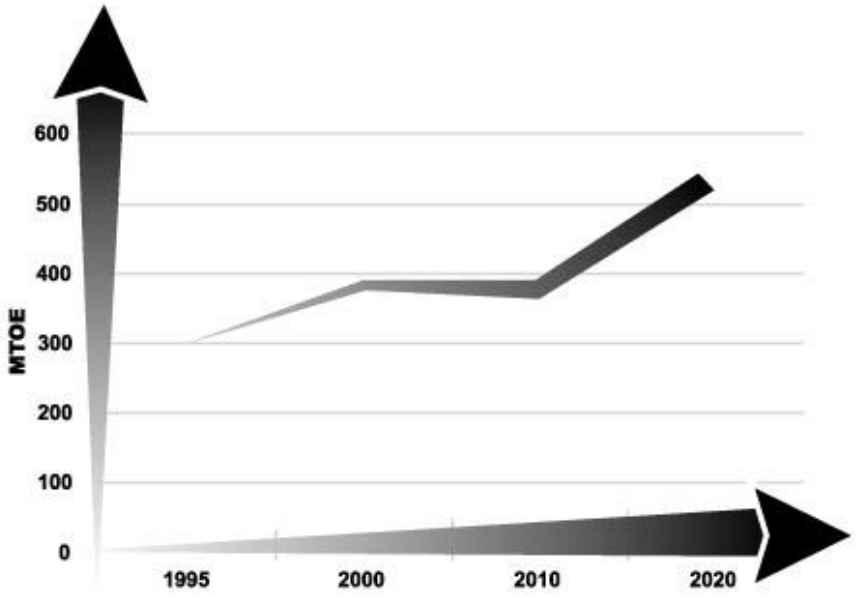
EU ENLARGEMENT WATCH

# The Role of Natural Gas in Europe




OCTOBER 2000

*EU Enlargement Watch* is an adhoc network of Environmental Groups and individuals in Western and Eastern Europe striving to ensure that environmental concerns remain a key consideration during the Accession Process. Currently *EU Enlargement Watch* focus is on energy issues. The previous report in this series was *Real Ways to Reduce Nuclear Risk in Eastern Europe*, published in October 1998.

This project was managed by Nathalie Francoeur from the Energia Klub in Budapest.

The development of this report, the associated training program and research trips would not have been possible without the generous support of a number of foundations, other environment groups and Governments. However, the responsibility for content of the report and the training program rests with the project and not the organisations that have supported it. We are therefore grateful and acknowledge the support given by the following: -

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**ENERGIA 2000**

# Contents

# Executive Summary

The use of gas has increased considerably within the European Union (EU) over the past decade, most notably in the power sector. However, in accession countries, very little gas is used to generate electricity although some is used in combined heat and power (CHP) stations. It is expected that in the coming years however, natural gas will be widely used to fuel power stations across an enlarged EU.

In August 2000, the Member States of the EU were required to have adopted legislation to increase competition within their gas markets. This Directive is expected to accelerate the process of liberalisation, in a similar fashion to that of the Electricity Market Directive of 1996. While some industrial interests are keen to promote the wider use of gas, concerns are raised about its environmental impact, its impact on the development of renewable energies, and the potential for an over dependency on supplies outside the Union, particularly from relatively unstable regions of the world.

In the coming months, a number of important developments are set to take place which will impact upon the EU energy policy. Firstly, the EU needs to act quickly if it is to reach the 8% (of 1990 levels) reduction target for $CO_2$ emissions by 2010 as laid out in the Kyoto Protocol, in particular as it relates to the Den Hague meeting in November 2000. Current predictions suggest that, if current trends continue, the EU will not meet its Kyoto targets and therefore action is needed, particularly in the power sector. A second important development revolves around the European Commission's current preparations of a Green Paper on Security of Supply of Energy.

This report seeks to review the current status of the gas sector in light of these and other developments, and point to some of the problems and advantages of increased use of gas across Europe, particulary as regards enlargement.

**Czech Republic**

The consumption of natural gas is increasing in the Czech Republic and it reached 9 billion cubic meters (Bcm) in 1999. The vast majority of gas supplies (79%) are covered from Russia, with 16% being supplied from a pipeline with Norway (finished in 1997), 2% coming from domestic resources and the remaining 5% coming from Germany.

The gas is primarily used for industrial purposes and households. No projects exist, or are being planned, for power generation based on gas, but a small part of the total volume is used for combined heat and electricity generation.

Usage of natural gas has not been made a priority in the state energy policy, where the main emphasis is put on the use of domestic coal and nuclear energy. Currently, gas represents only 20% of primary energy sources. The use of gas for electricity generation is discouraged both because of the large installed overcapacity (the Czech Republic currently exports about 30% of its electricity production) based on very cheap (though mostly low quality) domestic coal and heavily promoted nuclear plants, built by the dominant utility company CEZ, in which the state has majority ownership.

It can, however, be expected that, with the liberalization of electricity and gas markets, rapid changes to the current situation are possible. The threat of competition to other "established" plants and to the dominant position of CEZ is often given as an official reason why the Czech government asks for transition periods in the implementation of liberalization of its energy markets (a 33% liberalization of gas market is to be reached by 2008, with full liberalization of the electricity market by 2008). It is therefore advisable to not allow these exceptions from EU Directives and to ensure that the Czech government complies fully with the rules set forth by the EU.

The existing coal power plants are scheduled to be phased out between 2015 and 2030, when the coal mines are expected to be closed. It is therefore very likely that replacement capacities will be based mostly on gas fired plants. By that time, the currently negligible role of renewables and efficiency must also dramatically increase.

**Hungary**

Beginning in the 1980s, Hungary's gas distribution network has been developed rapidly. This has resulted in the current figures that show that 40% of Hungarian energy use is based on gas, which is, in terms of the primary energy portfolio, the second biggest share in Europe.

Consequently, Hungary now depends on imported gas for 60% of its requirements, and this figure is likely to increase due to the decline of domestic resources and an increase in consumption.

The inner structure of gas consumption is dominated by the residential sector, which has large seasonal fluctuations and consequentially large and expensive storage demands.

Bearing these conditions in mind, Hungary's natural gas consumption should not be significantly increased by changes in current energy sources and consumption patterns.

The expected liberalisation of the Hungarian gas market must take into account the need for the changing use of gas and a prioritization of its efficient use.

**Lithuania**

The share of natural gas in Lithuania's energy supply has decreased since the 1990s, during which time there has been an increase in the use of nuclear energy. According to forecasts, the demand for natural gas will more than double in the next twenty years, despite the operation of one unit at the Ignalina nuclear power plant.

In Lithuania, unlike in other countries in the region, residential consumers use only around 8% of the country's gas. District heating and power production are the largest users, consuming 50% of the total.

Significant investment in the old and outdated transport, storage and distribution network will be required to meet the challenge of growing demand. The development of the Baltic gas ring and cooperation with the neighbouring countries to develop a regional gas network is essential for the region's security of supply due to its current heavy dependency on Russian gas. Bearing these factors in mind, these investments should be planned using the least cost principle and implemented on a purely commercial basis, excluding state subsidies.

**Poland**

The use of natural gas in Poland is projected to grow significantly within the next decade from 12 Bcm to 22 Bcm. Of particular importance is the emerging market for combined-heat-and-power generation.

Currently, Poland does not meet EU requirements for NG storage facilities. Construction of new NG storage facilities is required by the EU and is necessary in order to increase security of supply. The storage capacity is predicted to grow from its current 1.1 Bcm to 4.5 Bcm in 2010.

The security of supply is an important issue discussed in the political arena in Poland as it relies on Russia for 70% of its gas. A search for potential new directions of NG supply (e.g. Norway or Denmark) is widely discussed. However, some argue that all the demand for NG within next ten years can be covered under the existing long-term contracts with GazProm.

Introduction of the $CO_2$/energy taxes might be an opportunity to promote natural gas use as a cleaner energy option than the use of coal.

For the last decade, Poland has made crucial steps in fighting the problems of low atmospheric emissions and has introduced many programs geared towards replacing coal with gas. Further programs to replace

coal with natural gas should be developed. However, where feasible, renewable energy sources should be given top priority.

**Slovakia**

Natural gas is the most important energy source in Slovakia. Currently, 97% of gas used in Slovakia has to be imported from Russia. There is only one gas fuelled power plant (excluding CHP) in Slovakia and thus gas use in the power sector is negligible.

Two thirds of total consumption is undertaken by the industrial sector, but the main area of growth is in the residential sector. The number of communities connected to the gas distribution system has tripled over the last seven years. Slovakia has the second densest gas distribution system in Europe.

The main transmission pipes from Russia to EU Member States pass through Slovakia, carrying 25% of Western Europe's gas supply.

Currently, one company (SPP) owns and operates all facets of the country's gas sector. Due to this monopoly structure, the development of the distribution systems is subsidised by the income obtained from gas transition through Slovakia.

Sales prices for domestic customers do not fully cover the supply and imports costs, and are therefore subsidized by transit fees.

Transformation of the gas industry and the entire energy sector in Slovakia is inevitable. Its success will depend on the fulfilment of four important issues: the restructuring and privatization of energy companies (Slovenský plynárenský priemysel – SPP and Slovenské elektrárne – SE, a.s.), the establishment of an independent regulatory body, the setting of energy prices on a real level for all consumer categories and the completion of an energy legislative framework. Government proposals are to privatise and liberalise the Gas markets in the coming years.

**E.U.**

Even with the passing of the deadline for Member States to implement the minimum market opening requirements of the EU's Gas Market Directive, it is clear that the majority of Members have gone far beyond the minimum market opening requirements. As a similar situation occurred in the staged opening of the Electricity Markets, the European Commission is preparing an accelerated market opening time-table for both the Gas and Electricity markets, due to be published in March 2001.

Gas consumption in the power sector is set to increase ten fold between 1995 and 2030, while installed capacity is predicted to rise from 45 GW to 450GW. This phenomenal increase is the result of an increased power demand and the closure of coal and nuclear power stations.

Gas is now the fuel of choice for newly built power stations in the EU, due to its lower construction costs and shorter construction times, its largely lower production costs and its aerial emissions levels that are lower than those in other fossil fuel plants.

EU domestic production covers 52% of its consumption, with 12% coming from Norway and 21% from Russia. The decrease in domestic reserves and increase in consumption will result in a much higher dependency in the future.

**Russia and Gazprom**

Russia has over 56% of the World's proven gas reserves, equaling over 50 trillion cubic meters.

Unlike a number of State oil concerns, Gazprom was not dismantled during the Russian privatisation process and continues to run on a highly centralised basis.

Despite its high (by Russian standards) revenues, Gazprom lacks investment in its infrastructure, which results in high leakage levels and lower environmental performance. It is estimated that between 6-50 Bcm is lost from its pipelines annually, representing considerable lost revenue and damage to the environment.

To increase its diversity, Gazprom and its partners are constructing additional pipelines to Western Europe including the Yamal Pipeline, which is estimated to cost $35 billion.

**Conclusions – The Role of Natural Gas in the Transition to a Sustainable Energy System in Europe**

Current trends suggest that the EU will not meet even the first $CO_2$ reduction target proposed under the Kyoto Agreement, an 8% reduction of 1990 levels of $CO_2$ emissions by 2010. Current emissions scenarios predict that the power sector, along with the transport sector, will fail to meet their indicative targets.

Modern natural gas fired power stations produce around 2.5 times less $CO_2$ per Kwh of electricity than equivalent coal stations. If gas stations replaced coal stations across an enlarged EU it would significantly reduce the region's $CO_2$ emissions and enable Kyoto targets to be met.

Such savings are so great that, even if all operating nuclear power stations were also closed and replaced by gas power stations – which would lead to an increase in $CO_2$ – there would still be an overall 6% decrease in $CO_2$.

Such a rapid introduction of gas is not desirable from an economic, environmental or long-term security of supply perspective and there are many other options that are more appropriate. In particular, investment should be prioritised first in energy efficiency and then in renewable energy.

A policy needs to be elaborated which allows the widespread and appropriate introduction of energy efficiency and renewable energy technologies. Only a policy that has these technologies at its centre can pave the way for a secure and sustainable energy future.

However, if used in an environmentally responsible and appropriate way, natural gas can play a role, for the short term, in reducing $CO_2$ emissions.

**Gas Use in CEE Countries**

| Country | Gas as a % of Primary Energy | Total Gas Consumption Bcm | % of Gas Imported |
|---|---|---|---|
| **Czech Republic** | 20 | 9 | 79% - Russia<br>16% - Norway<br>5% - Germany |
| **Hungary** | 38.6 | 12 | 83.5% - Russia<br>12.5% - Germany<br>4% - France |
| **Lithuania** | 23.2 | 2.3 | 100% - Russia |
| **Poland** | 10 | 10.3 | 32% - Domestic<br>68% - Russia |
| **Slovakia** | 32 | 7.1 | 97% - Russia |
| **EU** | 23 | 363.7 | 52% - Domestic<br>21%- Russia<br>12% - Norway<br>14% - Algeria |

# Introduction

The use of natural gas within the power sector continues to increase, and most forecasts suggest that, over the next twenty years, it will become the dominant fuel. Within the European Union (EU), the use of natural gas is currently estimated to be growing at a rate of around 4% per year. This trend is expected to continue for at least the next twenty years. Estimates from European Commission published research forecast that, by 2030, the installed capacity of gas fired power stations will have increased ten-fold from 45 GW in 1995 to 450 GW[1].

Prevailing attitudes once held that natural gas was once thought "too valuable" to be used for electricity generation purposes, but these attitudes have since shifted. In June 1998, the EU's Directive 98/30/EC Concerning Common Rules For The Internal Market For Natural Gas was adopted and it entered into force on 10th August 1998. Under the terms of Article 9, Member States were required to ensure full compliance with the Directive within two years (August 2000). The Directive is closely related to a similar Directive for Europe's Electricity Market (96/92/EC) which required Member States to begin opening their markets in February 1999. The minimum requirements of the Electricity Directive have, in most cases, easily been met. A similar degree of enthusiasm for the Gas Directive is expected and can already be seen in some recent developments. As a result of the rapid introduction of market opening and other reforms within Europe's energy markets, the European Commission have been charged by the Council to review the time-tables proposed within the original Directives. A report on this will be presented to the Council at the Stockholm EU Summit in March 2001.

While discussions continue on energy market reform, the European Commission is negotiating with ten countries in Central and Eastern Europe (CEE) for their accession to the EU. In order to join the EU, new Members must have adopted the EU's legislation, collectively known as the acquis. It is desirable, and in most cases intended, that this will occur prior to entry, although it is already clear that this will not be possible in all cases, hence the need for negotiations between the Commission and the prospective New Members.

The addition of these ten countries to the Union will result in an additional 100 million people, a 25% increase over the current population. Within the power sector in these ten countries from Central and Eastern Europe (CEE) the combined power generation capacity is around 95 GW, compared to the EU's current capacity of around 555 GW. While the Accession process will significantly impact upon the energy sector in CEE as they adopt the acquis, the EU will also have to make a number of policy and practical changes to facilitate a smooth enlargement process.

This report aims to look at the convergence of these three processes, the liberalisation of Europe's energy markets, the rapid move into gas fired power stations and the Enlargement of the European Union.

[1] European Union Energy Outlook 2020, The Shared Analysis Project,
November 1999, ISBN 92-828-7533-4, The European Commission, table 9-21

# Czech Republic

## Gas Consumption and the Energy Sector

The Czech Republic currently consumes approximately 9 Billion cubic meters (Bcm) of natural gas a year, a number that is predicted to increase to over 10 Bcm a year by 2002. Gas-fired power combined heat and power plants are expected to account for some 1.5 Bcm a year out of that total. As in the majority of the states of Central and Eastern Europe (CEE), energy prices in the Czech Republic remain far below comparable world levels. Currently, the price of gas for power generation and industrial users is 23% cheaper than the price for domestic consumers. Energy prices in the Czech Republic are heavily regulated and currently stand at about 30% of the European average. Throughout 1999, industrial consumers in the Czech Republic paid the equivalent of $140 per Mcm of gas, while domestic customers were charged $155. The United Nations Economic Commission for Europe, (UNECE) estimates that the Czech Republic's dependency on supplies of Russian gas will fall from its current level of 85% to 73% by 2010.

The Government has agreed in principle that there is an urgent need to increase gas prices. It is also pushing through its privatisation programme with the sale of its strategic stakes in the gas sector. In the summer of 1998, gas prices for domestic consumers were raised by 27%, with industrial users facing a 10% increase. The Czech cabinet approved a further increase of 15% in November 1999, which was to take effect at the beginning of 2000. At the same time, two more price rises were confirmed, a 10.7% hike for households in 2001 and a 7.5% hike in 2002. The hikes for industry will significantly lower at around 4%. These adjustments will bring the cost of gas in the Czech Republic more closely in line with current European levels, with cross subsidies between the gas and power sectors abolished by 2003. The cabinet also announced a provisional timetable for the deregulation of the gas market, to be achieved by 2008.

An Energy Law was passed in 1994, which granted the power to regulate the gas industry to the Ministry of Industry and Trade (MIT). As a result, the ministry is now responsible for overseeing the activities of the country's eight distributors and the production company, Moravske Naftove Doly, (MND). A new energy policy was inaugurated at the end of 1999 and a draft Energy Act is to be introduced in January 2001. An Energy Regulatory Administration has been created, but currently lacks independence from government interference. An independent regulator is to be set in place by 2002. In response to the demands of the EU gas Directive, a timetable for the liberalisation of the market has been promulgated, with a 20% opening proposed for August 2005, to be increased to 33% by August 2008.

### National Gas Consumption by Sector[2]

| PJ | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|
| total | 180.1 | 210.0 | 161.9 | 191.0 | 187.3 | 213.6 | 243.9 | 254.2 | 253.1 |
| industry | 97.1 | 107.2 | 59.0 | 77.8 | 87.0 | 95.8 | 117.9 | 111.3 | 100.7 |
| household | 49.2 | 56.7 | 52.8 | 55.3 | 62.4 | 65.4 | 73.6 | 84.9 | 84.6 |

*Sources: SEVEn 2000, VUPEK 1995*

The role of natural gas has been limited to industrial purposes and households. The recent growth of usage is heavily linked to an increased number of households with access to gas distribution during the 1990's.

[2] Data for gas consumption in the Czech power sector either not available or inconsistent, It is advisable, therefore, to be extremely careful with any comparative approach to the data.

Usage of natural gas was not made a priority in the state energy policy, which was adopted last year. This energy policy still puts primary emphasise on domestic coal and nuclear energy, and both are seen as beneficial for national energy "independence".

Gas currently represents only 20% of primary energy sources in the Czech Republic. Usage of gas for electricity generation is discouraged both because of large installed overcapacity of power plants (recently, the Czech Republic has been exporting almost 30% of its electricity production) based on very cheap (though mostly low quality) domestic coal and heavily promoted nuclear plants, built and operated by the dominant utility CEZ in which the State retains majority ownership. Ultimately, almost all power generation in the Czech Republic is based on coal (75%) and nuclear (23%).

### Industrial Use of Natural Gas (Mcm)

| | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|
| **Industry Total** | 4,458 | 4,766 | 4,812 | 3,202 | 4,489 |
| **Energy Sector** | 1,103 | 1,041 | 1,487 | 1,235 | 1,205 |

*Source: Czech Statistics Office 1995, 1996, 1997, 1998, 1999.*

The role of energy efficiency, which has enormous potential (energy intensity is 2.3 times higher compared to the EU average, compared through real parity purchase power) is neglected in these considerations. Renewable sources, which hardly exceed a 1% share on the base of primary energy sources are also marginalized..

It can, however, be expected that upon the liberalisation of the electricity and gas markets the situation can rapidly change. The threat of other competitive sources to „established" plants and the dominant position of CEZ has repeatedly been given as an official reason why the Czech government has asked for transition periods in the implementation of the liberalisation of its energy markets (a 33% liberalization of gas market is to be reached by 2008 with a full liberalization of the electricity market is to be reached by 2008).

Overpressure on the Czech electricity market, which remains under the tough control of the dominant, state-controlled CEZ utility, discourages positive developments in the energy sector (efficient technologies, new modern plants, increased use of natural gas). In any case, the role of natural gas in the Czech Republic will certainly increase in the long run. The existing coal power plants are slated to be phased out between 2015 and 2030, which is the time when the coal mines will be closed. It is therefore very likely that the replacement capacitites will be based mostly on gas-fired plants. By that time, the current negligible role of renewables and efficiency should also dramatically increase.

### Source and Total Gas Imported[3]

| year | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bcm** | NA[1] | 6.1 | 6.4 | 6.8 | 5.9 | 7.0 | 7.3 | 8.0 | 9.5 | 9.5 | 9.6 |

*Source: Geofond 1993, Geofond 1994, Geofond 1999*

[3] 1988 data for natural gas imports for what is now the Czech Republic are not available. However, the total figure for Czechoslovakia in that year was 11.2 Bcm. Therefore, it should be possible to derive the Czech figure from this and the Slovak one.

