COMMISSION OF THE EUROPEAN COMMUNITIES

Brussels, 18.10.1995
COM(95) 478 final

COMMUNICATION FROM THE COMMISSION

EUROPEAN COMMUNITY

GAS SUPPLY AND PROSPECTS

TABLE OF CONTENTS

1. Executive Summary

Introduction

1. Natural gas is increasing its market share in virtually all EC Member States. For the EC as a whole, it is expected to grow from around 19% of today's energy balance to around 26% in 2010. At the same time, as indigenous EC production declines, so dependence on imports from third countries is likely to rise significantly from almost 40% today to around 60% by 2010, and as high as 75% by 2020. Moreover, the uncertain political situation in certain of these major supplying countries gives rise to some concern.

2. The EC's natural gas industry has to date an exemplary record in the area of supply security. There is no reason to believe that this will change in the future. Member States have a responsibility for security at national level and the European Community has a responsibility at the level of the Community, especially in view of the Single Market.

3. This Communication is part of the framework set out in the Commission's Green Paper[1], and subsequent White Paper, in which security of supply is highlighted as one of the three pillars of EC energy policy. While this Communication is not intended to pre-empt further development of the legal framework related to other EC energy policy issues, such as the Internal Energy Market and Trans-European networks, it will help to inform the debate in regard to these policy matters.

4. The objective of the Communication is twofold:
   (a) to provide a platform on which to debate the future direction of the gas sector in the EC; and
   (b) to examine the issue of security of supply and to assess what may be done at EC level to enhance security of supply well into the next century.

5. The Communication is divided into three main chapters. The first looks at the gas demand and supply outlook to the year 2020, the "supply gaps" which emerge and the critical question of external relations. The second chapter examines certain market developments with reference to their possible impact on supply security. Finally, chapter 3 looks at the security measures currently available to the gas industry and assesses their effectiveness in the event of a major shortfall in supplies. There are no implications for the Community budget arising from this Communication.

6. The International Energy Agency recently carried out a study on Gas Security which covered the three main regional OECD gas markets i.e. OECD Europe, North America and OECD Pacific. This study shows there are substantial differences between these three regional gas markets, in terms of gas supply and demand and security of supply. Any conclusions specific to the European

---

[1] COM(94) 659 final

Community can only be drawn based upon a detailed analysis of the European situation of the kind contained in this paper.

7. In preparing this Communication, extensive consultations have taken place with industry, individual gas companies and Eurogas, and also with the Member States. These consultations have served to add value to the final paper.

Demand and supply prospects

8. Contracted gas supplies are more than adequate to meet projected demand in 2000. Assuming existing supply contracts are extended, there is at present a shortfall of up to 20% in contracted supplies to meet expected demand in 2010. New supply contracts, in excess of the total amount of gas presently consumed in the EC, will be required to meet expected demand in 2020.

9. However, gas supplies potentially available to the EC, both internal and external, are abundant and sufficient to meet demand well into the next century. Incremental supplies are most likely to come from the three main external suppliers, Russia, Norway and Algeria. All three suppliers have major projects to increase substantially gas exports to the EC.

10. There is no shortage of additional gas reserves accessible to the EC, for example from the Middle East and Central Asia, but it will have to be developed and transported by pipeline or LNG, over long distances with implications for cost and, in the case of pipelines, potential transit difficulties. In the long term, these factors may put pressure on gas prices which in turn could slow down the rate of increase in gas demand.

External relations

11. The EC is currently discussing strategies for the development of closer relations with some important energy producers in the FSU and issues like the conditions for access to energy products and for the construction of export outlets form part of the dialogue with these countries. The European Energy Charter Treaty provides a significant framework to encourage east-west gas trade and co-operation with existing and potential supplying countries. The construction of a framework similar to the Energy Charter, southwards, or an initiative by the Energy Charter Conference to extend the Charter process to cover other regional gas suppliers could reinforce supply security. The forthcoming Euro-Mediterranean Conference offers an opportunity to take this a stage further.

12. The consumer-producer dialogue provides a further framework to encourage closer ties with suppliers. The EC's growing import dependence and its strategic need for closer links with external suppliers should inform and motivate external relations policies with those countries. EC co-operation and technical assistance programmes, for example TACIS, PHARE and Mediterranean programmes, in the energy sector should be increasingly governed by such strategic imperatives.

13. The countries of Central and Eastern Europe face serious problems in the gas sector, not least a fragile security of supply situation stemming largely from dependence on a single supplier. These countries will look to the EC for increased trade, co-operation, integration and diversification of supply, especially with EC membership in prospect.

Market developments

14. Over recent years, there has been a tendency towards vertical integration along the gas chain, especially in the form of downstream investment by some external suppliers. This development is to be welcomed as it demonstrates an added commitment to EC markets by the suppliers in question and represents a factor for stability and security. At the same time, however, diversity of suppliers should be ensured.

15. There are a number of economic advantages which favour gas for power generation. When substituting other fossil fuels, natural gas also has important environmental advantages. As a result, the power generation sector may account for over 50% of the increase in gas use to 2010, representing almost one third of total EC gas consumption at this time. The increased demand for gas in power generation and the drive to reduce costs may encourage further direct links between power generators and gas producers as well as new price formulae reflecting the fact that coal is the main competitor to gas in this sector while the development of gas markets will allow new gas pricing concepts.

Short term security of supply at EC level

16. It is estimated that at the present time the EC could withstand an interruption from the main non-OECD exporters, Russia and Algeria, for periods of 9 and 20 months respectively. Even if a shortfall in supplies occurs simultaneously from both these non-OECD sources, the security period is almost 5 months. Full cross-border cooperation between Member States' gas industries using existing security measures is needed to ensure this level of security.

17. However, the supply situation differs considerably between Member States in terms of the natural gas share in primary energy consumption, domestic gas production, diversification of imports, degree of integration into the European gas grid, storage volumes and characteristics, market segmentation, share of interruptibles and dual-fired capabilities, LNG terminals and cross-border back-up cooperation with other gas companies. Security measures taken at national level vary as a function of these very different supply and demand situations.

18. The use of the EC dimension improves security of supply. EC gas companies already cooperate through cross-border back-up agreements on the basis of commercial considerations. The elements of an EC cooperation policy, geared to minimising the effects on consumers of a major interruption involves the use of a range of measures. These include demand reduction through the use of interruptible contracts; production flexibility, both in terms of a country's own production and imports from other EC producing countries; and use of the available storage at EC level. When applied in unison these measures increase

the gas available for internal trade at EC level as a consequence of the greater import diversity of the EC as a whole as compared to single countries.

Long term security of supply at EC level: Network integration

19. To exploit fully the security measures mentioned above, the integration of the EC gas system is a prerequisite and therefore, the interconnection of the EC gas system is crucial to maintain and assure an adequate security level.

20. While the EC grid is to a large extent integrated, thanks to the achievement of the European gas industry, there are a number of further interconnections which would enhance security. 80% of European gas reserves are located in the North Sea and the Netherlands. Pipeline projects joining the Continent from the North Sea as well as interconnections on the Continent between several Member States will provide critical improved deliverability of North Sea and Dutch supplies in the event of an interruption of supplies from Russia and/or Algeria.

21. In the event of a major shortfall in supplies, the most vulnerable Member States are Finland (Russian interruption), Greece (Russian interruption) and Portugal (Algerian interruption). However, Greece is constructing LNG facilities which will provide valuable additional security while the problem will be partially offset in Finland by dual firing capacity. Portugal may be able to cope with an Algerian interruption without LNG facilities but only if the planned new Spanish interconnection is completed and capacity in the French mainline system is increased. A long term solution for Finland would be a connection with Sweden as Nordic markets develop and any eventual development of gas supplies from the Barents Sea.

22. Also vulnerable to a lesser degree are: Spain (Algerian interruption), Austria (Russian interruption) and Italy (Russian or Algerian interruption). However, if the interconnections mentioned in section 5.3.1. are constructed and there is effective use of all the load balancing instruments, swap possibilities and reverse flows, as well as alternative LNG in the case of Italy and Spain, these Member States could maintain supplies for a considerable period.

