered by NAM and other operators, particularly in blocks K 7, K 11, K 14, L 2, L 10 and P 6, and in the Waddenzee at Appelscha and Rammelsbeek. According to unofficial sources, the entire Netherlands resources in the North Sea total 100-200 $\times$ 10^9 m^3.

(b) *The Federal German Republic*

According to official sources, Germany possesses 360 $\times$ 10^9 m^3 of proven and probable resources. The greater part of the proven resources, i.e. 352 $\times$ 10^9 m^3 lie in the north-west; 10 $\times$ 10^9 m^3 are located in the fore-Alps. The Rhine valley deposits in the Darmstadt region, a less recent discovery, are already almost exhausted. The potential reserves are evaluated at 235 $\times$ 10^9 m^3. These are situated almost entirely in the north-west.

(c) *France*

Proven resources in France are estimated at 195 $\times$ 10^9 m^3. Most of these reserves, i.e. 150 $\times$ 10^9 m^3 are at Lacq, in the south-west .The remainder, i.e., 45 $\times$ 10^9 m^3, are situated in south-west France, close to the Lacq field, and in particular near St. Faust, Meillon and Saint-Mercet.

(d) *Italy*

The official natural gas reserves in Italy total 178 $\times$ 10^9 m^3. Of these reserves, about 100 $\times$ 10^9 m^3 are situated in the Po Valley and the Adriatic offshore deposit, the remainder in Southern Italy and in Sicily.

3. **Natural gas reserves of acceding States**

For future development of the Community, it is also essential to know the natural gas reserves of acceding States. They consist almost exclusively in resources in the North Sea, belonging for the most part to Great Britain and Norway.

(a) *Great Britain*

The reserves in Great Britain are evaluated at 991 $\times$ 10^9 m^3. With the exception of the relatively small on-shore gas field at Lockton, these reserves were discovered in the British part of the Continental Shelf in the North Sea. The main British fields of natural gas in the North Sea are as follows :

Leman Bank	312×10^9 m^3
Indefatigable	113×10^9 m^3
Hewett Field	100×10^9 m^3
Viking Field	100×10^9 m^3
West Sole	57×10^9 m^3

Apart from these deposits which contain only gas, mention should be made of certain oilfields containing associated gas.

(b) *Norway*

The available data differ as regards the natural gas reserves situated in the Norwegian part of the continental shelf in the North Sea. The most usual figure given is 240×10^9 m^3, of which 200×10^9 m^3 of associated gas are in the Ikofisk oil field and 40×10^9 m^3 of wet natural gas in the Cod field. The Frigg natural gas deposit recently discovered by a Franco-Norwegian consortium, in the open sea about 300 km. north of Ikofisk, should contain even larger reserves than those at Ekofisk.

(c) *Denmark*

Natural gas has also been discovered in the Danish part of the continental shelf in the North Sea. It is not yet known exactly how much is available. However, the proven reserves amount to $20\text{-}30 \times 10^9$ m^3. According to the most recent data, the total workable quantity is double this amount.

(d) *Irish Sea*

Natural gas was also discovered last year in the Irish Sea. No estimates have as yet been communicated on the size of these reserves.

4. Natural gas resources in other countries

Proven world reserves are estimated to reach a total of $46\,600 \times 10^9$ m^3 approximately half the world oil reserves as they stand according to the most recent estimates. Community reserves represent a bare 7 % of the total world reserves. This figure rises to approximately 10 % if the North Sea reserves are included.

Part of the world natural gas reserves cannot be taken into account for a long time as regards future Community supply arrangements owing to their distance (e.g., Middle East, Far East, Australia). Nevertheless, those reserves affect Community supplies, in so far as other countries (particularly the United States and Japan) can depend, for their supplies, on substantial imports from those areas.

(a) *USSR*

The USSR possesses the largest natural gas reserves. Its proven reserves total $15\,000 \times 10^9$ m^3. They have risen sharply in the past few years, increasing, in 1970 and 1971 alone, by $3\,000 \times 10^9$ m^3, i.e., the equivalent of the total proven Community reserves. Estimates relating to present possibilities for recoverable natural gas amount to 82 000 × 10^9 m^3, i.e., the equivalent of proven world oil reserves. It is not possible to check the exactness of these estimates, but it is certain that with its huge sedimentary basins, many of them virtually untouched, the USSR possesses huge resources.

Over 60 % of the proven reserves are situated in western Siberia; 20 % are in the European portion of the Soviet Union and 15 % in Uzbekistan and Kazachstan. It is likely that future exploratory work will increase the proven resources, mainly in Siberia and in the regions of Central Asia.

A major part of these reserves is situated in regions with a harsh climate and very far from the principal consumption centres. This means that the USSR has to set up a vast network of pipelines in a relatively short period of time, a task involving numerous intractable problems both technical and economic. It is true that during the past decade the USSR has already built a high-capacity network of pipelines which has enabled it to increase its consumption tenfold in 10 years; the USSR is now trying — with the intention in particular of utilizing the deposits in West Siberia — to supplement its own production of pipes by purchasing in other countries, particularly in Western Europe. These deliveries are paid for by the sale of natural gas. Thus contracts have been signed with many countries, including some Community countries. Several of these contracts are linked to supplies of steel piping.

Considerable reserves of natural gas were discovered in the hydrate state in the permafrost situated around the Arctic Ocean. Natural gas hydrates are found at low temperature and high pressure in the solid state. The technical and economic problems of exploiting such deposits have not yet been solved.

(b) *Africa*

Natural gas reserves in Nigeria and North Africa, particularly in Algeria and Libya, must also be considered as major potential Community supply sources. Proven reserves are estimated at 4 200 × 10^9 m^3, of which approximately 66 % are in Algeria and 20 % in Libya. The Nigerian and Egyptian reserves are thought to be roughly equal, i.e., about 7 % in each of the two countries.

Algerian natural gas, most of which was discovered at Hassi R'Mel, is mainly found in non-associated natural gas deposits. An important exception is the oilfield Hassi Messaoud, containing large quantities of associated gas. The maximum annual extraction potential for natural gas in Algeria can be estimated at 100 × 10^9 m^3 by 1980.

Libyan natural gas, on the other hand, is largely associated gas, and thus it is virtually impossible to estimate the annual production capacity; this depends both on the amount of oil produced, and on the quantities of gas which have to be reinjected so as to maintain pressure in the field.

Algerian and Libyan natural gas is already being supplied to the Community. This gas is not brought into Europe by the normal method of pipeline but in methane tankers, having first been liquified on the Algerian and Libyan coasts.

The natural gas deposits discovered up to now in Egypt and Nigeria are not large enough to be able to provide a worthwhile contribution to the Community's supplies. Nevertheless, certain export possibilities could open up in the near future, especially as the prospects of additional proven resources seem likely. In fact, Nigerian natural gas is already the subject of negotiation with American companies.

(c) *Near East*

The oil-producing countries in the Near East possess large natural gas reserves. These are estimated at $10\ 000 \times 10^9$ m^3, mostly consisting of associated gas.

Iran possesses the principal deposits of non-associated natural gas in the Near East, i.e., about $6\ 000 \times 10^9$ m^3. A long-term contract concluded between Iran and the USSR provides for the supply to the latter of 10×10^9 m^3 a year.

Associated gas resources in Saudi Arabia are estimated at $1\ 400 \,.\, 10^9$ m^3; those of Kuwait at $1\ 100 \times 10^9$ m^3.

The deposits of associated and non-associated gas in the Near East are therefore great potential resources which may become of importance to Community supplies when economic transport conditions make this feasible. Certain quantities are already the subject of contracts with Russia and even, in a liquid form, with Japan, but the overall resources have only just started to be tapped.

At the present time, taking into account the rapid and steady increase in the consumption of natural gas in Community countries, and the experience gained in natural gas liquefying and transport techniques, projects for importing natural gas from the Near East to Europe deserve to be studied.

(d) *North America*

After the USSR, the United States, with $7\ 300 \times 10^9$ m^3, ranks second among the countries possessing natural gas reserves. American consumption of natural gas now totals nearly 625×10^9 m^3 a year. Since 1967, the discoveries made each year have been less than the annual consumption, and the ratio between proven reserves and annual consumption fell, in 1970, to such a low figure (12.5) that the United States now has to find other supply sources with the utmost urgency. In addition to synthetic natural gas produced from coal or oil, now the object of major research work, the United States is arranging to increase imports from neighbouring countries and to conclude new contracts with other countries.

Reserves in Canada, Mexico and Venezuela are estimated at a total of $2\ 800 \times 10^9$ m^3, most of which is situated in Canada ($1\ 700 \times 10^9$ m^3). Long-term import contracts have been concluded with Canada and Mexico, but they will probably not be sufficient to cover the growing needs of the US, especially as these countries are protecting the security of their own long-term supplies. For this reason, in November 1971, the Natural Energy Commission in Canada refused a request to step up the exports of natural gas to the US. Projects for the importation of liquefied natural gas from Venezuela are now being negotiated.

If large new deposits are not discovered soon in the US, it is predictable that this country will increasingly try to import supplies from other areas of

TABLE 1

Recoverable proven and probable world resources

(in 10^9 m^3)

Situation : 1970/71

	10^9 m^3 (2)		%	%
I — Europe excluding the eastern bloc		4 562	9.8	9.8
Netherlands	2 457 (1)		5.3	
Germany	360 (1)		0.8	
France	195 (1)		0.4	
Italy	178 (1)		0.4	
Community	3 190 (1)			
Great Britain	991 (1)		2.1	
Norway	240 (1)		0.5	
Denmark	30 (1)		0.1	
Acceding States	1 261 (1)			
Yugoslavia	99		0.2	
Austria	12		0.0	
II — European countries, eastern bloc		15 420		33.1
USSR	14.983 (1)		32.2	
Hungary	195		0.4	
Rumania	170		0.4	
III — Africa		4 202		9.0
Algeria	2 833		6.1	
Libya	850		1.8	
Egypt	142		0.3	
Nigeria	160		0.3	
IV — America		11 003		23.6
United States	7 278		15.6	
Canada	1 700 (1)		3.7	
Venezuela	765		1.6	
Mexico	340		0.7	
V — Near East		9 893		21.3
Iran	6 062		13.0	
Saudi Arabia	1 416		3.0	
Kuwait	1 105		2.4	
VI — Far East		1 492		3.2
World reserves		46 572		100.0

(1) Reserves either at 31 December 1971 or at 1 July 1971.
(2) The m^3 shown have variable calorific values.

the world. This is proved by the contracts for the importation of Algerian liquefied natural gas which have already been concluded, notwithstanding the fact that the delivered price for Algerian natural gas is distinctly higher than the American natural gas prices. Compared with the total sales volume, the proportion of imported gas is small, thus enabling the averable increase in distribution costs to be kept within reasonable limits. Many US distributors foresee a big rise in American natural gas pıices in the future. For many years, these prices have been maintained at an artificially low level, this being one of the reasons why the search for new deposits has not been sufficiently keen.

5. **Available natural gas resources in the Community** (1)

(a) *Community production of natural gas*

Netherlands

In 1970, the Netherlands production amounted to 30.6×10^9 m³. From now to 1975 it will be roughly trebled to some 90×10^9 m³, reaching 100×10^9 m³ in 1980. In 1985, if the deposits in the Dutch part of the continental shelf in the North Sea fulfil their promise, production totalling $110\text{-}120 \times 10^9$ m³ may be expected.

Italy

In 1970, production in Italy reached 14.2×10^9 m³. As the deposits in the Po valley are gradually being exhausted, the output will hardly increase from now to 1975. With the exploitation of the offshore fields in the Adriatic, however, this production will increase between now and 1985 and will probably attain $16\text{-}17 \times 10^9$ m³.

Germany

In 1970, natural gas production in Germany, at 12.9×10^9 m³, was almost level with production in Italy. From now to 1975, it will almost double to attain 21.5×10^9 m³. In the next few years, if large new deposits are not discovered, progress will be slow and production will reach 24×10^9 m³ in 1980. In 1985, it could total $26\text{-}28 \times 10^9$ m³ taking account of the extraction potential on the German continental shelf.

France

In 1970, French natural gas production was 7.7×10^9 m³. It will go on rising in the next few years, but this increase will remain relatively low as the reserves are limited. Production should attain 9.4×10^9 m³ in 1975 and reach a ceiling of 10.7×10^9 m³ in 1980.

(1) For Community countries, the figures given in this report refer to m³ of natural gas with a ceiling gross calorific value of 8 400 kcal per m³. The calorific values usually in force in these countries are :

France	9 200 kcal/m³
Germany	8 500 kcal/m³
Italy	9 100 kcal/m³
Netherlands	8 400 kcal/m³
Belgium	8 400 kcal/m³

Belgium-Luxembourg

Belgium and Luxembourg do not produce any natural gas. The small quantities of mine gas, which in 1970 were included in the report on natural gas, play a negligible role and will probably disappear owing to the closing-down of the collieries.

In 1970, in the Community as a whole, about 66.8×10^9 m^3 of natural gas were produced; from now to 1975, this output will rise to 135×10^9 m^3, reaching 155×10^9 m^3 in 1980 and 180×10^9 m^3 in 1985.

(b) *Natural gas imports from non-member countries* (1)

North Africa

In the Community of the Six, Gaz de France concluded a 15-year contract covering imports of 0.5×10^9 m^3 a year of Algerian natural gas to be liquefied in Arzew and delivered to Le Havre. The deliveries commenced in 1965. A new contract was then concluded by Gaz de France for the supply of an additional 3.5×10^9 m^3/year. The gas will be liquefied at Skikda and delivered to Fos-sur-Mer, near Marseilles. The deliveries are to begin in 1972. A further contract providing for the supply of $10\text{-}13 \times 10^9$ m^3/year is now being negotiated between the Sonatrach and a consortium of Community companies.

As regards Libyan natural gas, the Italian ENI group concluded a 20-year contract with ESSO for 3×10^9 m^3/year. After the settlement of the difference which arose with the Libyan government on the price of natural gas, deliveries began in the summer of 1971. Deliveries are made to La Spezia from the Libyan port Marsa el Brega.

Similarly, in Spain, Gas Natural SA of Barcelona purchases Libyan natural gas in the liquid state at the rate of 1.1×10^9 m^3/year, and will receive supplies of 1.15×10^9 m^3/year of natural gas from 1975.

Both Algeria and Libya possess natural gas reserves which — even in the long term — exceed their own requirements. It would therefore seem to be in the interests of both these countries to develop their exports of natural gas.

The difficulty at present preventing the achievement of these projects is the cost of transporting the gas, be it in liquefied form in methane tankers, or via pipelines across the Mediterranean.

Long-term contracts providing for the supply of about 27×10^9 m^3 of natural gas a year have been concluded in the past two years between Sonatrach — (Algerian national company for the transport and marketing of hydrocarbons) — and American companies. At the present time, the American Federal authorities have approved two of these contracts representing 10.5×10^9 m^3/year. The necessary liquefying installations will be built in the Algerian port of Arzew, which will thus apparently be the first world port for liquefied natural gas. About a third of the proven natural gas reserves in Algeria are thus already being sold under contract — including contracts concluded with European customers. Given the difficult natural gas supply situation in the United States, it is likely that these contracts will soon be followed by others.

(1) The data in this paragraph are expressed in m^3 having the original caloric values.

USSR

As regards imports of Soviet natural gas, Austria concluded a contract in 1966 for 1.5×10^9 m^3/year; negotiations are under way to raise this figure to $3\text{-}4 \times 10^9$ m^3.

In the Community, two major contracts were concluded towards the end of 1969 between the Soviet 'Sojusneft Export' on the one hand and the ENI and the Ruhrgas AG on the other.

The contract concluded between Russia and Italy is for a period of 20 years; supplies are to begin in 1974 and to gradually rise to their normal level of 6×10^9 m^3/year in 1977. It is not unlikely that this quantity will be stepped up to 10×10^9 m^3/year. The Russian gas intended for Italy will be transported, via Bratislava, through Lower Austria, Styria and Carinthia, thus enabling these regions to be supplied as well. The gas pipeline which will cross the Italian border at Tarvisio, near Udine, will be linked up to the existing Italian network at various points and will terminate, after crossing 390 km. of Italian territory, at Sergnano, near Milan. The plans have already been prepared and the pipelaying is in progress in Italy.

The German/Soviet agreement made provision in the first place for the supply of 3×10^9 m^3/year, with the possibility of increasing this to 5×10^9 m^3. Supplies are due to begin in Autumn 1973. Transport will be effected via Bratislava which thus becomes a major natural gas distribution centre for the countries of eastern and western Europe. Having crossed part of Czechoslovakia, the

TABLE 2

International natural-gas purchasing contracts in Europe

(in 10^9 m^3 at original calorific value)

Contracts	Date of entry into force	Period years	Rate of annual supplies (10^9 m^3)	Optional quantity
France - Algeria	1965	15	0.5	
Italy - Libya	1971	20	3.0	
France - Algeria	1972	15	3.5	
Germany - USSR	1973/74	20	3.0	
Italy - USSR	1973/74	20	6.0	
Germany - USSR	1973/74	20	4.0	1.0
France - USSR (1)	1976	20	2.5	
Germany - Belgium - France - Algeria	1977/78	20	10.0	3.0
Community			32.5	4.0
England - Algeria	1964	15	1.0	
Austria - USSR	1967	20	1.5	
Spain - Libya	1971	15	1.1	
Spain - Algeria (1)	1974	20	1.2	
Total			37.3	4.0

(1) Contract not yet concluded.

gas will end up at Waidhaus, at the east Bavarian and Bohemian border. This first contract was followed this year by a second which, exceeding the 2×10^9 m^3/year increase provided for, stipulates that the final supplies must be increased by 4×10^9 m^3/year to attain 7×10^9 m^3, with the option of further increasing this figure by 1×10^9 m^3.