On a regional basis, Bohemia accounts for 42% of the gas consumed in the Czech Republic, South Moravia 25%, North Moravia 19%, and the country's capital, Prague, the remaining 14%. In 1998, the Czech Republic imported 8.6 Bcm of Russian gas, purchased from Gazprom, for domestic consumption. Volumes fell to 7.8 Bcm in 1999. Estimates from the United Nations Economic Commission for Europe, (UNECE) suggest that by 2010 the domestic demand for gas in the Czech Republic could reach 12 Bcm a year.

Over 58 Bcm of Russian gas a year is currently piped through the Czech Republic en route to Western Europe. Russia supplies the bulk of the country's gas requirements via the Brotherhood pipeline. Ruhrgas also supplies gas to the Czech Republic, as does Wintershall, which has obtained distribution interests in the Czech Republic, where the company plans major expansion. During 1997 the Czech Republic started importing gas from Norway for the first time, thus breaking the country's traditional reliance on Russian supplies.

The state-owned gas company, Transgas, is responsible for the transmission of gas in and through the Czech Republic and supplies the country's eight regional distribution companies that cover Prague and the provinces of Bohemia and Moravia. In 1999, Transgas sold 9.37 Bcm of its gas to customers in the Czech Republic, with 16% of that total imported from Norway. Transgas is tied to Gazprom through a 15-year contract for gas deliveries.

Until 1997, Russia was the only source of imported gas, but in April of that year, Transgas, the state-controlled national monopoly importer signed a 20-year gas supply contract with Norwegian producers (GFU, a consortium of Statoil, Norsk Hydro and Saga Petroleum), under direction from the government. The GFU agreed to supply Transgas with 3 Bcm of gas per year and thus the first Norwegian gas was delivered in May 1997.

Also, in 1998, Transgas renegotiated the contract with its main supplier, Gazexport, and a new, 15-year contract was signed in October 1998. Russian supplies should reach 7 Bcm in 2002. Also, Gazexport will supply Transgas with an additional 2 Bcm to pay for the Czech company's pipeline services. In 1999, Russian gas contributed 78.7% of Czech imports, with Norway contributing 15.8% and Germany contributing 5.5% (Geofond 2000).

## Fuel Structure

In 1999, coal provided just over 45% of the Czech Republics primary energy requirements. Gas contributed about 20% of primary energy requirements with nuclear energy accounting for approximately 9%. Hydro electricity projects supplied under 1% of primary energy requirements, with the remaining energy demand being covered by the use of oil. The table below illustrates the last decade's shift away from a reliance on solid fuels to the use of gas.

| PJ | **1988** | **1989** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Solid fuels | 1,441 | 1,394 | 1,348 | 1,251 | 1,120 | 1,057 | 984 | 1,006 | 1,016 | 977 | 890 |
| Oil | 410 | 405 | 357 | 301 | 319 | 308 | 314 | 327 | 343 | 307 | 319 |
| Natural gas | 207[4] | 212 | 225 | 218 | 220 | 249 | 239 | 273 | 316 | 322 | 320 |
| Other gases | | | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nuclear electricity | 146 | 137 | 138 | 133 | 134 | 138 | 142 | 134 | 141 | 137 | 144 |
| Water electricity | NA | NA | 4 | 4 | 5 | 5 | 5 | 7 | 7 | 6 | 5 |
| Total | 2,183 | 2,144 | 2,070 | 1,899 | 1,788 | 1,748 | 1,683 | 1,748 | 1,823 | 1,744 | 1,669 |

*Sources: SEVEn 2000, VUPEK 1995, Czech Energy Committee Working Group 1995*

[4] Gas fuels generally (natural gas and other gases) in 1988 and 1999

## Electricity Consumption by Sector

| GWh | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | 44,916 | 46,646 | 46,457 | 42,456 | 43,584 | 43,445 | 45,195 | 48,306 | 50,778 | 50,000 | 49,112 |
| industry | 24,882 | 25,964 | 26,573 | 18,246 | 23,743 | 22,612 | 19,461 | 20,183 | 20,329 | 19,996 | 19,609 |
| household | 8,871 | 9,235 | 9,623 | 9,873 | 10,343 | 11,107 | 13,184 | 14,848 | 16,011 | 15,503 | 14,506 |

*Source: SEVEn 2000*

The Czech Republic has a significant overcapacity in its power plants – whereas maximum peak load never exceeded 10,000 MW during 1990's, domestic power plants today represent 16,200 MW of installed capacity. In addition to this, 2,000 MW is to be added to the grid by putting the Temelin nuclear power plant into operation (scheduled between 2000 and 2002).

This discrepancy is rectified through massive electricity exports, which are slated to reach 14 TWh (25% of total production), in year 2000. Electricity is exported from the Czech Republic for prices that are below what CEZ asks for the electricity it provides to regional distributors (on average 27 USD/MWh for the regional distributors, as compared to 14 USD/MWh for the energy that is exported). Moreover, exported electricity is produced by CEZ in its low-efficient outdated thermal plants or from Soviet designed nuclear reactors at Dukovany.

## Electricity Import/Export

| TWh | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| import | 3.6 | 4.8 | 5.4 | 2.0 | 0.9 | 0.9 | 1.6 | 2.5 | 3.1 | 2.6 | 2.1 | 2.4 | 2.5 |
| export | 2.6 | 3.2 | 2.2 | 1.3 | 1.5 | 3.0 | 2.0 | 2.1 | 3.1 | 3.8 | 4.5 | 5.7 | 13.0 |

*Source: UED 2000* **-=predicted*

## Domestic Gas Reserves and Storage Facilities

The Czech Republic has only half a dozen known gas fields, which provide little more than 2% of the country's total domestic gas requirements. Extraction is the sole responsibility of Moravske naftove doly (MND), which was formerly state-owned but which was floated on the Czech stock market during 1998. MND controls 600 Mcm of storage facilities located in Dolni Bojanovice and Damborice. A new storage facility, with a capacity of 180 Mcm, is under construction at Uhrice and should become operational in 2001.

Transgas, which has the exclusive right to import gas, uses 5 underground storage facilities in Lobodice (aquifer storage), Tvrdonice, Stramberk, Dolni Dunajovice (old gas fields) and Haje (a unique type of storage facility located in an old uranium mine). The total capacity of the facilities is about 1.8 Bcm. In addition, Transgas leases another 1 Bcm storage capacity abroad, in Lab (Slovakia) and, since 1994, Rehden (Germany). The company hopes to increase the capacity of storage facilities in the Czech Republic to 2.3 Bcm by 2010, while keeping the 1 Bcm storage capacity abroad.

## Map Showing Czech Gas Network


## Infrastructure Changes

**Gas consumption**: the industry has been expanding in the country during the 1990s. The gas consumption, imports and share of gas in the fuel mix significantly increased during the decade. This was particularly due to an increase in household consumption, a direct result of the government's major gasification programme, which was driven primarily by environmental concerns. The number of households that buy gas increased by 28 percent during the decade. More than 40% of household customers use gas for heating.

**Industry infrastructure**: The 1990s saw major construction activity in gas infrastructure, with local pipelines increasing from 15,000 km in 1990 to 37,000 km in 1998, and major national pipelines increasing by 20 percent. Also, Transgas has increased the capacity of the transmission pipelines, and currently operates 2,399 km of trunk lines.

**Ownership and privatisation**: The state-controlled gas company, Cesky plynarensky podnik (CPP), was divided into Transgas (state-controlled monopoly importer) and 8 regional distributors in January 1994. The regional companies were partially privatised in the first half of the 1990s and their mixed ownership led to sometimes dramatic stock market battles between foreign investors, the government and municipality shareholders. At the moment, the government controls a majority share in six of the eight companies, and more than 48 percent of the other two.

**Shareholdings in Czech gas distribution companies, 2000**

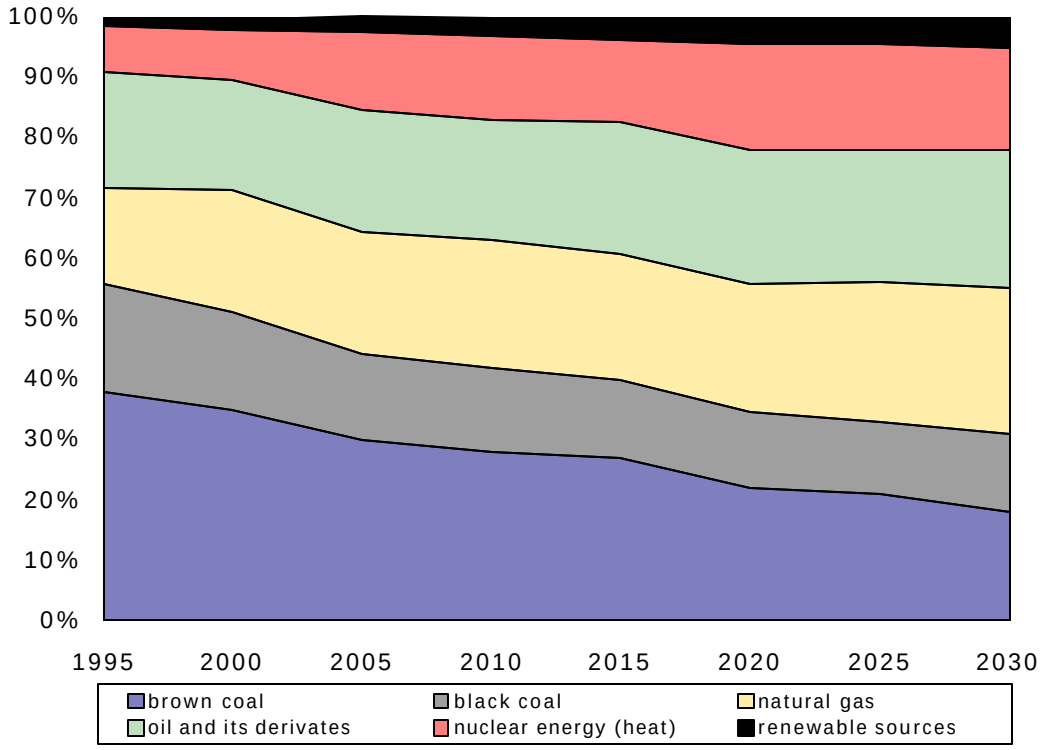
| *City/Region* | *Company* | *State Share (%)* | *Foreign/Municipal holdings (%)* |
|---|---|---|---|
| Prague | PP | 49.2 | RWE/Ruhrgas 4.46, City of Prague 34 |
| West Bohemia | ZCP | 50.1 | Ferngas Norbayern, 27.4, Bayernwerk 16.5 |
| North Bohemia | SCP | 50.0 | VNG 15.8, Wintershall 20.05, Communes 34 |
| Mid Bohemia | STP | 50.0 | Wintershall 30.04, Ruhrgas 13.2, RWE 1.0 |
| South Bohemia | JCP | 46.8 | Bayernwerk 16.5, Oesterreich Ferngas 34.5 |
| East Bohemia | VCP | 51.1 | Ruhrgas 15, SPP 10, GdF 3, SPP Bohemia 20 |
| North Moravia | SMP | 50.7 | SPP, 10, SPP Bohemia (Ruhrgas) 20 |
| South Moravia | JMP | 50.1 | Bayernwerk 35.5, GdF+Ruhrgas 14.4 |

*Source: Handelblatt research*

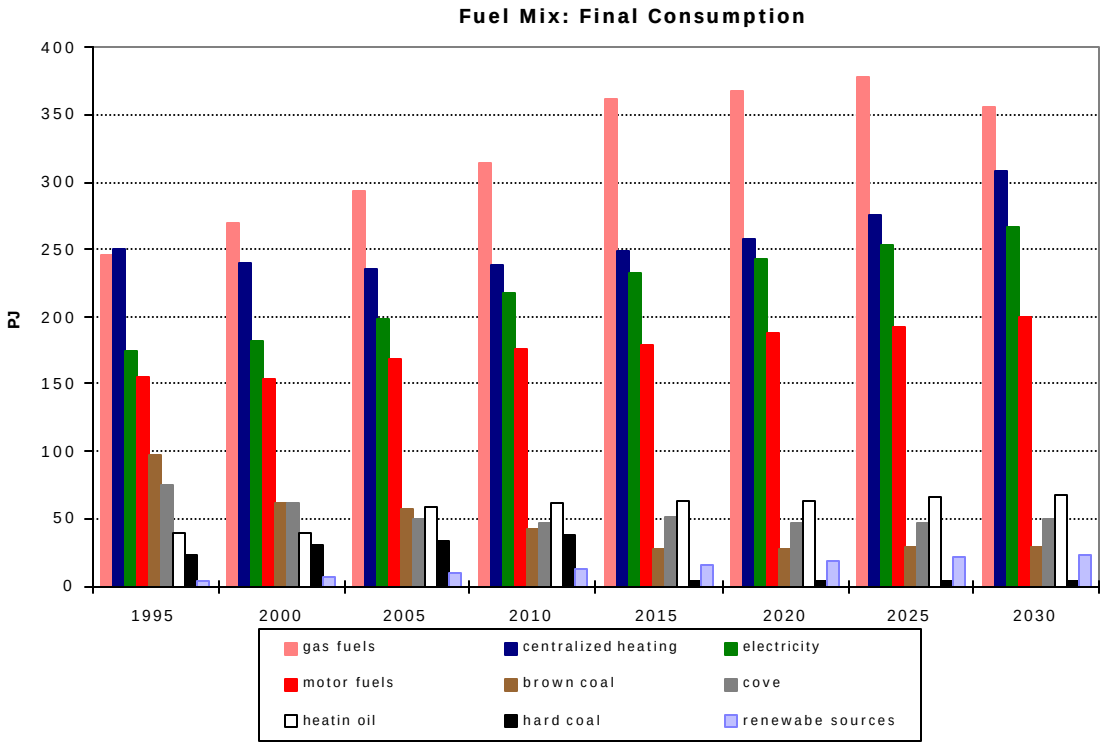
The future of the industry has become a highly politicised issue, and has prompted a major battle between different factions within the Social Democratic Party's minority government. In its plan, dubbed by critics as being "nationalisation", Miroslav Gregr's Department of Industry and Trade (DIT) proposes to re-merge the eight regional distributors with Transgas and privatise the gas industry complex as a single company. The DIT is also attempting to delay the privatisation process. On the other hand, the more liberal Department of Finance and its Minister, Vice-PM Pavel Mertlik, insists on a demonopolised structure for the industry and wants to keep the regional distributors independent from Transgas. The majority of the opposition parties in the Parliament support the latter of these positions.

In its Energy Policy, the Government has reservation about the timetable for full gas market liberalisation, and the issue has become the subject of intense discussions within the cabinet, revealing differing views among ministers. The EU Commission, in its 1999 review of the progress made by accession candidates, reported that the Czech Republic needs to further liberalise energy prices and dismantle monopolies. The state continues to retain majority stakes in gas distribution companies, as well as maintaining a dominant position in the gas pipeline system. The Czech Ministry of Finance favours the privatisation of both Transgas and the country's eight gas distribution companies. Price liberalisation is scheduled for 2002, but, given the current disparity with world levels, this may prove difficult to achieve.

**Fuel Structure: Primary Energy Sources**




*Source: Government's Energy Policy, January 2000*


Fuel Mix: Final Consumption
PJ
400
350
300
250
200
150
100
50
0
1995
2000
2005
2010
2015
2020
2025
2030
gas fuels
centralized heating
electricity
motor fuels
brown coal
cove
heatin oil
hard coal
renewabe sources

# Hungary

## Primary Energy Supply

Until a sharp decline in 1989-90, Hungary's energy supply had been increasing smoothly throughout the late 1980s. Energy use in the 1990s stabilised at a rate that was around 20% lower than in the 1980s (around 1050 PJ) and until recently showed little sign of increasing. This decrease in energy consumption is a result of factors relating to the restructuring of the economy. These factors include the collapse of several big, energy-wasting enterprises; the increasing level of energy efficiency and the fact that many aspects of the new economy are being located in less energy intensive sectors. However, despite these changes, producing one unit of Gross Domestic Product (GDP) in Hungary still requires more than double the average amount of energy needed in the EU.

The same process is being played out in Hungary as in highly industrialised and former socialist economies: the use of coal is decreasing, while the use of gas is increasing. The changing structure in the use of different fuels can be characterised in the following way:

In the 1970s, different types of coal satisfied half of Hungary's energy supply. By the end of the 1990s, the proportion had dwindled to around one sixth of its former rate (50% in 1970, 15% in 1997). During the period between 1970-2000, the share of oil in Hungary' energy supply fluctuated between 30-37%. These changes in levels of oil use have been largely dependent on the price of oil.

Unlike oil, whose role has remained fairly consistent, there has been a significant change in the role of natural gas use in Hungary. This change has essentially mirrored world trends. Consequently, although gas and oil prices move concurrently, the role of gas in Hungary's total primary energy supply increased from 13.5% to 26.2% in the 1970s, to 28.3% by 1990 and to 38.6% by 1996.

Since the Paks Nuclear Power Plant became operational, the proportion of nuclear energy used in Hungary has not changed significantly, and has remained at around 10-12%.

## Industrial Energy Consumption and its Structure

In Hungary, the percentage of energy used by industry had been increasing steadily until 1989, when it decreased significantly. In the 1990s it remained stable at 260-270 PJ, 35% of the total national energy usage. However, due to the increasing level of energy efficiency, between 1992-2000 a 70% increase in industrial growth was achieved despite a decrease of 10 % in the levels of energy use.

The share of the national energy consumption that was held by different types of coal changed from 25-27 million tons in the middle of the 1970s to 13-15 million tons by the 1990s. In the same period, the industrial use of oil decreased from 8-9 million tons to 6-7 million. Compared to its 8 million cum average in the 1980s, industrial gas use dropped to 6-6.5 million cum in the 1990s.

## Energy Consumption in Residential and Public Services and its Structure

Both the share of the total energy consumption and the absolute value of energy use in the household and public service sector grew until the 1990s. During the early part of the 1990s it remained constant at around 420PJ/year. In the early 1990s the share of national energy consumption that was held by households and public services was at 36%, but this has changed

in the last 3 years. In the current context, the percentage of households and public services using coal to satisfy their enrgy demand has fallen back sharply to 2% from its level of 20% in 1985. Meanwhile they satisfy 42% of their energy demand by natural gas (NG) (170-180 PJ/year).

The consumption of all other types of secondary energy has decreased by 15-20%.

### Energy Consumption of Electricity Sector and its Structure

In the last few years, changes in the structure of fuel use in the electricity sector have taken place in the following ways:

- Electricity demand increased by 30% between 1990 and 1998 (1990: 50.2 PJ, 1998: 64.7 PJ).
- Since the mid 1970s, the proportion of coal use in the energy sector has strongly decreased (50% in 1980, 30% by the end of the 90s).
- Nuclear power is very important to the electricity supply with the Paks Nuclear Power plant generating 40% of the total.
- The absolute value and proportion of hydrocarbons in electricity generation decreased from 4250 Mcm at their peak in 1982 to 3500 Mcm in 1990 and, subsequently, to 2700 Mcm in 1997).

| **Fuel** | **1986** | | **1996** | |
|---|---|---|---|---|
| | **PJ** | **%** | **PJ** | **%** |
| **Nuclear** | 82.8 | 22.5 | 155.2 | 38.5 |
| **Natural GAS** | 92.8 | 25.3 | 79.6 | 19.7 |
| **Oil** | 49.6 | 13.5 | 50.9 | 12.6 |
| **Hydrocarbons** | 142.4 | 38.8 | 130.5 | 32.3 |
| **Coal** | 142.3 | 38.7 | 117.8 | 29.2 |

*Source: Electricity Yearbook, 1996*

55% of the fuel used in CHP plants is gas (about 42 PJ in 1998) while heat generation plants use, in practice, only gas (some 17 PJ in 1998). In general, the gas supply of power plants plays an important buffer role for households, as household gas consumption has been growing.

### Domestic Fuel Production and their Import Proportion Excluding Gas

Ultimately, however, as much as the domestic production of the various fuels increases it cannot satisfy the growing demand. This results, therefore in an increase in the importance of fuel imports. Consequently, the share of imported fuel consumption grew from one third of Hungary's consumption in 1970 to a half in 1980. During the second part of the 1990s this share reached around 54%. Since 1980, around 86-87% of the demands for coal has been met by domestic production. However, in 1989-90 this percentage fell back to 78%. The absolute value of coal imports has kept falling in the 1990s, with the numbers falling from 1.7 million tons in 1990 to 0.6 million tons in 1998.

Similarly, the proportion of oil imports has not changed either. The rate at which Hungary imports coal has remained around 21-25% in the 1980s and the 1990s (production in 1990 equaled 1915 million tons with 1998 production equaling 1260 million tons when compared to import levels, which were at 6.4 million tons in 1990 and 6.1 million tons in 1998.) The proportion of oil and oil products in the structure of energy sources fluctuates between 30-35% in the 90s.