23. In the worst case scenario and unlikely eventuality of a simultaneous interruption of both Russian and Algerian supplies, Spain, Italy and Austria become much more vulnerable. Moreover Belgium and France might also be vulnerable especially if the interconnections mentioned above do not exist.

Transeuropean Gas Networks

24. Certain of the strategic interconnections mentioned above are common interest or priority projects under the Transeuropean Energy Network programme. The development of the TEN policy will permit the enlargement of the list of common interest projects to include, as market conditions change, some of the "missing" pipeline links and storage projects identified in this report, including the needs of the most vulnerable Member States, helping to bolster EC security of supply.

Storage and interruptibles

25. Bearing in mind the long lead time required for the development of new underground gas storage, an analysis of the costs and benefits of creating more storage capacity should be undertaken to cope with the increased demand, reduced flexibility resulting from declining EC internal production and increased external dependence. This is particularly important for Member States with less mature gas markets.

26. While global figures are available, an in-depth investigation of the actual amount of industrial and power generation interruptibility among Member States is required in order to determine the true level of interruptibility and the implications for security of supply in case of a major crisis.

27. Gas and electricity utilities could share energy during periods of shortage for either gas or electricity, as it is very rare that simultaneous gas and electricity peaks occur throughout the entire EC. With the potential large increase in interruptible power load, this instrument could significantly reduce long term vulnerability of almost all Member States.

Co-operation at EC level

28. Efforts should be made to ensure that EC co-operation is at its most effective in the event of a major gas crisis. A number of ideas may be worth developing in this context. One approach could be to agree security targets for Member States which could be differentiated provided the overall security objective is assured and there is an adequate degree of burden sharing. The security targets could be established using the optimal mix of security measures available to each, including improved cross-border co-operation.

29. Whilst security of supply does not present a major problem at present, there is no room for complacency. Emergency guidelines may be drawn up at EC level to establish a common language and emergency priorities when dealing with a major gas interruption.

30. Work should continue on analysing in-depth the evolving balance of all factors affecting security of gas supply at EC level and by Member State. This should take into account the costs and benefits of the various options, and cover not only developments on the supply side but also the implementation of TENs, completion of the Internal Energy Market and developments in external relations such as the European Energy Charter.

* * *

2. Conclusions

On the basis of the analysis presented in this Communication, the Commission invites the Council to note and endorse the following conclusions:

1. Gas markets are intrinsically regional in character and the EC's security of gas supply can only be properly assessed therefore on the basis of in-depth analyses of the gas situation specific to the European region.

2. Security of gas supply does not present an immediate problem at the level of the EC although there are important differences in supply security among the Member States. The mix of security measures developed by the European gas industry, that is network interconnections, storage, production flexibility, interruptible contracts, and cross-border agreements, differs from one Member State to another. However, co-operation at EC level could enable measures to be applied in a co-ordinated manner exploiting the flexibility of the gas system to the full, and thereby improve European security of supply.

3. The EC external dependence will increase progressively over the period under review with a large share of the incremental gas coming from non-OECD countries. While there is no shortage of gas reserves potentially available for the EC to meet the large increase in gas consumption expected to the turn of the century and beyond, the incremental supplies, which may be marketed economically, are most likely to come from the present three main external suppliers, Russia, Norway and Algeria. In case new suppliers emerge, these will also be outside and increasingly distant from the EC.

4. The completion of the internal market will facilitate the integration of gas markets and thereby reinforce security of gas supply. Co-operation and solidarity at EC level will give a signal to external suppliers and transit countries, and provide further reassurance to existing and potential gas consumers in the EC, thereby strengthening the EC's security position. This will reinforce co-ordinated responses to supply difficulties, maintain and improve the image of natural gas as a reliable fuel, facilitate the realisation of the large-scale projects needed to bring gas to European markets in the years to come, and act as a deterrent to possible shortfalls in supplies.

5. The flexibility of the gas system in the EC, enhanced by the development of the Trans-European Networks, should be kept under regular review, and strengthened when necessary, in order to be prepared over time to tackle potential shortfalls in supplies within the framework of the single, integrated EC energy market.

The Commission together with the Member States, the European gas industry, and other interested organisations, will examine the various issues raised in this Communication, keep a close watch on gas developments affecting security inside and outside the EC, and report again to the Council.

* * *

3. Present and prospective EC gas supply and demand and external relations

The table below summarises EC gas supply and demand trends in the years to come.

	1994	2000	2010	2020
1. Demand (mtoe)	254	311/320	392/411	432/496
2. Indigenous Production %	61	56	41	25/32
3. Import Dependency %	39	44	59	68/75

Sources - see tables in annex

3.1. Evolution of EC gas supply and demand over the past decade.

In the last ten years natural gas consumption in the EC has risen significantly, growing by more than 38%, from 184 Mtoe in 1985, to 254 Mtoe in 1994. The share of gas in the total EC energy demand currently stands at around 19%.

Indigenous EC production grew by 25%, from 126 Mtoe in 1985, to 157 Mtoe in 1994. Demand has therefore risen more sharply than production, the balance coming from imports from the three main external suppliers, Algeria, Norway and Russia. Imports rose by 62%, from 61 Mtoe in 1985 to 100 Mtoe in 1994. External dependence thus grew from 33% in 1985 to almost 40% in 1994.

Imports from Russia increased by 150%, from 21 Mtoe in 1984 to 53 Mtoe in 1994, representing 80% of the increase in external supply requirements. In 1985, the EC relied on Russia for 34% of total gas imports. By 1994 this dependence had grown by more than one third to 52%.

Imports from Algeria increased by over one third, from 17 Mtoe in 1985 to 23 Mtoe in 1994, following roughly the same growth rate as EC demand. EC dependence on Algerian imports slightly decreased during this decade, from 28% in 1985, to around 25% in 1994.

Imports from Norway increased by just 5%, from 22 Mtoe in 1985 to 23 Mtoe in 1994. In relative terms Norway's share of EC imported supplies dropped, from 36% in 1985 to 25% in 1994.

3.2. Present EC supply and demand (ref: table 2A).

In 1994, total EC natural gas demand was 254 Mtoe. Germany and the UK are the largest consumers (around 60 Mtoe each), Italy, the Netherlands, and France, consume 30-40 Mtoe each, while Belgium, Spain, Denmark, Ireland, Austria, Finland and Sweden each consume less than 10 Mtoe. Luxembourg's consumption is only 0.4 Mtoe, while Greece and Portugal plan to introduce natural gas in the years to come.

The share of natural gas in the total EC energy balance in 1994 was around 19%. The Netherlands has the highest gas penetration (49%) followed by a group of countries situated around the EC average: Italy, UK, Ireland, Belgium, Germany and Austria. France, Denmark and Finland are below the EC average, while Luxembourg, Spain and Sweden are situated well below the EC average.

In 1995 estimated proved reserves of natural gas in the EC stand at around 3,360 Mtoe (see table 1) although the potential exists to increase these reserves through new discoveries and advanced E & P techniques. The Netherlands and the UK between them possess more than 73% of total EC reserves. A large part of the EC's natural gas reserves is therefore concentrated in N.W. Europe.

Total EC natural gas production was 157 Mtoe in 1994. EC's natural gas producers can be divided into three groups. The first is composed of the Netherlands, and the UK, each producing over 55 Mtoe each. Italy and Germany produce around 15 Mtoe each, while another group consisting of Denmark, France, Ireland, Austria and Spain, are much smaller, producing less than 5 Mtoe each. Other Member States have no indigenous natural gas production.

Current figures show a reserves to production ratio for the EC of over 20 years. However, reserves are not evenly distributed within the EC, indigenous production does not cover demand and Europe does not have a fully interconnected gas network. Some Member States, particularly those at the periphery, find themselves in a relatively isolated position.

Regarding intra-EC natural gas trade, virtually no gas is exported outside the EC. The total amount of natural gas traded within the EC in 1994 was 30 Mtoe. The Netherlands is the one large gas supplier with Denmark supplying small quantities to Germany and Sweden. The Netherlands supplies Germany, Belgium, France and Italy. The UK, the other large producer, is for the time being not connected to the Continental European gas market[2]. This will change once the UK-Continent Interconnector is completed and in operation.

