

SECURITY OF GAS SUPPLY AND POWER GENERATION

SUMMARY

Natural gas-fired power generation is growing strongly in Europe, raising discussion on security of gas supply to the electricity sector and on the energy supply effects of integration between the power grid and the gas supply network.

Reference is made to recent official reports (IEA, EU Economic and Social Committee) welcoming the emergence of natural gas as a major fuel for electricity production and commending the responsible and successful role rightly played by the gas industry in securing adequate gas supplies to Europe.

The gas industry's views are given on the expected growth of gas-fired power generation in relation to available gas reserves and to diversification of primary energies used in the electricity sector. Views are given also on both long term and short term security of gas supply, both expected to be further enhanced with further growth of gas use, and on the mutually reinforcing effects on security of gas supply and of electricity supply expected from the extension of gas-fired power generation. As a supplier to the power industry, the gas industry takes all reasonable precautions to ensure continuity of contracted supplies taking into account cases of peak demand, of pipeline failure, and of some supply failure (a detailed review of these measures and options is given in the Eurogas report "Security of Supply of Natural Gas in Western Europe" ref. S/EUR/98/950, March 1998).

The report concludes that the forecast growth levels of natural gas share in power production will improve diversity of the fuel mix in the EU, which will enhance security of supply and stimulate new gas supply projects and gas supply routes. This development will drive the further diversification of gas supply sources for Europe. Moreover, the link between the gas and electricity markets will improve more generally security of energy supply in the European market.

INTRODUCTION

More than half of the power generation capacity currently under construction in Europe is natural gas-fired (source: Eurprog 99). In the mid 1990s the OECD International Energy Agency (IEA) and the EU Economic and Social Committee separately addressed the issue of security of supply in relation to increased use of gas for power generation. They concluded that there was no justification for restricting the use of gas in power generation neither for security of gas supply reasons nor for any other reason. On the contrary, the emergence of gas as a major fuel for electricity production was considered a beneficial development. Most new gas-fired plant use the Combined Cycle Gas Turbine (CCGT) process, often in combination with Combined Heat and Power, which offers many advantages including high efficiencies, low emission levels, low investment and operational cost, short project lead-times, flexibility in size.

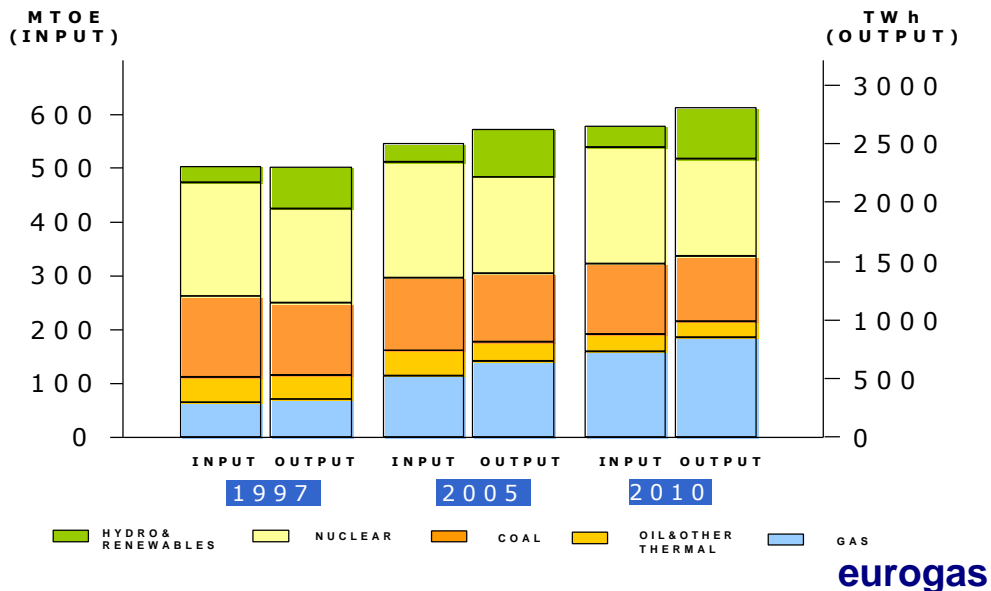
Discussions on security of gas supplies in relation to power generation continue. Gas industry views on these issues are presented in this paper.