## Natural Gas

**Consumption**

Despite price fluctuations, which mirrored world trends, the proportion of gas use increased from 13.5% in 1970 to 26.2% by the end of the decade and to approximately 38.6% in 1996. The absolute figures can be seen below.

**Natural gas consumption, Bcm – 1993-2000**

| 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|
| 9.0 | 9.4 | 10.2 | 11.4 | 10.8 | 10.8 | 12.0 | 13.0* |

*Source: BP Statistical Review, 2000* * Projection

**Structure Changes**

In general, the share of gas in the structure of Hungary's energy sources can be characterised by an increase in both the absolute and proportional values. However, the role of gas use in the different sectors has changed.

*Gas Consumption of Industry*

The gas demands of industry are similar to their total energy demands. They had been increasing due to political changes before falling sharply in the period between 1990 and 1992. Since that time industrial gas use has dropped to the same level it was at in 1970. Compared to the 117 PJ peak in 1987 there was a decrease of 40%, to 69.3 PJ, in 1997. Industrial use comprised 52% of Hungary's gas consumption in 1975, 46% in 1985, 37% in 1991 and has increased to 39% in 1997.

*Gas Consumption of Households*

In the 1970s and 80s coal, heavy fuel oil and firewood satisfied residential energy demand, as the gas network was not developed at that time. Following the development of the gas network, the regional distribution companies became significant suppliers of gas and are now the most significant customers in gas market. Compared to 1990 levels of 21.5% (91.9 PJ), 40% of the energy demand of households was satisfied by gas in 1998. Energy use in the household sector increased to 178.7 PJ in 1998. The increasing share of households in total gas consumption has resulted in higher divergences between winter and summer demand (70% of gas use takes place in the heating season), as most households use gas for heating. This increasing seasonal discrepancy in demand means that storage costs are increasing (see section for pricing).

**Natural Gas Production and Trade**

The gas 'economy' started in 1967 when the National Oil and Gas Industry Trust (Országos Kõolaj-és Gázipari Tröszt) companies – the ancestors of current regional gas distributors and MOL (Hungarian Oil and Gas Co.) – were established. In the 1970s and 80s, the capacities for the research and exploitation of domestic gas reserves developed in a short time. An initial production of 3.64 Bcm (in 1970) doubled in 15 years (the proportion of NG in Hungary's energy supply structure grew to 27% in this period). From 1986-87 it became clear that national reserves were being exhausted and were thus able to cover a dwindling proportion of the growing demand. According to MOL's estimates, the value of national reserves that can be exploited at a profit changed at the following levels:

| Year | **1994** | **1995** | **1996** | **1997** |
|---|---|---|---|---|
| Bcm | 49 | 46 | 43 | 40 |

*Source: Hungarian Gas Industry*

While 95% of gas demand was covered by domestic production in 1970, this proportion decreased to 64% in 1980, to 43% in 1990 and to 35% in the last two years. Meanwhile, gas has

become more important in the structure of Hungary's energy sources. In 1980 gas imports amounted to 23% of Hungary's total fuel imports. This proportion rose to 35% by 1990, to 44% by 1995 and has, since 1996, exceeded 50%.

*Sources of Gas Imports*

When Hungary began importing gas, 200 Mcm were imported from Romania. This volume was, basically, used solely in the chemical industry (1958-1975). However, from 1975 until 1996, the Soviet Union was the main source of gas imports, with a shift toward Russia and the Ukraine as the principal suppliers after the disintegration of the Soviet Union. Since 1996, when the Baumgarten (Austria) – Gyõr (Hungary) (HAG) pipeline was put into operation, Hungary has been buying gas from Rurhgas and Gaz de France, but much of this gas also comes from Russia through a roundabout route. The proportion of this route in total Hungarian NG importation is not terribly significant, comprising just 11% of the total in 1997 and 16.5% of the total in 1998.

The importance of this relationship, despite its considerably higher price, is that these companies will accept delivery from France and German security reserves in the case of a suspension of Russian gas supplies. The only Hungarian party dealing with import resource management is MOL, with its long-term-contracts. With regard to the management of the Russian imports, MOL contracted with PANRUSGAS (with 50% owned by MOL and the Russian national company, GAZPROM) in 1996.

This contract requires the Russian party to deliver 194 Bcm of gas in the period between 01.10.1996 - 31.12.2015 and provides the option of buying a further 2 Bcm per year during the 2000-2015 term. For Western-European imports MOL has a 10 year contract, established in 1995, with Ruhrgas AG for an annual delivery of 0.5 Bcm. In 1997 they signed another contract with Ruhrgas AG for 15 years, starting in 1998, for a further 100 Mcm per year. According to the contract, imports will reach the 1 Bcm level by 2006. A contract for 400 Mcm with Gaz de France came into force in January 1997. Both Western-European parties deliver through the HAG pipeline.

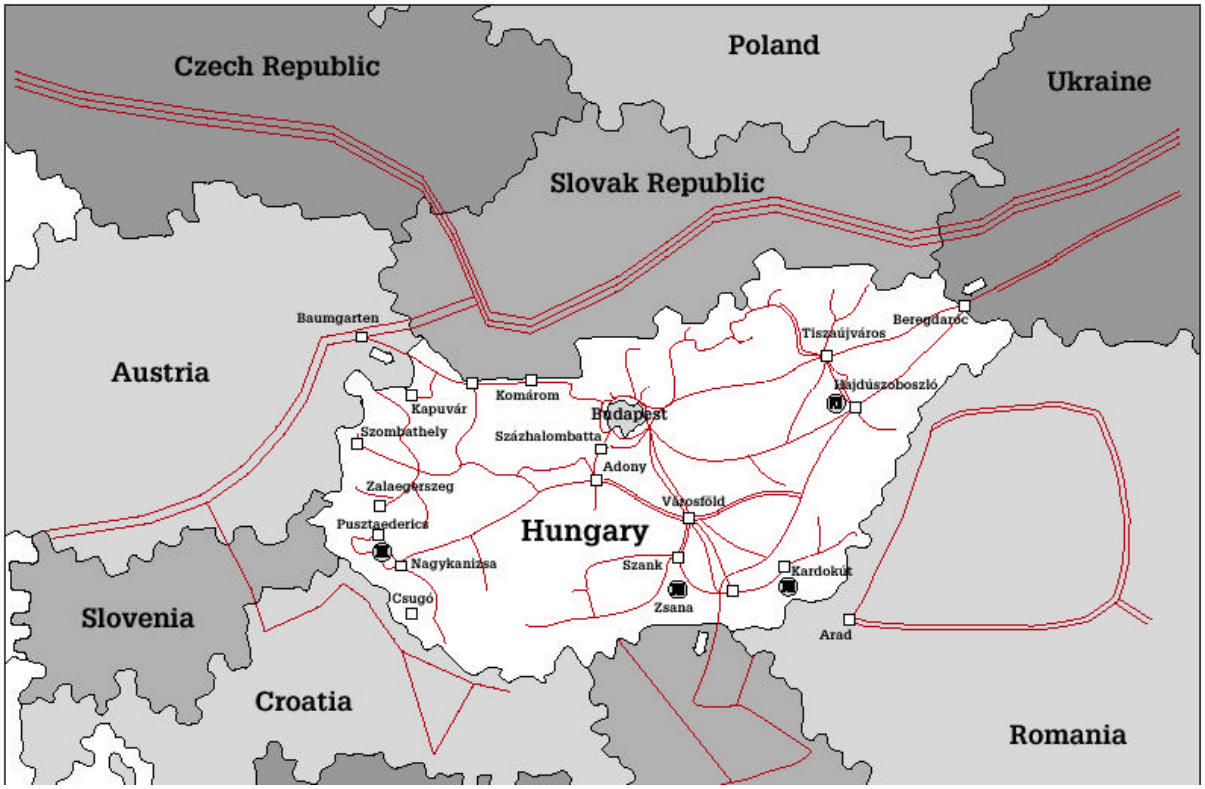
**Storage**

Due to its storage capacity and pipeline network MOL is the main distributor of imported and exploited gas. MOL runs Hungary's five big storage tanks, which, they claim, have a capacity of 3.3 Bcm. (The sixth will be completed by 2001 with further 700 Mcm storage capacity.)

Due to the significant proportion of the residential and public service sectors in gas consumption and the fact that long-term contracts are relatively inflexible, storage is a crucial point of Hungarian energy strategy and is a significant cost factor. MOL and the Government have forecast a 30% increase in gas use by 2005 and, consequently, are supposed to have enlarged their storage capacity to 4.4-4.5 Bcm by that time.

In accordance with the requirements of the International Energy Agency and the EU, the 90-day storage capacity was in place by 1998. During the winter peak season, 40-45% of the consumption can be satisfied from storage capacity.

**Gas pipelines in the Central and Eastern European region**



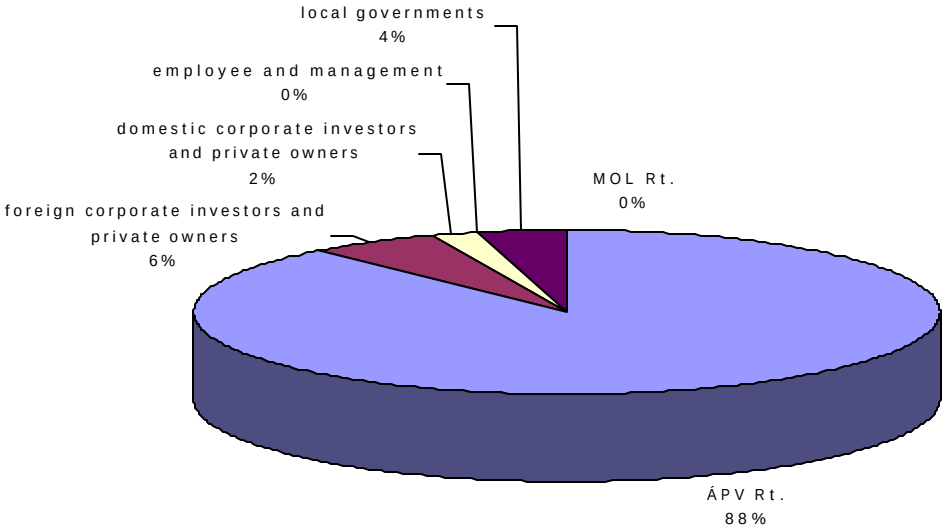

**Transport**

MOL runs Hungary's entire 5100-km long high-pressure gas pipeline network. The 66 848 km long distribution lines are run in part by regional distributors and partly by local governments. The high-pressure pipeline has an annual capacity of 16.5 billion cum with about 84 million cum daily peak capacity. The network was initially developed for the extraction of domestic reserves but is now suitable for satisfying regional demand and for the reception of imports. From a transport point of view, MOL is a natural monopoly and liberalisation would mean that its unused transport capacity (when available) would be made available to third parties (third party access principle). When considering the increase in peak consumption, the age of the pipeline network needs to be taken into account. 58% of the pipeline network is more than 15 years old, 23% is more than 25 years old and 19% is more than 30 years old. Daily demand will increase from 70-75 million cum in 1998-2000 to 100-105 million cum by 2015. From a strategic point of view, the gas transport business should also be encouraged to diversify its resources and to take advantage of Hungary's geographical location, following the example of Russian-Italian gas transport. This last point was also highlighted by the MEH (Hungarian Energy Office). Fortifying the NG transit role of Hungary requires the development of transport capacity.

## MOL Rt

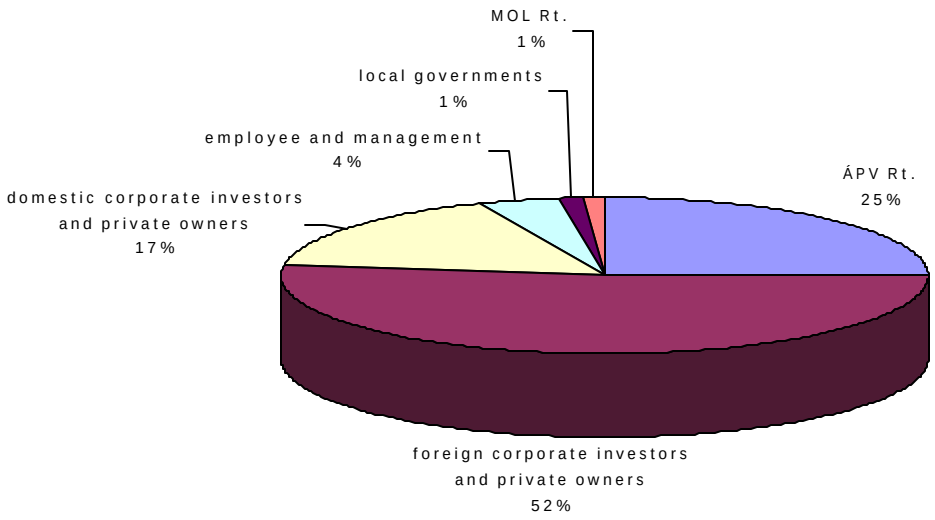
MOL has a crucial role in the Hungarian gas market, as it integrates gas exploitation and imports, runs the entire high pressure pipeline network and storage capacity, is the first link in the gas distribution chain and plays an important role in domestic trade. Since 1998, MOL has had the largest turnover of any trade or manufacturing company in Hungary and is one of the largest companies in the region. Its net returns in 1996 were 500 billion HUF and grew to 742 billion HUF by 1999. The nine companies of the National Oil and Gas Industry Trust (OKGT), established in 1961, were consolidated into a joint-stock company in 1991. MOL was privatised in three waves between 1995-1998. Its ownership structure changed as follows:

**Ownership structure of MOL in 1995**




According to the current scheme, the Hungarian Government intends to keep 25%+1 of MOL shares. As a result of privatisation, foreign corporate investors own more then 50% of its shares. Despite regulations, obligatory contracts and supply duties, MOL is ultimately a private company with a remit to maximise its profit.

**Ownership Structure of MOL in 1998**




**Regional Strategy of MOL**

MOL is striving to become the regional ruler of the oil and gas industry. Although it deals primarily with distribution, it is also involved in hydrocarbon exploitation and processing. MOL is also seeking strategic partners in Croatia (INA) and in Slovakia. The extension into Slovakia is an important question as the Russian gas pipeline runs through Slovakia, and could provide key reserves in an emergency.

By establishing the Borsodchem (a huge corporation in the chemical industry) and IPP (Independent Power plant Project), MOL has now also entered into the electricity sector. However, concerns have been raised over the potential monopoly these developments may create. Consequently, MOL has divided its gas business into three areas: storage, transport and distribution.

**Regional Distributors**

Regional distributors buy gas from MOL and supply mainly directly (households), but also indirectly (heating plants, public services) to residential consumers. They also supply industrial consumers.

Regional distributors were members of the OKGT and were thus established in 1967. They were changed into joint-stock companies in 1991 and left the OKGT at that time. All six of them were privatised in 1995 and, as in the case of MOL, foreign participation became dominant in their ownership structure (59% of their stocks are owned by foreign corporate investors and 40% are owned by Hungarian corporate and private investors of which 20% represents the share of local governments). They are primarily owned by large Western-European companies. (See the next table.)

### Main Owners of the Regional Distributor Companies in 1999

| | DÉGÁZ | DDGÁZ | KÕGÁZ | FÕGÁZ | TIGÁZ | ÉGÁZ |
|---|---|---|---|---|---|---|
| **Gas de France** | 67.6% | | | | | 63.9% |
| **Ruhrgas AG** | | 41.2% | | 16.3% | | |
| **Westfalische Gasverorgung AG** | | 41.2% | | 32.7% | | |
| **Bayernwerk Hungaria AG** | | | 29.7% | | | |
| **MOL RT** | 27.1% | 16.8% | 6.3% | | | 35.5% |
| **Italgas-SNAM S.P.A** | | | | | 50%+1 | |
| **EVN** | | | 29.7% | | | |
| **RWE** | | | | | 30% | |
| **Budapest Local Government** | | | | 50%+1 | | |
| **Local Governments** | 4.9% | | 9.3% | | | |

DÉGÁZ: Southern Lowlands Gas Distribution Company
DDGÁZ: South Transdanubian Gas Supply Corporation
KÕGÁZ: Middle Transdanubian Gas Supply Corporation
FÕGÁZ: Budapest Gas Works Company
TIGÁZ: Trans-Tisza Gas Supply Corparation
ÉGÁZ: North Transdanubian Gas Distribution Company

As MOL has supply obligations at a fixed price to the regional distribution companies, their income is secure and therefore not affected, in the short term, by problems arising from the difference between import and home trade prices.

#### Characteristics and Problems of Pricing

Currently, the bulk of Hungary's gas imports come from Russia and this is not projected to change over the next decade. In considering the proportion of storage and imports costs (1:4) and the fact that long-term import contracts are quite inflexible from a volume point of view, domestic production and storage play an important buffer role. Existing storage facilities can cope with seasonal variations in demand, most notably in the household sector.

In light of that, the question becomes whether residential consumers would be solvent if and when cross subsidies (i.e. between consumer sectors or between importers, producers and consumers) end as they are against competition. (At the end of the 1990s, a quarter of families had to spend more than 35% of their revenue on overheads – such as rent and heating).

MOL is the sole importer of NG and thus has a supply obligation. As the Government has largely ignored changes in import costs and has not let MOL raise distribution prices more than 12% (according to the Hungarian Energy Office (MEH), 33% would be justified), MOL claims its has suffered a loss. Without compensation mechanisms MOL is obliged to finance the Government's policy. In a case where the policy is to keep prices low in the long term, MOL could be compensated by the State or alternatively the gas business could be bought out by the State.

The legislative framework that would regulate the relation between and political considerations of the Government and MOL (operating as a profit oriented private company) has not been

elaborated as of yet. The current legislation is a mix, as it combines price setting by the Government, while, at the same time, letting other elements be determined by market forces. Taking into consideration the specifics of the energy sector and its strategic importance, it is crucial to solve the problem of complex legislation as soon as possible.

One of the MEH's major tasks has been to supervise a series of painful increases in domestic gas prices during 1996 and 1997. These changes were undertaken in order to bring Hungarian charges into line with world prices, although they remain far below the European average. During 1999, industrial consumers in Hungary paid the equivalent of $90 per Mcm of gas, while domestic customers were charged the equivalent of $125.

## Some Problematic Areas for Hungarian Energy Policy

The projection and development of an energy strategy up to 2015-20 is a process that will provide the theoretical framework for the steps that precede and follow energy market liberalisation. The stated aims of this strategy are to move towards energy saving, energy efficiency, resource diversification, supply safety, environmental protection and sustainability. On the other hand, legislation for the related fields of the energy sector (e.g. electricity sector, pricing, role of local governments, programs for energy efficiency, etc.) are not co-ordinated. It would be more suitable to develop the general energy policy regulations before specifically regulating certain sectors.

According to current forecasts, Hungary's primary energy consumption will not increase by 2010, unlike the proportion of imports. Taking into account previous processes, the current situation, world trends and national interests, the following issues are not emphasised enough in Hungarian energy policy:

- By 2015-20, the Paks Nuclear Power plant is unlikely to be in operation. Replacement of this generating capacity must be taken into account, without the jeopardising other priorities.
- In 2004, the environmental permits of coal power plants will be no longer valid.
- By that time, Hungary will have to meet the first Kyoto $CO_2$ emission reduction obligations. This is not a priority now, as present emission reduction obligations will certainly be fulfilled as a result of economic restructuring. (6% $CO_2$ emission reduction by 2010 on the 1985-87 average basis). However, a strategic energy policy should take into account prospective situations, particularly since, without strategic planning, it will be more difficult to fulfil future emission reduction obligations.
- The use of renewable energy must be increased in order to meet EU requirements. Governmental commitment to stimulate the renewable energy sector is rather shallow. Existing policy and financial instruments are insufficient and uncoordinated. However, taking into account emission reduction obligations, the need for replacing nuclear electricity generating capacity and the already huge share of gas in Hungary's energy consumption (which should not increase), it is clear that Hungary will need to rely more on renewable energy in the future.
- Coal use would probably not diminish considerably and its 10-12% share in Hungary's primary energy supply will remain the same. On the other hand, domestic coal reserves cannot be exploited for much longer, as they are non-economical, and as a result they are likely to be replaced by imports.

## Gas as an Issue of Energy Policy

The share of Hungary's primary energy supply currently occupied by gas is about 40%. This will probably remain stable, as an increasing dependency would endanger security. In light of this, the

issue revolves around the inner structure of gas consumption. As the import proportion is huge and consumption very high seasonally, due to the weight of the residential and public service sector, the following are crucial issues:

- The switch over to import-based gas pricing and the timing of the switch.
- The gas consumption structure should be changed to give priority to consumers who use gas more efficiently, e.g., through the use of combined heat and power plants.
- The State should be taking measures to form a favourable business environment rather than just providing financial assistance. Certainly, the former requires a more complex action plan that is not visible within the current steps being undertaken.
- The district-heating (i.e. heating plants) system is less competitive due to low household gas prices and relatively high industrial prices. When looking at the proportion of income/energy prices, a simple rise in the price of gas would not solve this problem.
- Nuclear power and coal cannot be replaced by gas, as the current share of total consumption held by gas is already very high.