The EC(15) imports 100 Mtoe in total, from four external suppliers: Russia is, the largest, supplying 53 Mtoe in 1994. Algeria and Norway have an almost equal share, around 23 Mtoe each while Libya is a very small supplier, 1 Mtoe. Germany is the biggest importer of natural gas from external suppliers, accounting for around 30% of the EC's total imports. France and Italy also import substantial volumes, while Belgium, Spain, Austria, and Finland import much smaller quantities from third countries. The Netherlands and the UK, although largely self sufficient import small volumes from Norway.

[2] With the one small exception of the UK offshore Markham field.

Dependence for the EC stands at almost 40%, but this varies significantly between Member States. Finland and Spain are almost 100% dependent while Austria and France are 80% dependent on imports from third countries and Belgium, Germany and Italy are between 50%-55% dependent. The Netherlands and the UK are below 10%, due to their large self-sufficiency. Denmark, Sweden, Ireland and Luxembourg do not import at all from outside the EC.

Dependence on non EC suppliers does not tell the whole story from a security of supply point of view. Consideration must be given to the sources of supply and to the diversity of sources.

3.3. Future supply and demand prospects (ref table 2B)

The following projections are intended as a backcloth to the chapters which follow. What is important is not so much the figures themselves but rather the trends which are revealed, especially levels of external dependence and supplies still to be contracted in the future. Data on demand is drawn from the Commission services' energy scenarios to 2020.

These scenarios explore energy futures according to different potential worlds. What is significant for the purposes of this paper is that the fundamental issues of strong gas demand growth and increased import dependence remain constant in all of these scenarios.

The environmental impact, particularly the level of CO_2 emissions does however differ according to the scenario used. Discussions of the scenarios in relation to Community energy policy, taking into account the EU's international obligations with regard to greenhouse gas emissions, will take place in more specific fora dedicated to this key issue. Moreover, it goes without saying that energy and environmental policies which emphasize greater energy saving and increased use of renewable energies will ease the problem of import dependence and hence improve the EC's security of supply.

For the object of the Communication which concentrates on gas supply issues, average figures or ranges have been used in order to draw out the main messages.

3.3.1. 2000

Demand is estimated to rise by 22-26% to 311-320 Mtoe. By this time natural gas will have been introduced in Greece and Portugal. Gas penetration may increase in Germany, Spain, Italy, the UK and Sweden. Gas will represent around 22% of the EC's total primary energy consumption.

EC natural gas production is projected to increase by 11% to around 175 Mtoe. Production thereafter may start to decline. The Netherlands may still be the largest producer, followed by the UK, these two countries representing together around 80% of the EC's total production. Denmark may also increase its

production while production in Italy, Ireland, Germany, France and Austria is expected to decline.

The total amount of natural gas traded within the EC could be around 30 Mtoe, with the Netherlands still accounting for the vast majority. By this time the UK-Continent Interconnector should be in operation, potentially supplying up to 18 Mtoe annually to markets on the Continent.

The EC is projected to need to import at least 136 Mtoe from third countries, representing a 36% rise. Contracted supplies for the year 2000 show that for the EC, as a whole, there may be a gas surplus at this time. In 2000, EC dependence will have risen to around 44%, with marked differences still apparent between Member States. Ireland, Sweden and Greece for the time being do not have contracted supplies to meet fully projected demand levels in 2000.

3.3.2. 2010

Demand is estimated at between 392 to 411 Mtoe, representing an average rise of 27% from 2000. Natural gas may replace obsolete nuclear power generation in the UK, Sweden and Germany. Spain and Italy may also sharply increase gas use in power generation. Gas could represent as much as 26% of the EC's total primary energy consumption.

EC natural gas production may decline by 6% from 2000 to around 165 Mtoe. The UK may continue to increase its production, to reach more than 50% of total EC production. It is likely however that by this time UK production will be used exclusively for domestic purposes and may not entirely cover projected demand. Dutch production may be in decline by this time.

The total amount of gas traded inside the EC, may fall to around 28 Mtoe, with the Netherlands still supplying almost all of it, while Denmark may provide small volumes to Germany and Sweden.

The EC may by this time have to import at least 227 Mtoe, representing a 70% rise over 2000. The EC will still have three main external suppliers. For the purposes of this assessment, the assumption is made that supply contracts expiring between 2000 and 2010 will be renewed. In this case the total amount of contracted supply will be about 168 Mtoe; Russia may account for 66 Mtoe, Norway for 57 Mtoe, Algeria for 40 Mtoe.

By this time EC external dependency may have risen to nearly 60% with Finland, Greece, Portugal and Spain totally dependent on external supplies and, France, Germany, Italy, Austria and Belgium heavily dependent. By this time it is possible that the UK-Continent Interconnector may be being used to bring imports into the UK.

In the case of Ireland and Sweden almost all gas has yet to be contracted to meet projected gas demand, while Greece presents a 50% deficit. In the case

of Portugal one third of the demand has still to be contracted, while for Italy, Germany and the UK demand may be between 10%-20% higher than contracted supplies and indigenous production. For the EC as a whole, up to 20% of expected demand will have to be filled by new import contracts, either from traditional or new suppliers.

3.3.3. Beyond 2010

All EC Member States face a shortfall to a greater or lesser extent in contracted supplies. For the EC as a whole, declining indigenous production combined with an expected large increase in demand may lead to an EC import dependence of up to 75% by 2020. The new supply contracts required to meet expected demand in 2020 could well be in excess of today's total EC gas consumption level.

3.4. The external dimension

3.4.1. Relations with external suppliers

The potential of the EC's three main external suppliers (Russia, Norway and Algeria) is large enough to cover much, if not all of this incremental demand. In addition, new suppliers will sooner or later enter the EC gas market. Small LNG quantities have already come from as far afield as the Gulf countries and Australia. By 2010 Nigeria may be providing Italy and Spain with LNG. In addition there are pipeline and LNG projects which might eventually bring gas to Europe from the Middle East, Central Asia, and even Central and Latin America. It has been estimated that some 200 mtoe per year of gas is available to European markets under these various new projects.

In any case, in the future more and more gas will have to be transported increasing distances to EC markets. Large investments, in the order of several billion ecus, will have to be made in order to establish production facilities and create the necessary pipeline and/or LNG infrastructure. As distances increase, so do costs and the security risks associated with transit across national borders. These factors may eventually put pressure on gas prices which in turn could affect gas demand in the long term.

The EC's import dependence will in any case increase considerably, making the EC dependent for an increasing share of its total gas demand on non-EC countries. Norway, a member of the EEA and the OECD, will remain a major EC gas supplier in the years to come. It is important to encourage close ties and friendly relations with the main non OECD suppliers, Russia and Algeria and also any new suppliers. Downstream integration in EC gas markets by external suppliers may strengthen security of supply (see chapter 4).

The European Energy Charter Treaty provides a significant framework to encourage energy trade and cooperation with signatory gas supplying countries, such as Russia, the New Independent States of Central Asia and of course Norway. The provisions of the Treaty on transit are especially important in the light of the EC's growing gas import dependence. The construction of a

framework similar to the Energy Charter southwards, or an initiative by the Energy Charter Conference to extend the Charter process to cover other regional gas suppliers could reinforce supply security. The forthcoming Euro-Mediterranean Conference offers a suitable forum to take this a stage further. In addition, the on going consumer-producer dialogue provides a further framework for stability and the establishment of closer ties.

The way to long-term security of supply is the diversification of supply sources and routes together with an external relations policy which encourages close links and mutual dependence between the EC and its external suppliers. The EC's growing import dependence and its strategic need for close ties with certain key external suppliers should motivate the EC's external political and commercial external relations policies with those countries, including technical assistance programmes. These programmes already include EC projects aimed at the rehabilitation of gas production, for example, projects launched under the TACIS programme for the Newly Independent States, and the promotion of energy efficiency.