In 1969, the 'Grand Franco-Soviet Commission' had concluded a framework agreement providing for the supply of 2.5×10^9 m^3 of natural gas a year. Under this agreement deliveries are to begin in 1975/76 and the final volume to be reached by 1980. No decision has yet been taken on the transport route for this gas. In principle, it is possible to take it to France via Czechoslovakia and the Federal Republic or via Austria and southern Germany. Another solution is also possible : this would be the exchange of equivalent amounts of Dutch gas, contracted for ENI, the Italian national hydrocarbons organization. In the event that any future supplies of North Sea gas were destined for the Community, possibilities of exchange might also arise.

Table 2 gives a summary of the natural-gas import contracts concluded in Europe.

(c) *Intra-Community exchanges of natural gas*

Exports from the Netherlands to other Community countries break down as follows :

TABLE 3

Dutch natural gas exports to other Member States

(in 10^9 m^3)

	1970	1975	1980	1985
Belgium	4.5	10.0 (1)	12 (1)	15 (1)
Germany	3.7	22.5	24	24
France	3.2	8.0	10	10.5
Italy	—	30	6	6
Total	11.4	43.5	52	55.5

(1) Including supplies from Belgium to the Grand Duchy of Luxembourg.

(d) *Available quantities of natural gas in the Community*

The natural gas availabilities in the Community totalled approximately 67×10^9 m^3 in 1970. From now to 1975 they will more than double, attaining 150×10^9 m^3. In 1980, it is probable that, if no large deposit is discovered in the Community and if no new natural gas import contracts are concluded, the available quantities will be about $183\text{-}196 \times 10^9$ m^3. From 1980 to 1985, they should still be able to rise to $218\text{-}232 \times 10^9$ m^3. These figures show that a spectacular increase in the natural gas supply cannot be expected after 1975 if no major fields are found, or if no major import contracts are arranged by that time (cf. Table 4).

TABLE 4

Available quantities of natural gas in the Community

	Germany	France	Italy	Netherlands	Belgium-Luxembourg	Community	
	$. 10^9 m^3$						1971 index = 100
1970	17	11	14	20	5	67	100
1975	49	22	23	46	10	150	224
1980	62-65	28-31	30-35	51	14	185-196	276-293
1985	71-77	32-34	33-39	65	17	218-232	325-346

6. Conclusions

Great efforts must be made if the basic natural gas supplies are not to shrink in the next few years. Such a trend would be particularly detrimental because of the great advantages linked to the most advanced development possible of natural gas supplies to the Community. Efforts should be directed both to intensifying prospecting and exploring activities and a detailed study of new possibilities of importing natural gas.

III - CONSUMPTION OF NATURAL GAS

1. The growth of overall consumption

(a) *Before 1970*

The discovery of large natural gas reserves, and particularly in the Netherlands province of Groningen of a field which, even on a world scale, may be considered as exceptional, was the beginning of a sharp rise in the mid-Sixties in the Community consumption of natural gas. Before then, the discovery in Italy of deposits in the Po valley and, a little later, the discovery in France of the Lacq field had already brought about a rapid increase in consumption in those countries. *Table 5* shows the growth of natural gas consumption in the Community over the past ten years. This table shows that the sales of natural gas in the Community rose from 11.5×10^9 m^3 in 1960 to 66.6×10^9 m^3 in 1970. The proportion of natural gas in the overall consumption of primary energy, which was only 2.7 % in 1960, reached 8.7 % in 1970. The growth rates, which averaged 15 % per annum between 1960 and 1965, increased rapidly in the following years to reach 39.0 % in 1968. The situation on the natural gas market was characterised from 1965 to 1970 by a supply greatly in excess of the demand.

By the second half of 1970, however, it was apparent that the Community natural gas reserves were already largely covered by long-term contracts, and that apart from the growth rates already provided for in these contracts, further expansion of consumption was hardly possible.

Almost overnight the buyers' market of 1965-70, characterized by a tendency to falling prices, became a sellers' market.

This reversal of the situation would doubtless have been less sudden if the fuel-oil price increases which occurred for various reasons in the winter of 1970/71 had not prompted a steep rise in the demand for natural gas. Numerous large consumers who had hitherto deferred converting to natural gas then tried, dismayed by the rise in fuel-oil prices, to conclude contracts for the purchase of natural gas, but found themselves up against a shortage.

(b) *Prospects to 1985*

Although the halt of the fuel-oil price rises and the slow advance of natural gas prices favour a gradual return to a more normal situation, it is improbable that the extreme surplus situation of the sixties will return. Even if natural gas reserves approaching the size of the Groningen field were discovered, they would easily be absorbed by the markets which have meanwhile developed in the Community and would no longer, as in the mid-Sixties, have to face psychological and technical barriers.

The relatively moderate growth expected in the future consumption of natural gas as compared with the growth rate recorded in recent years in no way

TABLE 5

Trend of natural gas consumption in the Community since 1960

	1960	1965	1966	1967	1968	1969	1970
Consumption in							
10^9 m^3/8 400 Kcal	11.5	18.9	22.2	28.1	39.1	51.6	66.6
in 1 000 Tcal	96.4	158.8	186.7	26.3	328.9	433.8	559.6
Increase per annum in %	on average	13.0	17.6	26.6	39.2	31.9	29.0
Index (1960 = 100)	100	165	194	245	341	450	580
Share in consumption of primary energy (in %)	2.7	3.3	3.8	4.6	6.0	7.2	8.7

implies that the expansion of the natural gas market has reached its limits. In the United States, natural gas at present represents a third of the overall consumption of primary energy. In the Netherlands, this proportion will doubtless be exceeded by 1985. If greater quantities of natural gas were available at reasonable prices, its share in the primary energy consumption could well, in the Community as a whole, be as high as in the United States, but this would involve availabilities of over 500 . 10^9 m^3/year, a figure which is unattainable, even on the most optimistic assumption.

2. Breakdown of natural gas consumption by categories of use

(a) *In 1970*

The breakdown of natural gas outlets to various categories of users in 1970 was as follows : about 20 % for electric power stations, 24 % for domestic use and nearly 48 % for industry. The rest, about 8 %, represents the consumption of other users, particularly the public services, the natural gas industry's own consumption, and leaks in pipelines.

With regard to the share of the power stations in the total consumption, vast differences can be seen in the Community countries. The bracket ranges from 12 % in Italy to 27 % in the Netherlands. Between these lie France with 16.6 %, Belgium with 21 % and Germany with 22 %.

The differences are even more marked in industrial consumption, the proportion of which (excluding power stations) in the overall consumption ranges from 31 % in the Netherlands to 62 % in Italy. In France, industrial consumption accounts for 45.5 % of the overall consumption, whilst in Belgium it is 48 % and 61 % in Germany.

The chemical industry represents 41 % of the total industrial consumption of natural gas. The data concerning the division of this consumption between use as a fuel or as a raw material are very incomplete. In the field of non-energetic uses, the production of ammonia holds first place.

The share of the steel-making industry in the total industrial consumption is about 19.5 %. This figure, which at first glance seems surprisingly low, is explained by the fact that owing to the coal and steel integration, this industry consumes large quantities of coke-oven gas and blast-furnace gas, thus giving it first place in the list of gas consumers.

The consumption of other industries represents 39.5 % of the overall industrial consumption of natural gas. It is impossible to break down this consumption among the numerous groups of industries; they are primarily the extracting industries (excluding fuels), the glass and porcelain industry.

This review of the structures of gas consumption does not reveal any distinct trend within the Community. In the different member countries the figures deviate variously from the overall value. Thus in the Netherlands, household users account for almost 40 % of the total consumption owing to the conversion of heating systems to natural gas, whereas in Germany the percentage is the lowest (13 %). In Belgium and Italy household consumption represent 17 % of the total consumption, and 21 % in France.

(b) *Prospects 1975-1980-1985*

Forward estimates of natural gas consumption per consumer group inevitably involve considerable uncertainty.[1] Generally speaking, it is probable that in the Community the household fraction will go from 24.1 % to 32.2 % in 1975, to nearly 35 % in 1980 and to 35.5 % in 1985. At the same time it is likely that there will be a decrease in industrial consumption, from nearly 48 % at present to 42 % in 1975, to reach 44 % in 1980 and 45 % in 1985. The share of the electric power plants in natural gas consumption, now 20 %, should remain roughly stable in the next five years; 22 % is predicted for 1975.

There will then be a moderate recession and the share will be 19 % in 1980 and approximately 17 % in 1985. This relative decrease of natural gas consumption in power plants, despite its growth in absolute figures, is explained by the fact that a large number of long-term contracts for the supply of large amounts, concluded in the period of surplus offer, will only produce their full effect in the next five years, but will not be increased or renewed after 1975.

With the prospect of insufficient natural gas in the Community, its combustion in power plants may raise certain problems.

As regards the breakdown of natural gas sales to the different groups of industries, it is difficult to give overall figures for the Community, because in respect of Germany and the Netherlands the only figures available for 1980 are overall estimates which have had to be completed by extrapolation. Estimates had to be made for 1985, there being no data for any of the Member States.

It is probable that the share of the iron and steel works and the other industries will increase to the detriment of the chemical industry. The iron and steel makers will not be able to cover their growing requirements by coke-oven or blast-furnace gases, the production of which will probably decline, and they will have to convert to natural gas. Meanwhile, the chemical industry will continue to expand and consequently its energy consumption will continue to grow, but the period of largescale conversions to natural gas, which over the past few years have contributed to an unusual rise in consumption, has practically come to an end. In the remaining branches of industry there are still many undertakings which use solid and liquid fuels, but will have to go over to gaseous fuels, as far as availabilities permit.

Table 6 gives the probable trend of the natural gas supply and demand in the form of balances for 1970, 1975, 1980 and 1985. It should be noted that the estimates for 1985 and for most of 1980, unlike those established for 1975, are, as regards Community production, based on data which are not entirely confirmed. If, contrary to all expectations, the exploratory work met with no outstanding success, the shortages would have to be made up by stepping up imports either by extending existing contracts or by concluding contracts with new suppliers.

(1) The data given in this document stem from firms and official sources, and have been supplemented by sectoral estimates, checked against the overall energy balances.

TABLE 6

Natural gas balances for 1970, 1975, 1980 and 1985 (*)

(in 10^3 Tcal UCP)

	Germany				France				Italy			
	1970	*1975*	*1980*	*1985*	*1970*	*1975*	*1980*	*1985*	*1970*	*1975*	*1980*	*1985*
Production	109.6	180.0	205.0	244.0	64.6	79.2	90.0	90.0	120.2	120.0	135.0 –150.0	140.0 –169.0
Imports from :												
Community countries	31.5	189.0	202.0	202.0	26.0	67.0	83.0	87.0	—	32.4	50.0	60.0
Non-member countries	—	33.6	122.0 –147.0	159.5 –209.5	5.5	40.0	66.0 –83.0	90.0 –110.0	—	40.8	67.0 –94.0	77.0 –99.0
Exports	—	2.6	5.0	10.0	—	—	—	—	—	—	—	—
Availability	141.1	400.0	524.0 –549.0	595.5 –645.5	96.1	186.2	239.0 –256.0	267.0 –267.0	120.2	193.2	252.0 –294.0	277.0 –328.0
Consumption :												
electric power plants	28.0	110.0	–120.0 –130.0	140.0	15.1	19.0	22.0 –27.0	20.0	14.8	13.0	15.0 –17.0	14.0
iron and steel works	25.4	33.0	50.0	60.0 –65.0	5.4	12.0	15.0 –20.0	25.0	12.2	20.0	25.0 –30.0	30.0 –35.0
chemical industries	24.9	70.0	90.0 –92.0	102.0 –112.0	17.9	33.0	45.0 –47.0	60.0	27.9	40.0	49.0 –54.0	60.0 –70.0
other industries	35.0	72.0	90.0	95.0 –100.0	14.4	35.0	48.0 –50.0	50.0 –60.0	34.3	59.8	82.0 –95.0	75.0 –95.0
household sector	18.3	105.0	163.0 –176.0	187.5 –216.5	24.2	74.0	95.0 –98.0	104.0 –110.0	20.9	52.0	75.0 –90.0	90.0 –105.0
Miscellaneous (own consumption, losses, statistical deviations, conversion into plant gases)	9.5	10.0	11.0	11.0 –12.0	19.1	13.2	14.0	8.0 –12.0	10.1	8.4	6.0 –8.0	8.0 –9.0
Total consumption	141.1	400.0	524.0 –549.0	595.5 –645.5	96.1	186.2	239.0 –258.0	267.0 –287.0	120.2	193.2	252.0 –294.0	277.0 –328.0

TABLE 6 (continued)

	Belgium-Luxembourg				Netherlands				Community			
	1970	*1975*	*1980*	*1985*	*1970*	*1975*	*1980*	*1985*	*1970*	*1975*	*1980*	*1985*
Production	0.5	—	—	—	266.4	756.0	860.0	1 008.0	561.3	1 135.2	1 290.0 –1 305.0	1 482.0 –1 511.0
Imports from :												
Community countries	37.7	84.0	100.0	116.0	—	—	—	—	95.2	372.4	435.0	465.0
Non-member countries	—	—	17.6	27.0	—	—	—	—	5.5	114.4	272.6 –341.6	353.5 –445.5
Exports	—	—	—	—	95.2	372.4	435.0	465.0	95.2	375.0	440.0	475.0
Availability	38.2	84.0	117.6	143.0	171.2	383.6	425.0	543.0	566.8	1 247.0	1 557.6 –1 641.6	1 825.5 –1 946.5
Consumption :												
electric power plants	9.9	20.0	22.6	21.0	46.8	113.6	115.0	125.0	114.6	275.6	294.6 –311.6	320.0
iron and steel works	4.7	10.0	12.0	17.0	4.8	15.0	16.0	30.0	52.5	90.0	118.0 –128.0	162.0 –172.0
chemical industries	8.2	13.0	20.0	25.0	31.6	60.0	68.0	90.0	110.5	216.0	272.0 –281.0	337.0 –357.0
other industries	5.6	19.0	24.0	30.0	16.6	35.0	45.0	78.0	105.9	220.8	289.0 –304.0	328.0 –363.0
household sector	6.6	20.0	37.0	48.0	66.6	150.0	170.0	207.0	136.6	401.0	540.0 –571.0	636.5 –686.5
Miscellaneous (own consumption, losses, statistical deviations, conversion into plant gases)	3.2	2.0	2.0	2.0	4.8	10.0	11.0	13.0	46.7	43.6	44.0 –46.0	42.0 –48.0
Total consumption	38.2	84.0	117.6	143.0	171.2	383.6	425.0	543.0	566.8	1 247.0	1 557.6 —1 641.6	1 825.5 —1 946.5

Where there are two figures one above the other, the one below being preceded by a dash, those are the two extreme values which may be taken by the parameter under consideration.
(*) 10 m^3 Tcal = 120 million m^3 (GCV = 8 400 kcal/m^3).

3. Conclusions

The potential demand for natural gas will increase rapidly over the next few years, and an effort must be made to augment the available quantities by discovering new deposits and concluding new long-term import contracts so as to prevent a serious shortage of natural gas. Even now there is a certain amount of difficulty in meeting the demand. The available data do not confirm that, as is sometimes said, this is only a case of temporary difficulties which will be overcome in the long run.

IV - PRODUCTION AND CONSUMPTION OF DERIVED GAS

1. General Aspects

The fuel gases obtained from solid, liquid or gaseous fuels are manufactured by companies either as a main product or as by-products. They comprise town gas, coke-oven gas, blast-furnace gas, so-called liquid gases (propane and butane) and refinery gas.

2. Town gas

The systematic production of gas in town gasworks, which used to provide the towns' entire gas supply, now only plays a minor role. In 1970 it represents only 2 % of the total gas production. At the present time, gas production at town gasworks is only rarely based on the classic process of gasification of hard coal, and cheaper processes using less costly raw materials have been adopted, such as fuel-oil, naptha, liquid gas or refinery gas.

At some plants, natural gas is also converted into town gas. Apart from a few cases where a linkup with the long-distance supply is impossible in the foreseeable future owing to the remoteness of the transport system, these gasworks will have to be shut down, unless they are able to provide a quality of gas interchangeable with natural gas, so that they can cover the peak demand periods. By 1975, town gas will probably represent less than 1 % of the total gas production in the Community.

3. Coke-oven gas

(a) *Production*

The derived gas holding the most important role in public gas supplies is coke-oven gas. At the end of the twenties, the gas surpluses from the colliery and steelworks coking plants were the reason for the construction of the first long-distance pipeline network. The steel industry will continue to need large quantities of coke for the production of cast steel in the blast-furnaces; coke-oven gas will therefore also be produced in large quantities. However, in the next 15 years, after a rise, there will be a gradual decline in the production of coke-oven gas. Owing to constant improvements in blast-furnace techniques, the coke requirements of the steel industry will not increase proportionately with the output of cast steel, as the new steel-making processes do not employ coke. The steady drop in the coke consumption of other industries and in the home will follow the same trend.

In order to forecast the future of coke-oven gas production it is necessary, since this is an 'inevitable' product, to use the coke production estimates as a basis. The ratio between the production of coke and the 'inevitable' gas output has remained relatively constant in recent years. The average coke/gas ratio for the past ten years in the Community, which amounted to 1.99 Gcal or 463 m^3 (GCV = 4 300 Kcal) per ton of coke produced, can therefore be taken as a basis.

To establish estimates relating to coke production, reference can be made either to the collieries' and the iron and steelworks' investment projects in coking plant, or to the estimated coke requirements of the iron and steel and other consumer sectors. For 1975, both methods can be applied and they produce approximately the same results.

Owing to lack of data on the coking capacity after 1975, estimates can only be based for the subsequent years on the predicted coke requirements, and on the assumption that this coke will be practically exclusively produced in the Community.