1. GROWTH IN EU GAS-FIRED POWER GENERATION

Each new gas-fired power station helps to increase Europe’s diversity of fuel supply and supports its environmental objectives.

Coal and nuclear are the dominant fuels for power generation in the EU according to European Commission estimates for 1998: nuclear 34%, coal 20,5%, hydro 12,9%, natural gas 12,8%. Coal accounts for 54% of the input fuel for thermal power generation.

**Power Generation in EU 15
(source: Eurprog 99)**

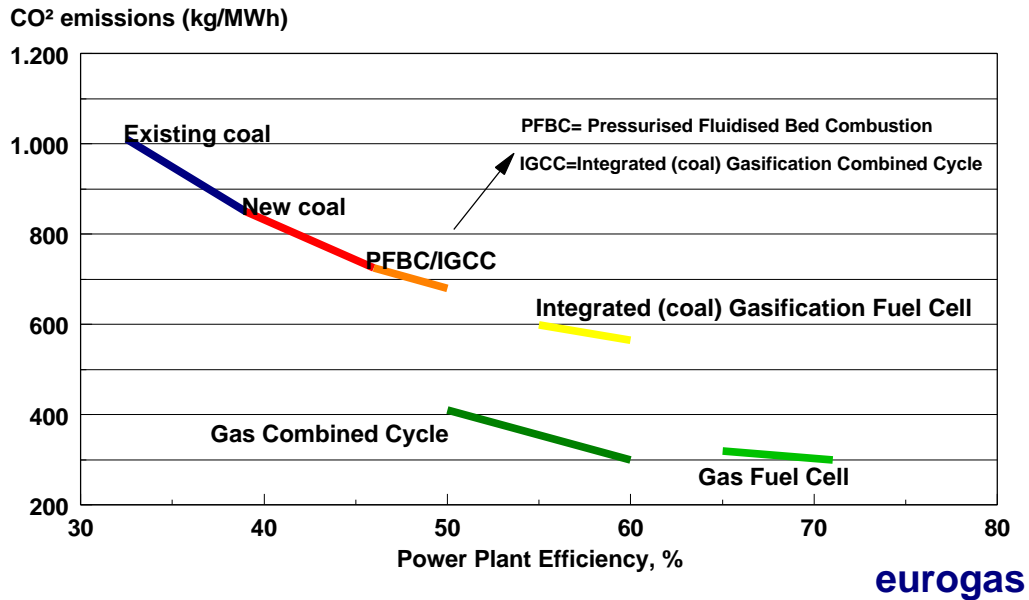


This graph shows the actual and foreseen input sources for power generation and the actual and foreseen output. The introduction of high-efficiency gas-fired power plants will increase substantially the overall efficiency of power production.

The economic and environmental advantages of natural gas make it well placed to increase its share of the power generation market. Eurogas expect that this share may increase from less than 10% in 1990-1995 to a percentage comprised between 25 and 35 (depending on load factors and definition of sectors) by 2010 broadly in line with European Commission forecast of 35% [source: Primes model]. This increase in the use of gas would enhance the balance and diversity of the fuel mix in European power generation, and bring it more in line with other major industrial regions of the world where gas already accounts for a larger share of the power generation market (North America 19%, OECD Pacific 26%, Central and Eastern Europe 18%, and CIS 39%) and higher gas consumption is foreseen.

Gas-fired power plants offer a real environmental advantage over plants fired with other fossil fuels. Power generation with gas produces no SO₂ and relatively small amounts of NO_x. As to CO₂, the advantage of gas over the other fossil fuels stems from two factors: lower carbon content and higher efficiency for combined cycle plants, limiting unit consumption of energy and emission of CO₂ per kWh produced.