3.4.2. Central and Eastern European Countries (CCEE) (ref: Table 2C)

In the time horizons considered in this report, many of the CCEE should become members of the EC. Excluding large international transit pipelines, it is estimated that CCEE countries will require at least 3 billion ecus of investment funding for transportation and storage projects over the next 15 years as well as around 100 million ecus for technical assistance associated with these projects. Moreover, CCEE countries will remain heavily dependent on gas imports from Russia, especially as indigenous gas production in the region declines in absolute terms, bringing the question of supply security sharply into focus. CCEE countries will be looking increasingly westwards to the EC to help solve their problems in the form of increased gas trade, integration and co-operation as well as economic assistance. The CCEE countries occupy a strategic location on the main transit routes linking eastern reserves with EC markets which should not be overlooked.

* * *

4. Market developments and implications for security of supply

This chapter aims to touch upon some present market developments which may affect security of supply.

4.1. Developments in the power generation sector (ref: table n° 3)

According to most projections, the power generation sector will account for over 50% of the increase in gas to 2010. It is thus useful to examine this phenomenon in more depth.

An EC Directive prohibiting the use of gas for power generation, giving instead priority to domestic and industrial uses, was withdrawn in 1991. The use of gas

for electricity production in recent years has increased due to the economic and environmental advantages of gas.

New developments in technology and the introduction of advanced materials have resulted in the introduction of Combined Cycle Gas Turbines (CCGT) in power generation. CCGT power plants have a much higher production efficiency, above 50%, than conventional gas turbines (around 35%), or coal fired plants (around 40%).

The cost of building and maintaining the gas-fired power plants is another advantage. Small and compact preassembled gas fired units, can be built in a much shorter time span than coal fired, or nuclear plants. This enables power generators to monitor and match electricity supply and demand more closely and therefore in a more cost effective manner.

The use of natural gas for power generation substituting other fossil fuels, presents a number of important environmental advantages as well, including lower CO_2, SO_2 and NO_x emissions, while dust emissions and waste are negligible. Natural gas is itself, however, a "greenhouse" gas and therefore particular attention must be given to the reduction of leakage at all stages of the production, transmission, distribution and utilisation chain.

Due to these advantages, gas use for power generation may increase from around 15% of total gas demand today to 32% in 2010 and perhaps even higher by 2020.

This increased share of gas in power generation and the drive for cost efficiency may encourage further direct links between power generators and gas producers as well as new price formulae to reflect the fact that coal is the main competitor to gas in power generation while the development of gas markets will allow new gas pricing concepts.

A precondition for direct purchases of this kind will be access to the transmission infrastructure to ensure reliable deliverability and the availability of surplus capacity in that transmission system. A few such direct contracts are already in place, mainly involving Norwegian gas suppliers on the one hand and the electricity undertakings, SEP in the Netherlands, Scottish Power and National Power in the UK on the other, but also between the Algerian producer Sonatrach and the Italian electricity utility ENEL.

4.2. Developments in the large industrial sector

For energy-intensive industrial undertakings environmental charges account for an increasing share in their cost structures and are therefore an important factor in the drive to remain competitive. Minimising environmental costs by the increasing use of natural gas, is already common in Member States which have strict environmental standards. The more mature the market, the less the geographic location of the large consumer will constrain the choice of supply. Contractual relations other than long term could develop which could add

flexibility and diversity to the market. The opportunity to build pipelines and the benefits of more competition upstream may give possibilities for large industrialists or groups of industrial undertakings to participate financially in supply projects which in turn might enhance diversification of supply sources.

4.3. Vertical integration along the gas chain

External suppliers are increasingly investing downstream. Downstream investments take the form of joint ventures of various kinds, participation in transmission companies, investments, direct sales to end users, and agreements on transfers of technical know-how. The most notable current examples are the Norwegian gas suppliers and Russia's Gazprom.

Norwegian gas suppliers' downstream activities allow them to accommodate new gas export volumes. Examples of this policy are the Netra joint venture and the small stake taken in the VNG transmission company, all in Germany, and the emergence of a gas marketing joint venture, Alliance Gas, with BP, in the UK. The increased role of Norwegian suppliers should enhance the deliverability of gas to European markets, which in turn will have a positive effect on security of supply.

Recent years have seen an increased presence of Gazprom in the markets of Western, Central and Eastern Europe. Examples of such joint ventures are Wingas in Germany, Prometheus in Greece, Gasum in Finland, the UK-Continent Interconnector, EuroPolGas in Poland, Panrusgas in Hungary and Volta in Italy. The formation of joint-ventures of this type is assisted by the opportunities created in these countries for external suppliers, and by Gazprom's historical links with Eastern Europe. Gazprom also owns assets in Moldova and Belarus. Whether Gazprom can fulfil its apparent strategy of increasing its downstream involvement in European gas markets will depend upon a number of factors including political developments in Russia, future revenues from gas sales and the availability of investment funds.

Sonatrach, the Algerian gas supplier, appears to be concentrating more on attracting the technological and financial resources needed to develop production, and not for the time being on downstream investments.

While the upstream involvement of EC gas companies is less common than the downstream involvement of gas producers, there are cases where the transmission companies are looking to gain access to gas reserves. There are also indications that oil companies are devoting more attention to gas projects than in the past. Implementation of international treaties like the Energy Charter Treaty and/or financial needs of external suppliers will, in the future, facilitate such a development.

It may be argued that security of supply benefits from the vertical integration, downstream and upstream. The added value derived from downstream and upstream investment indicates a greater commitment to the market in question and therefore to providing it with a regular and reliable supply of gas. However,

downstream investment by external suppliers could carry risks if not counterbalanced by the presence of alternative suppliers.

4.4. Horizontal integration in the gas market

The process of horizontal integration at the distribution level, in particular in the smaller Member States (examples are the Netherlands, Denmark, Belgium) was prompted by the Single Market. It is forcing utility service companies to economies of scale in the form of mergers or other forms of co-operation, enhancing efficiency and cost control in combining their gas, electricity and in some cases other public services. In other Member States, there has been a tendency towards fewer but bigger and more diversified and integrated regional or local utilities.

Differences in the industrial and commercial culture between the European electricity and the gas industries has been a reason why cross shareholdings or joint activities, for example in new gas fired generation capacity or gas transmission lines, have been slow to develop. The increase in gas-fired generating capacity could well lead to change in the next few years, given the potential mutual benefits and risk limitations for both industries. In the UK, for example, electricity distribution companies have taken advantage of the liberalised environment to secure direct access to North Sea gas supplies for power generation and to enter the gas supply market, often in the form of consortia.

4.5. Gas pricing mechanisms

Gas prices to final consumers in continental Europe are determined by using two approaches, the cost-based pricing method and the market value pricing system, with indexation mechanisms linking gas prices to the prices of the alternative competing fuel(s).

In a number of contracts for gas sales in the electricity generation sector, new pricing formulae have been used. Indexation clauses, for example against coal, electricity, general inflation have been developed as an alternative or in addition to oil-linked indexation and new pricing concepts could develop. Any decoupling of gas from oil prices in the power generation sector with the present market structure may not necessarily lead to lower gas prices. To avoid the greater volatility of oil-linked gas prices, power producers may be inclined to pay a premium for gas when the price of this is linked to a more stable fuel like coal. Moreover, the alternative fuel for electricity generation in the case of CHP and CCGT is light oil distillates which means gas is priced at a premium in this instance. These developments could facilitate the implementation of new gas supply projects.

In the UK gas prices are decoupled and determined by market forces of gas supply and demand for commercial, industrial and power generation users. Competition among suppliers determines the gas price, while the alternative for consumers is a wide range of competing gas suppliers. In addition to oil, other

forms of indexation can now be found. Spot market deals have emerged and it seems only a matter of time before reference to spot market prices for longer term gas contracts will occur.

* * *

5. Security of supply at EC level

5.1. Introduction

Gas security of supply may be defined as the ability of the gas system to provide a continuous and reliable supply of gas to customers on an economic basis and to cope with interruptions whether of a technical, economic or political nature.