Another important issue is governmental responsibility. Whereas the spread of gas use took place through governmental assistance (pipeline network, low prices, etc.), current energy efficiency investments in the household sector have to be financed mainly by the consumers themselves (with existing funds being extremely limited).

The overwhelming majority of individual gas heating systems that were built in the 1980s are inefficient and out-dated. Developing financial mechanisms to replace these systems with more efficient ones is not being discussed. Thus, development of the system that resulted in dependency was originally achieved through governmental assistance, which is, when examining ways in which to change current and immediately foreseen conditions, largely absent.

The development of such a large gas network (70% of settlements are connected to the gas grid) may hold back regional resource diversification and the use of local renewable energy sources. The size and the development of this network further hinders the development of medium sized heating systems (currently comprised of single-flat-heating and huge, inefficient, district-heating), which would be able to respond to changing demand in a more flexible way. Furthermore, these middle-sized systems have effective fuel consumption levels and represent a real opportunity to influence energy consumption and costs. In brief, they encourage energy savings and would be the most effective gas fuelled CHP plants. The environmental friendliness of CHP Plants has not been taken into account in the current pricing scheme

**Some Issues of Gas Market Liberalisation**

The opening of the market, slated to take place during the year 2002, should be achieved in a way that keeps energy policy priorities in order, including:

- A regulation that develops supply security. Companies running storage and transport facilities (now just MOL) should be forced to carry out system-developments that meet the changing demand.
- Gas prices will probably decrease for authorised consumers. On the other hand, in the case of the switchover to import based pricing that is likely to be carried out (when considering the present tension in market) prices will increase for household consumers. A significant and fast price rise could cause social tension, and thus a schedule to keep in operation cross-subsidies

temporarily should be elaborated and the initiation of a social tariff system (cross-subsidies between household consumer groups with different income level) should be considered.

- Authorised consumers (those who will be enabled to choose their supplier) should not be allowed to switch between public utility providers and the free market to take advantages of actual price differences.
- District-heating plants should be included in the first group of authorised consumers (defined by the EU directive) in order to benefit from market liberalisation.
- Timing of the gas market liberalisation should respect electricity market liberalisation.
- It is a question whether horizontally (electricity, gas, heating) and vertically (distribution production) integrated companies in the energy sector will engage in real competition. They are regulated only from the point of view of accountancy and operation, but not from ownership structure.

**District-heating and Cogeneration**

640 000 flats (500 000 in blockhouses) are connected to district-heat systems. Despite more than 2 million people being affected there is no strategic action plan in progress, either in the current or in the proposed future energy policy, for resolving the problems of district-heating, which is the most problematic field of the energy sector. The roots of this crisis are to be found in the former system. District-heating plants are mainly gas-fired but, as it was mentioned above, they are not competitive largely as a result of discrepancies in gas pricing for different consumers. Before 1995, the industrial price was higher, but, since then, this proportion has been changing as price rises for households have been higher than for industry. In 1998, the difference between the two was 40%.

When district-heating systems were developed combined heat and power (CHP), was not primarily a means of generating heat. The situation is getting better, but an incentive system has not been elaborated yet. Hungary's power generation sector is notable for its widespread use of CHP, as 12% of annual electricity consumption comes from CHP / cogeneration plants. All except six of the power plants deliver more heat than electricity, so power generation can almost be viewed as a by-product of the heat sector. Such wide reaching use of CHP would normally be associated with high levels of efficiency but, unfortunately, this is not the case in Hungary. The systems are generally in a poor state of repair, with distribution losses of over 20% occurring in some systems. The heat transmission pipeline systems are out-dated (owned by local governments and managed by heating service companies) and the companies' capital accumulation is not enough to finance the development of the system. The problem occurs largely because local governments (who are also the pricing authority) are inclined to underestimate the heating service to avoid price rises.

Heat losses are such that many households find they cannot rely on the district heating system to provide all of their space heating and hot water requirements. Until recently, cross-subsidies in gas pricing meant that district heat cost up to 30% more than heat from individual gas boilers. Many households have therefore switched to natural gas for their heat and hot water requirements.

Industrial customers have also tended to switch away from district heat in large numbers, thereby further damaging the financial viability of the heating companies. Urgent investment is needed in system refurbishment in order to reverse these trends, thus enabling heating companies to hold on to existing customers. However, the most recent changes in gas pricing should eliminate the cross-subsidy to households. The heat transmission pipelines are out-dated (owned by local governments and managed by heating service companies). As the companies' capital accumulation is insufficient to finance the development of the system because the local governments (who are also the pricing authority) are inspired by political interests and inclined to underestimate the heating service to avoid price rises.

The ownership structure of district heating also hinders the rationalisation and modernisation of the system. Modernising the system is essential in order to enable the consumers to save. Consumers cannot finance the modernisation of the system, nor can companies, or local governments. A co-ordinated financial mechanism that would ensure the modernisation of the system should be elaborated with the participation of all parties.

**Regulation and Institutional Backround**

The Hungarian Energy Policy contains the principles of the national energy policy, and the Natural Gas Market Business Model Draft contains the principles for the restructuring and the liberalisation of the market.

Hungary adopted the European Energy Charter in February 1995. In November 1998, the Government declared that by the time of EU accession, Hungary would comply with the gas related part of the *aquis*, and would not apply for derogation accordingly. The Ministry for Economics is responsible for the regulation of the gas industry. Issuing permits and monitoring with nation-wide competence is the responsibility of the MEH, which was established in 1994 and is controlled by the Government. Its main tasks are: -

(1) the monitoring of companies in the gas and electricity industry.
(2) customer protection. As market rule becomes more widespread the customer protection function should be reinforced. (To that end, the MEH would probably be more efficient if it was controlled not by a Ministry but by the Parliament.)

The most important gas regulatory instruments are the following:

- The Mining Act of 1994 (and its modifications and additions) deals with gas research, exploitation, transport, and storage. These functions can be passed to enterprises under concession according to the Law on Concession (1991). Transport and storage concessions can also be sold together.
- The Act on Natural Gas Distribution (1994) defines conditions that a distributor has to meet.
- Two other very important pieces of legislation for the present and future operation of the gas market are the 1995 Act on Privatisation, and the Act on Pricing (1990).

The other main pieces of legislation connected to the gas market are in the following areas:

- On environmental protection (e.g. 1995: general rules of environment protection, 1996: environment affect monitoring);
- On competition (e.g. 1996: unfair market behaviour);
- On MEH;
- Regulation of particular fields (e.g.: system modernising);
- Customer protection (e.g. 1996 modernising the customer protection regulation, relation between service companies and organisations of representation);
- Fundraising (Energy Saving Credit, German Coal Aid Credit Scheme, Environmental Protection Fund Objective Task, etc.);
- On functions and responsibilities of local governments;
- On EU accession.

In general, it can be said that the elements necessary to reach the targets are in place, but the strategic, harmonised regulation of the different interconnected fields of the gas market and the economy could be more complete.

A new draft gas act is in preparation, and should be presented by the end of 2000. This act anticipates the liberalisation of the gas market only when Hungary formally accedes to the EU, possibly in 2003. Initially, market opening will be 35%, with third-party access likely to be dealt with on a negotiated basis. MOL is to be restructured and a new pricing structure introduced with the costs related to the price of imported rather than domestically produced gas.

## Conclusions

Natural gas plays an important role in Hungary's energy consumption. The supply of natural gas is covered mainly by imports. This dependency should not increase. A significant portion of Hungary's gas consumption comes from the inefficient residential and public service sectors. As these sectors use gas primarily for heating, there develops a large difference between winter and summer consumption. Consequently, this seasonal discrepancy requires a huge and expensive storage capacity. The large share of households in gas consumption was initially developed by governmental support that kept prices for households low, while keeping industrial prices much higher until 1995.

The current and previous pricing policy and subsidies have enabled the development of a gas network in Hungary. However, the creation of this network dominates the energy field and, consequently, holds back the development of renewable energies, CHP plants and efficient district heating. Despite the facts mentioned above, efficiency and energy saving problems cannot be solved by a simple price increase, as this would result in huge social tension.

Although liberalisation is supposed to result in increases in efficiency and energy saving in the long-term, it would also cause significant and fast price increases for households. To protect residential consumers, the timing of liberalisation and supporting systems must be further elaborated. Schemes such as financial mechanisms and funds for energy saving and efficiency investments in district-heating and in household sector as well need to be introduced.

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# Lithuania

## The Energy Situation in Lithuanian

During the Soviet era there was a well-developed energy industry in Lithuania with huge regional utilities exporting much of their production. However, this energy production was totally dependent on imported fuels, with indigenous energy resources making up only 3% of total production. About 40% of the electricity produced was exported. Within this system, however, every aspect of the energy flows and energy resources exchange was directed to the East.

The 10 year transition period in Lithuania was accompanied by a decline in its economy. At the end of 1994 the Lithuanian GDP dropped to 56% of its 1990 level. This unilateral decline in the economic sector was followed by a similar decrease in energy consumption. In 1998, primary energy consumption decreased to 57% of its 1990 level while the consumption of fossil fuels decreased to 49% of 1990 levels. The share of indigenous energy resources (wood, peat, hydro and some oil) in primary energy balance during the period 1990-1998 increased almost 4 times, while the share of imported fuels decreased from 38% to 17% during the transition period. There was also a steady growth in the volume of domestic oil extraction - from 12 000 tonnes in 1990 to 278 000 tonnes in 1998. By 1998 the total production of local resources was twice as high as it was in 1990.

Until 1970 the actual consumption of coal in Lithuania was increasing, but its share of the overall energy budget was decreasing. After 1970, Lithuania's total coal consumption decreased. Initially, the Lvov and Donetsk coal basins in Ukraine, along with the Silesia coal basin in Poland, supplied the majority of Lithuania's coal. The principle source of coal imports later shifted to the eastern regions of the USSR, but this import was ultimately constrained by high transportation costs.

After the restoration of independence in 1990 the sudden political upheaval was followed by deep, difficult and largely unexpected changes in all sectors of economy, including the energy sector. An abrupt price rise in all primary energy resources, the loss of former Eastern markets and several other factors led to a deep decline in industry. Since then, energy demand and production have decreased considerably.

In the last decade there have been significant changes in the percentages of the different types of energy that make up Lithuania's primary energy consumption. The share held by nuclear power increased from 25% in 1990 to a 36.4% in 1997. At the same time the share of oil decreased from 42% in 1990 to 33.2% in 1997. Due to Lithuania's economic decline, the primary consumption of natural gas decreased from 27% of total Lithuanian energy consumption in 1990 to 22.0% in 1997.

Recently, the consumption of primary energy has decreased due to lower electricity production, followed by a decrease in exports. In 1999 primary energy consumption dropped by 11% over its 1998 levels. Within the primary energy balance oil products, nuclear power and natural gas amounted to 41%, 29% and 21%, respectively, with other sources (solid fuël and hydro power) amounting to 9%. Recently, nuclear and oil have increasingly formed significant parts in the primary energy structure, however, in future, the primary energy structure will be balanced by increasing the share of Lithuania's energy market that is occupied by natural gas and renewable energy resources.

### Curent Status of Natural Gas Sector in Lithuania

Lithuania's National Energy Strategy declares that natural gas, from a technological, economic, and ecological point of view, is the most efficient fossil fuel. Taking into account the abundant

gas reserves in Russia, the existing export routes, Lithuania's favourable geographic location and existing technical facilities for gas transmission, natural gas is the fuel that provides the best prospects for Lithuania.

After the implementation of the planned international pipeline constructions –Yamal Pipeline – Lithuania will be situated in the middle of an important European gas transportation corridor. Considering the potential of underground storage sites in the Baltic countries, both existing (Incukalns, Latvia) and planned (Dobele, Latvia, as well as Vaskai, Lithuania) this situation will facilitate the integration of the Baltic regional gas network into an interconnected European gas system.

**Overview of the Gas Sector**

Natural gas plays a significant role in Lithuania's primary energy supply. In 1980, 20.6% of total energy consumed came from natural gas. Since then, consumption has risen at an annual rate of about 1%, to 24.5% in 1985 and 27.0% in 1990. Despite this general trend, gas consumption fell to 17% of the primary energy demand in 1993, reflecting increased use of low-cost heavy fuel oil. However this situation was temporary and in 1999 natural gas consumption increased to 23.2% of the primary energy demand.

The share of gas in Lithuania's primary energy demand is expected to increase in the future. Lithuanian authorities expect gas consumption to increase from 6 Bcm in 1991 to 7.2 Bcm in 2015.

At present, all natural gas comes from Russia through the transit pipeline network. In 1991, less than 6 Bcm of natural gas was consumed in Lithuania, falling to 3.4 Bcm and 2.3 Bcm in 1992 and 1999 respectively. In addition, Lithuania transports about 2 Bcm of natural gas a year to Kaliningrad and Latvia. The development of a number of additional pipelines, Baltic Ring, Lithuanian-Polish and Minsk-Kaliningrad, are all designed to increase diversity of transit and increase security of supply.

Use of natural gas will decrease air polluting emissions from thermal power plants, factories and households, which are currently using Heavy Fuel Oil (HFO) with a 2.5-4.0% sulphur content. Typically, a fuel switch-over from the present dual-fuel (oil and gas) system to an all-natural-gas firing system would bring about a decrease of a of 100-140 000 tons per year (almost 70%) in the levels of current pollutants emitted from thermal power plants in Lithuania.

Until 1990, Gas Company "Lietuvos Dujos" (Lithuania Gas) was the sole gas subsection-executing agency, directly under the control of the former Ministry of Energy (recently incorporated into the Ministry of Economy). During that period, the former Soviet authorities entirely directed the management of the company, including the marketing and future investment programs. Lentransgas, the central agency, controlled the natural gas subsector.

In 1991, in addition to "Lietuvos Dujos", 10 gas distribution companies were formed, based on district divisions in Lithuania (Vilnius, Kaunas, Klaipeda, Siauliai, Panevezys, Alytus, Marijampole, Ukmerge, Trakai, and Kedainiai).

In 1993 the company was restructured into a strategic state enterprise company. On 8 May 1995 “Lietuvos Dujos” was registered as a joint stock company. The regional distribution companies became responsible for expanding gas distribution networks, while JSC “Lietuvos Dujos” became responsible for supplying gas and operating the national gas pipeline grid. JSC “Lietuvos Dujos” also plays a pivotal role in import and export contracts under the Ministry of Economy.

With 34 out of 51 cities and 103 settlements supplied by gas, the gas distribution network extensively covers residential areas in Lithuania. Today, the transmission gas pipeline in Lithuania spans approximately 1450 km, excluding the 3,800 km of extensive underground gas distribution networks in large cities. There are 51 gas dispatch centres in each city and 940 gas regulation stations from which gas is distributed to consumers.

As a result of a governmental decision, a Commission to manage the process of restructuring and privatisation of the gas sector was established. Restructuring of JSC “Lietuvos Dujos” is needed to meet the EU Gas Directive and to ensure transparency of costs. According to the Government's Program, the technical and managerial performance will be particularly improved due to the privatisation of the gas sector. Their intention is to create companies that do not require state finance for investments. Privatisation should only be carried out with the assurance of adequate powers for the Regulator to control the private monopoly of transmission and distribution. In 2000, the government will, by public tender, appoint a privatisation adviser who will assist the Government in making the restructuring and privatisation process clear and transparent.

The predictions on future development of the gas sector in Lithuania are optimistic. The National Energy Strategy envisages the growth of natural gas demand in primary energy balance. One reason for this is the reduced production of HFO in the Mazeikiai oil refinery after the plant’s modernization. Another reason behind the optimistic predictions is the closure of Ignalina Nuclear Power Plant (INPP) and the replacement of nuclear energy by electricity from gas burning thermal power plants.

The predictions envisage that the new consumers demand will come from small and micro Combined Heat and Power Plants (CHP), small district heating systems and new direct consumers who will switch to gas from other fuels. The number of new consumers is expected to increase after the construction of new transmission lines, principally a branch to Mazeikiai and a branch in Sakiai-Klaipeda via Jurbarkas, Taurage, and Silute.

The National Energy Strategy recommends the construction of an underground gas storage facilities at Vaskiai, the development of a means to access the Latvian Incukalns underground storage and the development of a way to connect the Lithuanian and Polish gas systems. This interconnection, if supplemented by the simultaneous construction of an Estonian-Finnish interconnection, would be a major component to the Baltic gas ring. The ring provides for the access to North Sea gas fields and upgrades the reliability from "one external supplier" to a "diversified supply".

The Strategy requires a revision of the Lithuanian Gas Network Extension Plan and a drafting of regional plans for the extension of distribution networks. These plans should be regularly updated (in 4-5 years) relying on a least-cost approach. In keeping with the guidelines for the growth of gas consumption, Lithuanian Energy Strategy has set the guidelines for reliability of gas supply. Accordingly, reliability is one of the major goals of JSC “Lietuvos Dujos”. This reliability can be broken down into 3 levels:

**Technical level:** This level is mainly dependent on the efforts and skills of the company. At present, the technical and organizational measures undertaken by the company are sufficient for the uninterrupted supply to customers but the lack of funds for technical examination and renovation of pipelines and equipment negatively affect the service's reliability. Recently, however, the reliability has increased owing to decreased gas demand and, this has, consequently, reduced gas load flows and pressures. Technical reliability also depends on State policies related to the gas sector, mainly on those relating to energy pricing.

**Financial level:** This level is related to the economic viability of the company. It depends partially on the financial management of the company, but mainly on the general economic situation of the country. Key elements of this situation are the payment capability of gas customers, the growth rates, the industry's activities, the stability of banking and finances systems, etc. The Lithuanian government plays the main role in providing the necessary financial reliability. Nevertheless, the company can affect the general economic situation through initiatives in transparent and fair gas pricing, by contribution to the formulation of the State economical development program and through international co-operation.

**External reliability** is the most uncertain level of reliability as "one external supplier" determines it. Various fluctuations in the views of the Russian Government, in Russia's political and strategic objectives and ultimately, as an "abuse of monopolistic position" may compromise supplies. The external reliability level may also be slightly influenced by JSC "Lietuvos Dujos" and the Lithuanian Government.

The Public Investment Program of 1998-2000 foresees the development of the gas transmission network project for Akmene, Mazeikiai, Siauliai and Pakruojis districts. Acording to the findings of this project, it is necessary to build a gas pipeline of 102 kilometres in length of various diameters and 3 gas distribution stations (GDP) in order to increase gas supply to individual and commercial consumers in the North - Western part of Lithuania. It will allow a greater number of consumers to use natural gas and will serve to decrease the consumption of heavy fuel oil and coal. Accordingly, $SO_2$ pollution of the atmosphere will be reduced by 28,600 tonnes, $NO_x$ pollution by 6,400 tonnes with CO and ashes also decreasing substantially.

#### Regulatory Framework of the Lithuanian Gas Sector

The gas sector in Lithuania faces a serious challenge of reliability and safety of supply related to certain on-going processes. On-going internal (restructuring, privatization, etc.) and external (globalization of energy markets, conditions for EU accession, etc.) processes require specific regulation in the energy sector as a whole as well as in separate subsectors (power, gas, oil). The process of the preparation of national regulations and approximation of EU Directives has alreadfy started in Lithuania. It is expected that appropriate regulations will be a strong tool to increase the efficiency and reliability of the gas system. Correspondingly, the regulation itself is moving towards deregulation when examined in the context of the liberalization of energy market. The major factors influencing the establishment of a regulatory framework for the gas sector in Lithuania, can be outlined as follows:

- the Constitution Act of Lithuanian Republic and Energy Law as primary legislation;
- the globalization of energy markets;
- Lithuania's policy for the access to the EU;
- The Energy Acquis communautaire, including all Treaties, Directives, Regulations and International Agreements.

*National Legislation and International Relations*

Lithuania's comprehensive legislation concerning the gas sector is not as yet completed. The Government of Lithuania has established a committee to finalize national gas-related laws and regulations. However, the legislation has not yet passed through the Parliament. A draft law to implement the EU Gas Directive was produced at the end of 1999 and hopefully will be approved by the Parliament before the end of 2000. This law will set out the main actors in the gas market and elucidate their rights and duties. The Public Utility Regulatory Law will establish the relationship between the gas companies and the Regulator as well as establishing the method of price regulation (by price cap).

The Energy Charter Treaty, a fundamental act ot Acquis Communautaire, was ratified by the Lithuanian Government in June, 1998. Despite this late ratification date, the Government is trying to implement Treaty's ideas and principles of deregulation and reliability in gas systems. The Law on Competition was adopted, and as a result the State Competition and Consumer Protection Office and the State Energy Control Committee were established. The first pricing methodology for natural gas, which was approved by the Committee, was cost-reflective (1998).