The calculations made on this obviously uncertain basis provided the following results : Community production of coke-oven gas which in 1970 amounted to 134 200 Tcal or 31.2 . 10^9 m^3 with a gross calorific value of 4 300 Kcal will decrease slightly and reach 127 500 Tcal or 29.7 . 10^9 m^3 in 1975. Thereafter, the gradual drop in the production of coke-oven gas will be slight (on average 1.2 % per annum). In 1980, it is probable that production will total 120 500 Tcal or about 28 . 10^9 m^3. It seems that this production will not thereafter decrease much more, and in 1985 it will still be of the order of 117 000 Tcal or 27.3 . 10^9 m^3. It is not impossible, however that these estimates will be overstepped if, for example, steel production increases more than is expected or if the specific consumption of coke drops more slowly than expected.

(b) *Consumption*

From the estimates concerning the consumption trend of coke-oven gas, it is clear that about 40 % of the overall production will be used under the heading of own consumption to heat the coke ovens. This percentage should decrease slightly, partly owing to the closing down of the obsolete plants, partly to the use of other fuels. The main consumer of coke-oven gas will doubtless remain the steelworks. Its share in the total consumption, which was 23.7 % in 1970 should rise steadily to over 31.5 % in 1985.

Coke-oven gas will find a growing market in the electric power plants, more especially the colliery and iron works plants. The power plants share in the total consumption will probably triple in the next 15 years, going from 5.9 % to 17.4 %. In other sectors the share in overall consumption will probably drop from 31 % in 1970 to 13 % in 1985. This drop principally concerns the sales of coke-oven gas to industry and to local distribution boards.

These two opposite trends in consumption by the ironworks and especially the power plants, on the one hand, and by the other consumer sectors on the other, make it possible to solve a problem which is constantly cropping up : how to remove coke-oven gas from the longdistance supply system and replace it with natural gas, without causing too many difficulties. The fears which have often been voiced, that serious problems would be created in the coking sector, do not seem to be justified. As the first symptoms of a natural-gas shortage are already appearing, it is more likely that coke-oven gas will once more

TABLE 7

Coke-oven gas balances for 1970, 1975, 1980, 1985

(in 1 000 Tcal UCP)

	Germany				France				Italy			
	1970	1975	1980	1985	1970	1975	1980	1985	1970	1975	1980	1985
Net production	77.1	61.0	59.0	57.0	26.3	27.0	25.0	24.0	13.6	17.0	16.5	17.0
Own consumption	28.4	23.0	22.0	22.0	11.6	11.0	10.0	9.5	6.2	7.0	6.6	7.0
Consumption : in power plants	3.0	6.0	12.0	12.0	2.2	2.5	5.0	4.0	1.1	2.0	3.0	3.0
Consumption : in the metallurgical industry (*)	15.1	14.0	14.0	14.0	6.6	6.0	6.0	7.0	3.4	5.1	5.0	6.0
Other consumption	30.6	18.0	11.0	9.0	5.9	7.5	4.0	3.5	2.9	2.9	2.0	1.0
Total consumption	77.1	61.0	59.0	57.0	26.3	27.0	25.0	24.0	13.6	17.0	16.5	17.0

TABLE 7 (continued)

	Belgium				Netherlands				Community			
	1970	1975	1980	1985	1970	1975	1980	1985	1970	1975	1980	1985
Net production	13.5	16.5	13.0	12.5	3.7	6.0	7.0	7.0	134.2	127.5	120.5	117.5
Own consumption	5.4	7.0	5.0	4.5	1.1	1.9	2.1	2.0	52.7	42.9	45.6	45.0
Consumption : in power plants	1.6	2.2	2.0	1.5	—	—	—	—	7.9	12.7	22.0	20.5
Consumption : in the metallurgical industry (*)	4.9	5.8	6.0	6.5	1.8	3.2	3.6	3.5	31.8	34.1	34.6	37.0
Other consumption	1.6	1.5	—	—	0.8	0.9	1.3	1.5	41.8	30.8	18.3	15.0
Total consumption	13.5	16.5	13.0	12.5	3.7	6.0	7.0	7.0	134.2	127.5	120.5	117.5

(*) Includes in particular direct deliveries to other industries, deliveries to distributors, losses and a statistical deviation.
The dashes mean that the quantities are less than the unit chosen.

become a sought-after fuel and that demand will exceed the supply. An effort has been made in *Table 7* to establish a balance-sheet of production and consumption of coke-oven gas for 1970, 1975, 1980 and 1985 in the Community and all the Member States.

4. **Blast furnace gas**

The gas which bulks the largest in the general Community supply is blast-furnace gas. It does not contribute directly to the public gas supply system. The long-distance transport of blast-furnace gas would be totally unprofitable owing to its low heating value and the need for further compression. In practice, this gas is therefore almost exclusively used in the metallurgical industry and in ironworks power plants. Small quantities also contribute to the heating of coke ovens. Blast-furnace gas is in rare cases mixed with coke-oven gas for the public supply.

Nevertheless the considerable quantities of blast-furnace gas, which as to calorific value equivalent are equal to the Community coke-oven gas, are indirectly important to the public supply, as they make a major contribution to meeting the gas requirements of the iron and steel industry and its power plants, thus enabling other amounts of gas to be released for the public supply.

The total net production of blast-furnace gas in the Community reached 142 500 Tcal in 1970, approximately 6 % more than the entire production of coke-oven gas. The same reason which will cause a gradual decrease in coke-oven gas production after a slight increase up to 1975 will cause a parallel trend in the net production of blast-furnace gas. From now to 1975, production is likely to rise slightly to reach 145 800 Tcal, then it will gradually drop to 129 500 Tcal in 1985.

Table 8 gives an idea of the development of blast-furnace gas in the various Member States for 1970, 1975, 1980 and 1985, as well as for the Community as a whole.

5. **Refinery gas and liquid petroleum gas**

(a) *General aspects*

The estimates relating to refinery gas and liquid petroleum gas are based, in respect of production, on data worked out in the context of overall estimates for the oil sector.

It has proved difficult to establish estimates of imports and exports of these products. As regards refinery gas, there is virtually no importing or exporting, but there are exchanges with non-Community countries in the L.P.G. sector. However, this foreign trade depends mainly on the short-term economic situation and is subject to very strong fluctuations. If the total liquid gas consumption and its growth rate are compared with the quantities imported, it can be seen that the imports are intended mainly to compensate for fluctuations in production.

TABLE 8

Balance sheet for Blast-furnace gas for 1970, 1975, 1980, 1985

(in 1 000 Tcal GCV)

	Germany				France				Italy				Belgium			
	1970	1975	1980	1985	1970	1975	1980	1985	1970	1975	1980	1985	1970	1975	1980	1985
Net production	56.2	53.0	52.0	50.5	39.3	40.5	38.0	35.5	11.1	16.0	17.0	17.0	18.6	19.0	16.0	14.5
Consumption : in power plants	13.9	13.5	13.0	12.0	11.8	12.0	11.0	9.5	3.3	5.0	6.0	5.0	4.5	5.0	3.0	2.0
in the metallurgical industry (*)	40.3	37.9	37.5	37.0	27.5	28.5	27.0	26.0	6.7	11.0	11.0	12.0	13.1	13.0	13.0	12.5
Other consumpt.	2.0	1.6	1.5	1.5	—	—	—	—	0.1	—	—	—	1.0	1.0	—	—
Total. consumpt.	56.2	53.0	52.0	50.5	39.3	40.5	38.0	35.5	11.1	16.0	17.0	17.0	18.6	19.0	16.0	14.5

	Luxembourg				Netherlands				Community			
	1970	1975	1980	1985	1970	1975	1980	1985	1970	1975	1980	1985
Net production	13.2	12.5	9.0	7.5	5.1	4.8	5.0	4.5	142.5	145.8	137.0	129.5
Consumption : in power plants	3.2	3.0	1.5	0.5	2.4	3.0	2.0	1.5	39.1	41.5	36.5	30.5
in the metallurgical industry (*)	9.6	9.2	7.5	7.0	2.7	1.8	3.0	3.0	99.9	101.4	99.0	97.5
Other consumpt.	0.4	0.3	—	—	—	—	—	—	3.5	2.9	1.5	1.5
Total consumpt.	13.2	12.5	9.0	7.5	5.1	4.8	5.0	4.5	142.5	145.8	137.0	129.5

(*) Includes in particular direct deliveries to other industries and a statistical deviation value.
The dashes mean that the quantities are lower than the unit chosen.

In sum, imports of L.P.G. can therefore be disregarded with little risk of error, and have thus not been included in any estimates.

As regards exports and the consumption of the various groups of users, for which no estimates are available from the oil and gas industries, the figures in this report are based on an extrapolation of trends observed over the past five years.

There are no estimates for 1985 concerning the capacities of the Community oil industry. The extrapolations do not therefore go beyond 1980.

Tables 9 and *10* give an idea of the probable development of the refinery gas and L.P.G. balance sheets.

(b) *Refinery gas*

Refinery gas is only considered here insofar as it plays a part in public supplies, i.e., excluding direct sales to third parties.

Present refinery gas delivery contracts which have been concluded with distribution companies are due to expire in the next few years and, consequently, this share of refinery gas will fall considerably within a few years and by as much as 87 % by 1980, a drop from 12 771 Tcal to 1 600 Tcal.

Unprocessed refinery gas is supplied to two consumer groups — the chemical industry which uses this gas as a raw material and, to a lesser extent, certain power plants located close to the refineries.

(c) *Liquid petroleum gas*

In addition to gas supplied via fixed pipelines, the distribution of L.P.G. in containers and tanks also plays a part in the domestic sector. In this case it is in the form of propane or butane or a mixture of the two, which can be liquefied at a relatively low pressure and transported in steel containers or in tankers.

In the next ten years, household consumption will continue to rise considerably and will have doubled by 1980; this is also true of consumption in the transport sector, whereas industrial consumption of L.P.G. will only increase slightly. This is partly due to the fact that propane will be used less and less in the production of town gas.

6. **Conclusion**

On the whole, the production and consumption of derived gases will not undergo any great changes in the next 15 years. However, the proportion of derived gases in the overall gas consumption will gradually decline. There will anyway be noticeable differences in the distribution among the various categories. Town gas will almost completely disappear; the production of coke-oven and blast-furnace gas will decrease slightly, whereas the volume of gases derived from oil products (ıefinery gas and liquid petroleum gas) will increase, particularly L.P.G. which, from 1980 onwards, should head the list of derived gases.

TABLE 9

Refinery gas balance sheet

(*Tcal GCV*) [1]

	Germany			France			Italy		
	1970	1975	1980	1970	1975	1980	1970	1975	1980
Net production gross internal consumption	18 992	10 800	10 000	4 492	6 000	7 500	4 350	4 500	5 000
Chemical [2]	7 372	7 500	7 500	1 472	2 800	4 000	2 994	3 100	3 400
Gasworks	10 331	800	—	2 360	2 000	1 500	80	100	100
Electric power plants	1 289	2 500	2 500	660	1 200	2 000	1 276	1 300	1 500

	Netherlands			Belgium-Luxembourg			Community		
	1970	1975	1980	1970	1975	1980	1970	1975	1980
Net production gross internal consumption	2 021	2 000	2 000	1 671	2 500	3 000	31 526	25 800	27 500
Chemical [2]	2 021	2 000	2 000	392	1 000	1 500	14 251	16 400	18 400
Gasworks	—	—	—	—	—	—	12 771	2 800	1 600
Electric power plants	—	—	—	1 279	1 500	1 500	4 504	6 500	7 500

(1) Average conversion rate : 1 Tcal - 80 t refinery gas (in GCV. of 12,500 kcal/kg)
(2) May include small quantities intended for other industries.

TABLE 10

LPG balance sheet

(Tcal UCP) (*)

	Germany			France			Italy		
	1970	1975	1980	1970	1975	1980	1970	1975	1980
Production	22 450	26 100	30 600	28 920	38 500	50 000	25 082	26 000	31 000
Exports to third countries	1 501	1 600	1 600	5 036	6 000	6 500	2 905	2 000	2 400
Gross consumption	20 949	24 500	29 000	23 884	32 500	43 500	22 177	24 000	28 600
Transports	129	500	1 000	—	—	—	5 160	7 000	9 000
Household use	4 607	8 000	13 000	22 178	30 000	40 800	12 181	13 000	16 000
Miscellaneous (other industries, own consumption, gasworks, etc.)	16 213	16 000	15 000	1 706	2 500	2 700	4 836	4 000	3 600

	Netherlands			Belgium-Luxembourg			Community		
	1970	1975	1980	1970	1975	1980	1970	1975	1980
Production	8 444	9 000	10 000	4 527	6 600	8 800	89 423	106 200	130 400
Exports to third countries	2 475	2 000	1 500	1 094	1 400	1 800	13 011	13 000	13 800
Gross consumption	5 964	7 000	8 500	3 433	5 200	7 000	—	93 200	116 600
Transports	697	1 000	1 500	320	400	500	6 306	9 400	12 000
Household use	2 494	2 800	3 200	3 113	4 800	6 500	44 573	58 600	79 500
Miscellaneous (other industries, own consumption, gasworks, etc.)	2 778	3 200	3 800	—	—	—	25 533	25 200	25 100

(*) 1 Tcal = 84 t LPG (GCV = 12,000 kcal/kg).

These forecasts raise two questions :

(i) will the rapid penetration of the market by natural gas impede sales of derived gases, the production of which is inevitable?

(ii) will the development of liquid petroleum gas sales compete dangerously with gas distributed by pipelines?

The answer to the first question is obviously no. It is only in respect of sales of coke-oven gas that certain problems were expected; it should, however, be possible to effect a gradual reduction of coke-oven gas outlets, narrowing them down to the iron and steel industry, without any sudden upheavals. The adjustment of the coke-oven gas price to a level comparable with that of natural gas should be greatly aided by the present rising trend of energy prices in general and natural gas prices in particular.

The answer to the second question is also no, as long as liquid petroleum gas continues to be supplied almost wholly by Community producers.

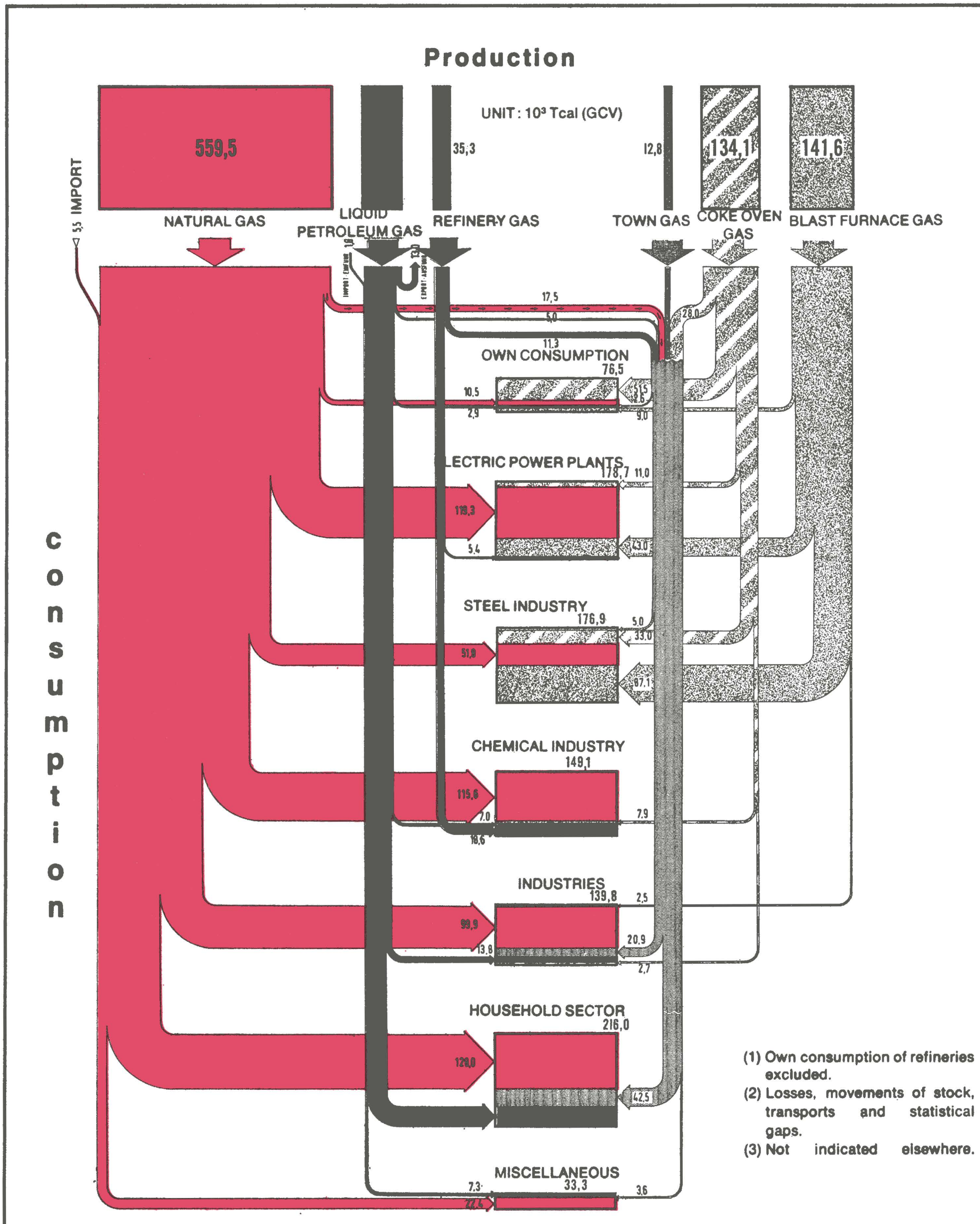
If, however, it were necessary to import large quantities of liquid petroleum gas from oil-producing countries, who sometimes have considerable surpluses of propane and butane, this gas, sold in containers, might increasingly compete with natural gas which relies on pipelines for its distribution.