Despite its advantages as a fuel, gas would not have won its significant position in the energy market if customers had not been able to depend on it for their needs. Demonstrated security of supply has ensured the growth of the industry to its present importance in a number of European countries and will help markets to develop in other countries of the EC.

Over the years, companies have developed packages of measures, geared to the requirements of their business, for both the long and the short term. Security of supply has a price. The challenge of the gas industry is to ensure the optimal balance between risk-minimising measures and the price which the market is prepared to pay. Long term measures include forward planning of markets and supply volumes, diversification of supply, storage and interruptible customers[3]. Negotiations on import contracts and the undertaking of large construction projects with long lead times are also part of a company's regular activities to maintain supplies. In the shorter term, security of supply is achieved through efficient management of the transmission and distribution networks and operational decisions to meet changing demand levels. Decisions to secure supply to customers are as much part of routine management as of long term strategy.

The increasingly interconnected grid and the integration of markets will tend to result in natural gas markets in Europe with a dimension larger than a national one. The Commission, in its Green Paper, has stated that this increasingly interconnected European gas grid and the diversified nature of the gas infrastructure and sources of supply among Member States require that advantage should be taken of the Community dimension to enhance security of supply. The Green Paper goes on to say that short-term security of supply in the gas sector requires a careful and in-depth examination of the specific measures necessary to respond to a gas supply crisis. This chapter is a first

---

[3] Gas companies supply to some of their bigger customers on the basis of interruptible contracts which allow them to reduce the demand during periods of peak consumption. These interruptible customers are generally industries and power generation plants which, in exchange for a lower gas price, have backup fuels and facilities with which to face the gas interruptions.

attempt to do this, analysing security of supply from the point of view of the EC single market as a whole.

5.2. Short term aspects of security of supply in the EC

A diversified situation

The supply situations differ considerably between countries in terms of levels of indigenous natural gas production, diversification of imports, degree of integration into the European natural gas grid, storage volumes, market segmentation, share of interruptible supplies etc. Security measures taken at national level, in order to safeguard gas supplies, vary as a function of these very different demand and supply situations within the EC. As a result, short-term shortfalls in supplies in all European Community countries can be prevented or coped with in one way or another. Information collected and consultations with the gas industry demonstrate, at least qualitatively, that the current operational practices, contractual arrangements and supply infrastructure are adequate to cope in the short-term with a major shortfall in supplies to one external supply source, at least in the more mature European gas markets. Over time this will also be the case for the newer markets where similar infrastructures and practices are developing.

The measures available to ensure supply security vary widely between Member States as shown in table n°4 in annex.

Crisis simulation

In the case of a major shortfall in supplies, a combination of measures can be taken with the object of minimising the effects on consumers. Such measures include the use of interruptible sales contracts, flexibility of supply from both indigenous production and imports, underground storage and mutual assistance and co-operation between neighbouring gas companies. A study undertaken by the Commission services in consultation with the gas industry takes into consideration the effect of these individual security measures on the overall security of the EC. When evaluating the EC dimension, it has been assumed that full cross-border co-operation between gas industries which are interconnected has been fully utilised. The demand and supply conditions prevailing during the first quarter 1994 were taken as a basis, being the most recent year for which detailed information is available. This period is not representative of the most severe weather conditions so that results should be considered as indicative only.

The risk of supply shortfalls from Norway, an EEA and OECD member, has not been considered.

According to the origin of the shortfall in supplies, the results of the exercises are as follows:

<u>shortfall in supplies from the FSU</u>

The application of the security measures concerned (interruptibles and production flexibility) only by the countries directly affected by the shortfall in

supplies, have an effect equivalent to a 29% reduction of the EC imports from the FSU.

Co-operation and joint implementation on a Community-wide basis of the same security measures to use the added value of the EC dimension, increases this figure to 36% of the EC imports from this source. The EC storage cover is, in this case, 283 import days[4] .

shortfall in supplies from Algeria

Under the same assumptions the effect of the security measures is equivalent to a 26% reduction of the EC Algerian imports when applied individually by the countries concerned by the supply cut but a 56% reduction when the added value of the EC is taken into consideration. The corresponding EC storage cover is 625 import days of Algerian gas.

shortfall in supplies from all non-OECD suppliers

Co-operation on a Community-wide basis would reduce the overall non-OECD import needs by 21% and the EC storage cover would be of 136 import days.

Conclusions from the analysis may be drawn as follows:

- The interruption of supplies from a main non-OECD supplier are solved more effectively when there is co-operation at a European level to cope with the supply shortfall. Therefore, the use of the EC dimension improves security of supply.

- EC gas companies already co-operate through cross border back-up agreements. However, there is little available data on them and it is not possible to establish if they would exploit the EC dimension to the full in the case of crisis affecting several Member States.

- The elements of such EC co-operation involve the use of measures such as demand reduction through the use of interruptible contracts; production flexibility, both in terms of a country's own production and imports from other EC producing countries; trade of gas made available as a consequence of the greater import diversity of the EC as a whole as opposed to single countries; and use of available storage at EC level.

- To exploit fully the measures mentioned, the full interconnection of the EC system of transmission lines linking the different EC sources of supply is crucial.

As an example, the effects of the planned UK - Continent Interconnector on security of supply have been analysed. During the reference period, in the case of a FSU cut in supplies, the Interconnector would allow for a partial substitution

---

[4] Cover days are calculated by dividing the estimated strategic storage capacity by the volume of FSU imports per day needed after applying the security measures.

of the supplies lost from this source. In that way, the EC imports from the FSU could be reduced by half and the EC storage cover increased a further 6 months.

- Use of the measures referred to above, exploiting the EC dimension to the full, would take place in the normal commercial and operational environment in which the gas industry functions. However, though higher prices will ensure that markets clear, even in a crisis situation, this may create political strains. Consideration should be given to emergency guidelines at EC level which might help to tackle such problems in an orderly manner.

5.3. Long term aspects of Security of Supply in the EC

The supplies available at any given time are a function of the deliverability of all available sources to the EC. The actual proven reserves of gas available to the EC from the EC's own production plus Norway provide security, but proven reserves are no indication of current deliverability. Short term security of supply is dependent on deliverability and available pipeline and storage capacity. Long term security of supply is more a function of marketable proven reserves and long term planned increments to pipeline and storage capacity.

To maintain security of supply in an expanding market, strategic decisions to develop new sources of gas and to enhance the pipeline and storage infrastructure must be made years in advance. The short term and long term perspective of gas security are in fact interrelated.

The following analysis examines the security of supply implications of further interconnections within the European network and alternative sources of supply as well as the load balancing needs and potential in terms of storage and the interruptibles market. The information provided by Member States on gas transport and storage infrastructure under Council Regulation 1056/72[5] is a starting point in such an analysis.

5.3.1: Network integration possibilities

Additional interconnections between European transmission grids and alternative interconnections with sources of supply will improve the transmission deliverability and will provide additional diversity of supply. Further integration of the European grid will improve the key elements of security of supply - improved gas market interruptibility, increased storage capability, improved economic feasibility of distant supply sources and potentially improved flexibility in producer contract negotiations (see map in annex of existing network and pipeline projects).

There are a number of key interconnections which will be vital to increased security of supply. Approximately 80% of European reserves are located in the North Sea and the Netherlands. Therefore, the critical issue is the ability to

[5] OJEC L120 25.5.72 p.7

deliver these reserves. The two most important elements of this deliverability are production capability and pipeline capacity.

The EC is well placed with regard to the geographical distribution of world reserves: 70% of all known gas reserves are less than 4000 to 5000 kms from the centre of Europe. In addition to the three largest suppliers, others are starting to emerge in the Middle East, Latin America, Africa and Central Asia.

The analysis in Annex I emphasises interconnections which maximise transmission deliverability from the North Sea and the Netherlands which are considered the most reliable sources in case of a shortfall in supplies from Russia, Algeria or both. It also reviews the most significant new supply projects.

5.3.2. Producer Incentives on Security of Supply

Sufficient transmission deliverability is only useful if there is adequate supply potential. The proven reserves of the North Sea production area appear to be more than adequate to meet any shortages for a substantial period. However, proven reserves do not necessarily imply supply deliverability which requires that the reserves are "onstream", with production capability in place.