Efficiencies and Carbon Dioxide Emissions from Fossil-Fuelled Power Plants

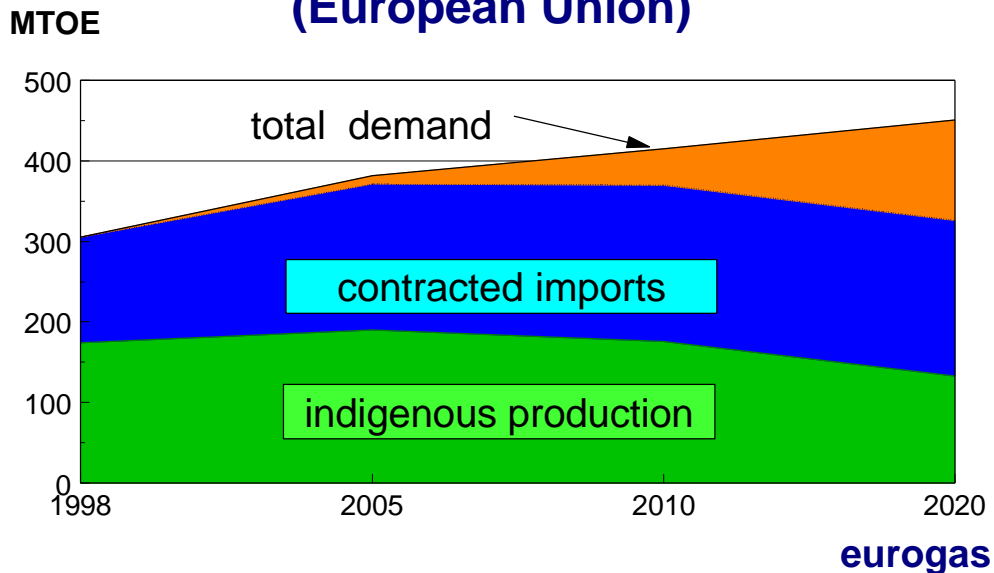


2. LONG TERM SECURITY OF GAS SUPPLY

Worldwide currently proved reserves of natural gas represent over 60 years of current demand (source: 1999 BP Amoco Statistics), and new exploitable volumes discovered each year during exploration exceed the growth in gas demand. Taking into consideration natural gas sources which will require more technical development to make them economically exploitable, total static gas reserves worldwide amount to 175 years of consumption (source: IGU 1997 report).

Within the global context of natural gas logistics, Europe's domestic production covers 70% of its demand, with the balance imported from major non-Western European producers including Russia and Algeria. With the expected sustained growth in European gas demand, the imports ratio will possibly double over the next two decades.

Gas Demand & Supply Outlook 1998 - 2020 (European Union)



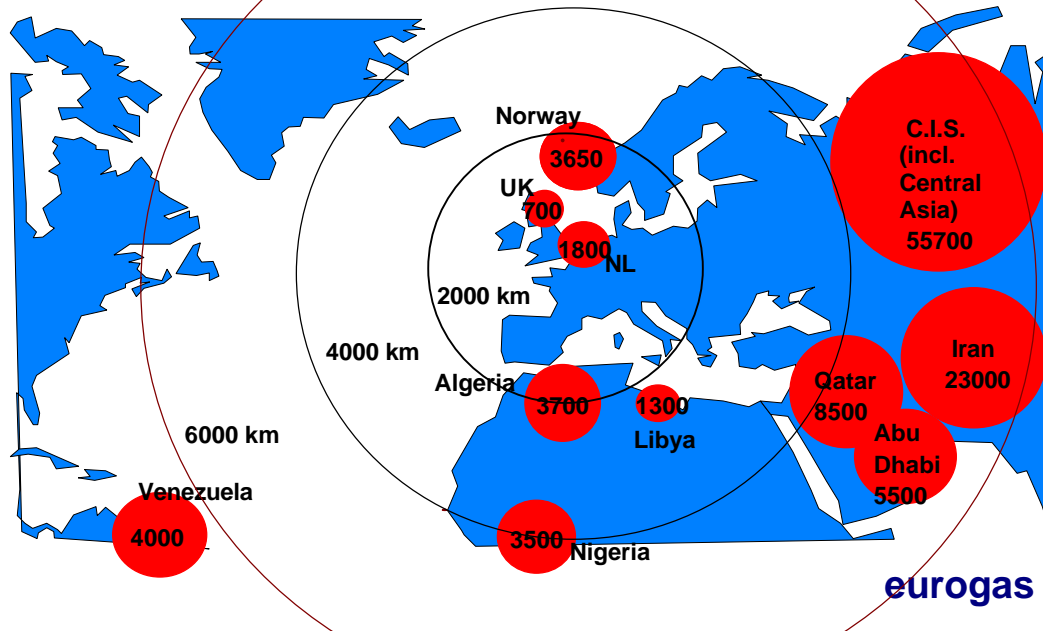
The European gas supply industry has already been working to obtain the supplies required in the near future and is confident that the further import volumes required in the longer term will be mobilised and available in good time, considering:

- ⤴ the location of the European market within economic distance from the main gas reserves worldwide (FSU, Central Asia, Middle East, Africa);
- ⤴ EU demand and supply forecasts showing that the bulk of the supply has already been contracted by the gas industry under long term take-or-pay contracts to meet future demand including expected growth of gas sales to the power sector. Given lead times of 7 years and more for new supplies, the industry is actively and successfully mobilising new supplies and developing new supply routes;
- ⤴ the track record to date of the industry in providing gas supplies to Europe, which led the OECD International Energy Agency to recommend continued reliance on the industry for future security of gas supply;
- ⤴ the economic significance of gas exports for the exporting countries, and the growing involvement of European gas companies in third-country gas projects and business;
- ⤴ the political support from EU and national authorities in promoting external (energy) relations;
- ⤴ the continued development of gas production and supply technologies and practices in combination with extending gas markets world-wide, resulting in cost reductions and further extension of the scope of economic gas sourcing for supplies to Europe.

In short, there are sufficient natural gas reserves for future needs within economical reach of Europe. The extent to which these reserves will become available for supply will depend on the sustained competitiveness of natural gas relative to other fuels and to alternative investment

options for investors and capital lenders. The proven commercial practices of European gas suppliers, of the economic interest of gas producers and of the favourable demand outlook for gas should inspire confidence for long term gas development.

**Proven Reserves, billion m³
(source CEDIGAZ, 1998)**



3. SHORT TERM SECURITY OF GAS SUPPLY

Within the short term, gas demand may fluctuate because of weather changes and the subsequent need for more or less heating in dwellings, and because of economical cycles and other seasonal down to daily fluctuations of energy demand from gas users in industry, commerce and service trades, and also the electricity supply industry. The basic responsibility for supplying the gas under normal predictable fluctuating demand conditions lies with the gas industry, which takes technical and comprehensive operational measures and offers commercial contract options to customers that will ensure adequate supplies for agreed off-take conditions. A review of these measures and options is given in the Eurogas report “Security of Supply of Natural Gas in Western Europe” (ref. S/EUR/98/950, March 1998). These measures take into account cases of peak demand, of pipeline failure and of supply source failure. More specific comment is given in the following in respect of flexible supply options to the power generating industry and of the impact of gas-fired power generation on electricity grid capacity.

4. GAS-FIRED GENERATION, GRID CAPACITY AND POWER/GAS SYNERGISM

Capacities of power transmission network tend in general to be complex to quantify accurately and additions to the grid very costly. The possibility, however, to site gas-fired plant at locations that would not have been acceptable for coal or nuclear plant means that

the transmission system can be used more effectively when gas-fired plants are added. In addition, if new connections are required on the gas network to supply these plants then this too tends to enhance security of supply as the variety of supply routes increases.

The electricity supply business requires a certain reserve capacity (sometimes referred to as the 'plant margin') to allow for outages of production units and for deviations from the average trend due to temperature variations and the business cycle.

Currently the EU has generating capacity in excess of the reserve required in each Member State but this is expected by the electricity industry to decrease in coming years. (see footnote ¹). It can also be argued that with the competitive pressures of liberalisation new capacity would be set up to take advantage of more efficient power generation technologies. That would mean larger reserve capacity and improved ability for the electricity industry to cope with outages and demand variations, at least as long as existing generation facilities are not decommissioned. There will still be a need for reserve capacity for spinning reserve requirements and possible outage of some power generation plant. Such reserves typically amount to a generating capacity of perhaps 20% above the actual peak day requirements if all plants are available.

On the peak day in most years there will be generating and transmission capacity available which is not fully used. If some of this generating capacity is linked to the gas market (via a gas-fired power station) then, even on these peak days, there is the possibility of gas not required but contracted by the electricity market returning to the gas market.

The question can be raised whether peak demand for electricity e.g. in cold weather periods and at daily peak hours coincides exactly with peak demand for gas, to the disadvantage of security of gas supply to power generation. In Eurogas' opinion, such concerns are unfounded.