V - COMMUNITY GAS BALANCE SHEETS

The following tables summarize in graphic form the 1970 and 1975 balances for all gas categories of importance to public gas supplies. These flow diagrams show, more clearly than a list of figures, the extent of the structural change now taking place in Community gas supplies.

FLOW SHEET OF ALL TYPES OF GAS

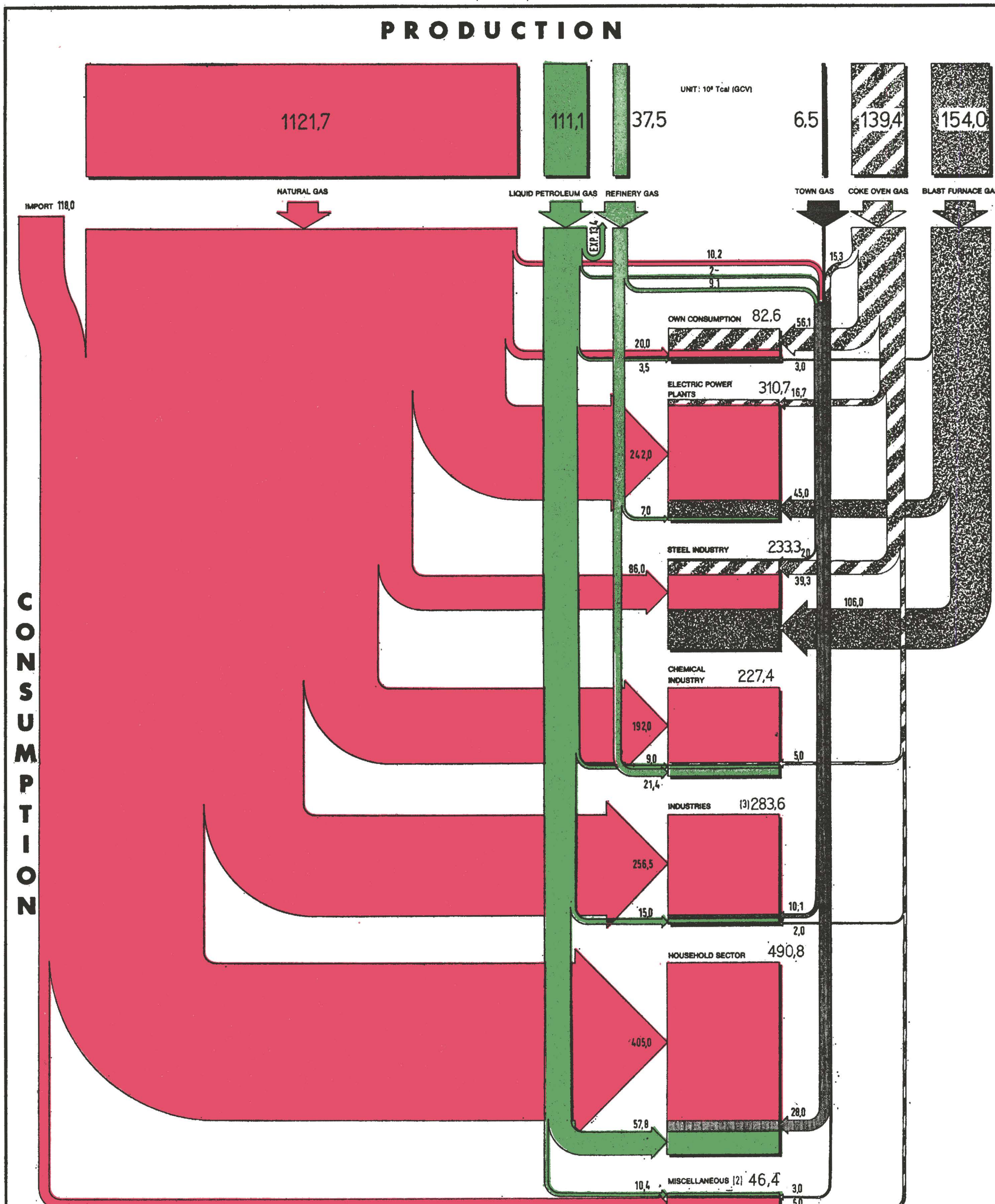
COMMUNITY - 1970 (ESTIMATES)



(1) Own consumption of refineries excluded.
(2) Losses, movements of stock, transports and statistical gaps.
(3) Not indicated elsewhere.

FLOW SHEET OF ALL TYPES OF GAS

COMMUNITY – 1975
(ESTIMATES)



(1) Own consumption of refineries excluded.
(2) Losses, movements of stock, transports and statistical gaps.
(3) Not indicated elsewhere.

VI - TRANSPORT, DISTRIBUTION AND STORAGE OF GAS IN THE COMMUNITY

1. General aspects

In order to cover the gas requirements of industry and the population in the Community, not only sufficient reserves, but above all a comprehensive transport, storage and distribution system are necessary.

In addition to the usual process of transport by pipelines, the transport of liquefied natural gas in special tankers is becoming of increasing importance in the international maritime trade.

As the pipelines and methane tankers are highly capital-intensive equipment, they must be used as much and as regularly as possible if costs are to be kept relatively low. Because of seasonal variations in demand, which are becoming more and more marked, it will also be necessary to provide a storage system enabling these flutuations to be levelled out.

As regards supplies to small or medium-sized consumers, every town needs a more or less ramified distribution network enabling the last consumer to be supplied. As these networks already exist in most places for town gas, provision should be made, apart from the construction of new networks or the enlargement of existing networks, for their complete conversion to natural gas.

2. Gas pipelines

Long-distance pipelines for gas have existed in Germany for several decades, well before natural gas was thought of. They originated at the coking plants of the Ruhr and the Sarre, at the Aix-la-Chapelle basin and at Salzgitter, in the industrial area of Lorraine and the Belgian Borinage, and at the Limbourg collieries in the Netherlands. These transport networks however, were of a purely regional nature. With the exception of the Saar area, there were no international connections. Even the first discoveries of natural gas of a regional or at most of national importance in Northern Italy, south-western France, Germany and the Netherlands in no way altered this situation.

Table 11 shows how the length of the pipelines in the Community and in the various Member States has developed since 1960. According to this Table, the total length of the pipelines has risen in the past 11 years from 28 700 km. to some 58 700 km., an increase of 105 %. This percentage does not show the extent to which the gas transport capacities have grown in the Community, as at the same time the sections of pipelines and the operating pressures were greatly increased.

It is difficult to determine exactly how these factors have affected the increase of transport capacity; however, an approximate evaluation shows that the

TABLE 11

Length of transport pipelines

(Unit : km)

	Community	Germany	France	Italy	Netherlands	Belgium	Luxembourg
1960	28 741	9 784	9 840	4 640	3 500	977	—
1961	32 037	10 020	12 448	4 910	3 680	979	—
1962	32 473	10 376	12 834	4 782	3 720	1 031	—
1963	34 566	11 528	12 928	5 207	3 800	1 103	—
1964	37 752	13 430	13 453	5 350	4 380	1 139	—
1965	39 796	14 262	13 702	5 496	5 150	1 170	16
1966	42 317	15 437	13 944	5 702	6 005	1 213	16
1967	46 827	16 936	14 541	6 490	7 214	1 630	16
1968	52 827	20 390	15 104	7 598	7 713	2 022	16
1969	55 677	21 334	15 828	8 423	7 969	2 076	47
1970	58 806	22 286	16 439	8 921	8 970	2 143	47

total transport capacity of gas pipelines in the Community in 1970, expressed in Tcal/km., has increased more than tenfold since 1960.

With the rapid increase in the consumption of natural gas, it is expected that the transport capacity will also continue to increase rapidly in the next few years, either by means of additional compression plants and parallel pipelines, oı by new pipelines.

The transition in the next few years from purely regional or national transport networks to a united Community network can thus be anticipated.

Starting from Bratislava, a natural gas pipeline via noıthern Czechoslovakia is to connect the south German region to Soviet supplies. The transport route for the Soviet natural gas which is to be supplied to France from the mid-Seventies onwards has not yet been finally decided upon. The construction of a pipeline linking Bratislava (Czechoslovakia) to France and the simultaneous delivery of very large quantities of North Sea gas to the Community would enable a crossroads of natural gas pipelines to be set up in the centre of the Community, thus strengthening the security of supply. A much discussed project concerns an additional east-west link, crossing Warsaw, Berlin, north-west Germany, Belgium and northern France.

3. **Transport of liquefied natural gas in methane tankers**

The liquefying of natural gas at a temperature below 161° C enables its volume to be reduced to 1/560, thus making it possible for methane tankers to transport large quantities of energy, comparable to those transported for several decades by oil tankers. The cost of transport by methane tankers, however is, foı the same amount of energy transported, higher than for oil or petroleum products.

At the present time, there are three plants for liquefying natural gas intended for international trade, with a total capacity of 7.5×10^9 m³/year; two other plants which will probably reach an overall capacity of 10×10^9 m³/year are being constructed. In addition, there exists a series of projects which would bring the world liquefying capacity to about 35×10^9 m^3/year.

Table 12 gives a list of the plants mentioned, their owners and present or planned operating capacities.

The capacity of methane tankers now in service in the world is of the order of 400 000 m^3, corresponding to a gas volume of 223×10^9 m^3 in the gaseous state. The capacity of methane tankers ordered in mid-1971 slightly exceeds 1×10^6 m^3, i.e., 560×10^6 m^3 of gas in the gaseous state.

Table 13 lists the methane tankers in present use or on order. This table shows that most of the tankers now in service are used to transport liquid natural gas to Western Europe, of which 145 500 m^3 goes to the Community.

On the other hand, most of the methane tankers on order will be used to transport natural gas to the United States and Japan. As regards the transport of gas to the Community, two 40 000 m^3 tankers will transport Algerian natural gas to France; a further ten tankers will be needed to transport the Algerian natural gas which has recently been contracted for by a European consortium.

It is anticipated that the rapid development of the methane tanker fleet will increase in the next few years. By 1975, the world tanker capacity should reach 2.5 million m^3, i.e., 1.4×10^9 m^3 of natural gas in the gaseous state. Japan and France are in the process of carrying out studies concerning the construction of 150 000 - 200 000 m^3 tankers.

The regasification of liquefied gas in the port of destination is a relatively simple process, basically consisting in passing the liquefied gas through heat-exchangers.

Table 14 shows the regasification plants for liquefied natural gas, whether they are in operation, under construction or planned.

The capacity of regasification plants in the methane ports is greater than the volume of the liquefied natural gas which is unloaded in application of the present contracts. At the end of 1971, this capacity rose to 10×10^9 m^3, whereas the quantity of natural gas arriving at these unloading ports only reached 7.5×10^9 m^3/year.

In the course of the next five years, the world capacity of the regasification plants will undoubtedly exceed 60×10^9 m^3/year, but only 10×10^9 will be located in Community countries.

Table 15 gives a view of concluded and projected liquefied natural-gas delivery contracts in the world.

If the U.S. Federal Energy Commission authorises all the projects submitted for imports of liquid gas, the United States would be able to import $7 - 8 \times 10^9$ m^3 of gas in 1975 and about 40×10^9 in 1980; 60 % of this gas would come from Algeria, in which country the American import companies have already made sure of about 25 % of the total natural gas reserves.

Cautious estimates show that by 1980, approximately 50 - 60 methane tankers, representing a total transport volume of over 3 million m^3, will be in service. At that date, seaborne natural gas will total some 90×10^9 m^3/year, of which

TABLE 12

Natural gas liquefying plants

Location	Owner	Liquefying capacity m^3/year of natural gas	Number of liquefying units	Liquefying process	Storage capacity m^3
A — *In operation at 31 December 1970*					
1. Arzew (Algeria)	Camel	2×10^9	2	standard cascade	71 000
2. Marsa el Brega (Libya)	Esso	4×10^9	2 (double)	integrated cascade	96 000
3. Kenai (Alaska)	Philips/Marathon	1.5×10^9	2	standard cascade	108 000
B — *Under construction*					
4. Skikda (Algeria)	Somalgas	4.5×10^9	3 (+ 1 planned)	standard cascade	112 000
5. Brunei (Borneo)	Shell-Mitsubishu	5.5×10^9	44	integrated cascade	
C — *In preparation* (1)					
6. Arzew (Algeria)	Sonatrach	$15\text{-}20 \times 10^9$	6	standard cascade	

(1) It appears to be extremely difficult to provide technical information on liquefying plants whose construction has not yet been decided upon. Only Arzew is quoted here, insofar as it concerns the El Paso-Sonatrach contract.

TABLE 13

Methane tankers

Name of ship	Capacity m^3	Year of delivery	Technique	Trading between	Owners	Shipyard
A — *In operation at 30 June 1971*						
1. Aristotle (ex Methano-Pioneer)	5 123	1960	Self-supporting tanks (Conch)	—	Gazocéan	Alabama D.D.
2. Methane-Princosa	27 400	1964	Self-supporting tanks (Conch)	Algeria - England	British Methane	Vickers
3. Methane-Progress	27 400	1964	Self-supporting tanks (Conch)	Algeria - England	British Methane	Harland Wolff
4. Jules Verne	25 500	1965	Self-supporting tanks (Conch)	Algeria - France	Gaz de France	Seine Maritime
5. Polar Alaska	71 500	1969	Use of isolated ships' hulls as storage space (Gas-Transport)	Alaska - Japan	Phillips/Marathon	Kockuma
6. Artic Tokyo	71 500	1969	Use of isolated ships' hulls as storage space (Gas-Transport)	Alaska - Japan	Phillips/Marathon	Kockuma
7. Esso Broga	40 000	1969	Self-supporting tanks (Esso)	Libya - Italy	Esso	Italcantieri
8. Esso Portovenare	40 000	1969	Self-supporting tanks (Esso)	Libya - Italy	Esso	Italcantieri
9. Esso Liguria	40 000	1970	Self-supporting tanks (Esso)	Libya - Italy	Esso	Italcantieri
10.	40 000	1970	Self-supporting tanks (Esso)	Libya - Spain	Esso	El Ferrol
B — *Under construction or on order*						
11. Desartes	50 000	1971	Use of isolated ships' hulls as storage space (Techni-Gas)	Algeria - USA	Gazocéan	Atlantique
12. Hessi	40 000	1971	Use of isolated ships' hulls as storage space (Gas-Transport)	Algeria - France	Sonatrach	CNIM - La Seyne
13. Hessi	40 000	1973	Use of isolated ships' hulls as storage space (Techni-Gas)	Algeria - France	Mess. Maritimes	La Ciotat
14. Hessi	75 000	1972	Use of isolated ships' hulls as storage space (Techni-Gas)	Brunei - Japan	Shell	Atlantique
15. Hessi	75 000	1973	Use of isolated ships' hulls as storage space (Techni-Gas)	Brunei - Japan	Shell	Atlantique

TABLE 13 (continued)

Name of ship	Capacity m^3	Year of delivery	Technique	Trading between	Owners	Shipyard
16. Hessi	75 000	1973	Use of isolated ships' hulls as storage space (Techni-Gas)	Brunei - Japan	Shell	Atlantique
17. Hessi	75 000	1974	Use of isolated ships' hulls as storage space (Techni-Gas)	Brunei - Japan	Shell	Atlantique
18. Hessi	75 000	1974	Use of isolated ships' hulls as storage space (Techni-Gas)	Brunei - Japan	Shell	La Ciotat
19. Hessi	75 000	1974/1975	Use of isolated ships' hulls as storage space (Techni-Gas)	Brunei - Japan	Shell	CNIM - La Seyne
20. Hessi	75 000	1975	Use of isolated ships' hulls as storage space (Techni-Gas)	Brunei - Japan	Shell	CNIM - La Seyne
21. Hessi	120 000	1974/1975	Use of isolated ships' hulls as storage space (Gas-Transport)	Algeria - USA	El Paso	France - Gironde
22. Hessi	120 000	1974/1975	Use of isolated ships' hulls as storage space (Gas-Transport)	Algeria - USA	El Paso	France - Gironde
23. Hessi	120 000	1974/1975	Use of isolated ships' hulls as storage space (Gas-Transport)	Algeria - USA	El Paso	Kockums
24. Hessi	120 000	1974/1975	Use of isolated ships' hulls as storage space (Gas-Transport)	Algeria - USA	El Paso	Kockums
25. Hessi	120 000	1974/1975	Use of isolated ships' hulls as storage space (Gas-Transport)	Algeria - USA	El Paso	Kockums
26. Hessi	120 000	1974/1975	Use of isolated ships' hulls as storage space (Gas-Transport)	Algeria - USA	El Paso	Kockums
27. Hessi	30 000	1973	Self-supporting tanks (Moss)	Not announced yet	Smedvig	Moss/Rosemberg
28. Hessi	35 000	1974	Use of isolated ships' hulls as storage space (Gas-Transport)	Not announced yet	Lofoteu	CNIM - La Seyne
29. Hessi	35 000	1975	Use of isolated ships' hulls as storage space (Gas-Transport)	Not announced yet	Lofoteu	CNIM - La Seyne
30. Hessi	87 500	1973	Self-supporting tanks (Moss)	Not announced yet	Buriss Markes Boegh	Moss/Rosemberg
31. Hessi	87 500	1974	Self-supporting tanks (Moss)	Not announced yet	Kwener/Bjorge/ Hadan	Moss/Rosemberg
32. Hessi	87 500	1974	Self-supporting tanks (Moss)	Not announced yet	Moller/Fearnley/ P.O.	Moss/Rosemberg
33. Hessi	87 500	1975	Self-supporting tanks (Moss)	Not announced yet	Esso	Moss/Rosemberg
34. Hessi	88 000	1974	Use of isolated ships' hulls as storage space (Techni-Gas)	Not announced yet	Gazocéan	Swan/Hunter
35. Hessi	120 000	1975	Use of isolated ships' hulls as storage space (Techni-Gas)	Not announced yet	Gazocéan	La Ciotat
36. Hessi	120 000	1975	Use of isolated ships' hulls as storage space (Techni-Gas)	Not announced yet	Gazocéan	La Ciotat

TABLE 14

Liquefied natural gas Regasification plants

Location	Owner	Regasification capacity : m^3/year of natural gas	Storage capacity m^3 of LNG	Number of storage tankers
A — *In operation at 30 June 71*				
1. Canvey Island (England)	Gas Council	3.7×10^9	242 000	10
2. Le Havre (France)	Gaz de France	0.7×10^9	36 000	3
3. Keghishi (Japan)	Tokyo Gas-Tokyo Electr.	1.5×10^9	160 000	4
4. Panigaglia (Italy)	SHAN	3×10^9	100 000	2
5. Barcelona (Spain)	Gaz Naturel S.A.	1.05×10^9	80 000	2
B — *Under construction*				
6. Fos-sur-Mer (France)	Gaz de France	3.5×10^9	70 000	2
7. Sodegaura (Japan)	Tokyo Gas-Tokyo Electr.	5.5×10^9		
C — *In preparation* (1)				
8. Cove Point (USA) 9. Savannah (USA)	El Paso and others	15×10^9		

(1) Because of the difficulty of obtaining information on projected regasification plants, only the most probable projects have been listed here.