Production deliverability from the North Sea has been expanding in recent years. In particular, production from the UK offshore has been expanding at a rapid pace. Norway is about to bring the massive Troll platform into production, significantly enhancing Norwegian deliverability.

However, some exploration and production policies currently inhibit producer incentives. Policies requiring state participation in exploration and production, the landing of gas onshore, the national transmission company right of first refusal, and exclusive rights over a gas production area are all examples of policies which may hamper overall supply deliverability.

The EC Exploration and Production Directive (94/22/EC)[6], and the implementation of the European Energy Charter Treaty will assist in providing producers with greater opportunities to explore and produce within Western Europe.

5.3.3. Storage and Interruptibility (ref. table 4)

Another important ingredient of security of supply is swing deliverability which comes primarily from storage and interruptibility. These associated instruments in the sales and transportation of gas are utilised to make up differences in the production and consumption streams.

---

[6] Directive 94/22/EC of the European Parliament and of the Council of 30 May 1994 on the conditions for granting and using authorizations for the prospection, exploration and production of hydrocarbons (OJEC L.164).

The development of **storage** in Western Europe has largely tracked the development of gas markets in each of the individual countries. Countries which have domestic supplies have a different approach from countries which rely heavily on imports as the former can rely on the production flexibility of their own gas fields.

Member States in the EC rely extensively on storage to meet winter peak demands. Current storage can at maximum cover two months of peak winter demand. However, storage capacity alone does not necessarily demonstrate which countries are most vulnerable. Member states have different approaches to security of supply as discussed in the sections above.

Historically, Europe's own large gas fields provided both short and long term supply security. In the long term as the fields begin to decline, this cushion of security will progressively diminish.

The future storage plans of the gas industry will almost double the total existing working storage volume of the EC in a time horizon from 2000-2015. However, while this expected increase is higher than the expected gas demand increase, the level of storage relative to external import dependence will be lower in 2010 than today.

Storage projects are long term projects and therefore an analysis of the costs and benefits of creating more storage capacity should be undertaken to cope with the increased demand, reduced flexibility inherent in declining EC internal production and increased external dependence. This is particularly important for the less mature gas countries.

Similar to storage, **interruptibility** plays a key role in swing deliverability, and as such, interruptible customers provide a critical role in meeting security of supply needs.

Most European transmission companies maintain a significant amount of industrial and power generation interruptible customers. Interruptible contracts typically vary in length from one week up to three months or the entire heating season.

Transmission companies tend to aim to maintain a high quality of service to large industrial users in order to convince them not to switch to fuel oil. Different types of interruptible contracts exist in the Member States and the use of them also seem to vary greatly among them. Industrial sectors affected would be different from country to country and so priorities of interruption need to be analysed. In order to determine the true level of interruptibility and the implications for security of supply in case of a major crisis, an investigation of the actual amount of interruptibility among Member States would be required.

5.3.4. Mutual support of gas and electricity systems

Power generation gas use could play a future role in improving security of supply in the EC. For example, if a significant percentage of the power generation market was equipped with long term dual fuel capability, such that a large number of power generation users were capable of performance without gas for a portion of the winter season, the security of supply implications would

be significant. The forecast increased share of CCGTs in the generating system may however limit this flexibility as in the case of CCGTs the alternative fuel used is higher value gas oil.

The power generating capacity of electricity utilities usually includes a reserve margin necessary to ensure system reliability. This excess generating capacity allows flexibility in the choice of individual generating units. Therefore, if the availability of natural gas to a particular region is reduced it is usually possible to reduce the load on gas fired generating units and shift the load to non-gas powered units so as to accommodate the reduced gas availability or to make more gas available for end users other than electricity generation. Thus, significant substitution exists within each power network.

Another consideration is the lack of constant demand for electric power. Demand varies both on a seasonal, daily and hourly basis. Such variations are also not identical from region to region in Europe due to a number of factors such as weather, regional primary fuel mix, levels of industrialisation and the local prevailing utilisation of technologies. Therefore, if one region in the EC is experiencing a reduced availability of natural gas, the electric transmission system can allow for power to flow into that region from other regions which may have a more secure gas supply or excess non-gas powered generation capacity. By utilising the electric transmission system, a local reduction in gas availability may be accommodated to some extent by the substitution of electricity from one region to another. The role of energy sharing combined with the anticipated gas fired power generation growth appear to be powerful tools to be utilised in addressing security concerns, and should be investigated further.

5.4. Transeuropean Gas Networks

The above section has put in evidence the importance of an integrated EC gas system (networks and storage) to improve supply security.

The EC Treaty introduced, in Art. 129B, a new Community policy on Transeuropean networks including energy networks.

Some of the strategic projects of network interconnection and storage projects mentioned in the above section have in fact already been agreed by the institutions of the Community as common interest or priority projects as they fulfilled the criteria set down in the implementing TEN regulations, including the economic viability requested.

The continuation of this policy in the future will allow the Community's institutions to set priorities on other projects which are equally important from a security of supply point of view, and may include some of those projects referred to above.

5.5. Co-operation at EC Level

The above analysis shows that the Community dimension could have added value when dealing with potential major gas supply shortfalls. It seems, therefore, appropriate to consider ways to verify and improve existing co-operation in this area.

- Work should continue on analysing in-depth the evolving balance of all factors affecting security of gas supply at EC level and by Member State. This should take into account the costs and benefits of the various options, and cover not only developments on the supply side but also the implementation of TENs, completion of the Internal Energy Market and developments in external relations such as the European Energy Charter.

- A number of ideas may be worth developing in this context with Member States, the European gas industry and other interested organisations, namely:

1. The United States, which is largely self-sufficient with regard to gas supplies, has a curtailment plan, used by the US Federal Energy Regulatory Commission, which provides useful guidance on an equitable approach to interrupting customers according to priority of need. A similar plan may be appropriate as EC Emergency Guidelines which each Member State is encouraged to implement, taking into account national characteristics.

2. Some national transmission companies already have what are known as Mutual Assistance Agreements which could be structured in order to meet a recommended curtailment plan. However, it would be desirable to investigate how to optimise these Mutual Assistance Agreements from an EC perspective and to ensure that such agreements are enforceable at times of crisis.

3. Another approach could be to establish Security Targets. For example, a target might be that each Member State would ensure that they have either sufficient storage, interruptible capability, production/import flexibility, internally or through back-up or other arrangements for access to supply in other Member States to cope with an interruption of supply from the non-OECD suppliers during the 6 winter months. Another target could be to establish the provision of "x" days of total gas consumption. These targets could be differentiated provided the overall security objective is assured and provided there is an adequate degree of burden sharing. The Security Targets approach would require an investigation into which are the most vulnerable Member States and what are the potential damages in case of a gas loss. The analysis could then concentrate on the most economically feasible mechanisms for each Member State, including the added value offered by full use of the EC dimension.

These various approaches need to be discussed fully with Member States, the gas industry and other interested organisations before any EC guidelines could be drawn up.