The EU Directive 90/337/EEC on price transparency for electricity and natural gas obligates the Member States to introduce transparency principles in pricing methodologies, which vary considerably in different Member States. The idea of the Directive is to prepare procedures that enable the eligible industrial customers to contract a gas supplier who offers the best and most competitive prices. The category of eligible customers is introduced in the Draft of Gas Pricing Methodology (1999, Lithuanian Energy Institute and JSC "Lietuvos Dujos") as well as in the transparency of tariff structure. This draft is strictly cost-reflective and obviously deregulatorily-focused. It should be mentioned that national laws exclude the excise tax for natural gas, as opposed to electricity, which is included to the list of goods subjected to excise tax.

The EU Directive 91/296/EEC on gas transit in transmission network requires Central and East European countries to establish national laws that will secure mandatory transit based on fair and non-discriminatory provisions for all interested countries. Consequently, the technical, financial and legal provisions of the transit should be combined coherently. As pertains to Lithuania, the Draft of Gas Pricing Methodology sets "the best incentive approach" to transit. The national law in question is expected to be the Natural Gas Law that is drafted.

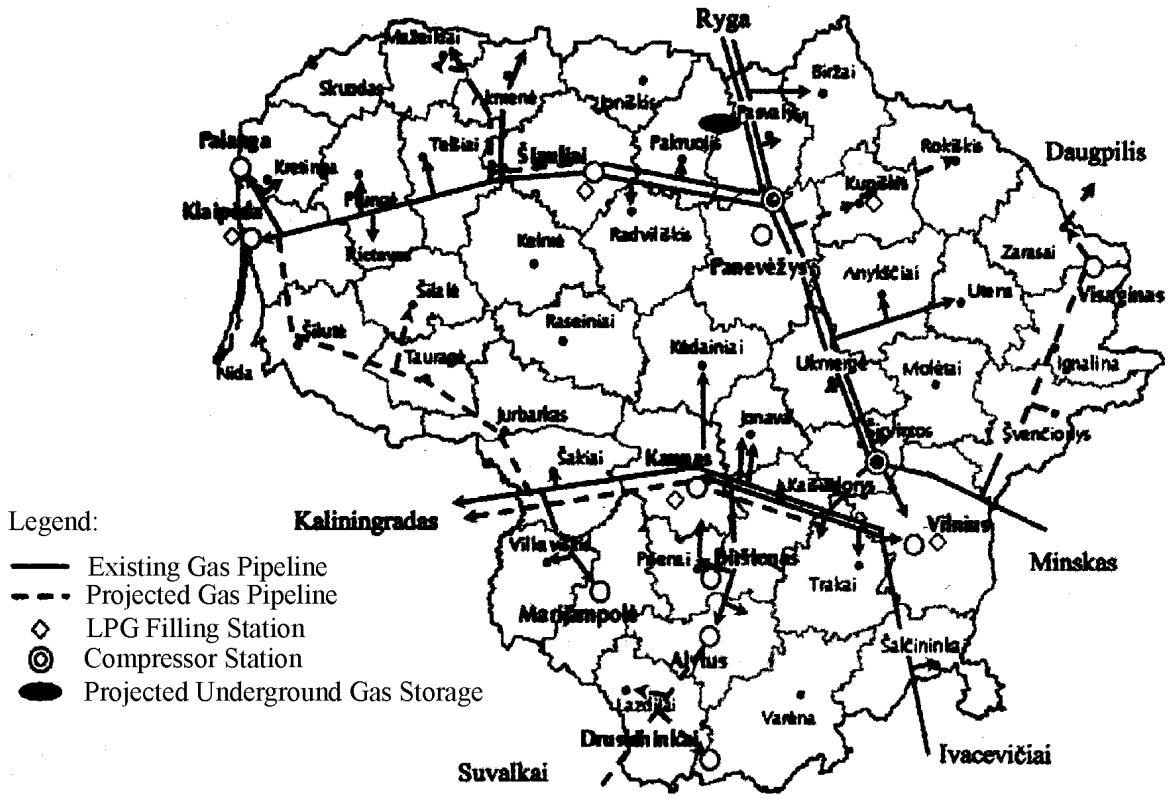
**Gas Supply**

The gas supply network in Lithuania has existed since the 1960s. Today, there are two main gas supply pipeline routes from Russia via Belarus:

- Minsk - Vilnius supply line (constructed in 1989);
- Ivaceviciai - Vilnius supply line (constructed in 1961) curently unused.

In addition, one bi-directional pipeline exists between Lithuania and Latvia. Overall, the total gas supply capacity to Lithuania is about 14 Bcm per year. Maximum operating pressure of the gas pipeline network is maintained at 50 bar. Inside Lithuania, there are three main gas supply and transit lines:

## Chart of Gas Pipeline Network in Lithuania




Legend:

- Existing Gas Pipeline
- Projected Gas Pipeline
- LPG Filling Station
- Compressor Station
- Projected Underground Gas Storage

- Vilnius-Panevezys transit line (1988);
- Panevezys-Siaurai-Klaipeda transit line (1962-64);
- Vilnius-Kalinigrad transit line (1986).

## Technical Data of Gas Pipelines in Lithuania

| Name of Pipeline | Design Capacity Bcm / year | Diameter (mm) | Length (Km) | Year of Commission |
|---|---|---|---|---|
| 1. Ivaceviciai-Vilnius | 0.6 | 720 | 61.9 | 1961 |
| 2. Vilnius-Panevezys-Riga<br>First section from Ponevezys<br>Second section from Ponevezys | 4.0 | 720<br>529<br>325 | 24.4<br>117.7<br>3.5 | 1988 |
| 3. Riga-Panevezys-Vilnius (2nd line)<br>Riga-Panevezys<br>Panevezys-Sirvintos | | <br>720<br>720 | <br>59.5<br>126.2 | |
| 4. Vilnius-Kaunas<br>Vilnius-Elektrenai<br>Elektrenai-Kaunas | 3.3 | <br>720<br>377 | <br>39.4<br>47.1 | |
| 5. Panevezys-Siauliai-Klaipeda | 0.5 | 377 | 106.4 | 1962-64 |
| 6. Vilnius-Kaliningrad<br>Branch to Jonava<br>Branch to Jonava-Kaunas<br>Kaunas-Kaliningrad | 0.9 | <br>820<br>720<br>530 | <br>22.1<br>78.8<br>83.6 | 1986 |
| 7. Minsk-Vilnius<br>Minsk-Sirvintos<br>Sirvintos-Vievis | 11.8 | <br>1200<br>1020 | <br>58.3<br>24.8 | 1989 |

One compressor station with a total compression horsepower of 6,260 kW is installed at Panevezys, about 170 km north of Vilnius from where the compressed gas is supplied to Siauliai, Klaipeda, and to consumers along the gas transmission pipeline. Russian gas exports through Lithuania exit at two locations: At the border with Latvia, about 200 km north of Vilnius, providing a bi-directional design capacity of 2 Bcm per year; and at the border with Kaliningrad with an installed capacity of 0.5 Bcm per year.

Lithuania is completely dependent on Russia for its gas. Currently, the largest Russian gas supplier is JSC "Gasprom". Since Lithuanian independence, gas has been supplied on short-term contracts. At the end of 1999 a long-term agreement on the natural gas supply was reached between JSC "Lietuvos Dujos" and JSC "Gasprom". This agreement is valid for 6 years, from 2000 until 2005. Under the terms of the agreement, the gas supply volume is foreseen for 6 years, however an agreement on the gas price is set for two years. The contract price in the first half of 2000 was 76 US$ per 1000 $m^3$ of gas. Prior to August 1992, the contract price was US$ 90 per 1000 $m^3$ of gas, with roubles accepted in payment, although the exchange rate was a source of continual dispute.

Given the limited energy resources and markets, Lithuania should pursue regional cooperation with other Baltic states. CIS republics and Eastern European countries should cooperate in all possible gas trade areas, including gas supply and transit arrangements, unified regulatory frameworks, future investments and technical standardization. In particular, an optimization of gas supply/distribution should be sought, thereby maximizing the utilization efficiency of the existing gas pipeline network and enabling storage in the region through commercial cooperation. Combined with domestic gas price reform, the Ministry of Economy and JSC "Lietuvos Dujos" should seek a longer-term contract with Russia, incorporating an indexation with competing fuels and periodic price reviews. The gas transit to Kaliningrad should be used effectively in negotiating gas supply with Russia.

During the current period it will be important to find ways to enhance the national security of supply, which, at present, depends exclusively on a single supplier through a single pipeline. Alternative supply routes, even if from the same source, as well as storage should be made feasible by the end of 2005.

Potential improvements that have been identified but not yet economically justified are:

- To refurbish and develop gas interconnections with Latvia, including metering stations;
- To evaluate the potential for shared underground gas storage in Latvia or equivalent storage inside Lithuania at Vaskai;
- To connect Lithuanian and Polish gas networks as part of integration with the European gas grid and the Baltic Gas Ring. An international agreement between the two countries is needed as a firm basis for this development;
- To improve the technical parameters of the gas import from Russia through the pipeline Minskas – Vilnius, by installing a new compressor station. This project would be undertaken in order to meet the required parameters for the most distant and large consumers;
- To support gas transit to the Kaliningrad Region as an alternative link to Poland, for security of supply.

Conditions in long-term gas supply contracts should be carefully weighed to compare the advantages of known prices with the lack of flexibility to respond to future markets.

**Gas Distribution**

From its inception in the 1960s, the gas distribution network has gradually expanded. 20 years ago gas distribution was primarily intended for use at industrial factories as raw feed stock and/or fuel. Today, the distribution network extensively covers residential areas in major cities. In large cities, fairly extensive gas distribution service is provided. In Lithuania about 3800 km of gas distribution pipelines have been installed. In Vilnius, about 530 km of underground gas distribution lines have been installed for use by households.

The fact remains, however, that major gas users are thermal power plants, district heating plants and boiler stations. In 1999 they used over 50% of Lithuania's total gas consumption in comparison, industries used about 8%, and households in large cities used about 7% of the total gas consumption.

Inside Lithuania only one gas compressor station exists. The station at Panevezys was constructed in 1973 to transport gas in three directions; to Latvia and Klaipeda (where gas is transferred from Minsk), and to Vilnius (where gas is sent from Latvia). The station has seven 1,500 HP reciprocating compressors, all of which were manufactured in Russia. The maximum gas-handling volume is limited to 7 Bcm per year while gas compression is being undertaken, thereby increasing pressure from 44 bar to a maximum 53 bar. At present, the gas compressor is used to send gas to the cities of Siauliai and Klaipeda.

Gas is sent at a maximum pressure of 45 bar to each gas dispatch centre in the large cities. At dispatcher centers, the gas pressure is lowered and regulated at about 12 bar. At these centres, gas is also filtered and odorant is added. Under the control of a dispatcher, there are many (in the case of Vilnius, 80) gas regulating stations where gas pressure is further lowered to about 3 bar to distribute to end-users. In cities, the gas distribution networks use underground steel pipelines with forced electric cathodic protection.

**Gas Consumption**

Natural gas consumption in Lithuania had fluctuated during the decades since the 1960s. In 1980, less than 4 Bcm was consumed, while in 1991 consumption reached nearly 6 Bcm. Owing to the economic turmoil prevailing in Lithuania, total primary energy consumption is falling dramatically and gas consumption therefore fell to 3.4 Bcm in 1992, 1.8 Bcm in 1993 and 2.2 Bcm, in 1999. In 1991, the largest share of gas (52%) was consumed by thermal power and district heating plants, followed by industry (37%), household and services (8%) and agriculture (3%). The dominance of thermal power, district heating, and industry continued until 1999, as can be observed below.

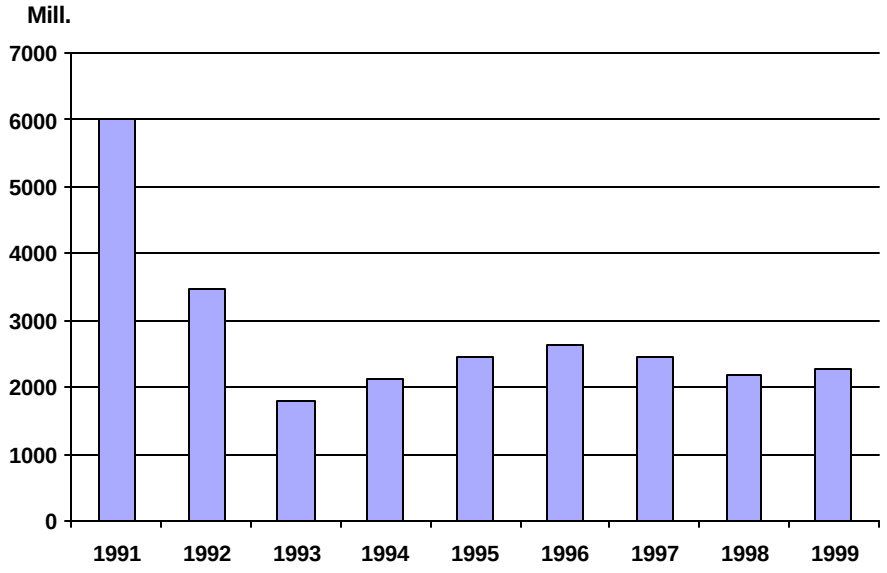
**Consumption of Natural Gas by Sectors, ktoe/year**

| Sector | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|
| Natural Gas Consumed for Energy Production: | | | | | | |
| Heat Production | 930 | 1092 | 1083 | 1071 | 869 | 906 |
| Electricity Generation | 62 | 43 | 120 | 83 | 49 | 45 |
| Industry | 133 | 136 | 141 | 146 | 154 | 148 |
| Residential Sector | 207 | 183 | 182 | 148 | 123 | 122 |
| Agriculture | 5 | 5 | 7 | 6 | 7 | 12 |
| Transport | 5 | 4 | 0 | 1 | 1 | 1 |
| Other Consumers | 35 | 37 | 41 | 35 | 21 | 45 |
| Non-Energy Consumption | 319 | 482 | 548 | 471 | 489 | 520 |
| Loses | 34 | 46 | 46 | 41 | 41 | 27 |
| Natural Gas Gross Consumption | 1730 | 2028 | 2168 | 2002 | 1754 | 1826 |

Between 1991 and 1993, during the period of the transitional economy following the restoration of Lithuania's independence, consumption of natural gas decreased significantly. After the large and unexpected decline in demand for natural gas, its consumption increased, although not significantly, from 1994 to 1996. In 1997 and 1998 consumption of natural gas diminished again. This was a result of the drop in petroleum prices on the world market, which was not adequately reflected in the price at which Russia exported natural gas. Another reason behind this fall was the reduced output of electricity from thermal power plants as Ignalina NPP continued to cover the basic demand for electricity.

Over the past decade gas consumption has averged around 2.2 Bcm/year. This has partially offset the present constraints on the gas supply. The Ministry of Economy has been encouraged to pursue extensive energy efficiency improvements, in part by establishing a demand-side management program in an effort to minimize the need for investment in future gas transmission systems. Energy efficiency improvements in such large gas consumers as thermal power, district heating cement, and fertilizer plants needs to be achieved by modernization, process conversion and rehabilitation.

**Consumption of Natural Gas in Lithuania, million m$^3$**



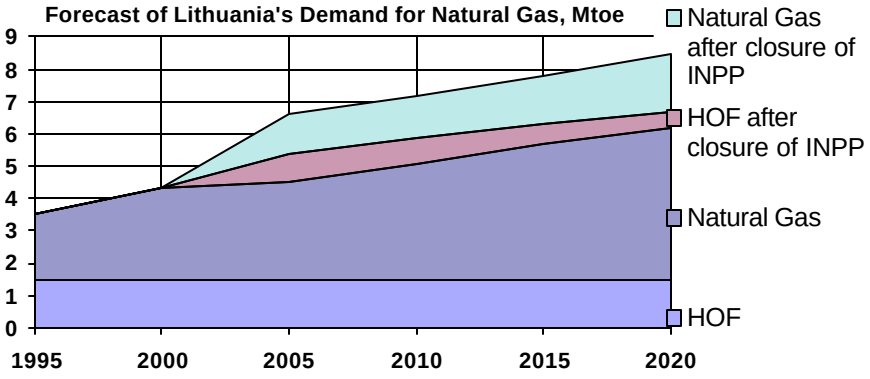
## Future Prospects for the Natural Gas Sector

### Demand of Natural Gas

In the future, consumption of natural gas will not be restricted by technical capacities of supply. The capacity of pipelines entering Lithuania exceeds current consumption and a part of them are completely idle. All of the largest fossil fuel-fired power plants are connected to transmission pipeline systems so their gas supply is guaranteed.

However, the most promising new consumers of natural gas are the modernised systems that provide district heat and direct consumers, who are not already connected to the gas network, burning gas for heating needs. The supply of heating energy from various small CHP affords a very favourable opportunity to increase the use of natural gas. Even the current economic indicators for those plants now make them financially attractive when compared with other heating systems.

As Lithuania integrates into the European Union, the decision to postpone the decommissioning of Unit 1 of Ignalina NPP until 2005 was taken. In preparing forecasts for gas demand in the 21st century, the closure of the Ignalina NPP should be considered a probable option.




The National Energy Strategy underlines the point that the HFO burned in Lithuania has a relatively high sulphur content, while the HFO with a low sulphur content cannot compete with natural gas due to embedded desulphurization costs. In future, the consumption of HFO should not exceed the current level. Thus, considering the anticipated rapid growth of the Lithuanian economy and the most feasible energy intensity of GDP, the high growth rate of gas demand is foreseeable.

Hence, Lithuania's National Energy Strategy points to favourable opportunities and trends for increasing gas consumption. Nevertheless, to take advantage of these opportunities, it is essential to renew and expand considerably the gas transmission and distribution networks.

### Plans for Natural Gas Network Expansion

Originally, JSC “Lietuvos Dujos” expected the natural gas consumption for industry and district heating to continue increasing. As a result, in 1999, JSC “Lietuvos Dujos” constructed 94.6 km of new gas pipelines.

During the years of the socialist planned economy, natural gas was used quite intensively in Lithuanian industry and households. Thus, Lithuania inherited from the Soviet period a well-developed network for distribution of natural gas, which has also been consistently improved during the years of independence.

However, the Lithuanian gas network, built in the early 60's requires upgrading. Significant portions of the transmission pipelines in current use (560 km) were built 25-30 years ago and

have reached the point of technical amortisation at which they should be replaced by new ones. Out-dated, worn-out and aged pipelines should be examined for their technical suitability and should be, if necessary, replaced by new ones. However, the Lithuanian natural gas system is short of funds for technical examination and renovation activities. The actions set out in the plans of JSC "Lietuvos Dujos" match the increasing gas demand forecasts of the National Energy Strategy. Therefore, the most important tasks for the extension of the transmission pipeline network are the following:

- to extend the second line of the transmission pipeline Siauliai - Klaipeda to Kursenai, building a branch to Mazeikiai, Pakruojis and to the JSC "Mazeikiu Nafta" oil refinery;
- to build a second branch to Siauliai;
- to build transmission pipeline branches to Smilgiai, Kupiskis, Rokiskis, Nemencine, Ignalina, and Druskininkai.

In the future, for higher security of the natural gas supply, a proposal has been drafted to link the branches of Kaunas and Klaipeda by a loop that will also furnish the gas to Priekule, Silute, Silale, Taurage, and Jurbarkas.

Since in both the short and long-term Lithuania's gas will be supplied from a single source (Russia), it is necessary to take certain steps to increase the reliability and security of this source. Principally, it should be considered that security is increased when there are more transit pipelines to which Lithuanian consumers can connect, as well as when gas storage facilities have a greater volume.

In the near future, it will be necessary to revise The Lithuanian Gas Network Extension Plan, as the decisions made by neighboring countries will have a considerable impact on it. These decisions include, most importantly, Russia's plans for gas supply to the Kaliningrad Region, and the use of Latvian and Lithuanian underground gas storage facilities on a regional scale. In Lithuania it is possible to establish an underground gas storage facility in Vaskai with a working capacity of about 0.6 Bcm and to cooperate with Latvia in using the existing Incukalns gas storage facility and in developing the promising Dobele gas storage facility.

In order to make the construction of a transmission pipeline feasible, it is essential to complete, in the year 2000, a revision of the Lithuanian Gas Network Extension Plan for the years 2000-2010 and regional plans for the extension of the distribution network. These plans should be revised every 4-5 years.

**Prospects for Improvement of Reliability of Gas Supply**

During the years of the transitional economy the relative technical reliability of gas supply has increased because of the sharp decrease in delivery volumes, the drop of pressure in pipelines, and the decline in hydraulic flows. Conversely, when confronted with a lack of funds for examination and renovation of pipelines, the reliability goes down. Therefore, in the future, in order to attain the rapid growth in gas demand as foreseen in the National Energy Strategy, it is essential to increase the reliability of gas supply by all possible means.

The most important aim of the national gas company, JSC "Lietuvos Dujos", is to secure the reliability of deliveries of natural gas. The company's technical and organisational activities guarantee uninterrupted supply of gas to consumers from distribution and transmission pipelines. This level of reliability (technical level) should also be maintained in the future. It will depend not only on the efforts of "Lietuvos Dujos" but also on the pricing policy of the State.