TABLE 15

Sea transport of LNG

Contracts	Length years	Start of deliveries	Yearly quantities 10^9 m^3	Number of ships	Liquefying plant	Terminal	Export company	Import company
A — *In execution at 30 June 71*								
1. Algeria - United Kingdom	15	1964	1.0	2	Arzew	Canvey Island	Camel	Gas Council
2. Algeria - France	15	1965	0.5	1	Arzew	Le Havre	Camel	Gaz de France
3. Alaska - Japan	15	1969	1.4	2	Kook Inlet	Neghishi	Phillips/ Marathon	Tokyo Gas- Tokyo Electr.
4. Libya - Japan	20	1971	3.0	3	Marsa el Brega	Panigaglia	Esso	SNAM
5. Libya - Spain	15	1971	1.1	1	Marsa el Brega	Barcelona	Esso	Catalana de Gas
B — *To be executed*								
6. Algeria - USA (1)	20	1971	0.5 (1)	1	Arzew (1)	Boston	Alocéane	Distrigas Corp
7. Algeria - France	15	1972	3.5	2	Skikda	Fos-sur-Mer	Somalgaz	Gaz de France
8. Brunei - Japan	20	1973	5.6	7	Soria/Lumat	Osaka	Shell	Tokyo Gas- Tokyo Electr. Osaka-Gas
9. Algeria - USA	25	1974/1975	15.0	12	Arzew	Cove Point Savannah	Sonatrach	El Paso

(1) The Distrigas Corp. of Boston signed a further contract for about 1.2×10^9 m^3 of gas a year for 20 years. Part of the LNG deliveries will come from the Skikda liquefying plant. The number and size of methane tankers allocated are not known.

45 % will go to the United States, 25 % to Japan and 20 % to Community countries. In 1975, however, the Community share of international trade in natural gas could reach 30 %.

4. Gas distribution pipelines in the Community

(a) *Construction and enlargement of distribution pipelines since 1960*

Between 1960 and 1970, the total length of the town gas distribution networks increased in proportions varying according to the country. In 1970, having grown by 45 %, the total length was 234 200 km., of which 75 300 km. were in Germany and 65 300 km. in France. In third position were the Netherlands with 44 900 km., then Italy with 31 500 km., Belgium with almost 17 700 km. and Luxembourg with about 500 km.

In the countries which have always possessed networks for town gas distribution and long-distance transport of gas, such as Germany, France and Belgium, the growth rate of these networks is in general fairly moderate in comparison with growth rates in Italy and in the Netherlands, where the discoveries of vast reserves of natural gas have stimulated the construction of a great many new distribution pipelines.

There are no official statistics concerning the future development of distribution networks. Nevertheless, it is probable that in Italy the extension of the distribution networks will continue at roughly the same rate as during the past ten years.

The vast natural gas distribution programme announced by the ENI, particularly where central and southern Italy are concerned, shows that a considerable lengthening of the main distribution pipelines is to be expected. It can therefore be calculated that the average annual growth rate of 7.2 % registered between 1958 and 1968, will in all probability remain at the same level until 1975.

In Germany, France and Belgium, the growth rate of the distribution networks will not exceed 1.5-2 % and will be very little higher in the Netherlands.

(b) *Conversion to natural gas*

The appearance of natural gas on the markets of Community countries has not only stimulated the growth of the supply system but has also caused technical and economic problems for the distribution companies.

Because the heating value of natural gas is almost twice that of ordinary town gas and its density and flame propagation velocity are different, it has hitherto been impossible to use this new fuel in the domestic and industrial burners in present use. In addition, it has often been impossible to use the town distribution mains without adequate modifications, as dry methane, unlike traditional town gas, dries out the joints along the pipelines, causing large and dangerous leakages.

Conversion is expensive and generally takes several years. It is not yet completely finished.

Over the past 10 years, about 50 % of all gas burners have been converted. On the basis of different programmes provided by the various Member States, it can be estimated that by 1975 about 90 % of all the gas burners will have been converted to natural gas.

The present situation in the various Member States is as follows :

In *Germany*, in 1970, there were 542 distribution companies who supplied town gas to about 7.0 million households. At the end of 1970, 192 distribution companies, or 35 %, had converted to natural gas and 33 % of the households were being supplied with natural gas. There were 29 plants which continued to supply, in addition to natural gas, manufactured gases. In accordance with the programmes established by the German distribution companies, the natural gas conversion operation will be completed by 1975 at a rate of 700 000-800 000 users a year. After completion of this programme, about one million users will still receive supplies of derived gas.

In *France*, at 31 December 1971, some 4.9 million subscribers out of a total of 7.8 million were being supplied with pure natural gas. The conversion programme is to be continued at the rate of 500 000 subscribers a year, and completed by 1977/78.

In *Italy*, there is no specific natural gas conversion programme. This operation forms only one of the aspects of the general 'methanisation' programme developed in 1969 by ENI, Italgas and the other town distributors. This programme is notable for its flexibility, which makes it highly adaptable to availabilities of natural gas and proved very efficacious at the time of the troubles with the Libyan natural gas supply arrangements.

Italy is the only country in the Community where there has been since 1960 a steady increase in the number of users of manufactured gas, with a calorific value of 4 300 kcal/m^3. From 1960 to 1969, the number of subscribers rose from 3.1 to 4.6 million. At the beginning of 1969, two-thirds of these 4.6 million subscribers were using manufactured gas. (1) Nevertheless manufactured-gas subscribers only represent 28 % of overall gas consumption. At the present time, conversion to natural gas is mainly being carried out in Turin, Florence and Padua, whilst the work has been completed in Venice, Trieste, Genoa and Bologna. It is estimated that by 1975 a further 2 million subscribers will have been converted to natural gas and one million will still be using manufactured gas. Conversion to natural gas should be completed by 1980.

In *the Netherlands*, conversion to natural gas began in 1963 and was entirely completed in five years. Some 3.3 million users are now being supplied exclusively with natural gas.

In *Belgium*, the first deliveries of Dutch natural gas started at the end of 1966. At the same time the task of converting the equipment of some 1.6 million subscribers was also begun. This operation was completed in May 1972.

Luxembourg has been receiving Dutch gas since the beginning of 1972, through the Belgian Distrigaz Company. In this country, some 47 000 users still have to be converted to natural gas. The conversion should be completed towards the end of 1972.

(1) The term 'manufactured gas' also includes a mixture of natural gas with other gases.

5. Gas storage in the Community

(a) *General aspects*

Owing to its intermediate position between production and storage on the one hand and distribution on the other, storage has to fulfil a wide range of duties involving various operating techniques and different types of storage facilities.

The three principal tasks are :

(i) to obtain a balance between consumption fluctuations on the one hand and the need to keep the transport load as nearly constant as possible on the other, so as to obtain the maximum return from the capital invested;

(ii) to ensure security of supply to the consumer by curing the technical troubles;

(iii) to put the methane tanker loading and unloading operations on a regular basis, as the liquefying and regasification processes are carried out continuously, whereas sea transport is intermittent.

(b) *Surface storage*

Conventional storage is usually effected in metal tanks situated at ground level and known as 'gasometers'. In addition to these prewar cylindrical gasometers, spherical gasometers where gas is stored under high pressure have also been built.

This surface storage is hardly suited to dealing with the everworsening problem of seasonal fluctuations. Gas is increasingly being used for domestic heating, and the ratio between the maximum and minimum values of daily consumption is growing and has, in many cases, already reached 10 :1. The installed gasometer capacity in the Community could become insufficient to absorb, even only partially, fluctuations as wide as these. This is why, when long-distance distribution of coke-oven gas was undertaken, very high capacity underground reservoirs were installed.

(c) *Underground storage*

Underground storage can be in three forms :

(i) storage in exhausted natural gas fields

(ii) storage in underground aquifers

(iii) storage in artificial cavities
(e.g. : salt domes)

The utilisation of exhausted fields usually only requires a low capital investment and, furthermore, it has the great advantage of providing capacities of the order of 10^9 m^3 and enables most of the equipment already installed (bore holes, piping, etc.) and residual gas to be utilized.

At the present time, *Italy* is the only country which uses this type of storage. Four exhausted beds in the Po Valley with an overall capacity of about 3×10^9 m^3 are in use.

Germany is considering storing in this way imports from Russia and the Netherlands, also the gas produced in Northern Germany. The Russian gas would be stored in Bavaria, the Dutch and German gas near Frankfurt.

In *Belgium*, the possibility of using abandoned coalmines is being tested, but storage capacity would not be very high.

Reservoirs in underground aquifers would require far greater capital investment. Moreover, a large amount of the gas stored (frequently 50 % and more of the maximum storage capacity) forms what is called the 'gas cashion' and as such must be counted as lost. Once the reservoir has been fitted out, the operating costs are approximately the same as for storage in exhausted fields.

France, with 3.9×10^9 m³ in five reservoirs, leads Europe in this type of storage, and is now searching for new underground storage structures: prospecting has been carried out in the Saint Cyr du Gault area (Loir and Cher), et Château Renault (Indre and Loire) and in the department of Bouches du Rhône.

In *Germany*, the maximum aquifer storage capacity is about 1×10^9 m³. There are a total of five reservoirs of this type. This capacity, however, does not enable a sufficiently regular load factor to be obtained, and new structures are being sought. The Federal Ministry of Economy has briefed the Federal Geology Office to carry out a systematic study of geological formations which could be used for storage.

The Netherlands and *Belgium* do not as yet possess underground structures suitable as aquifer storage space. Reservoirs of this type do not appear to be necessary in the Netherlands, as the distances are relatively short and, moreover, exhausted gasbeds could be used if necessary.

Storage in salt domes is a new technique which consists in storing the gas under pressure in caverns artificially formed by washing out the salt.

This type of storage is more expensive than storage in underground aquifers, and is only suitable for small volumes.

Two reservoirs are now being used in the Community, one at Kiel, the other at Tersanne (France). The latter is used to level out the consumption fluctuations affecting the Lyons region between summer and winter. It is soon to be linked by pipeline to the Fos-sur-Mer regasification plant which, from 1973 will receive Algerian liquefied natural gas.

(d) *Storage of liquefied natural gas*

The most modern technique consists in storing the gas in liquid form. The advantage of this lies in the fact that methane liquefied when at -161° C is greatly reduced in volume.

This type of storage, however, is far more expensive than underground storage in the gaseous state. It can only be considered where underground storage is impossible for geological reasons and where, at the same time, there is a high industrial and demographic concentration.

For the time being, apart from the experimental plant near Nantes, the Community only has one storage installation of this type, which came into service at the end of 1971 at Stuttgart.

(e) *Predictable development of storage capacity*

Underground reservoirs represent by far the biggest type of storage in Community countries, with a maximum capacity of 7.6×10^9 m³, which is equivalent to a live capacity of 3.4×10^9 m³.

11 % of this capacity is used for manufactured gas, but by 1975 this percentage will have decreased considerably owing to conversion to natural gas.

The maximum capacity is broken down as follows :

Germany	870 million m³	= 11.4 %
France	3 870 million m³	= 50.6 %
Italy	2 900 million m³	= 38.0 %
Community	7 640 million m³	= 100.0 %

By 1975, a total of thirteen reservoirs in Germany (underground aquifers, salt domes and exhausted fields) will have come into use, with a maximum storage capacity of about 3.5×10^9 m³.

Italy, during the same period, will increase present live storage capacity in line with a stepped-up daily extraction potential.

Taking into account the fact that France is to increase its underground gas storage capacities by 1×10^9 m³, the maximum storage capacity in the Community countries will total some 12×10^9 m³ in 1975.

This capacity will still not provide optimum storage, technically and economically speaking, in the Community. This is due partly to the fact that the natural gas storage possibilities are not always where they are needed and partly because, when all the projects already mentioned have been completed, the Community storage capacity will only total about 10 % of the annual consumption in 1975, whereas the United States storage capacity represents about 25 % of the annual consumption. These figures must, however, be compared cautiously, as the overall supply picture — if only because the distances are greater — is totally different in the United States and in Europe.

Table 16 shows the storage installations already in use or to be completed by 1975 in the Community.

6. **Conclusions**

The transport and distribution network and storage installations are being developed in all the Community countries.

The construction of main north-south and east-west transport pipelines is leading to ever closer intracommunity integration of the national gas transport networks which, several years ago, were still very isolated.

(1) According to the definition of the group of experts on 'Gas Statistics' of the Economic Commission for Europe (Geneva), the maximum capacity represents the total volume of gas which may be contained in the underground reservoirs, and the live capacity represents the total recoverable volume.

TABLE 16

Community underground storage reservoirs, completed or planned

Country and site	Owner	Type of reservoir	Type of gas	Date of entry into service	Maximum capacity 10^6 m^3	Useful capacity 10^6 m^3	Daily capacity max. 10^6 m^3
Germany							
at 31 December 70							
1. Reitbrook I (Hamburg)	Hamburger Gaswerke	Aquifer	Refinery gas	1957	75	30	0.2
2. Engelbostel (Hannover)	Ruhrgas AG	Aquifer	Coke-oven gas	1954	200	85-90	1.6
3. Hähnlein I (Darmstadt)	Ruhrgas AG	Aquifer	Mixed gas (4 500 kcal/m^3)	1960	200	100	3.3
4. Eschenfelden I (Nürnberg)	Ruhrgas Saarferngas Stadtwerke Nürnberg	Aquifer	Mixed gas (4 500 kcal/m^3)	1967	300	150	1.4
5. Pliening (München)	Stadtwerke München	Aquifer	Natural gas	1967	50	20	0.2
under construction or planned							
6. Oldenburg	EWE Oldenburg	Salt dome	Natural gas	1973/74	40-45	—	
Kiel	Stadtwerke Kiel	Salt dome	Mixed gas (4 300 kcal)	1972	4	2	1.2
Stockstadt (Darmstadt)	Brigitta/ Elwerath	Exhausted field	Natural gas	Undetermined	I) 100 II) 200	50 100	0.7-0.8 1.5-2.0
Wolfersberg (West Munich)	Bayerngas	Exhausted field	Natural gas	1973/74	550	270	1.6
Frankenthal (Worms)	Saarferngas	Exhausted field	Natural gas	Undetermined	200		
Mürzbach (Bamberg)	Ruhrgas AG	Aquifer	Natural gas	Undetermined	500		
Neindorf (Braunschweig)	Salzgitter-Ferngas	Aquifer	Natural gas	Undetermined	300		

TABLE 16 (continued)

Country and site	Owner	Type of reservoir	Type of gas	Date of entry into service	Maximum capacity 10^6 m^3	Useful capacity 10^6 m^3	Daily capacity max. 10^6 m^3
Reitbreek II (Hamburg)	Hamburger Gasw.	Exhausted field	Natural gas	Undetermined	350		
Neustadt (Rbge)	Ruhrgas	Aquifer	Natural gas	Undetermined	300		
Italy *at 31 December 70*							
1. Brugherio (Lombardia)	Agip	Exhausted field	Natural gas	1966	1 100	600 (1)	11.0
2. Sergnano (Lombardia)	Agip	Exhausted field	Natural gas	1965	900	400 (1)	7.5
3. Ripalta (Lombardia)	Agip	Exhausted field	Natural gas	1967	500	70 (1)	1.0
4. Cortemaggiore (Emilia-Romagna)	Agip	Exhausted field	Natural gas	1965	400	50 (1)	0.5
France *at 31 December 70*							
1. Beynes (Yvelines)	Gaz de France	Aquifer	Manufactured gas	1956	320	150	3.0
2. St. Illiers (Yvelines)	Gaz de France	Aquifer	Natural gas	1965	1 000	500	10.0
3. Chemery (Loir et Cher)	Gaz de France	Aquifer	Natural gas	1968	1 000	500	10.0
4. Velaine sous Amance (Meurthe et Moselle)	Gaz de France	Aquifer	Natural gas	1970	700	350	8.0-10.0
5. Tersanne (Drôme)	Gaz de France	Salt dome	Natural gas	1970	50	30	2.0
6. Lussagnet	S.N.P.A.	Aquifer	Natural gas	1957	800	400	6.5

(1) Annual useful capacity.

Moreover, international links are being forged with non-member countries: pipelines linking Russia with other east European countries, methane tankers forming a link with North Africa and perhaps, in the future, with other African and Middle-Eastern oil and gas producing countries.