TABLE 1

EC PROVEN GAS RESERVES (1994)
in Mtoe

BE - Belgium	---
DE - Germany	342
DK - Denmark	121
EL - Greece	---
ES - Spain	20
FR - France	35
IRE - Ireland	17
IT - Italy	301
L - Luxembourg	---
NL - Netherlands	1874
O - Austria	21
P - Portugal	---
SF - Finland	---
S - Sweden	---
UK - United Kingdom	630
EUR 15	**3361**

Source Oil and Gas Journal 1995

Table 2A

Break-down by Member States for 1994

	BE	DE	DK	EL	ES	FR	IRE	IT	L	NL	O	P	SF	S	UK	EUR 15
1. Natural gas demand (mtoe)	9.5	61.2	2.7	-	6.2	29.2	2.2	40.7	0.4	32.6	4.9	-	3.3	1.3	60	254
2. Share of natural gas demand %	19.2	18.0	12.9	-	6.6	13.0	21.6	27.6	3.5	49	19.1	-	10.3	2.5	26.7	19.4
3. Indigenous production in Mtoe	0	14.0	4.3	-	0.1	2.7	2.2	16.4	-	59	1	-	-	-	57.9	157.6
4. Intra-EC exchanges in Mtoe	4.2	17.8	-2.5	-	-	3.2	-	3.9	0.4	-28.7	-	-	-	1.3	-	-
5. External dependency a) mtoe	5.3	33.5	0	-	6	22.7	-	20.6	-	2.3	3.9	-	3.3	-	2.4	100.1
b) %	56.8	54.7	-	-	96.7	80	-	50	-	7	80	-	100	-	4	39.4
of which in mtoe Algeria	3.5	-	-	-	4.0	6.9	-	8.9	-	-	-	-	-	-	-	23.3
Libya	-	-	-	-	1.1	-	-	-	-	-	-	-	-	-	-	1.1
Norway	1.9	9.4	-	-	0.9	6.3	-	-	-	2.3	-	-	-	-	2.4	23.2
Russia	-	24.1	-	-	-	9.5	-	11.7	-	-	3.9	-	3.3	-	-	52.5

Totals do not add up due to storage
Sources: Eurostat, EC Commission, IEA

TABLE 2B

EC GAS DEMAND AND SUPPLY SCENARIOS

	2000	2010
1. Natural Gas Demand (mtoe)	311/320	392 / 411
2. Share of Natural Gas in total demand (average)	22%	26%
3. Estimated Indigenous Production (mtoe)	175	165
4. Intra EC Gas Trade (mtoe)	30	28
5 External Dependency - mtoe	136/145	227 / 246
- %	44/45	58 / 60
6. Contracted Volumes * - Russia	66	66
- Algeria	39	40
- Norway	48	57
- Others	5	5
- Total	158	168
7. Deficit mtoe	-	-59 / -78

Sources: EC Commission (2020 analysis)
Member States
IEA
* mtoe

TABLE 2C

GAS SUPPLY AND DEMAND - COUNTRIES OF CENTRAL AND EASTERN EUROPE[1] IN MTOE

	1993	2000[2]	2005[2]	2010[2]
DEMAND	**62**	**67**	**71**	**81**
PRODUCTION	**28**	**22**	**18**	**16**
IMPORT REQ.	34	45	53	65
SUPPLY[3]	41	41	41	41
Total gap		**4**	**12**	**25**

Source: EC Commission

---

1) Includes Albania, Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia.

2) The central scenario between high and low scenarios.

3) (assuming a long term supply commitment of 41 Mtoe/yr of CIS gas imports through the existing infrastructures)

TABLE 3

GAS IN POWER GENERATION

	EUR 15
mtoe **PRESENT** % of PG in total gas demand	39.0 15.3
mtoe **2000** % of PG in total gas demand	83-102 27-32
mtoe **2010** % of PG in total gas demand	150-154 37-38
mtoe **2020** % of PG in total gas demand	161-216 37-43

Sources: EC Commission (2020 Analysis)

Table N°4

Diversity of Supply Situations and of Security of Supply Measures Applied in EC Member Countries

	Austria	Belgium	Germany	Denmark	Spain	France	U.K.	Italy	Ireland	Netherlands	Sweden	Finland	Average/ Total
Natural gas sales in Mtoe	4.9	9.5	61.2	2.7	6.2	29.2	60	40.7	2.2	32.6	1.3	3.3	253.8
Natural gas share in PEC (%)[1]	19.1	19.2	18	12.9	6.6	13	26.7	27.6	21.6	49	2.5	10.3	20.5
Domestic gas production (%)[2]	20	0.0	22.9	100.0	3.2	9.2	96.5	40.3	100.0	100.0	0.0	0.0	62
Net non-EC import dependency (%)[2]	80	56.8	57.7	0.0	96.7	80	4	50	0.0	0.0	0.0	100.0	39.4
Number of supply countries, incl. inland production	4	3	5	1	5	5	2	4	1	3	1	1	14
Number of inlet points for cross-border/shore supply	3	6	some 15	1	4	5	5	many	2	5	1	1	many
Share (%) of gas sold for power generation	33.4	26.7	21.2	6.4	7	2.9	7.3	20.3	45	26	16.8	51.2	15.3
Share of interruptible sales in 1993(%)	na	27%	na	industry 25% All power pls.	17%	Industry 20%	16%	Industry 25% Some power pl.	na	Some power pl.	10-20%	90%+	na
Formulated security of supply policy?	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Number of storage facilities	6	3	33	2	1	15	7	8	0	1 (LNG)	0	0	77
Maximum working volume, mill m³	2,500	527	10,314	440	460	10,300	3,566	14,000	0	appr. 75	0	0	42,200
Maximum withdrawal capacity, mill m³/day	23.3	appr. 19	262	18	3.6	170	141.8	appr. 250	0	appr. 31	0	0	appr. 920
Storage volume in % of 1993 sales	33.8	4.7	14.4	15.3	5.1	28.1	5.6	28.0	0.0	0.2	0.0	0.0	13.9
Extension of storage capacity planned[3]	yes	1,100	19,000	1,200	4,500	14,000	yes in function of market	21,000	under study	7,000	R&D in lined rock caverns	Has been studied	73,900
Back-up cooperation with other companies?	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Special features	Large storage capacity in depleted fields	Gas grid increasingly interconnected	Well integrated. Balanced supply	Self sufficient. Storages	Increasing storage capacity	Large storage capacity in aquifer structures	Well integrated. More than 50 fields	Large storage capacity in depleted fields	Interconnected with UK system	More than 130 fields + Groningen	Small market with dual firing back-up	Few but large customers. SNG plants	

1) PEC = Primary Energy Consumption
2) In % of total gas supply
3) The future storage volume referred to in this line is the expected working volume at different points in time over the 2000-2015 time horizon.
Sources: Eurostat and Eurogas

Potential Interconnections to improve North Sea and Netherlands deliverability and significant new supply projects.

The potential interconnections, ranked in terms of probability of construction, are the following:

North Sea supply interconnections

- Europipe***
- UK/Continent Interconnector***
- Norwegian pipeline to Dunkirk***
- Interconnections between the Dutch offshore and the UK offshore*
- Interconnections between Zeepipe and Dunkirk to the UK and other places on the continent*

Continental Europe interconnections

- Interconnections between Spain and Portugal***
- Looping and further interconnections between Belgium and German, French and Dutch systems***
- Additional French/Spanish interconnections (Maghreb II)*
- Enhancement of TENP (Trans Europa Naturgas Pipeline) from the Netherlands to Italy or Italian/French interconnection in the north*
- Southeast France/Northwest Italy interconnection*
- Finland/Sweden interconnection*
- Extension of Maghreb II to Germany or increase capacity in the French mainline system*
- Additional Austria/Germany interconnections or looping*

*** Under construction or planned with a high probability of construction
** Planned construction but still in the development stage
* No firm plans for construction

North Sea Interconnections

The Europipe, due to come onstream this year with an annual capacity of 12bcm[7], will increase the flow of North Sea gas to Germany.

The proposed UK/Continent interconnector will allow up to 20 Bcm annually to be delivered to the Continent with economically viable access to most of the North Sea. It is anticipated that surplus deliverability will be available from the North Sea via the Interconnector from 1998. The UK/Continent interconnector is a strategic pipeline. The parties constructing the line are providing the

[7] 1 billion cubic metres (bcm) is equivalent to 0.9 million toe.

capacity prior to assurances of dedicated downstream markets, thus taking the risk that they will find a market once the pipeline is built.

The planned pipeline from the Norwegian sector of the North Sea to Dunkirk (France) with an annual capacity of 12 Bcm will increase the availability of North Sea gas supplies to France and other EC countries.

The connections between the Dutch and UK offshore which are only under discussion, would further enhance North Sea deliverability. Other interconnections could link the existing Zeepipe line and the planned Norway to Dunkirk pipeline and the UK offshore system at Bacton.

These interconnections would all create surplus deliverability.

Continental Europe Interconnections

Additional interconnections in Continental Europe would enable this surplus deliverability to move downstream to the most import-dependent markets in the European Community. Some Dutch/Belgian/German/ French interconnections are planned, as are two interconnections between Spain and Portugal. However, currently unplanned additional strategic capacity would assist France, Italy, Austria and Finland.