The financial aspect involving the reliability of deliveries has a larger degree of risk. It depends on the country's economic situation, the consumers' ability to pay, the state policy on restructuring and privatisation (i.e. energy sector regulation), and the competitiveness of other energy resources (mainly, petroleum products) in the domestic market.

**Chart of Integration of Russian and North Sea Natural Gas Fields**


The weakest point of reliability, at present and in future, is at the level of external conditions of supply. This level is determined almost entirely by the single external supplier, in this case, Russia. The determinants then become Russia's economic and political interests, its views on difficult and crisis situations, its tactics of political and economic pressure, and the technical state of its gas supply system. The Government of Lithuania and "Lietuvos Dujos" respectively can only exert partial influence on such external conditions.

Taking into account the external conditions of supply, international relations and the probable denouement of events in the future, the most important measures for increasing reliability of the natural gas supply are as follows:

- Renewal of gas supply through the currently closed pipeline Ivaceviciai - Vilnius;
- Construction of the gas storage facility in Vaskai;
- Construction of a new (parallel) line to Kaliningrad;
- Connection of the pipeline branches to Kaliningrad and Klaipeda by a loop line;
- Restoration of the interconnections with Latvia;
- Interconnection of Lithuanian and Polish gas networks.

Expert evaluations that have been made by the Lithuanian Energy Institute and Western specialists (Dansk Olie & Naturgas A/S, Pipeline Engineering GmbH) demonstrate that both in the short and long-term gas will be supplied from only one source - Russia. Thus, the sole source is one external supplier and one pipeline, Minsk - Vilnius. The pipeline's actual transmitting capacity (at a pressure of 50 bars) is approximately 10 Bcm per year, which is as much as 2.6 times more than current consumption.

In order to increase reliability of supply from this source, it is possible to restore the old Ivaceviciai - Vilnius line. This pipeline has not been in use for a long time, but its technical condition in Lithuania is estimated as satisfactory. Additional technical activities would certainly be necessary in Belarus in order to examine the technical state of pipelines and to restore the compressors. This option would guarantee supply in the event of an accident on the Minsk-Vilnius line while also acting as an extra interconnecting link between Lithuania and Belarus. In the future, it would be possible to transport an increased gas flow to Lithuanian consumers as well as increasing transit to Latvia.

With the construction of the underground gas storage facility in Vaskai, security would be considerably upgraded. The facility's construction was planned in the National Energy Strategy (1994, 1999). The Energy Committee of the Baltic Council of Ministers, in its memorandum of 1998, expressed its intent to build this storage facility. It will provide for the uneven seasonal demand for gas during the winter, in case the Minsk-Vilnius pipeline becomes overloaded. The Lithuanian JSC "Geonafta" has carried out underground geological investigations and confirmed the suitability of Vaskai geological structure for a storage facility. The French firm "Sofregas" also examined the technical and financial possibilities of the Vaskai gas storage facility.

A second pipeline to Kaliningrad would also increase the reliability of supply. This pipeline would be built in connection with the planned construction of the Kaliningrad CHP. This pipeline would provide for the increase of gas demand in the Kaliningrad Region, from 0.5 Bcm to 2.6 Bcm in the year 2005. Construction has already been co-ordinated with "Gazprom". A contract for design work has already been signed with the Russian institute "Giprospecgaz", and the design phase has started. The pipeline would go from Vievis through Kaunas and Sakiai. Firstly, from a political point of view, this pipeline will increase the reliability of supply as the Lithuanian monopoly on transit would become much more significant and Russia's dependence on transit deliveries would increase. This will have an indirect influence on reliability of supply. Secondly, this option would encourage Russia to take more interest in the reliability of the Minsk - Vilnius line.

A second pipeline to Kaliningrad would also give JSC "Lietuvos Dujos" an opportunity to expand gas supply to new regions currently without access to natural gas. Connecting the Klaipeda line and creating a second line to Kaliningrad will enable this scenario. This Sakiai-Jurbarkas-Taurage-Klaipeda loop would significantly increase the reliability of supply for the Klaipeda node.

A considerable contribution to the increase of reliability would be the restoration of an interconnection with the Latvian gas system. Latvia's Incukalns gas storage facility can store up to 2.12 Bcm of gas. Prior to the restoration of independence, the Lithuanian and Latvian gas systems were connected by two lines and gas was supplied to the storage facility through the Lithuanian gas network. In order to renew supply to the Latvian gas storage facilities, the technical condition of the pipelines on Latvian territory should be checked and a gas metering station should be built at the border. The National Energy Strategy and Energy Committee of the Baltic Council of Ministers foresee an eventual reconnection of the two gas systems. This option is essentially one part of a large project of regional importance, namely the Baltic gas ring.

The Baltic gas ring would significantly increase the reliability of gas supply to Lithuania. A relevant contribution to the Baltic gas ring would be the interconnection of the Lithuanian and Polish gas systems. This connection will enable a transfer of gas supplies to Lithuania from Poland, but the construction of an interconnecting pipeline will require considerable investments. Even without completing the ring in Polish territory an interconnection with Poland would be an additionall source of gas for Lithuania and Latvia, one which is practically independent from Russia. The Energy Committee of the Baltic Council of Ministers decided to pursue this interconnection as well as interconnection between the Estonian and Finnish gas systems, which would complete the ring thereby securing a high level of reliability for the entire Baltic Sea System. The implementation of the Baltic ring would extend the European internal gas market considerably.

The interconnection of the Lithuanian and Polish gas systems is a long-term objective of Lithuanian, Latvian and Estonian energy policies. The European Union's policies, as well as the regional policies of the Baltic Sea countries, are very important to the establishment of a Baltic gas ring.

As Lithuania accedes to the European Union, all the restructuring activities will be harmonised with the European legislation on natural gas, with a special view to the Directive on the Internal Gas Market. Lithuania has already ensured an opening-up of the market since JSC "Lietuvos Dujos" controls only 60 percent of the country's gas market.

In general, the Lithuanian plan for the expansion of the gas network, supply, and reliability will be very much influenced by neighbouring countries' decisions, mainly by Russia's plans for gas supply to the Kaliningrad Region and use of Latvia's and Lithuania's underground gas storage facilities on a regional scale.

**Environmental Issues**

The main problem of the energy sector performance is the integration of environmental concerns into sectoral policies and related coordination. The following objectives of the Lithuanian National Energy Strategy have been formulated with the assessment of the principal factors that determine energy policy:

- Reliable and safe energy supply with least costs;
- Increase of energy efficiency;
- Reduction of the impact upon environment;
- Regional cooperation and collaboration;
- Preparation of the Lithuanian energy sector for integration into the EU;
- Improvement of the energy sector management.

The objective of the environmental strategy in the energy sector is to ensure that Lithuania will be able to meet the obligations of International Conventions and to fulfil requirements of the fifth EU Environmental Action Programme, the Lithuanian Environmental Strategy, the Strategy for Approximation in the Environment Sector, the United Nations Framework Convention on Climate Change (UN FCCC) and the National Implementation Strategy. For these reasons, parameters should be set and measures for the implementation of these requirements should be proposed.

Among the primary goals for sustainable economic development is the creation of a legal/economic system that will avoid conflict between the qualitative economic growth and anthropogenic loads upon the environment. The main tasks for the implementation of the country's sustainable economic development have been laid out in the National Environmental Strategy.

The main requirements for the energy sector established in the National Environmental Strategy are:

- promotion of energy conservation and use of renewable energy resources;
- minimisation of pollution from power plants through improvement of the fuel combustion process and change to “cleaner fuels”.

Of paramount importance are technological changes that provide a considerable environmental benefit. In the interim, the best existing but not expensive technologies based on the best foreign experience are to be introduced gradually. New power plants should be constructed only if based upon a thorough study of the demand, capacities, types of fuel and its supply as well as ecological acceptability, reliability and safety.

The targets set in National Environmental Strategy can be met by:

- Drawing up an atmosphere protection law;
- Developing a energy/$CO_2$ tax;
- Modernising and installing new boiler-burners, which would reduce NOx emissions;
- Gradually applying modern technologies which do not require large investments;
- Setting up air-quality monitoring and public information systems in Lithuania's biggest cities and creating effective monitoring systems in energy and industrial enterprises;
- Assessing the condition of dust-catching equipment or installing it;

Manufacturing, installing and repairing dust-abatement equipment.

## Conclusions

Promotion of the gas network and increasing the share of the gas as the replacement for other fossil fuels should be the main priority (especially due to the closure of 1 Unit of Ignalina NPP and replacing its capacity). The main attention must be paid to the technological changes giving large social, environmental and economic benefits.

- Increasing natural gas consumption both in energy and household sectors requires significant investments in the transportation, storage and distribution network in order to enable the additional demand. These investments should be planned using least cost principle and implemented on purely commercial basis, excluding state subsidies.
- The development of the Baltic gas ring is crucial for Lithuania's security of gas supply (the same for Poland, Latvia and Estonia) due to the total dependency on Russian gas. Construction of the transit gas pipelines to the Kaliningrad region and Poland are also of great importance for the diversification and increasing of the security of gas supply in Lithuania.
- Regional co-operation is essential for the Baltic countries. The restoration of interconnections with the Latvian gas system, with the aim to share usage of the existing gas storage facilities would be a considerable contribution to the increase of reliability of supply. The capacity of existing gas storage facilities in Latvia Incukalns exceeds recent gas demand of both Lithuania and Latvia.
- The construction of new gas storage facilities in Lithuania (Vaskiai) should be considered including all economic, social and environmental aspects.

Development of the gas network should not hinder promotion of renewable energy sources in regions.

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# Poland

The Polish energy sector is almost entirely based on coal combustion. Both brown and hard coal supply 68% of primary energy in Poland, while the natural gas share is only 9.8 and the shares held by renewable energy sources are less than 5.1% (and could be as low as 2.5%)[5]. The coal-based energy sector is the main producer of $CO_2$ pollution in Poland. Furthermore, coal combustion by households significantly contributes to low level emission in big urban areas. In a number of cities, low emission has been eliminated by the introduction of coal-to-gas conversion programs.

Changes in primary energy use are anticipated in the near future. The hard coal industry, which has been heavily subsidised for decades, will be pushed to lower its uneconomical production from 116.9 million tons in 1998 to 105 million tons in 2005 and 92 million tons in 2010[6]. Closure of the most inefficient coal mines is also anticipated. It is also expected that the role of other energy sources (natural gas and crude oil) will rise in this period.

## Market for Natural Gas in Poland

The Polish Oil and Gas Company [*Polskie Górnictwo Naftowe i Gazownictwo (PGNiG)*] was established in 1981 by consolidating smaller companies dealing with the exploration, production, transmission and distribution of oil and natural gas. Since that time, PGNiG has played a dominant role in the natural gas market. In April 2000, PGNiG was ranked tenth on the list of the 500 biggest enterprises in Poland. According to the newspaper "Rzeczpospolita", PGNiG had annual revenues of PLN 6.6 billion ($1.45 billion) and employs 33 000 people. In 1996 the Polish government said PGNiG needed restructuring. The next step in the "Governmental Program of Organisational Restructuring of PGNiG" was to separate service and technical assistance companies from PGNiG. Fifteen companies were established as separate entities, most of which are fully owned by PGNiG. They employ 13,500 people.

Some changes have already been introduced and PGNiG has started to partially restructure itself. This has led to the establishment of separate accounting systems for transmission, distribution and production of natural gas. This division should help to identify the costs, profits and losses incurred in those fields. The shape and dynamics of restructuring and privatisation of PGNiG have been a source of competition between two opposing concepts. The concept of the Ministry of Finance, based on the analysis by Price Waterhouse Coopers (PWC), envisions PGNiG divided into six separate companies: one for gas exploration and extraction, one for natural gas transmission and storage and four dealing with distribution. According to this proposal, four distribution companies and the exploration and extraction company should be privatised as soon as possible. The company dealing with transmission and storage would remain a state owned company.

[5] Ekonomiczne i Prawne Aspekty Wykorzystania Odnawialnych • ród³ Energii w Polsce", EC BREC/IBMER

Estimates: Energy Market Agency – 4.4%, Main Statistical Office – 4.8%, EC BRC – 2,5%, Ministry of Economy – 5.1%.

[6] „Energy Sector in Poland", World Energy Council, Warsaw 1999.

The second concept was prepared by the Ministry of Economy and was based on an analysis by Andersen Consulting and Merrill Lynch. The Ministry of Economy suggested that PGNiG should not be divided into separate companies but only reorganised. Privatisation would take place by selling stocks to financial investors. During the Parliamentary session in May 23, 2000, the Council of Ministers approved changes to the document "Governmental Program of Organisational Restructuring of PGNiG" (1996). The new recommendations of the Council of Ministers are similar to the concept of the Ministry of the Treasury. According to these recommendations, an exploration-extraction company will be set up using the capital of the companies that operate exploration and extraction (see below) and divisions of PGNiG that have the same scope of activities. A transmission and gas storage company will be the legal continuation of PGNiG. Additionally, the program includes the establishment of four distribution companies.

During the first phase of restructuring, the government plans to separate the aforementioned companies as offshoots of PGNiG. At the same session, the Council of Ministers approved the following schedule:

- Minister of Treasury will prepare a schedule for necessary actions. Based on this document, the Board of Directors of PGNiG will work out a scheme for PGNiG division.
- By the end of 2000, the financial and economic analysis of future companies will be completed.
- By the end of 2000, the Minister of Treasury will present to the Council of Ministers the proposal for natural gas sector privatisation.

PGNiG is going to invest about five billion Polish Zloty ($1.1 billion) within the next five years. The lion's share of this money will be invested in the construction of new gas storage facilities. Another field where PGNiG will invest money is in CHP generation. Together with the Pump-Storage Power company and Finesco, PGNiG will be involved in building new CHP plants. Furthermore, there are plans to invest in the telecommunication sector, an increasingly common practice for energy companies. To develop the NG infrastructure and improve the condition of PGNiG, the World Bank granted a loan of USD 187 million in 1990.

Despite the dominant role of PGNiG, several new actors have emerged in the natural gas market. These are:

**Bartimpex S.A.**, a company that was established in 1989, deals with the import of natural gas from Russia (10-13% of natural gas used in Poland is imported by Bartimpex S.A.). Recently, Bartimpex S.A. planned investments in the construction of a new pipeline connecting Poland (Szczecin) with Germany (Bernau). This pipeline would be used to transport natural gas from Norway. In May 1999, a contract was signed that would actualise the annual purchase of 500 million cubic meters of natural gas from Norway.

**EUROPOL Gaz S.A.** was set up in 1993 to design, construct and operate the Polish section of the longest gas pipeline in Europe (a 4000-kilometer pipeline from the Yamal Peninsula to Western Europe). EUROPOL Gaz S.A. is the owner of the Polish section of the pipeline. Shareholders of EUROPOL Gaz are: the Polish Oil and Gas Company (PGNiG) – 48%, OAO GAZPROM – 48% and Gas-Trading S.A.– 4%.

**Petrobaltic** is the company that deals with offshore oil extraction. In the extraction process, NG is treated as a waste by-product and released into the air. The US Government provided the grant to work out the plans for NG transmission from the platform and for building the CHP plant in Wladyslawowo that will use this gas. This plant, with a heat production capacity of 20 MW and a power production capacity of 14 MW, would use NG from the platform until 2015. The whole undertaking would require the construction of a 75 kilometre long under-water pipeline.

Several joint-venture companies have received concessions for hydrocarbons (oil and natural gas) exploration in Poland. These are: Apache Poland, Medusa Oil & Gas Poland, RWA-DEA Polska Oil, Calenergy Gas Polska, Warmia Petroleum Co., and Wielkopolska Energia. Further concessions for Exxon-Shell and EuroGas Poland are under negotiation.

**Concessions issued to the companies with foreign capital for hydrocarbons exploration**

| Company | Numbers of concessions | Area |
|---|---|---|
| Wielkopolska Energia (Texaco + El Paso) | 16 | 12 200 sq. km |
| Warmia Petroleum Co. | 6 | 4 300 sq. km |
| Apache Poland (Pomerania) | 10 | 9000 sq. km |
| Apache Poland | 21 | 19 700 sq. km |
| Calenergy Gas Polska | 14 | 12 600 sq. km |
| RWA-DEA Polska Oil | 11 | 10 000 sq. km |
| Apache Poland (East) | 16 | 12 600 sq. km |
| Medusa Oil & Gas Poland | 4 | 3 300 sq. km |
| Apache Poland (Carpathians) | 12 | 4 200 sq. km |
| **Total** | **110** | **87 900 sq km** |

*Source: Nafta Gaz, Nr 6/2000, Instytut Górnictwa Naftowego i Gazownictwa, Krakow, 2000*

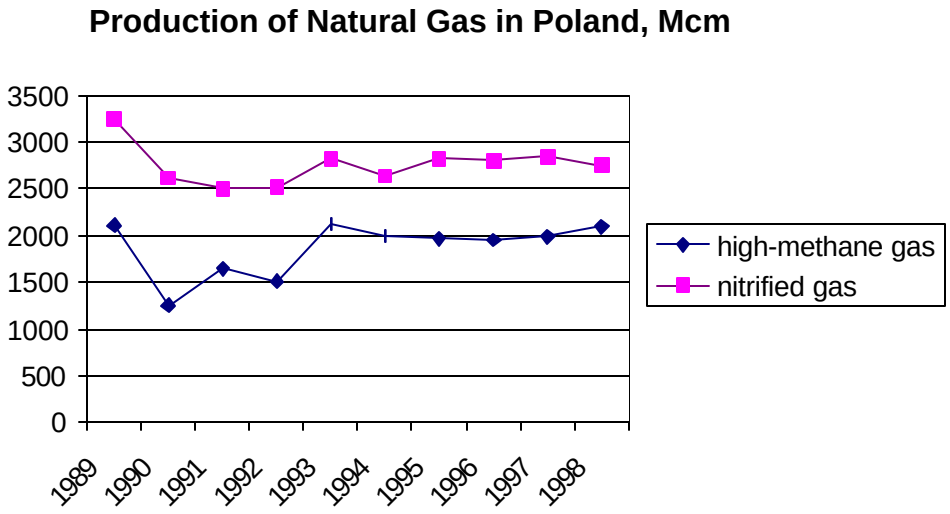
PGNiG has been granted 82 concessions covering an area of 37 thousand square kilometers. Furthermore, PGNiG plans to extend its concessionary area by more than ten thousand kilometres[7]. The Company has already submitted the request for additional concessions to the Ministry of Environment, which is in charge of granting such exploration blocks.

## Natural Gas Exploration, Transmission, Distribution and Storage

Poland is a country with relatively few natural gas resources. Domestic production ranges between 4.5 and 5 Bcm a year and represents only 32% of the total natural gas used. Two main exploration regions in Poland are *Przedgórze Karpackie* (Carpathian Foredeep) located northwest of the Carpathian Mountains and *Ni¿ Polski* (Polish Lowlands). Natural gas from Przedgórze Karpackie is high-methane gas (97%), with small amounts of nitrogen and other impurities. Currently, about 30% of production originate in Przedgórze Karpackie. Natural gas from Ni¿ Polski, which represents over 60% of total domestic production, has low quality and heat values, and contains between 30 and 40% nitrogen.

[7] „Nafta Gaz"; no 6/2000, Instytut Górnictwa Naftowego i Gazownictwa, Krakow, 2000

The future potential of recoverable natural gas is estimated to be 608 Bcm. It is worth noting, however, that some studies predict that the future potential of natural gas may reach 2247 Bcm (genetic method)[8]. However, current commercial resources are 146.2 Bcm[9]. In recent years, the largest growth in newly discovered natural gas fields was in Ni¿ Polski. In particular, a new field in *Baranówko-Mostno-Buszewo* (BMB) was responsible for 34.3% of all documented increases of natural gas reserves between 1991 and 1998. Documented gas reserves amount to 9.8 Bcm.