Gas transport, both in tankers and pipelines, is more costly than the transport of oil, but the structural changes in progress in the energy market should give rise to a reappraisal of the possibilities, so that Europe does not get left behind in the field of liquid natural gas imports.

The urban gas distribution services are continuously developing their capacities. The conversion of distribution equipment to natural gas is already partly completed; most of the remainder will be finished in the next two or three years.

The search for geological formations for underground storage of gas is intensive. The growing fluctuations in the consumption of natural gas between winter and summer could pose certain problems of security of supply. The fitting-out of underground storage installations is running up against natural limitations, which do not affect the overall capacity so much as the regional capacities. The installation of liquid natural gas reservoirs could indeed solve these problems in part, but the storage costs for liquid natural gas are so high that this system could only be used in special cases.

VII - CAPITAL INVESTMENT IN THE GAS INDUSTRY

1. In the Community

From 1963 to 1970, the Community gas industry invested a total of $\$5 \times 10^9$, i.e., 5 % in the plants producing manufactured gas, 40 % in pipelines and 55 % in distribution equipment. It has not been possible to estimate satisfactorily the capital invested in the exploration and production of natural gas. The only figures available were supplied by Germany, showing a constant increase up to 1966, followed by a considerable drop of over 50 % from 1966 to 1969. It was only in 1970 that a small improvement was noted. However, this information concerning Germany does not make it possible to draw conclusions for the Community as a whole.

Annual investment expenditure in the gas industry doubled from 1963 to 1970 to reach $800 million a year (see *Table 17*). According to industrial forecasts, this sum will increase again in 1971, to exceed $\$1 \times 10^9$ in 1972.

After this date, up to 1975, there will be some falling off, owing to the completion of the great international pipelines.

On the other hand, the work of conversion to natural gas which, for the next five years, will represent on average 25 % of capital spending in the distribution sector, will help to maintain investment in this sector at a high level.

The estimates for the coming five years make provision for an overall amount of $\$5 \times 10^9$, of which 2 % is for gas manufacture, 45 % for transport and 53 % for distribution.

Up to 1970, the gas industry itself financed about 35 % of its capital investment. It is not certain that this figure will remain unchanged by 1975, the self-financing rate having evolved too differently in each year and each country to enable a general trend to be perceived.

2. In the member countries

A study of the pattern of gas industry investment in the various Member States gives the following results :

— *In Germany*, at the present stage of development of the gas industry, it is extremely difficult to predict how the investment needed to expand the transport and distribution networks will be divided over the different years.

The German firms therefore confine themselves to an estimate that the expenditure entailed by pipeline construction will rise to double the 1970 figure, this before 1972, whereas the present level of investment in the distribution sector will remain more or less the same up to 1975.

— *In Belgium*, the construction of the pipeline up to the Belgium-Luxembourg border involved in 1971 a considerable increase of investment in the

TABLE 17

Total investment by the gas industry

Completed : 1963 - 1970
Planned : 1971 - 1975

(in $ '000)

Country	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Germany	123 075	177 575	157 875	170 750	215 650	196 500	206 676	219 444	244 000	278 700	277 400	267 100	266 800
Belgium	24 391	27 488	25 863	37 309	94 932	84 510	89 266	82 819	88 409	94 136	64 535	64 716	64 421
France	103 337	117 472	136 849	156 997	183 397	177 436	186 620	164 484	196 357	229 549	232 254	240 751	238 761
Italy	41 230	48 120	45 565	34 440	66 180	101 005	108 947	108 941	187 300	192 900	196 900	201 900	201 400
Netherlands	105 300	132 947	145 980	181 205	168 122	142 700	121 300	224 000	280 000	277 000	235 000	160 000	135 000
Total EEC	399 333	503 602	512 132	580 701	728 281	702 151	712 809	799 688	996 066	1 072 285	1 006 089	934 467	906 382

transport sector. This pipeline is to supply Dutch natural gas to Luxembourg under a contract concluded between the Belgian Distrigaz Company and the Luxembourg company set up for this purpose. It is also intended to supply the industrial zones through which it passes, and various urban centres in the provinces of Namur and Belgian Luxembourg. Major works are also planned for 1972 and 1973 : duplication of the greater part of the Poppel-Blareguies main line, Winkele-Warnant-Dreye link-up etc.

Over the 1966-72 period, conversion costs account for 37 % of capital spending in the distribution sector.

The conservative estimates of the Belgian gas industry indicate a lower level of investment in 1973, 1974 and 1975 than in 1967-72.

— In *France*, development of the investment programme involves tackling the construction or reinforcement of major networks and continuing the conversion work, and here the critically mounting labour costs are a significant factor.

  In the next few years, a major portion of the investments (60-70 %) will continue to be spent on the renewal, extention and conversion to natural gas of the distribution networks.

— In *Italy*, as a result of the concluding of natural gas import contracts with Russia and the Netherlands and the programme adopted by ENI for the supply of natural gas to central and southern Italy, the transport expenditure in 1971-75 will be twice that of the previous years.

— In *the Netherlands*, the natural gas transport and distribution companies have gradually reduced their capital spending since 1967 as the building of the great pipelines exporting gas to neighbouring countries and the natural gas conversion programme reached completion. This tendency to reduce investment, however, was halted by the recent decision of the Gasunie on the construction and strengthening of wide-bore pipelines for the international transport of natural gas to Belgium, Germany and Italy, the development of the national pipeline network, and the increase of the number of new connections.

3. **Conclusions**

The gas industry's estimates concerning future capital investment from now until 1975 are extremely cautious, particularly as regards the transport.

Considering that the demand for natural gas will probably double by 1975, it is questionable whether in certain cases the estimates concerning the level and the rate of investment take account of the need to build new transport lines for additional supplies of natural gas to consumer centres.

It appears essential to duplicate most of the wide-bore transport lines and expand the distribution centres by 1975, involving an overall investment of the order of $\$6 \times 10^9$, i.e., 20 % over the estimates of the Community gas industry (1).

(1) This calculation of investment growth in the Community is based on the principle that this growth is a function of two independent variables : gross internal consumption and industrial production.

VIII - AID, TAXES AND VARIOUS DUES

1. General aspects

This chapter deals with the taxation applicable to gas, aid granted to the gas industry and the dues linked to the exploitation of gas in the Community.

The study of the taxation on gas comprises a review of the indirect taxes on gas consumption (turnover tax, specific taxes and local taxes), the direct taxes which specifically affect the gas industry, and the Customs duties.

2. Direct aid to the gas industry

In the Community, only Germany has a system of direct aid to the hydrocarbons industry. The 1969 budgetary law empowered the Federal government to allocate DM 575×10^9 between 1969 and 1974 to the development of liquid and gaseous hydrocarbon production. This aid is granted :

(i) for the search for new hydrocarbon deposits outside Community territory;

(ii) for the acquisition of a share in the acquisition of deposits outside the Community,

3. Royalties and various production dues

Germany

In Germany, the extraction of natural gas is subject to a due which must be paid to the Land in which the gas is extracted. This due usually amounts to 5 % of the value of the production.

France

The holder of a concession on a natural gas deposit has to pay the State a due fixed at 5 % of the value of the production, if this exceeds 300×10^6 m^3/a year.

Italy

Law No 613 of 21 July 1967 on the extraction of liquid and gaseous hydrocarbons within the territory of the Republic of Italy lays down the following system of production dues : an annual due of Lit 40 per ha, and an annual levy of 9 % of the quality of hydrocarbons extracted on land and 5 % of the quantities extracted off-shore.

Natural gas extracted in the Po Valley, an area where the concessions are exclusive to the ENI, is not subject to any dues.

In the Basento valley, no dues are levied on the percentage of the production used in local industries. The same applies to the natural gas which is extracted and used in the provinces under the 'Cassa per il mezzogiorno' jurisdiction (law extending the 'Cassa per il mezzogiorno' Act).

Netherlands

In accordance with the pre-1968 concession acts, the State levies royalties amounting to 10 % of the net results. In later concessions, the royalties amount to a rate varying from 0 to 16 % of the production value (according to the amount produced).

4. Direct and indirect taxation

Certain fiscal advantages granted in connection with direct or indirect imports for reasons of regional, social or sectoral policy may be of the nature of indirect aid.

(a) *Direct taxation*

Belgium

Owing to their particular character, the intermunicipal and municipal utilities are exempt from company taxation.

France

Those exceptions to the general taxation system applicable to companies cover public services on the one hand (this is the case for a certain number of public gas distributors, who are exempted from taxation on profits) and, on the other hand, to hydrocarbon prospecting and producing companies which are granted the tax rebate allowed for the discovery and development of deposits. Laid down by the law of 7 February 1953, this system grants a profits tax exemption the maximum amount of which, for each financial year, must not exceed :

(i) 27.5 % of the total sales of products extracted from deposits developed in France and in the Overseas Departments,

(ii) 50 % of net taxable profits obtained in the year in question from the sale of these products in the crude or processed state.

The Law of 21 December 1963 provides that the reserves so formed can be employed abroad. The reserve must be reinvested within five years in new searches.

Italy

Pursuant to Law No 825 of 14 August 1960, no State duties (imposta erariale) are levied on hydrocarbons consumed by industries in the Basento valley. The same applies to natural gas extracted and consumed in southern provinces under the jurisdiction of the Cassa per il Mezzogiorno (Law No 717 of 26 June 1965).

Pursuant to Law No 6 of 11 October 1957, no duties or taxes of equivalent effect are levied on natural gas extracted in the Po Valley (region in which concessions are reserved exclusively to the ENI).

In Italy, companies exploring in off-shore areas can obtain exemption from the tax on movable assets to the amount of 50 % of the profits, on condition that it is reinvested in prospecting. The ENI is exempt from tax on its share issues.

(b) *Indirect taxation*

The various types of indirect taxation on gas consumption in Community countries are shown in the two following tables, i.e., for natural and derived gases in *Table 18* and for liquid petroleum gas in *Table 19.*

As regards indirect taxation, the Member States apply to gas either the normal turnover tax rate or a reduced rate. Within the various countries, this rate is the same for all fuels, except in Belgium, where the average rate of 14 % has been temporarily lowered to 6 % for natural gas and solid fuels.

Italy is the only country with specific taxes on gas consumption. The partial abolition of these taxes is under review in the context of a reform of the present system of indirect taxation.

(c) *Municipal duties and equivalent charges*

Italy is the only country to levy municipal duties on gas. This system is governed by the Royal Decree of 14 September 1931, No 1175. It provides for a duty of 1.50 Lit/m^3 up to 4 500 kcal. Above this calorific power, the duty is proportional. The communes are authorized to increase this tax by a maximum of 50 %.

France has a special municipal tax 'patente' levied by the State from the distributors, in proportion to the quantities sold.

This duty amounts to :

— FF 2/1 million th for sales to households,

— FF 1/1 million th for other uses.

For the fraction of sales exceeding the quantities sold in 1969, the above duties are reduced respectively to FF 1 and FF 0.10 (OJ of 31 December 1971).

In *Germany*, there are no municipal duties on gas, but the municipalities can impose a concession duty (Koncessionsabgabe) on the gas distributors, the amount being limited by a regulation. This duty is levied on profits and is considered as the counterpart of a generally exclusive right to ensure distribution and to use the public roads for this purpose. The amount of this duty is proportional to the turnover. The maximum rates, fixed by law (a percentage of the gross turnover), depend on the size of the municipality and on the category of user (household users or users enjoying special tariffs).

5. **Customs dues**

Intra-Community trade in gas is exempt from Dustoms dues. As regards imports from non-member countries, the situation is as follows :

(i) Methane : common external duty of 1.5 %, at present suspended

TABLE 18

Taxation applicable to natural gas and manufactured gases in the Community

(Rate in force at beginning 1972)

	Germany	France	Italy	Belgium	Netherlands	Luxembourg
		A — *Turnover tax*				
1. VAT	11 %	17.5 %	(1)	6 %	4 %	5 %
2. Others :						
(a) natural gas	—	—	6 % (2)	—	—	—
(b) manufactured gas	—	—	4 %	—	—	—
		B — *Specific taxes*				
1. Excise :						
(a) natural gas	—	—	1 lit/m³	—	—	—
(b) manufactured gas	—	—	0.20 mit/m³	—	—	—
2. Municipal rates	—	Fixed tax of FF 0.001/1 000 th for household consumption. FF 0.0001/1 000 th for industrial consumption, additional centimes varying according to municipality	from 1.5 lit. to 2.25 lit/m³ (3)			

(1) As from 1 January 1973 the VAT will be introduced in Italy at probable rates of 6 % for household consumers and 12 % for others.
(2) Levied 'una tantum' at the time of transfer from producer to transporter.
(3) The above rates apply to a GCV of 4 500 kcal/m³. Above that, the tax becomes proportional. Thus the m³ of natural gas with a GCV of 9 000 kcal will be taxed at between Lit 3 and Lit 4.50 m³ according to the municipality.

TABLE 19

Taxation applicable to LPG in the Community

(Rate in force at beginning 1972)

	Germany	France	Italy	Belgium	Netherlands	Luxembourg
A — Turnover tax						
1. VAT: motor fuel	11 %	17.6 %	—	18 %	14 %	5 %
fuel	11 %	17.6 %	—	6 %	4 %	4 %
2. Others: motor fuel	—	—	9 % (2)	—	—	—
fuel	—	—	16.8 % (3)	—	—	—
B — Specific taxes						
1. Excise: motor fuel	12.30 u.a./100 kg (6)	(1)	15.82 u.a./100 kg	3.40 u.a./Hl	—	1.8 u.a./Hl
fuel	—	—	3.20 u.a./100 kg (4)	—	—	—
2. Import tax	—	—	3.20 u.a./100 kg (5)	—	—	—

(1) LPG is not used as motor fuel in France.
(2) The taxable lump sum amounts to 128 890 Lit/t (i.e., 11 600 Lit/t) (June 1971).
(3) The taxable lump sum amounts to 50 000 Lit/t (i.e., 8 400 Lit/t). LPG intended for the network is subject to a tax of 4.80 % calculated on a taxable value of 32 000 Lit/t, (i.e., 1 536 Lit/t). LPG used in chemical processing is exempt from tax.
(4) Levied at the time of manufacture.
(5) Levied at the time of import.
(6) Raised to 13.66 u.a./100 kg. on 1 March 1972.
(7) The amounts expressed in units of account have been converted according to the parities in force on 27 October 1969.

(ii) Liquid petroleum gas :
   (a) for use as motor fuel : common external duty of 1.5 %
   (b) for use as fuel : common external duty of 1.5 %
(c) other uses : common external duty of 1.5 % now suspended.

6. **Conclusions**

The duties and taxes on gas are extremely varied in the Member States and frequently run counter to the common law. The dues on the production of natural gas range between 5 and 20 % of the production value, depending on the country. They therefore have a very uneven effect on the competitive position of the different Community companies. It would be advisable to harmonize these dues so as to neutralize their effect on the competition level, and to reduce them to the minimum in order to encourage the search for natural gas.

By 1 January 1973, VAT will have been introduced in all the member countries.

In respect of gas, however, the rates vary from one country to another and range from 4-17.6 %. It is hoped to standardize these rates in the course of solving the general problem of harmonizing the VAT rates.

The form and level of the duties levied by the municipalities on the sale of gas differ widely. Owing to the greater or lesser financial difficulties confronting the municipalities in the various countries, however, it would appear to be very complex and difficult to achieve this harmonization.

The Customs duties on gas imports do not pose any specific problems at present.

The aid system is extremely varied from one member country to another. This causes inequalities in the competitive positions of natural gas producers in the Community. Harmonization of objectives and methods would be welcome, as much to encourage the search for natural gas as to avoid distortion of competition.

IX - GAS PRICES

1. General aspects

Natural gas prices, as for other commercial products, are established at different levels, i.e., at the production stage, at several intermediate marketing stages and at the final consumer stage.

As regards gas sales, it is usual to distinguish between the large consumers (industry and electric power plants) and small consumers (household, craftsmen, trade, etc.), as at this last stage the gas is sold in all the member countries at officially published tariffs, whereas for the large industrial consumers, special individual contracts are often concluded.

Consequently, the transparency of gas prices is often very varied at these different levels. Furthermore, the dividing line between consumers subject to official tariffs and users benefiting from special tariffs is at a very different level in the various Member States. For example, in Germany, only households and small and medium-sized businesses pay for gas at the official tariffs, whereas in France, the official tariffs are also applied to relatively large consumers. In the Netherlands, price transparency seems to be completed, except for interruptible contracts. Nevertheless, each country has special tariffs which are not published.

A particular feature of gas tariffs, which they share with electricity prices, is that generally speaking they comprise two factors : a 'variable component' proportionate to the quantity of gas actually consumed, expressed either as volume units or as heating units, and a 'fixed component' which takes account of the degree of the service provided and the regularity of consumption. As regards household users subject to official tariffs, the 'fixed price' is most often found, amended and simplified, in the form of a basic price or a meter charge.

In addition to these two main items, other factors affect the fixing of gas prices. For instance, as regards the household users, the costs of conversion to natural gas are borne either by the consumer or by the distributor; for industrial consumers, there are the costs of a connecting pipeline, borne either by the consumer or by the gas supplier.

The result is that between consumers who appear to be comparable as to quantity and regularity of consumption, price comparisons are only possible within certain limits.

2. Present situation of gas prices in the Community

(a) *General aspects*

Generally speaking, gas prices applied in the Community have, from 1960-70, evolved to the advantage of the consumer; overall, they have tended to drop, although certain price or tariff increases have occasionally been recorded at the regional or local level.

This development is mainly due to two factors :

(i) the size of the natural gas supply, which exceeded the absorption capacity on the short and long-term markets,

(ii) the movement of prices of the energy source constituting gas's main competitor, i.e., fuel-oil, whose prices have generally tended to drop.