For example, gas coming in from the Maghreb line (a TEN pipeline whose first phase will be operational by 1996) via a potential new interconnection between Spain and France (Maghreb II) would be a critical security of supply interconnection for the Southern EC.

In the case of a Russian shortfall in supplies, volumes from this line could serve not only southern France, but, if an interconnection were constructed between Southeast France and Northwest Italy, volumes could also be transported along the French coast to Northern Italy. Pipelines normally supplying Western Italy from Austria could be reversed to supply Austria from Italy. German interconnections could assist Austria in the northern part of the country.

This Maghreb II pipeline is also of strategic importance in the case of an Algerian cutoff. Without this pipeline or an LNG terminal, Portugal would be left in an extremely vulnerable position. The only source of supply would be the Lacq, France to Zaragoza pipeline which is insufficient to meet the needs of Spain and Portugal. However, the loss of Algerian supplies might be handled by reversing the flow of the Maghreb II to serve Spain and Portugal using Russian and North Sea supplies.

In the highly unlikely worst case scenario of a simultaneous interruption of Russian and Algerian supplies, the interconnections discussed above would be vital to prevent major shortfalls in supplies in some EC Member States.

This worst case scenario would present an extremely difficult situation for Finland, Portugal, Greece, Spain and Austria. Also, in the short-term, until the

UK/Continent Interconnector and the Norway to Dunkirk lines are in service, Belgium, France and Italy might be vulnerable. The Spanish/French, French/Italian, German/Austrian interconnections referred to above and some looping of the French mainline system would all be necessary. An unplanned line linking Dunkirk/Zeebrugge to Lyon and Turin could extend secure North Sea supplies to Italy. The full use of all security measures, referred to in section 5.2. would also be required. Spain, Italy, France and Greece could seek out possible alternative LNG sources. Finland would have to rely on its interruptibility and dual-fuel system. A long term solution for Finland would be a connection with Sweden which may be a possibility as the Nordic market develops and any eventual development of gas supplies from the Barents Sea.

These scenarios indicate that it would not be possible for a very large portion of the gas available from the North Sea through the various pipelines to be transported through the southern French system. A potential solution would be to extend the proposed Spanish/French interconnection to near Strasbourg and the Midal System (already linking supplies from Russia and Norway). This interconnection would complete a strategically significant pipeline link between the three main external EC gas suppliers.

Additional Pipeline Capacity via Swaps, Displacement and Exchange
In addition to the potential capacity from additional construction, capacity is also made available by cooperative efforts among traders. If and when the interconnections mentioned above are realized the potential for swaps or transportation by displacement of gas supplies in the EC will increase significantly.

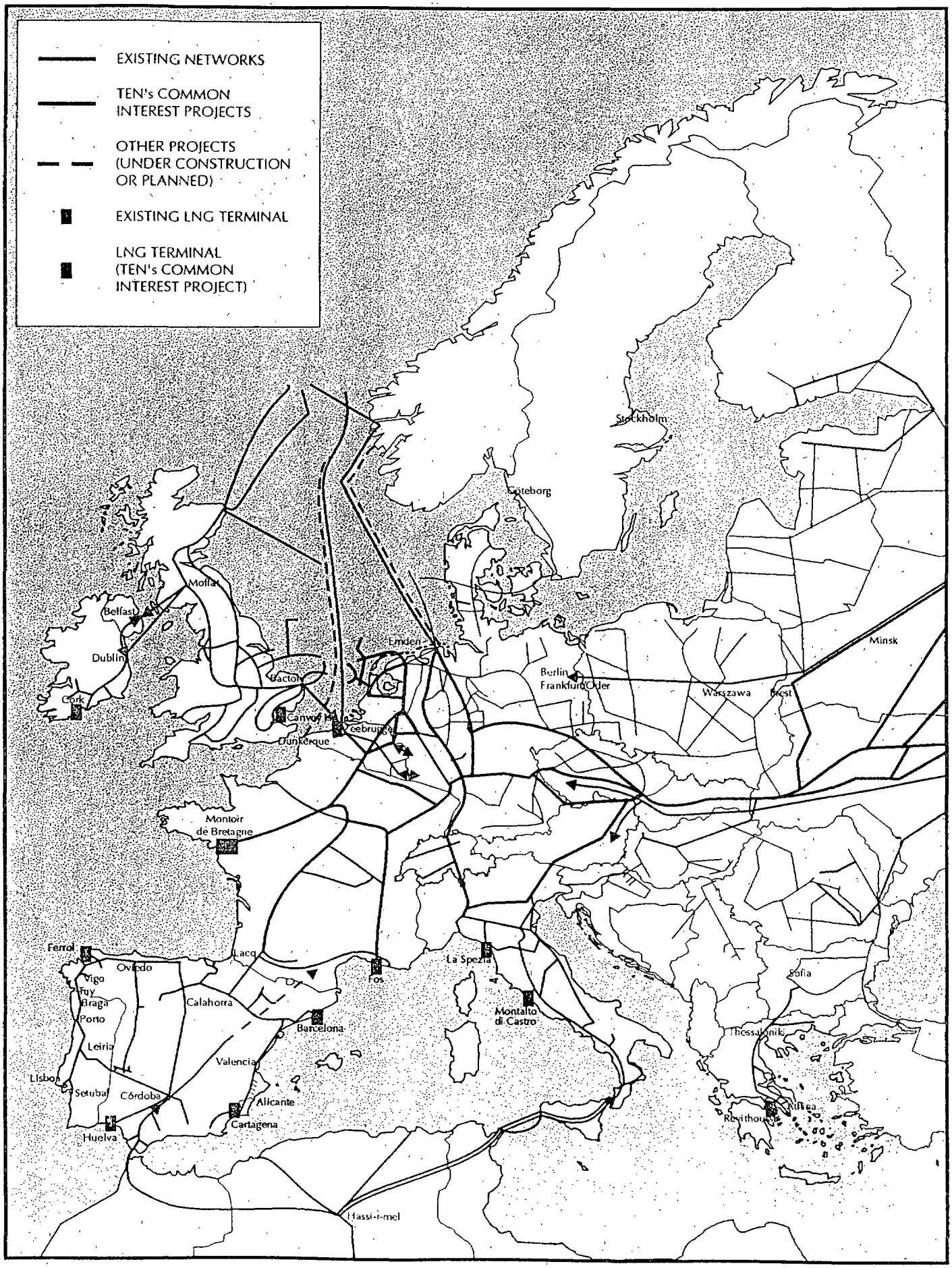
Long term potential sources of supply
The proposed Yamal-Europe pipeline from Russia through Belarus and Poland has been identified as a TEN project. It will provide a second major export route for Russian supplies to the EC and an alternative to supplies through the Ukraine. The construction of the Yamal pipeline system will take place in stages with the sections in Germany, Poland and Belarus to be finished first. When finally completed in the next century, planned capacity of the pipeline to Europe may reach over 50 bcm. In the long term it is possible to imagine a new East/West line which, crossing the Central and Eastern European countries, would extend the gas from Yamal to southern markets in France, Italy and Spain.

A pipeline from Turkmenistan through Iran or the Caspian Sea has been under discussion for some time although the distance to EC markets may give rise to economic and transit difficulties. The only Member state which may be within economically feasible pipeline reach is Greece.

LNG from Nigeria, Trinidad & Tobago, Venezuela, Yemen and Qatar are all potential sources to Europe. The realisation of these projects would increase the flexibility of supply available to the EC.

The bringing on stream of new supplies is limited principally by economics (either project costs or price levels in Europe) and will not be realised unless justified by market development. In the case of long distance pipeline projects, transit across several national borders may present a further difficulty.

EUROPEAN NATURAL GAS NETWORKS



ISSN 0254-1475

COM(95) 478 final

DOCUMENTS

EN 12

Catalogue number : CB-CO-95-536-EN-C

ISBN 92-77-94616-4

35

Office for Official Publications of the European Communities

L-2985 Luxembourg