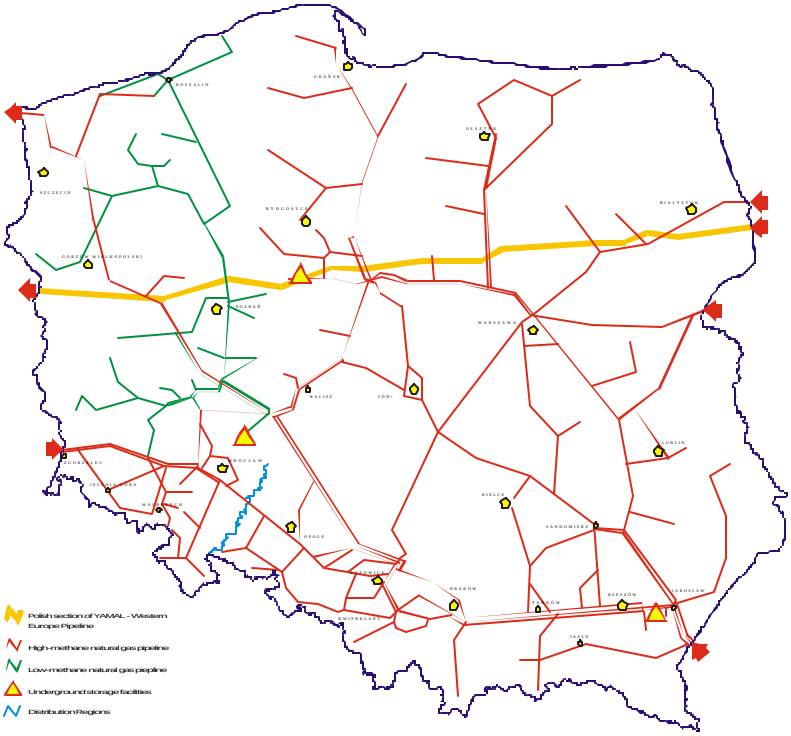



Besides exploration in Ni¿ Polski and Przedgórze Karpackie, some natural gas reserves exist in *Górnoœl¹skie Zag³êbie Wêglowe* (Upper Silesian Coal Region), where it is possible to obtain natural gas from the de-gasification of coal-mines. This production amounts to 0.2-0.25 Bcm per year. Despite considerable natural gas reserves in coal mines, the utilisation of this gas proves costly when using existing technologies and this kind of production will disappear with the closure of the coal mines.

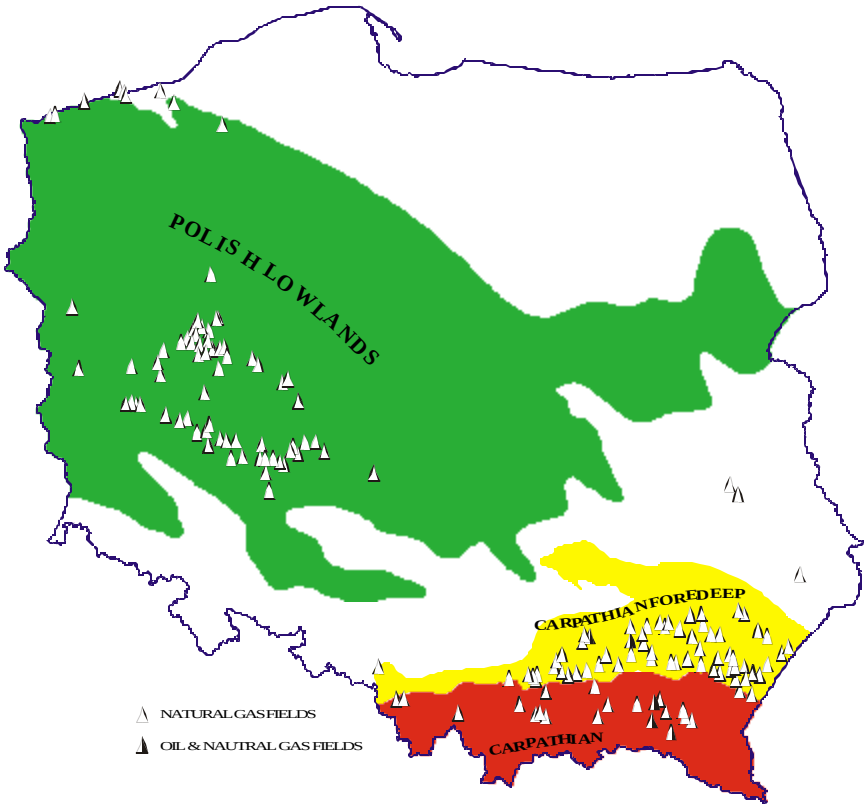
The Polish natural gas system consists of 17, 400 km of high-pressure transmission pipelines (8.4 MPa) and 94,600 km of distribution network. (See map below) In 1998 there were 5.8 million household users connected to a high-methane distribution network. This number has grown consistently in the past decades.

[8] Przegl¹d Geologiczny" (Geological Review); no 4/1998, Instytut Geologiczny
[9] "Energy Sector in Poland", World Energy Council, Warsaw 1999

## The Yamal Pipeline




Construction of the first string was completed in 1999. Despite original plans, construction of the second string is still uncertain.



The target capacity of the pipeline is to transport 65 Bcm annually. According to the contract with Russia, within the next 25 years Poland will buy 250 Bcm of natural gas through the Yamal pipeline.

In order to comply with EU requirements, Poland has to increase its natural gas storage capacities. Currently, these capacities are about 1.1 Bcm, which is below current demand of 2 Bcm. The demand for high-methane natural gas varies from 19 Mcm a day (6 Mcm for the household sector) in summer to 45 Mcm a day (31.5 for household sector) in winter. To balance winter peaks, PGNiG has rented 350 Mcm of storage facilities in Belarus and Ukraine. It has already happened that, during winter peaks, these countries used storage facilities that were rented and reserved for Poland. The storage demand is projected to grow to 4.5 Bcm in 2010. Therefore, investments in new gas storage facilities are among the top priorities of PGNiG and the government. The largest NG storage facility in Poland is located in Wierzchowice (Lower Silesian Voivodship). The facility's current capacity of 600 Mcm will be increased to 3.5 Bcm. Additional storage facilities are located in Mogilno (capacity – 400 Mcm), Brzeznica, Swarzow, Husow and Strachocina.

## Present and Future Role of Natural Gas

The current consumption levels of natural gas in Poland are lower than in other European countries. The share of natural gas in primary energy use is about 9.8 percent, while the corresponding figure in the EU countries exceeds 20%. To date, gas has not been used in power generation, which is, currently, primarily based on coal. The overall use of gas in Poland is approximately 12 Bcm, of which nearly 70% is imported (primarily from Russia). In 1995, Poland signed a long-term contract with Russia for gas deliveries. This contract was written in anticipation of increasing imports amounting to 13 Bcm meters in 2010. In order to diversify supply sources, Poland is seeking opportunities to buy NG from the North Sea Region, specifically Norway. In 1999 the Government concluded an agreement with Norway on yearly purchases of 500 Mcm, starting from late 2000 (“small contract”). NG coming from this contract will be delivered to Poland via the German system. There are further plans to increase imports from Norway to 5 Bcm. However, transportation of such quantities of NG would require construction of a new transmission pipeline, going from Norway through Denmark and under the Baltic Sea to Poland. In July 2000, both the Polish and Norwegian Prime Ministers announced this investment plan. According to the Polish government, negotiations regarding a “large contract” ought to be completed in December 2000.

Besides the Norwegian contract and the possible investment in the pipeline from the North Sea, PGNiG has conducted negotiations with the Danish enterprise, Dansk Olie of Naturgas A/S, on constructing a pipeline linking Dutch gas fields with the Polish Baltic Sea coast. The pipeline (called Balticpipe) would have the capacity to transport 10 Bcm a year and the costs of investment would be EURO 350 million (excluding on-land facilities in Denmark and in Poland). The European Union assigned USD 2 million for preliminary plans of the project. Concerns regarding diversification of the NG supply is an important issue to be addressed by the Polish government. However, some question remains as to whether Poland will be able to consume NG coming from both the long-term contract signed with Russia as well as from one of the alternative sources, such as the Norwegian “large contract” or the Baltic pipeline project with Denmark. The Polish Government and PGNiG are negotiating with other countries (Slovakia, Czech Republic, Hungary and Lithuania) on NG deliveries from new pipelines.

The role of natural gas in Poland will increase significantly in the coming decades. The official governmental document, "Energy Policy Strategy until 2020", forecasts a greater than two-fold growth in demand for NG until 2020[10].

**Prognosis of Natural Gas Balances – Bcm**

| SCENARIOS | SOURCE | 1997 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|---|
| PRZETRWANIA (stagnation) | Production | | 4.3 | 4.2 | 3.8 | 3.6 |
| | Import | | 12.1 | 15.5 | 19.1 | 22.4 |
| | Export | | 0.0 | 0.0 | 0.0 | 0.0 |
| | **Country demand** | | **16.4** | **19.7** | **22.9** | **26.0** |
| ODNIESIENIA (business-as-usual) | Production | 3.7 | 4.3 | 4.2 | 3.8 | 3.6 |
| | Import | 8.3 | 13.6 | 17.8 | 21.2 | 25.7 |
| | Export | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | **Country demand** | **12.0** | **17.9** | **22.0** | **25.0** | **29.3** |
| POSTEP-PLUS (development-plus) | Production | | 4.3 | 4.2 | 3.8 | 3.6 |
| | Import | | 11.4 | 14.2 | 18.3 | 24.0 |
| | Export | | 0.0 | 0.0 | 0.0 | 0.0 |
| | **Country demand** | | **15.7** | **18.4** | **22.1** | **27.6** |

*Source: Energy Policy Strategy until 2020, Ministry of Economy*

Although there is no consensus regarding the future demand for NG, and some forecasts have been overestimated, most studies present the same trend and emphasize a constant increase in the percentage of natural gas as a primary energy source. An emerging market is anticipated for combined heat-and-power (CHP) generation based on natural gas. Until now, there have been a few projects with CHP burning natural gas in Poland. The first installation was built in Gorzów Wielkopolski. This CHP plant uses natural gas from the nearby Baranowko-Mostno-Buszewo fields, which are the reservoirs of nitrified natural gas. Another example was the investment of an American company, Enron, in CHP in Nowa Sarzyna (116MW). There are other new projects that are under different phases of the investment process. These are:

**Power plant in Zarnowiec.** Construction will start in 2001 and will be completed in 2003. The power plant, with a total capacity of 250 MW, is the investment of two American corporations: AES Corp. and Failure Analysis Associates.

**Investment in the city of Poznan** (one of the biggest cities in Poland). The CHP will be supplied with nitrified natural gas from nearby gas fields (new field of PGNiG "Koscian S").

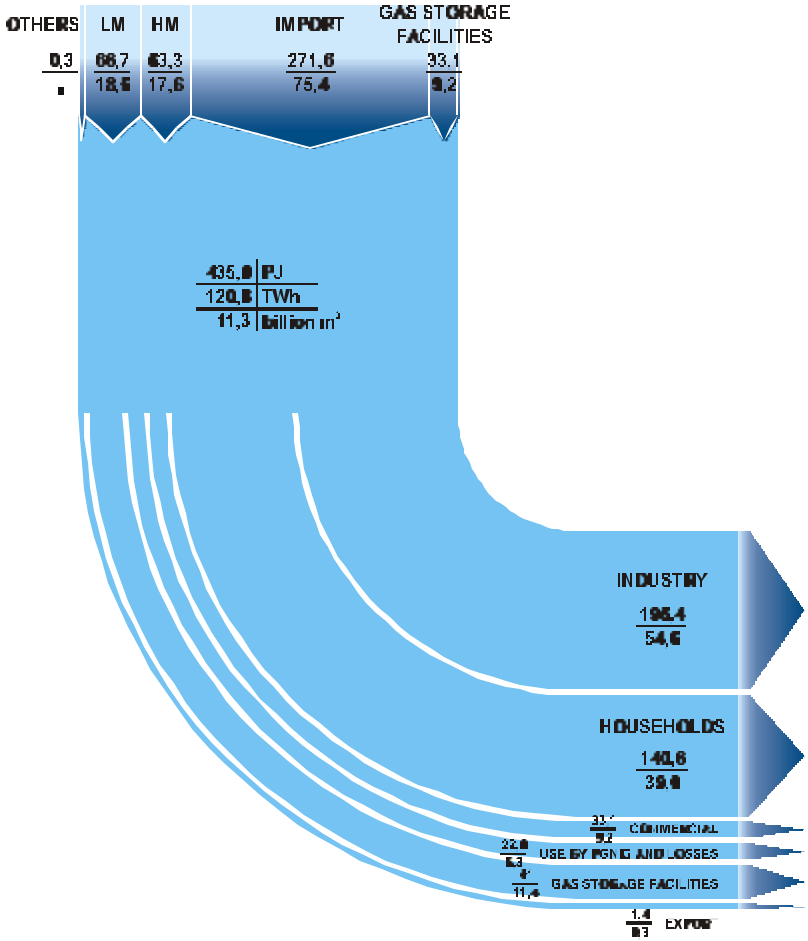
**Investment in CHP in Zielona Gora** will use local nitrified gas sources as well.

**Power plant in Jaroslawiec.** This is an investment of the British Company – Eastern Generation. The total capacity of the plant will be 120 MW.

[10] „Za³o¿enia Polityki Energetycznej Polski do 2020" (Energy Policy Strategy until 2020); document approved by Council of Ministers February 22, 2000

Power and CHP generation based on natural gas will undoubtedly rise in the next few years. This generation can act as a substitute for the coal-based energy currently dominating the Polish energy market. Gas-based CHPs may emerge particularly in western Poland (Wielkopolska and Dolny Slask), in the areas located close to nitrified natural gas fields e.g. Poznan, Gorzow and Zielona Gora. The Polish Power Grid Company (PSE S.A.) has designed a model that will predict the use of different fuels by the energy sector between 1995 and 2020. According to this prediction, NG use by the energy sector would rise from 1 Bcm in 2000 to 4.5 billion in 2010 and 10.4 billion in 2020. At the same time the role of hard coal would decrease about 30% compared to 2000 levels and brown coal use would shrink by about 20%[11].

**Annual Flows of Natural Gas in PGNiG Grid**




*Source: "Annual Report 1998", Polish Oil and Gas Company, 1999*

Trends show that, since the 1970s, there has been an increase in the use of natural gas by households. There are 6.6 million household users of NG in Poland, representing an annual average increase of about 87 000 users in recent years [12]. However, due to the high costs of such investments, a large number of small towns and municipalities do not have access to the gas grid. As PGNiG (the owner of the grid) is not always willing to finance the distribution system and because municipalities lack sufficient financial resources, third party financing may gain popularity. This scheme is in line with a new Polish Energy Law that was passed in 1997.

[11] ZPR-2
[12] "Raport Roczny 1998" (Annual Report 1998) PGNiG, 1999

In western Poland, German companies are particularly active in this field, establishing distribution companies together with local municipalities. Another scheme provides the possibility for municipalities to obtain loans from PGNiG and other companies. The municipalities would remain owners of the grid but would have to contract long-term (usually 30 year) purchases of NG from PGNiG.

It is worth noting that, in many small municipalities where investments in NG systems exceed the local financial capacities, renewable energy sources may substitute for other fuels such as coal and natural gas.

Nitrified natural gas plays a minor role in domestic sector use, with 776 000 households using this kind of gas. The nitrified natural gas grid will disappear within the next 20 years and low-methane gas will be used mainly locally and particularly by the energy sector.

The costs for heat generation with natural gas exceed the costs of production based on brown and hard coal. The condition for the rapid increase of natural gas use in energy production is the reduction of the price gap between natural gas and coal. However, forecasts suggest that, instead, an expansion of this gap can be expected in the next 20 years[13].

**Unit cost of heat energy in Poland in 1997 [PLN / GJ]**

| Energy source | Cost PLN / GJ |
|---|---|
| Brown coal | 10.63 |
| Hard coal | 11.64 |
| Natural gas | 19.5 |
| Heat oil | 28.59 |
| LPG | 38.88 |
| Biogas | 14.76 |
| Solar collectors | 18.85 |
| Utilization of industrial wastes | 11.84 |
| Hydro energy | 12.9 |

*Source: "Gaz ziemny w strukturze energetycznej Polski", R. Ney et. al, „Nafta Gaz", no 12/1999, Krakow*

It is worth noting that the price of natural gas imported from Russia was 66.6 – 71.6 USD / 1000 cubic meters (German gas cost 87.5 USD / 1000 cubic meters), and that these prices were lower than the prices used in simulations extending for the next 20 years. The reform of the coal industry and the removal of coal subsidies should also enhance the use of natural gas in the Polish energy sector.

Some experts anticipate that an important trend in the coming years will be the emergence of local NG markets and dispersed CHP generation in sources of one to several MW. Multi-energy companies will become the main energy suppliers and will extend the scope of their activities to services related to environmental protection, renewable energy sources or water management[14].

## Policy Implications and Legal Background of Natural Gas Use in Poland

Increasing energy security was given high priority in Polish energy policies[15]. Changes in the structure of primary energy use and a shift from coal to other fuels (mainly natural gas) will lead to growing import dependency. Therefore, diversification of natural gas suppliers is a big political concern. Currently, nearly all imported NG comes from the Russian Federation. Plans for

[13] „Gaz ziemny w strukturze energetycznej Polski", "Nafta Gaz", no 12/1999, Warsaw
[14] "Perspektywy Lokalnych Rynkow Gazu Ziemnego", Jan Popczyk
[15] "Energy Policy Strategy" until 2020

importing significant quantities of NG from alternative countries such as Norway and Denmark have been advanced, and the first 200 million cubic meters of Norwegian NG will be delivered to Poland in 2000/2001. Nevertheless, proposals for purchasing additional amounts of NG from Scandinavian countries are opposed by some politicians and representatives of the mining industry. These opponents emphasize that Poland will not be able to use the quantities of NG that would be contracted for under these new agreements. Because these contracts require high investments by the NG providing countries, large transmissions of NG are necessary to guarantee profitability.

Recently, problems related to NG became a political issue. The president of Gazprom asked Poland to change the planned route of the Yamal – Western Europe pipeline. According to the new proposal, the pipeline would branch in Poland, splitting off from the existing east-west pipeline and extending to Southern Europe. The statements of the Polish decision makers in this matter were not clear and often contradictory. The problem is that the proposed new route would enable Russia to avoid Ukraine in the natural gas transit (apparently the dispute between Russia and Ukraine concerns overdue payments for NG). Accepting the Russian proposal would jeopardize Poland's relationship with Ukraine, a strategic partner. This makes the decision fairly complicated from a political point of view.

The main legal acts that influence natural gas exploration, transmission, distribution, storage and use are: Energy Law, Geological and Mining Law, and Environmental Protection legislation. Exploration activities require obtaining the concessions from the Department of Geology of the Ministry of Environment. The Geological and Mining Law specifies the type of concession arrangement in which a company is granted a lease for an agreed upon period of time[16].

The main body responsible for regulating the energy market is the Energy Regulatory Authority (ERA). The President of the ERA is responsible for the control and approval of gas tariffs, issuing licenses for transmission, distribution, production, storage and commercial traffic of natural gas. The president of ERA is also in charge of settling disputes in negotiations about access to the systems and denial of access. The scope of activities undertaken by the ERA is generally in line with EU requirements such as the authorization procedure of the 98/30/EC Directive. According to the Energy Law, design, construction and exploitation of facilities should ensure rational and efficient use of fuels.

Integration with EU and the obligation to comply with *aquis communataire* are the crucial factors that force changes in the Polish NG market. Polish legislation does not fulfill all of the provisions of the 98/30/EC Directive. The Energy Law to Natural Gas Extraction in Poland limits the Third Party Access (TPA) rule. This rule does not comply with the EU requirements, however, Poland has promised to abolish this limitation upon joining the EU. Within this restrictive clause, the following customers have a right to use the distribution services on the TPA basis:

- As of 1 January 2000, customers purchasing more than 25 million cubic meters a year;
- As of 1 January 2004, customers purchasing more than 15 million cubic meters a year;
- As of 5 December 2005, customers purchasing than less 15 million cubic meters a year.

When compared to the 98/30/EC directive and its provision concerning *eligible customers*, the Energy Law assumes a full opening of the gas market within eight years of the date the Law

[16] „Poland – Natural Gas Upstream Policy", UNDP, ESMAP, Report No. 206/98, August 1998

becomes effective, i.e. – by 2005[17]. Unlike the Directive, according to current Polish law, the power producers burning natural gas are not defined as eligible customers independently of their gas consumption. This gap will need to be eliminated.

Under the provisions of the executive regulation to the Energy Law, the obligations of the gas companies include appointment of the grid operators i.e. the distribution system operator and the dispatch system operator. The range of tasks of the operators of the grid is similar to that introduced by the EU legislation[18].

In the field of gas markets, the Polish government has declared its readiness to join the EU by the end of 2002, although Poland will not be able to fulfil provisions of Articles 17 and 18 of the Directive by that date. Poland has asked for a transitional period to comply with these articles. This is mainly because the gas market in Poland is not prepared to compete with the liberalised gas market in the EU countries. This notwithstanding, the government emphasises the need for the restructuring and privatisation of the gas industry. Furthermore, after completing the restructuring process, at least one additional year will be needed to enable the Polish entities to operate in the competitive domestic market (with market prices) before implementing the provisions of the Directive.

Several European Directives play important roles with regard to the problems related to environmental protection and use of NG. These are: Directive 85/337/EEC, on assessment of the effects of certain public and private projects on the environment and Directive 94/22/EC, on the conditions for granting and using authorizations for the prospecting, exploration and production of hydrocarbons. Although the Polish Environmental Protection Act stipulates an obligatory environmental impact assessment of investments like the construction of pipelines, NG storage facilities, exploration and extraction, Polish procedures are not as advanced as European ones. These procedures require the preparation of a report on the environmental impact of the investment but they do not include, for instance, a consultation process as required by the Directive 977/11/EC. New legislation in the field of access to information, environmental impact assessment and consultations with the society is currently being prepared in the Polish Parliament.