Both these factors have affected the general level of gas prices, and consequently of manufactured gas prices, particularly coke-oven gas, a development which has not helped the long and arduous restructuring of the Community's mining industry.

The reversal of the situation of the natural gas market which, from the buyers' market it was, became in late Autumn 1970 almost overnight a sellers' market, was surprising for its suddenness. Yet this situation had been imminent for some time owing to the fall of the natural gas surplus in the Community. There is no doubt that its suddenness was due to the difficulties brought about by a combination of circumstances in the Community's fuel-oil supply arrangements and to the consequent sharp rise of light and heavy fuel-oil prices.

In 1971, however, the natural gas price situation on the Community energy market continued to show great stability, gas prices having only gone through relatively minor fluctuations. The steep changes in fuel-oil prices only slightly affected natural gas prices and these effects were not felt immediately, as natural gas supply contracts are usually long-term and the price adjustment clauses frequently found in these contracts usually only make provision for partial and deferred adjustment of natural gas prices to fuel-oil prices.

(b) *In the Member States*

In *Germany*, the last rise in fuel-oil prices did not affect gas prices until the end of 1971 and then only slightly, as the fixing of gas prices in the industrial sector is usually based on the average level of fuel-oil prices for the preceding year. The application of the index clauses led to a limited rise of 1-2 % on average of the natural gas prices for industrial users. In the domestic sector, the situation is similar. This sector has also experienced a series of tariff increases which, however, have on the average remained within narrow limits for the whole of 1971. In 1972, on the other hand, a sharper rise in natural gas prices is to be expected, in both the industrial and the domestic sector.

In *France*, the natural gas prices for French producers had been blocked since 1967. In May 1971, they were increased by 15 %.

As regards the industrial consumers, natural gas prices were increased three times in 1971, by 15 % in May, 7 % in August and another 1.5 % in November. These increases made it possible to reduce the difference between the prices for heavy fuel-oil and natural gas heating by about 75 %.

In the household sector, after a 3 % rise in May, a second rise of 2 % occurred in August. In this sector, the increases were not applied uniformly over all the tariffs, but were adjusted in keeping with the authorized average increase of returns.

In the next few years, further price increases are to be expected, as the price policy of the French government is aimed at harmonizing natural gas prices in the long term.

In *the Netherlands*, the price of natural gas for industrial consumers is linked to the price of fuel-oil by a special formula. Following the fuel-oil price rise which occurred in Autumn 1970, the prices actually applied to industrial users increased to the point where they exceeded the export prices of Dutch gas. This had the effect of considerably reducing the difference between the prices paid by the industrial consumers in the Netherlands and by industrial consumers of comparable size in the other Community countries.

In the domestic sector, no significant price fluctuations have as yet been recorded. The prices are only about half the tariff prices applied in other Community countries. In the towns, the illustrative prices put forward by the 'Commissie Samenwerking der Regionale Organen Gasvoorziening' (SROG), which are generally applicable, have remained unchanged since 1 July 1967.

The SROG has nevertheless amended its tariff as follows :

Tariff group	Annual consumption in m^3	Fixed charge in Fl.		Price in Fl/m^3	
		before	now	before	now
I	0 - 300	12	18	25	25
II	301 - 600	27	33	20	20
III	601 - 2 100	87	93	10	10
IV	2 101 - 170 000	150	135	7	8
Heating of large complexes	20 000	12 (1)	12 (1)	7	8

(1) Per household.

In *Belgium*, as from July 1970, the new terms agreed by the Dutch supplier enabled the Distrigaz rates to be adjusted for sales to industry and for public distribution.

The price reduction which followed, varying according to regularity, was of the order of 5 %. Since then, the only price variation recorded in the industrial sector has resulted solely from Distrigaz's application of the adjustment formula (1), i.e., a rise of 1 % between the fourth quarter of 1970 and the fourth quarter of 1971.

For the new industrial contracts, concluded as from May 1970, the indexing formula has been modified and now comprises a parameter representing the movement of the 'frontier' price of natural gas.

After the advent of the VAT on 1 January 1971, the situation in the distribution sector was as follows :

(i) a tax abatement to the distributors was passed on to the customers in the form of a pre-tax tariff reduction;

(ii) the tariffs in the domestic sector were restructured.

(1) This is an index whose main parameters produce the structure of the net price for natural gas (in particular, the price of steel tubing and the wages).

The prices, tax included, remained stable at a rate of consumption ranging between 150-330 m^3 NG/p.a. Consequently, the introduction of the VAT did not raise the prices of gas for consumers using it for normal cooking and water-heating purposes. The introduction of the VAT meant a slight price increase for the other customers.

In *Italy*, gas prices applied to industry remained for the most part unchanged. The prices of gas used for technological purposes remained stable; those for gas intended for the chemical industry increased by 2.5 %. On average, price rises in the household sector reached 1.5 %.

3. Survey of gas prices actually applied in international transactions

Owing to the development of worldwide trade in natural gas, it is now possible to talk about international natural gas prices. *Table 20* gives an overall view of the prices published to date by the Press. However, these are general pointers which do not take account of specific contract terms, (returns, regularity, insurance, risk insurance, etc.).

4. Conclusions

The fairly general lack of gas price transparency in the Community makes it virtually impossible to draw any conclusions in good time concerning the price trend and the development of the competition situation. The same is true for the potential effects of natural gas prices on the possibilities of regional development and on the pros and cons of natural gas in industry.

The upward trend of natural gas prices recorded in the Community for the last year or so at every level is certainly unfortunate from the consumer's point of view. It results from the movement of prices of competing energy sources and the dwindling of natural gas supplies. This situation, howevei, has a positive factor, in that it stimulates investment in the prospecting sector in particular.

TABLE 20

International gas prices (1)

(in $/gcal)

Dutch gas at the Belgian border	1.469
Dutch gas at the German border	1.469
Dutch gas at the French border	1.624
Dutch gas at the Italian border	1.748
Russian gas at the German border	1.413
Russian gas at the Austrian border (first contract)	1.666
Russian gas at Bratislava for Italy	1.217
Russian gas at Bratislava for France	1.857
Algerian gas delivered to UK, Canvey Island	2.527
Algerian gas delivered to France (Le Havre)	2.459
Algerian gas delivered to France cif Fos-sur-Mer	1.547
Algerian gas delivered to USA fob Arzew	1.21
Algerian gas delivered to USA/Distrigas Boston (cif)	2.70 (2)
Algerian gas delivered to USA/El Paso, Cove point (cif)	2.30 (2)
Algerian gas delivered to USA/El Paso, Cove point (cif)	3.05 (3)
Algerian gas delivered to USA/El Paso, Savannah (cif)	3.29 (3)
Algerian gas delivered to the European Consortium (fob)	1.63
Algerian gas delivered to the European Consortium (fob)	1.80 (4)
Algerian gas delivered to (cif) Dunkirk or Zeebrugge estimated at	2.181 - 2.42
Libyan gas delivered to Italy (fob) Marsala el Brega	1.39
Libyan gas delivered to Italy (cif) La Spezia	1.706
Libyan gas delivered to Spain (cif) Barcelona	1.706
British North Sea gas (Leman-Bank-Indefatigable)	1.236
British North Sea gas (Viking-Field)	1.550
British gas produced on land (Lockton-Field)	1.097
Alaskan gas delivered to Japan (cif Yokohama)	2.06
Brunei gas delivered to Japan (cif Osaka)	1.90

(1) The above prices have all been published in the international press. It has not been possible to check them in detail. The prices given, not in dollars but in national currencies, have been converted to dollars at the following rate : £ 1 = $ 2.60, Hfl 1 = $ 0.308.
(2) Pre-regasification price in the contract concluded in 1969.
(3) Price authorized by the Federal Power Commission for deliveries beginning in 1977.
(4) Price valid after indexing for the start of supplies (1977-1978).

TABLE 21

Gas prices in the household sector (Community and United Kingdom) without VAT
(situation at 30 June 1971)

(in $/gcal)

Consumption in gcal/year		1	2.5	5	10	20	50	250 (7)
Hamburg	(1)	24.86	17.81	14.26	11.04	9.07	7.89	— (7)
Hannover	(1)	17.21	15.19	12.30	9.07	7.27	6.19	— (7)
Düsseldorf	(1)	20.77	17.60	11.64	8.69	7.21	6.33	— (7)
Frankfurt	(1)	24.59	19.67	15.36	9.23	7.76	6.87	— (7)
Stuttgart	(1)	24.04	20.66	15.14	9.23	8.91	8.71	— (7)
München	(1)	20.77	15.30	12.46	10.03	8.72	7.29	— (7)
Pau	(2)	21.06	14.98	12.89	9.67	8.05	5.93	4.31
Angoulême	(2)	23.23	15.56	13.50	10.28	8.66	6.25	4.92
Lille	(2)	22.32	18.00	12.89	9.67	7.89	5.91	5.26
Nancy	(2)	21.60	18.00	13.25	9.85	7.89	5.91	5.26
Paris (extra muros)	(2)	23.05	18.00	15.81	12.40	8.92	6.24	4.62
Roma	(10, 3)	14.60	12.20	9.16	7.41	6.04	5.11	3.87
Torino	(10, 3)	16.43	14.47	11.48	8.16	6.49	5.34	3.69
Bruxelles	(4)	21.82	18.66	16.51	11.40	8.84	6.39	5.36 (8, 9)
Anvers	(4)	21.84	18.69	16.87	11.41	8.84	6.39	5.36 (8, 9)
Liège	(4)	21.52	18.36	16.58	11.27	8.84	6.39	5,36 (8, 9)
Amsterdam	(5)	9.94	9.94	8.29	5.80	4.43	3.17	2.49 (9)
Eindhoven	(5)	11.60	9.61	8.12	5.72	4.39	3.15	2.48 (9)
's-Gravenhage	(5)	13.26	10.28	8.45	5.88	4.52	3.40	2.81 (9)
Haarlem	(5)	11.60	9.61	8.12	5.72	4.39	3.15	2.48 (8, 9)
Utrecht	(5)	11.83	10.50	8.56	5.94	4.50	3.19	2.48 (8, 9)
Manchester	(6)	14.40	11.52	11.04	9.60	8.28	7.06	6.40
Leeds	(6)	19.20	13.44	11.52	9.60	8.16	7.01	6.39
Sheffield	(6)	16.80	11.52	10.08	8.88	7.32	6.24	5.63
Stoke on Trent	(6)	16.80	13.44	11.04	9.12	7.56	6.63	6.13
London	(6)	24.00	17.28	13.92	11.28	8.76	7.25	6.44
Bristol	(6)	24.00	17.28	12.96	11.76	9.36	7.49	6.49

(1) $ 1 = DM 3.66.
(2) $ 1 = FF 5.554.
(3) $ 1 = Lit 625.
(4) $ 1 = BF 50.0.
(5) $ 1 = Hfl 3.62.
(6) $ 1 = £ 0.4165.
(7) Special contracts.
(8) 115 days of use a year.
(9) Communal heating and hot water for a 12-flat building.
(10) Charges : Rome Lit/m³ 4.55, Turin Lit 4.5/m³.

TABLE 22

Gas prices to industry (Community and United Kingdom) without VAT (1)
(situation at 30 June 1971)

in $/gcal

Consumption in gcal/year	100		250	1 000	5 000	10 000
Hamburg (prices according to tariff only)	11.53 (3)		11.46	— (2)	— (2)	— (2)
Hannover	9.19 (3)		7.65	— (2)	— (2)	— (2)
Düsseldorf	10.33 (3)		10.00	— (2)	— (2)	— (2)
Frankfurt	11.48 (3)		10.43	— (2)	— (2)	— (2)
Stuttgart	13.14 (3)		12.81	— (2)	— (2)	— (2)
München	8.32 (3)		7.77	— (2)	— (2)	— (2)
Pau	6.72 (4)	6.00 (5)	5.53	4.14	2.63	2.34
Angoulême	7.26 (4)	6.54 (5)	5.79	4.59	3.24	2.70
Lille	6.03 (4)	6.03 (5)	5.26	4.88	4.54	2.86
Nancy	6.03 (4)	6.03 (5)	5.26	4.88	4.10	2.92
Paris (extra muros)	9.07 (4)	8.52 (5)	7.95	6.84	6.30	6.23
Roma	4.80		4.53	3.88	3.71	3.69
Torino	4.80		4.53	3.88	3.71	3.69
Bruxelles	8.11 (7)	6.94 (6)	5.51 (8)	4.26 (8)	3.79 (8)	2.18 (9)
Anvers	8.11 (7)	6.94 (6)	5.51 (8)	4.26 (8)	3.79 (8)	2.18 (9)
Liège	8.11 (7)	6.94 (6)	5.51 (8)	4.26 (8)	3.79 (8)	2.18 (9)
Amsterdam	2.74 (5)		2.57	2.57	2.19	2.06
Eindhoven	2.73 (5)		2.57	2.57	2.19	2.06
's-Gravenhage	3.02 (5)		2.80	2.69	2.19	2.06
Haarlem	2.73 (5)		2.57	2.57	2.19	2.06
Utrecht	2.76 (5)		2.57	2.57	2.19	2.06
Manchester	8.54 (4)	8.88 (5)	8.38	8.07	— (2)	— (2)
Leeds	7.82 (4)	7.82 (5)	7.33	7.09	— (2)	— (2)
Sheffield	8.71 (4)	8.71 (5)	8.00	6.61	— (2)	— (2)
Stoke on Trent	8.33 (4)	8.33 (5)	8.04	7.11	— (2)	— (2)
London	9.89 (4)	9.89 (5)	9.70	7.39	— (2)	— (2)
Bristol	8.16 (4)	8.54 (5)	7.78	7.20	— (2)	— (2)

(1) For $ rate see Table 21.
(2) Special contracts.
(3) Unit price for domestic uses and heating.
(4) Heating of premises only.
(5) Heating of premises and industrial use.
(6) Load factor – less than 115 days/year.
(7) Load factor – more than 115 days/year.
(8) 250 days of use a year.
(9) 250 days of use a year and 4000 hours of use.

X - THE STRUCTURE OF GAS ENTERPRISES IN THE COMMUNITY

1. General aspects

In the Community countries, the gas sector has undergone a complete structural upheaval in the last ten years. The essential factor in this restructuring is the massive conversion to natural gas. This restructuring started with the discovery of the gigantic Dutch natural-gas field at Groningen. It will continue with the importing of large additional quantities of gas from non-member countries such as Russia, Algeria and Libya. The discovery in certain member countries of smaller but worthwhile natural gas deposits has also contributed to this restructuring. As the production of natural gas increases, the traditional derived gases grow less important. In the towns, the gas companies are converting and the manufactured-gas producers are becoming buyers and distributors of natural gas. This process is visible in the most recent national legislations.

2. Germany

(a) *Production*

The three most important natural gas producers are Gewerkschaft Brigitta, Gewerkschaft Elwerath and Mobil Oil AG; Esso and Shell respectively have a 50 % control over the first two companies; they have also been placed under the management of a joint holding company. In 1970, they represented 57 % of German natural gas production. The German companies, headed by Wintershall AG, represented in 1970 some 18 % of the overall German production of natural gas.

(b) *Transport*

There are many gas transport companies in Germany. First, there are the transport companies proper, the 'ETG' (Erdgastransportgesellschaften), which transport German and Dutch natural gas from the north to the south; then there are the natural gas producers who carry out the transport and sale of their product themselves, such as the Gewerkschaft Brigitta and Gewerkschaft Elwerath (Hanover) and the Erdgasverkaufs-GmbH (Münster), the latter being the sales organization for a number of natural gas producers in north Germany. Lastly, there are transport companies who also deal with sales to the end consumer (particularly to industrial consumers), i.e. :

— Ruhrgas AG, Essen
— Thyssengas GmbH, Duisburg
— Westfälische Ferngas-AG, Dortmund
— Energieversorgung Weser-Ems, Emden

— Salzgitter Ferngas GmbH, Salzgitter
— Gasunion GmbH, Frankfurt
— Gasversorgung Süddeutschland GmbH, Stuttgart
— Ferngas Nordbayern GmbH, Bamberg
— Bayerische Ferngas GmbH, München
— Saarferngas AG, Saarbrücken

The largest of these long-distance gas transport companies is Ruhrgas, 60 % of whose capital is held by the Ruhr mining companies, 25 % by the Gewerkschaften Brigitta and Elwerath and 15 % by other natural gas producers. Ruhrgas itself operates the longest transportpipeline network and also participates in a certain number of the above-mentioned transport companies. The biggest group of natural gas producers in Germany (Esso/Shell) participates directly or through various affiliated companies in Ruhrgas as to 30 %, in Thyssengas GmbH as to 50 % and in the Gasversorgung Süddeutschland as to 25 %.

(c) *Distribution*

Industrial users are supplied either by the large long-distance gas transport companies, or by municipal distribution companies. The other users (households, tradesmen or craftsmen) are supplied by the urban distribution companies, mainly owned by the municipalities.

3. Belgium

(a) *Production*

Owing to the natural gas imported from the Netherlands, the production of manufactured gas for public distribution has been almost totally abandoned. On the other hand, 'inevitable' gases are still being produced (coke-oven, blast-furnace), mainly used for own-consumption by the electric power plants and the iron and steel industry.

(b) *Transport*

In Belgium, 'Distrigaz' holds an exclusive concession for the transport of Dutch natural gas. The company shareholders are the Belgian State as to one-third, Esso and Shell as to another third (1/6 each), private Belgian companies with interests in this sector holding the last third.

(c) *Distribution*

Large industrial consumers are directly supplied by Distrigaz. The other consumer categories are supplied by a number of distribution companies, mostly mixed inter-municipal enterprises (association of municipalities and one or more private companies).