The gas network itself is designed to enable overall gas demand on the coldest day in many years to be satisfied. This supply capacity is adapted to growing market demand with corresponding extensions and interconnection of the gas grid. Therefore, allowing as well for the various means used in optimising network operations, the gas system tends to have the ability to cope with higher demands that occur on the average peak days. The correlation between periods of high electricity demand and high gas demand can be far from perfect, and differences in market characteristics can actually offer opportunities to improve efficiency and enhance security of supply by linking the markets. Of course, these positive effects will vary depending on each market characteristics.

Away from the peak days each system is even more robust, but integration still offers advantages in additional supply security in the unlikely event of a disruption to the gas or electricity grids. There are also efficiency gains and cost savings in electricity generation that will result from allowing the market to determine the best economic use of gas (and other fuels) on any individual day.

Increasing the physical links between the gas market and the electricity market through the use of gas-fired power generation will enhance the overall security of energy supply, even before taking account of conventional interruptible sales contracts or dual-firing capabilities.

5. INTERRUPTIBLE CONTRACTS AND DUAL FIRING

¹ according to Eurprog 1999, the difference between total available capacity for internal demand and the likely maximum peak demand, after deduction of the required reserve capacity, was 35.2 GW in 1997 and is expected to be 27.5 GW in 2000, 15.2 in 2005 and 10 GW in 2010

Throughout Europe, many medium and large gas customers choose to buy their gas on an interruptible basis. The gas supplier and the customer, both contract partners, jointly decide on commercial terms and on the conditions under which supplies respectively off-take can be interrupted by either the supplier or the customer.

In principle, the difference between an interruptible and a firm contract is that the customer in the former case can switch to alternative supplies in order to optimise economics in given market situations. This facility, in addition to the lower price paid for interruptible gas than for firm gas, should compensate for the extra cost incurred by the interruptible customer for securing alternative operational solutions in case of imposed interruption, such as investment in dual firing back-up facilities or power exchanges among regions and countries.

The availability of dual firing facilities, mostly oil-based, in itself will enable the customer (power generator) to arbitrage oil stocks against gas supply in energy market for economic gain. The customer can also decide that other plant is cheaper to operate in case of gas supply interruption, and not use gas-fired plant capacity during gas interruption without a need for dual firing facilities.

Future development in interruptible supplies will also depend on the development of back-up capability and dual (or multi)-firing capacities based on natural gas, which will depend in part on the trends in the use of CCGTs and CHP (combined heat and power, or co-generation). Back-up capability is generally not considered for these plants to offer a normal operational alternative to gas-firing, because of lesser energy efficiency and/or impact caused on the turbine. New technological developments may mitigate these drawbacks in future. On the other hand, dual (or multi)-firing plant, having the ability to use during normal operation more than one fuel type, is employed as a load balancing tool at times of peak demand for gas in the hands of power generators. In the UK both systems are used at the initiative of the some power generators in times of high gas spot sales prices. Environmental legislation however might limit extended use to be made of dual firing.

For the gas supplier, interruptible sales contracts offer one approach to balancing peak loads and enhancing the overall security of gas supply. For the electricity sector, interruptible gas contracts offer optimisation opportunities for improved economics. They also enhance security of power supply as choices can be made for power production. It should be emphasised again that interruptible sales contracts are based on mutual voluntary commercial agreement between supplier and customer and are not imposed by either party on the other.

This report does not address the question of long-term security of supply of secondary fuels to be used by power generators in the event of a gas supply interruption under interruptible supply contracts. This is a matter of consideration by the electricity producer as one of several elements in making the decision for such a contract depending on local business conditions. These elements comprise fuels economic availability, competitiveness of power product generated, environmental requirements, public acceptance, and overall business risk assessment and management, all of which will contribute to qualifying the business decision to be taken. In a competitive market, the gas supply package will have to be the preferred option justifying its high growth expectations in power generation.

6. CONCLUSION

In line with the earlier mentioned findings of IEA and the EU-ESC, Eurogas can only conclude that the forecast growth levels of natural share in power production will improve the diversity of the fuel mix in the EU. This will enhance security of supply and stimulate new gas supply

projects and new gas supply routes, resulting in further diversification of gas supply sources for Europe.

Moreover, Eurogas is convinced that the link between the gas and electricity markets will improve security of energy supply in the European market for the benefit of both electricity and gas customers.