4. France

(a) *Production*

As in the other Member States, the production of derived gases is gradually decreasing, giving way to the cheaper natural gas. Town gas production is, with one or two exceptions, in the hands of the nationalized company Gaz de France; 60 % of coke-oven gas production is held by the nationalized company Charbonnages de France, the remainder being produced by the French metallurgical industry.

Natural gas production is mainly in the hands of several companies in which the French State has a controlling interest. This is in particular the case of the largest gas field, at Lacq, exploited like its neighbouring deposits by the SNPA in which the State oil group ELF-ERAP holds the controlling interest.

(b) *Transport*

Natural gas in France is transported by Gaz de France and SNGSO. The CeFeM (50 % SNPA — 50 % GDF) has no technical transport activities; its role is purely a commercial one as purchaser of gas from the SNPA and retailer to the public distributors of the GDF and to industrial customers. GDF transports on the corresponding network, the CeFeM paying its operating expenses and the financial and amortization charges of the network.

On the other hand, SNGSO (GDF 30 % — SNPA 35 % — ERAP 35 %) purchases the gas from the producers SNPA, ERAP, ESSO-REP, transports it on its network and retails to public distributors and to industrial firms.

(c) *Distribution*

The industrial users linked to the transport network are supplied by the DGF, the CeFeM, or the SNGSO. Public distribution consumers are supplied as to about 95 % by GDF, the rest being supplied by the municipal boards, e.g., in Bordeaux, Grenoble, Colmar and several small towns.

Strasbourg has a special system; 'Gaz de Strasbourg' is a mixed-economy company in which the Town holds a controlling interest, the other shares being held by a private company.

5. Italy

(a) *Production*

The production of town gas is carried out by municipal or private companies. Coke-oven gas primarily comes from the coastal iron and steel works of Italy. Italy's largest natural gas producer is the ENI. In the Po Valley ENI holds, pursuant to the 1953 law, an exclusive concession for the production and transpoıt of natural gas.

(b) *Transport*

In Italy, natural gas is mainly transported (as to 97 %) by the SNAM, which is a 100 % subsidiary of ENI.

(c) *Distribution*

Most of the industrial users are supplied by SNAM (a company of the ENI group); the other industrial users are supplied by a private or urban distribution companies.

6. Luxembourg

(a) *Transport*

SOTEG, 50 % owned by the State and 50 % by a group of steel industries, transports the gas delivered by DISTRIGAZ and supplies, among others, SYTRAGAZ, which is mainly formed of municipalities and which has its own regional transport and distribution network in the south of the country.

(b) *Distribution*

The large industrial consumers are supplied by one of the above-mentioned transport companies, the other users being supplied by Sytragaz or by municipal distribution companies.

7. Netherlands

(a) *Production*

Here, gas supplies are solely based on natural gas. The only natural gas producer exploiting the Groningen field and, consequently, the principal natural gas producer in the Netherlands, is a 'Maatschap' specially set up to exploit this deposit. The shares are distributed as follows: 60 % to the Nederlandse Hardolie Maatschappij (NAM: 50 % ESSO, 50 % SHELL); 40 % to the Dutch State through the 'Staatmijnen'. There are also other Dutch, French, American and German producers who exploit smaller deposits.

(b) *Transport*

In the Netherlands 'Gasunie', owned as to 10 % by the State, 40 % by the 'Staatmijnen' (nationalized companies), 25 % by Esso and 25 % by Shell, holds the sole right to transport natural gas from Groningen.

(c) *Distribution*

All the large industrial users are supplied by Gasunie, the other users by municipal distribution companies.

8. Conclusions

The structure of Community natural gas suppliers is extremely varied. It ranges from companies enjoying a de facto or de jure monopoly to a number of companies that have agreed among themselves on the limits of their respective sectors of activity.

In the natural gas production field, it is often thought that the dominant situation enjoyed by a single producer owing to natural conditions poses a problem. It is perfectly feasible, however, that the discovery of new natural gas deposits and the importing of natural gas from non-member countries will gradually balance this situation. The setting-up of 'joint enterprises' for the prospecting and extraction of natural gas could contribute to this development.

The very varied structure of the gas transport systems and the legal disparities which cause it could become a problem requiring a solution at the Community level, should it ever happen that intra-Community trade in gas and the importation of gas from non-member countries become liable to difficulties because of these discrepancies.

XI - SUMMARY AND CONCLUSIONS

An analysis of the situation of the gas industry in the Community and of its probable trend over the next 10 or 15 years shows that the enormous expansion of gas consumption in the past five years has by no means ended. The future growth will still be as spectacular, although there is the possibility of a slight slowing down towards the middle or the end of this decade.

The growth of gas availabilities is mainly due to natural gas, 99 % of which, at the present time, still comes from Community sources. The increasing volume of imports from non-member countries which will be needed in the future will not jeopardize the high degree of security of supply of gas, since the simultaneous integration of the transport networks will provide additional security.

The analysis nevertheless highlights a number of questions and points out problems that are already arising at the present time and others that are due to crop up in the future. They may fall into four groups :

(i) information problems
(ii) supply problems
(iii) structural problems
(iv) problems of tax policy, of aid and of price-policy.

1. **Information problems**

The fullness, worth and speed of information on the many factors affecting the natural gas market and its future development are often far from satisfactory. A solid basis of information is necessary, however, so that one can at any moment have a precise idea of the supply situation and its probable development and take appropriate decisions in the energy policy field.

(a) *Data on the natural gas reserves*

Community reserves of natural gas are and will long continue to be the essential source of the Community's gas supply. In seeking an exact knowledge of the present state of the reserves, one can only partly rely on official published figures. Hitherto, there have been no uniform criteria for evaluating gas reserves and classifying them as proven, probable or possible reserves. Most of the time, recent discoveries are only known through the press, whose information is often contradictory and does not permit a reliable evaluation of the reserves.

(b) *Information on intra-Community trade in natural gas*

The supply of natural gas, which until recently was a purely national matter, is becoming more and more of a Community affair. Deliveries of Dutch natural gas to other member countries will continue to increase in the future. After the enlargement of the Community, there is every reason to think that intra-Community trade in natural gas will be stepped up. As regards the supplies, there are reliable annual statistics, but in order to have a clear picture of the long-term trend of intra-Community trade in natural gas — essential in evaluating the structure and security of supply — the details gleaned from the press on the contents of natural-gas supply contracts are not sufficient. In addition to the overall quantities and delivery rates provided for, other contractual terms such as the minimum and maximum quantities, the requirements concerning regularity, etc., should also be known.

(c) *Information on natural gas import agreements with non-member countries*

Import into the Community of natural gas from non-member countries only play a subsidiary part at the moment. They will be stepped up considerably over the coming years if, allowing for the rise in demand, supplies are to be assured in the long term. Potential problems of security of supply can only be appreciated if these agreements are made known in good time, together with the annual volumes for which they provide and their period of validity.

(d) *Information on capital investment*

A study of the natural gas market cannot be based solely on statistical data. The static aspect of facts must be supplemented by a dynamic component, in particular the companies' assessment of the future development of the natural gas market. This assessment is reflected in the companies' current and planned investment activities.

Regarding capital spending in the production, transport, distribution and storage sectors, the statistics published by industry, particularly its forecasts, are highly insufficient. Thus, virtually nothing is known of investment in natural gas prospecting although, in this field, current and future investment show the industry's view of the future particularly clearly.

(e) *Information on prices*

In order to evaluate the market situation, it is essential to know the prices and their trend. The only real price transparency is that of the official published tariffs. The borderline between the latter and the specific contracts is at a widely differing level in each Member State. The Commission's departments have no knowledge of the non-tariff prices ruling in the Community countries.

The future development of natural gas prices is largely determined by the 'at source' prices and the free-at-frontier import prices. Here again, information is incomplete and undependable. Similarly, the prices applied between the producers or transporters on the one hand and the public distribution authorities on the other are for the most part unknown. Information on the price-adjusting clauses which are an integral part of very many supply contracts is also very scarce. Frequently, these clauses link the gas price more or less rigidly to the price of fuel-oil, alone or in combination with other parameters, such as wage costs, certain material costs or the cost-of-living index.

2. **Supply problems**

Natural gas consumption is increasing at such a rate that the discoveries made within the Community will probably be unable to keep pace with it. It is uncertain whether the prospecting carried out on the Continental Shelf of the Community will be able to restore the balance. In order to cover the growing requirements and to ensure sufficient supplies in the long term, it will become increasingly necessary to resort to imports from non-member countries.

(a) *Prospecting activities*

There are many geologists who are far from denying the possibilities of exploiting new natural gas reserves in the Community. In particular, they foresee definite prospects at greater depths, and in the Community's Continental Shelf. Here, however, the financial risk is particularly great. As regards the Community, the problem is therefore to stimulate investment. The Council's proposal for a regulation on the application of the joint enterprise status to activities stemming from the hydrocarbons industry should contribute to the solution of this problem.

(b) *Natural gas imports*

Despite every effort to enlarge the basis of the natural gas supply in the Community, it will be necessary, in view of the growing consumption, to import additional quantities from non-member countries. These imports could primarily come from the north African countries and from the USSR. Other regions, however, especially those countries in the Near-East which are particularly rich in associated gas, could also be of interest as suppliers to the Community. At present these countries are usually obliged to burn off the gas which accompanies oil extraction. Even if the ex-source price level is very low, as is likely owing to the need to offset the high level of transport costs, this associated gas could become a source of extra revenue, both for the producer countries and for the firms operating there. For reasons of security of supply the sources of natural-gas supply imports must be as widespread as possible, in view of the worldwide increase in natural-gas import requirements; an over timid attitude towards natural gas import possibilities could have virtually irremediable consequences as regards the Community's long term security of supply in natural gas. The concluding of longterm natural gas import contracts with developing countries could be very profitable for both partners.

(c) *Utilization of natural gas*

Owing to the abundance of natural gas on the Community market during the last few years, all the potential users without exception were showered with offers of natural-gas supplies, as it was essential to market the recently discovered reserves and to obtain a profit from the enormous sums invested, particularly in the construction of transport pipelines. This situation has undergone a complete change since the winter of 1970/71. As the available reserves have now all been contracted for, it is unlikely that any more natural-gas purchase contracts can be concluded by large consumers, particularly the electric power plants, who are only willing to pay the lowest prices. The automatic responses of the market are already directing natural gas towards the most profitable consumer sectors. The natural gas supply contracts are mostly long term, however, and in many cases, supplies to power plants will only reach the very large quantities provided for in the contracts at the very time when predictably there will no longer be any natural gas available for this purpose. For some time there has been a tendency to restrict the duration of contracts with power plants to a few years only, but even so the supply of large quantities of natural gas to electric power plants may pose problems in the future.

(d) *Substitution of natural gas for coke-oven gas*

Natural gas is an energy source competing both with solid and liquid fuels and with other gases, including coke-oven gas. There is the question of whether the breakthrough of natural gas may be detrimental to the outlets for coke-oven gas, a by-product of the coking process. A preliminary examination of this problem carried out by mining and coke-oven gas industry experts concluded that it will probably be possible to retain a 'nucleus' of outlets for coke-oven gas in the regions situated close to the coking plants. It should also be borne in mind that the supply of coke-oven gas will not indefinitely be able to keep up with the demand for gas, so that gradually supplies to the areas surrounding these regions will have to be supplemented by natural gas.

3. **Supply structure optimization problems Interconnected natural-gas network**

There is an increasing trend to greater integration of national natural-gas transport networks in the various Community countries which were relatively isolated only a few years ago. This European integration of the transport networks is solely due to natural gas. It originated in imports by Community countries of Dutch natural gas from the Groningen deposit, and continued with imports from non-member countries, e.g., the USSR and Algeria. It could continue to develop when the deposits of natural gas in the North Sea have been connected to the mainland. Thus several large supply crossroads are likely to make their appearance in the future. It is not yet possible to predict the exact location of these nuclei, but it is very probable that the Soviet gas pipeline, which runs from east to west, and the supply line for Dutch and North Sea gas which runs from north to south will meet in the Franco-German region situated between Mannheim and Strasbourg. In the event of an east-west pipeline going through Warsaw, Berlin and north-west Germany, i.e., in a more northerly latitude, there would probably be a second crossroads in the Belgo-German frontier area. The supply of Dutch, Soviet and Libyan natural gas to northern Italy will generate a useful crossroads in north-western Italy. The establishing in the Community of a fully integrated natural gas transport network must be considered a good thing as regards security of supply. This raises several problems, however, which are examined below.

(a) *The various natural gas qualities*

Because of the way the natural gas supply has been developed in the Community countries, the quality differs from one area to another. In the north of the Community, i.e., in the Netherlands, Belgium and Luxembourg, most of W. Germany and north-eastern France, the quality of the gas distributed is that of Groningen gas, characterised by an upper calorific power of 8 400 kcal. In the south of the Community, i.e., Italy, south and south-east Bavaria and most of France, the supply is based on a quality of natural gas with a higher gross calorific value, of about 9 200 or 9 500 kcal/m^3. These gas qualities are not directly interchangeable, so that these two vast supply zones grew up side by side. This means that the apparatus used by the natural gas consumers in the north cannot be used in the south, and vice versa.

Security of supply is not helped by this division of the Community into two zones. Although it would be technically feasible to match the two, it does not appear to be absolutely necessary and would also be hardly justifiable from the standpoint of costs. It would therefore be advisable to examine whether, in the regions near these two zones, an interchangeability arrangement should be provided so as to ensure two-way security of supply.

The quality of the Groningen gas is in many ways exceptional. That this quality is predominant in the Community is due to the fact that the greater part of the Community natural gas reserves come from the same deposit. It is to be expected that, as new deposits are mined and as natural gas imports from non-member countries are increased, the gases with a high calorific power will steadily gain ground. This is yet another reason to encourage interchangeability of the two gas qualities in restricted zones.

(b) *Natural-gas transit*

During the next few years, forseeable agreements on the transit of natural gas will become of increasing importance. Because of the structural differences between the gas industries in the various Community countries and because of the differing legal provisions, intra-Community trade and the transit of natural gas originating in non-member countries could encounter several hurdles which should of course be examined from the standpoint of free movement of goods. After a study of the provisions in force in the various member countries in regard to natural-gas transport and transit, their harmonization could be envisaged if necessary.

(c) *Natural-gas storage problems*

Owing to seasonal variations in the consumption of natural gas, gaps which are increasing as natural-gas central heating is becoming more widespread, it is becoming necessary to construct and develop larger storage capacities in order to keep pipeline load rates as well balanced as possible. In addition to several exhausted natural gas fields which, however, only exist in certain Community regions, there are other geological formations which would serve as storage space; but the finding and fitting out of these cavities would entail high costs. The question therefore arises, whether it would perhaps be advisable to study the overall natural-gas storage capacities in the Community, taking due account of the differences in consumption, in order to attain the optimum storage situation in the Community in keeping with the geological possibilities. This study should include the question of setting up large storage installations as 'joint undertakings'. These installations would be used to store the natural gas that different firms in different member countries imported from non-member countries or from the continental shelf areas bordering the Community.

(d) *Technical trade barriers*

The legal provisions and technical safety specifications are widely divergent from one country to another. The differences in these provisions, for instance in the pipeline field, may be the source of impediments to intra-Community trade in natural gas and equipment for the transport of natural gas.

Work undertaken hitherto with a view to harmonizing the safety requirements relating to the construction of pipelines has encountered difficulties stemming from the fact that member country concepts of the general economics of such a device are often radically different. It is imperative to continue the efforts to overcome these difficulties, in view of the importance of safety legislation to the gas supply system.

4. **Taxation, aid and prices policy problems**

The fiscal system applicable to gas, the various types of tax benefits and aid and the tariff-setting systems are extremely different from one country to another. These differences can unbalance the competition situation in the gas industry and the user industries even inside the individual member countries.

(a) *Turnover tax*

As from 1 January 1973, the turnover tax will be levied in all the Member States in the form of a value-added tax.

The harmonization of these VAT rates will constitute the second stage. It is not known at the present time whether this harmonization will bring energy consumption under the normal VAT rate, as in Germany, or a special rate, as in Belgium and the Netherlands. The different Member States have various views on this matter.

(b) *Consumption-specific taxes*

Up to now, Italy is the only country with specific taxes on the consumption of natural gas. It does not seem to be advisable to introduce specific taxes on natural gas consumption in the other countries, as this would be likely to set back the efforts accomplished to stimulate greater investment in the various gas industry sectors. In this field, harmonization should aim at equal treatment for natural gas and for the other fuels. The tax now levied on fuel-oil in several Community countries is the result of an exceptional situation. The efforts of the Commission are aimed at lowering the taxes on fuel-oil while harmonizing them at the same time. A specific tax on natural gas would run counter to this effort to exempt fuel consumption from all taxes.

(c) *Municipal taxes*

In certain Community countries, municipal taxes are levied on gas supplies to the final user within the framework of very different taxation systems. Harmonization only seems possible in the context of the solution to the municipalities' financial problems. There are also other municipal and regional policy problems involved, which should be studied with a view to harmonizing the tax regulations.

(d) *Tax reliefs — Aid*

The various systems of aid and tax relief applicable in the different member countries often have different aims in view. It might well be advisable, for reasons of security of supply and protection of the environment, to harmonize them at the Community level in order to encourage the production of natural gas.

(e) *Prices*

To the extent to which they are known, gas prices are extremely varied within the Community. On the one hand, the distribution costs, which depend on several factors such as volume, regularity, storage possibilities, distances, etc., which vary from one country and one region to another, involve certain restrictions in the setting of prices; on the other hand, this situation reflects the differences in the competitive situation of gas on the national or regional fuel markets. Furthermore, in certain Member States, gas prices are directly influenced by the public authorities.

Harmonization of the provisions seems hardly possible, as the concept of the government's role in the supply of natural gas is far from being the same in each country. Nevertheless, efforts, should be made to improve price transparency and to approximate price regulations in the various countries in order to prevent distortions of competition between the different users.

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