## Environmental Aspects of Natural Gas Use

It is anticipated that in next 20 years, the use of hard coal by the energy sector may decrease by 30% and the use of brown coal may fall by about 20%[19]. At the same time, the share of natural gas used in the production of electricity will reach 17%, while currently it is negligible. Reducing the levels of the use of coal and converting to natural gas in the energy sector will bring about a reduction of the emissions of various pollutants. However, growing demand for energy can weaken this effect.

In past years, low atmospheric level emission from burning hard coal for heating purposes have adversely affected the environment in big urban areas like Krakow. Particulates, $SO_2$, $NO_x$ and other pollutants originating from these processes affected the health of thousands of citizens, caused acid rains and damaged the cultural heritage of Krakow. Since 1994, the city of Krakow, with financial support from United States Agency for International Development and Municipal Environmental Protection and Water Management Fund, has initiated a program to eliminate low

[17] "The executive regulation on the schedule of access to the transmission services by different groups of consumers"; Official Journal of Law of August 20, 1998, No. 107
[18] "The executive regulation of the Minister of Economy, of July 14, 1998"

level emission. Between 1994 and 1999, about a hundred big coal-based boiler houses in public buildings were eliminated, either through coal-to-gas conversion or by connecting them to the heat system. Over 300 privately owned boiler houses were converted from coal to gas. The switch in fuels and the elimination of coal based boiler houses resulted in significant reductions of air pollution. The average annual $SO_2$ concentration fell by about 60 % between 1989 and 1998 and for the first time did not exceed acceptable levels. Particulate emissions also dropped by 60%.

As mentioned previously, it is anticipated that the cost differential between generating energy from natural gas and generating energy from coal will increase. This disproportion works in favour of an increased use of coal. Therefore, an introduction of $CO_2$ related taxes could diminish this gap and enhance the feasibility of cleaner energy sources such as renewable sources or natural gas. Currently, the $CO_2$ charge in Poland is only PLN 0.15/tonne of $CO_2$, which is far below estimated external costs related to $CO_2$ pollution. Implementation of $CO_2$ tax or a charge of PLN 0.054/kg of $CO_2$ would substantially increase the competitiveness of heat and power generation from NG[20].

Although natural gas is regarded as a clean alternative for coal, some external environmental costs still occur during the exploration, transmission, distribution and use of NG. Upstream adverse effects on the environment are: land disturbance, drilling waste disposal and potential damage to ground water and soil. The environmental impact of NG transmission includes land disturbance, methane leaks from pipelines, and noise from equipment such as compressors. The end-use of NG still produces some atmospheric pollution and $CO_2$ emissions, although smaller than those emissions that come from the end use of coal[21].

While substitution of natural gas for coal can contribute to significant decreases in greenhouse gas emissions and other atmospheric pollutants, the construction and use of a natural gas infrastructure also brings about external environmental costs. Without denying the important role of natural gas in meeting international agreements on greenhouse gas reductions, it is crucial to strongly promote renewable energy sources wherever it is feasible. Especially in many small municipalities, renewable energy sources can be an efficient substitute for other fuels, such as natural gas or coal.

[19] "Nafta Gaz", no 12/1999, Instytut Górnictwa Naftowego i Gazownictwa", Krakow, 1999
[20] "Koszt Produkcji Ciep³a w Elektrociep³owniach Parowo-Gazowych", J. Szargut, „Gospodarka Paliwami i Energi¹", no 2/1999 Following other estimates author assumes the external costs of $CO_2$ emissions is PLN 0.054/kilo of $CO_2$
[21] "Natural Gas 1998: Issues and Trends", Energy Information Administration

## Conclusions and Recommendations

To achieve a reduction of greenhouse gases, especially $CO_2$, one should consider the introduction of economic instruments that would favour less polluting energy sources (renewable energy sources or natural gas). Broad discussion on the implementation of energy/$CO_2$ taxes should take place among various decision makers. The implementation of $CO_2$ related taxes could be part of a wider tax reform program, where additional revenues from energy or $CO_2$ taxes are used to lower other distortionary taxes and promote clean energy programs. Such a tax could lead to a double dividend (environmental and employment). German tax reforms, for example, stipulate a decrease in tax rates in national security contributions and the earmarking of part of these revenues for programs promoting CHP.

Further legislation is needed in the field of environmental impact assessment for all investments in NG exploration, transmission, storage etc. in order to comply with EU requirements. It is important to implement legislation on the consultation process with interested parties before undertaking investments affecting the environment.

Finally it is important to estimate the external costs of different fuel cycles in Poland e.g. natural gas, coal or hydro – like in the EU sponsored EXTERNE project. This will provide knowledge of any adverse effects of different fuel uses on the environment and will help to indicate the least damaging options. The promotion of renewable energy sources should gain more attention in energy policies. Unlike EU targets that seek to increase the share of renewables in primary energy sources to 12% by 2010, the Polish Energy Policy Strategy only requires a 6.5% target by 2020. Clearly, decision makers in Poland do not consider renewable energy sources a high-priority issue.

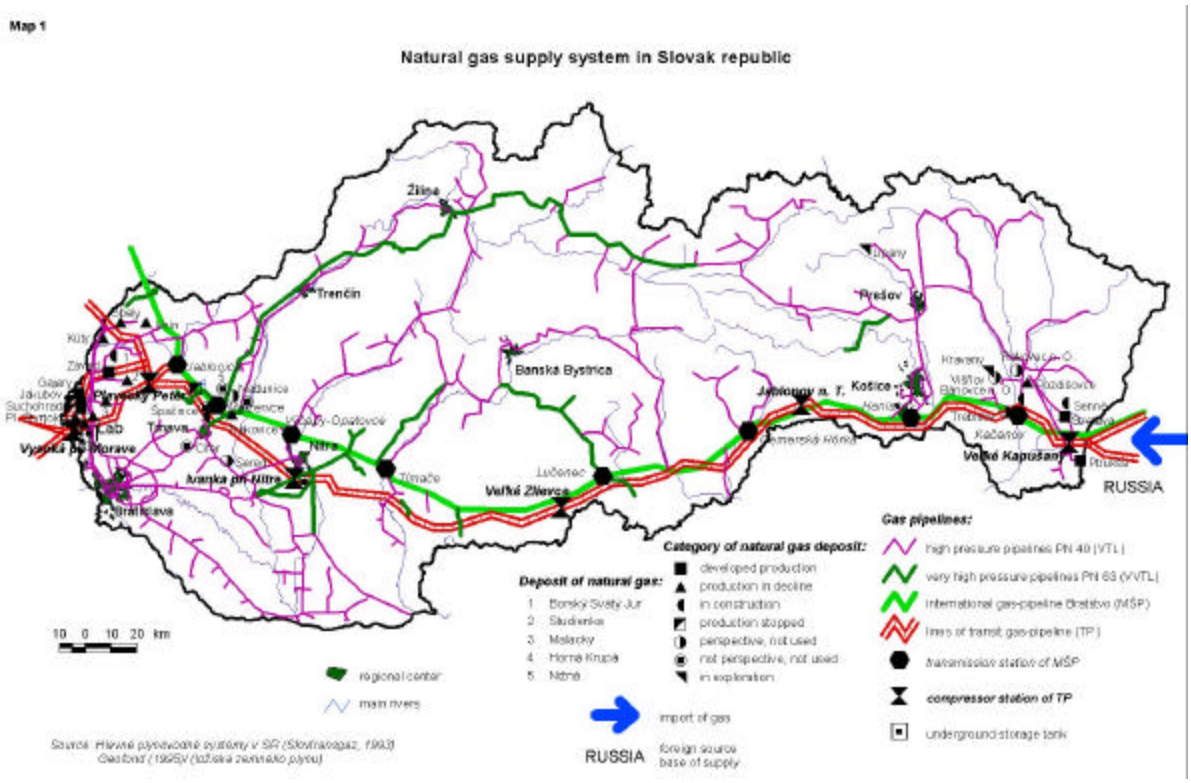
# The Slovak Republic

Natural gas is becoming the most important energy source in Slovakia and the related gas industry is the most important branch, not only of the Slovakian energy sector, but also of the entire economy. A state monopoly enterprise, Slovak Gas Industry (Slovenský plynárenský priemysel, SPP), belongs to the most important companies in Slovakia. Owing to revenues from the transit of gas through Slovakia in recent years, it has also earned large profits. Therefore, further developments in the utilization of natural gas in Europe and in Slovakia itself could have a great impact on the country.

## Natural Gas Sources and Extraction

The domestic reserves of natural gas in Slovakia are relatively small. Estimates of the geological (total known) stock is 27 991 Mcm (1. 1. 2000) and is concentrated in 25 locations in Záhorská (18) and in the East-Slovakian lowlands (7). Deposits in the Danubian lowland seem to be so far unproven. Evaluated (exhaustible) stock (11 284 Mcm) comprises 40.3% of the total geological stock.

Due to a low reserve base, extraction is not very developed and is concentrated in locations in Záhorie (*Gajary, Jakubov, Borský Jur, Závod*). Extraction capabilities are also being developed in the East-Slovakian lowland (*Ptrukša, Senné, Stretava*). The rest of Slovakian demand was covered by imports from the Russian Federation through the gas-pipeline *Bratstvo (Brotherhood)*, as well as through the *transit gas-pipeline*.

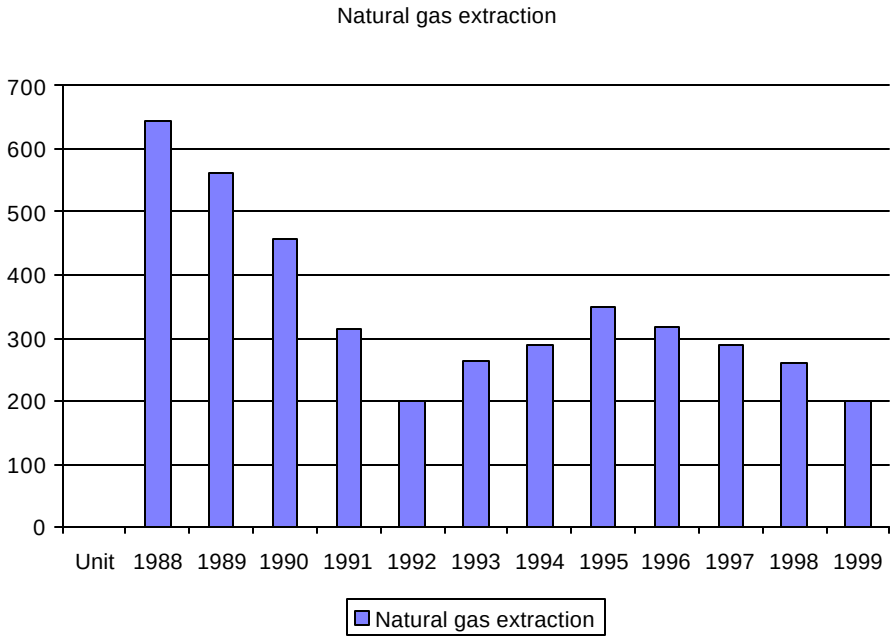


Domestic extraction of natural gas in 1999 accounted for 216 Mcm, 3.0% of the total consumption. Approximately 97% of the remaining Slovakian demand for gas is filled by imports from Russia. In 1999, Slovakia purchased 6.86 Bcm of natural gas from Russia. According to current estimates, this volume should grow in the future. There are already plans to buy 7.7 Bcm this year. By 2005 the volume of natural gas imported from Russia should increase to 8 Bcm. Along with the aforementioned quantities imported from Russia, small quantities are also imported from Germany, especially during the peak demand period, 148.4 Mcm in 1999.

**Development in Securing Sources and Demand of Natural Gas**

| | Unit | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|
| Natural gas from Russia – through the transit system | Bcm | 74.1 | 74.5 | 79.0 | 81.4 | 77.6 | 84.1 | 88.3 |
| Of which: for abroad | Bcm | 72.1 | 71.5 | 75.7 | 77.5 | 73.8 | 79.9 | 83.4 |
| Supply for SR | Bcm | 2.0 | 3.0 | 3.3 | 3.9 | 3.8 | 4.2 | 4.9 |
| Natural gas extraction | Mcm | 264 | 288 | 349 | 317 | 289 | 260 | 216 |
| Purchase of gas | Bcm | 5.9 | 6.1 | 6.3 | 7.0 | 7.0 | 6.9 | 7.2 |
| Consumption (without own consumption and losses, Sale of SPP) | Bcm | 5.8 | 5.8 | 6.3 | 6.6 | 6.778 | 6.702 | 7.100 |
| Capacity of underground storage | Bcm | 1.7 | 1.7 | 1.9 | 2.0 | 2.0 | 2.1 | |
| Production of propane-butane (related to natural gas extraction) | Thous. Tonnes | 1.2 | 1.2 | 1.2 | 1.26 | 1.0 | 0.558 | 0 |

*Source: Ministry of Economy 1999a (MH 1999a)*




The extraction of hydrocarbons, undertaken in Nafta Gbely, is currently affected by a year-to-year decline in extraction and by recession in the crude oil industry. The quantities of gas that are expected to be extracted from Slovakian deposits are shown below.

**Prognosis for Natural Gas Extraction**

| Commodity / year | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|
| Gas (Mcm) | 236 | 235 | 238 | 215 | 206 | 244 | 220 |

*Source: Ministry of Economy 1999a (MH 1999a)*

The increase in gas extraction predicted for the period between 2004 and 2005 will require there to be some extraction of gas from the cap of the crude oil deposit in Gajary-báden. In 2001, extraction operations are also expected to include the deposit in Bánovce (possibly Trebišov) with a capacity of 200 Mcm, requiring an investment of 250 mil. SKK (5.8 mil. EUR). Currently, these proposed activities are in a phase of technical-economic assessment.

## Importance of Natural Gas in the Context of the Energy Sector of Slovakia

Slovakian energy intensity, expressed as the share of total primary energy consumption in GDP, has followed a consistently declining pattern since the establishment of the Slovak Republic. However, when compared to the average in the EU countries it remains 7.7 times higher. When considering this disparity, while also considering the exchange rate and applying the real purchase power parity, it is 2.3 times higher than that of the EU. This is partially a result of the low productivity of labour compared to the EU countries, but is also reflective of a high industry share in the generation of GDP and a high proportion of energy intensive branches of industry.

A slow-down in the GDP growth in the past years has been accompanied by a slight reduction in primary energy consumption, a decline in final energy consumption, and a decline in electricity consumption. Per capita consumption of primary energy sources in Slovakia is approximately equal to 85% of the average in the EU countries (MH 1999b).

**Energy Intensity in Slovakia**

| Indicator | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|
| GDP in c.p. 95 (bil. SK) | 460.8 | 483.4 | 516.8 | 550.8 | 586.8 | 612.7 |
| GDP in c.p. 95 (bil. EUR) | 10.7 | 11.2 | 12.0 | 12.8 | 13.6 | 14.2 |
| Primary energy sources (PJ) | 733 | 718 | 742 | 754 | 739 | 693 |
| Final energy consumption (PJ) | 549 | 537 | 542 | 552 | 547 | |
| Energy intensity – PEZ*/HDP 95 (PJ/bil. SK) | 1.59 | 1.49 | 1.43 | 1.37 | 1.26 | 1.13 |

*Source: Ministry of Economy 1999a (MH 1999a)* * = PEZ – primary energy sources

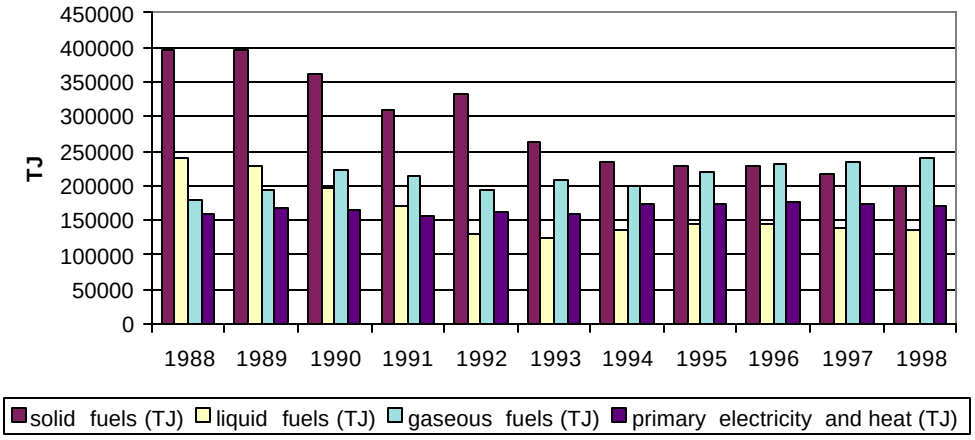
Slovakian energy consumption is characterized by the growing role of gaseous fuels, the most important being natural gas, in covering needs and by a decline in the use of liquid and solid fuels. In connection with the commissioning of the Mochovce Nuclear Power Plant (NPP), the share of primary electricity and heat (especially from nuclear fuel) has grown significantly. The share of the total consumption that is comprised of gaseous and solid fuels is approximately 30%. Compared with other Central European countries, Slovakia had the most balanced structure of energy consumption, one that does not reflect the expressive domination of any one single source. Efficiency in the utilization of primary energy sources was around 70%.

## Primary Energy Sources Used in the SR

| Year | Total (TJ) | Solid Fuels (TJ) | Slid fuels (%) | Liquid fuels (TJ) | Liquid Fuels (%) | Gaseous fuels (TJ) | gaseous fuels (%) | primary electricity and heat (TJ) | primary electricity and heat (%) |
|---|---|---|---|---|---|---|---|---|---|
| **1988** | 976900 | 396968 | 40.64 | 240150 | 24.58 | 179848 | 18.41 | 159934 | 16.37 |
| **1989** | 986256 | 396672 | 40.22 | 228389 | 23.16 | 194029 | 19.67 | 167167 | 16.95 |
| **1990** | 945279 | 360155 | 38.10 | 197550 | 20.90 | 223014 | 23.59 | 164560 | 17.41 |
| **1991** | 848624 | 309732 | 36.50 | 169289 | 19.95 | 213980 | 25.21 | 155623 | 18.34 |
| **1992** | 820816 | 333459 | 40.63 | 129664 | 15.80 | 194777 | 23.73 | 162916 | 19.85 |
| **1993** | 754803 | 263625 | 34.93 | 124165 | 16.45 | 207591 | 27.50 | 159422 | 21.12 |
| **1994** | 743605 | 235375 | 31.65 | 134788 | 18.13 | 198369 | 26.68 | 175073 | 23.54 |
| **1995** | 766371 | 228914 | 29.87 | 145762 | 19.02 | 219132 | 28.59 | 172563 | 22.52 |
| **1996** | 779950 | 227090 | 29.12 | 143722 | 18.43 | 231621 | 29.70 | 177517 | 22.76 |
| **1997** | 764654 | 216418 | 28.30 | 139374 | 18.23 | 235123 | 30.75 | 173739 | 22.72 |
| **1998** | 744794 | 198822 | 26.69 | 134908 | 18.11 | 239848 | 32.20 | 171216 | 22.99 |

*Source: Statistical Yearbooks of the Slovak Republic*

**Primary Energy Sources Used in the Slovak Republic**




It can be assumed that the structure of primary energy consumption is going to shift towards a higher utilization of natural gas in industry and households, as well as a shift, in these sectors, towards greater uses of electricity and heat production. Currently, there is only one gas fuelled power plant (excluding CHP) in Slovakia and thus gas use in the power sector is negligible. Solid fuel consumption will stagnate or be reduced due to more stringent requirements on emission limits (mainly in the case of brown coal). The share of nuclear energy in total primary energy consumption will decrease after the decommissioning of the first and second units of the nuclear power plant Jaslovské Bohunice in 2006-2008. (MH 1999b).

## Electricity Consumption by Sector (GWh)

| Year | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| High voltage consumers HV | 16453 | 16658 | 16411 | 14597 | 13492 | 11952 | 12199 | 13377 | 14336 | 13857 | 13395 | 12984 |
| Low voltage Residentials LVR | 3444 | 3585 | 3717 | 3802 | 3701 | 4137 | 4489 | 4998 | 5451 | 5562 | 5666 | 5673 |
| Low voltage Entrepreneurs LVE | 1940 | 2022 | 2021 | 1977 | 1874 | 1964 | 1977 | 2086 | 2201 | 2300 | 2328 | 2344 |
| Total LV | 5384 | 5607 | 5738 | 5779 | 5575 | 6101 | 6466 | 7084 | 7652 | 7862 | 7994 | 8017 |
| Total consumption LV+HV | 21837 | 22265 | 22149 | 20376 | 19067 | 18053 | 18665 | 20461 | 21988 | 21719 | 21389 | 21001 |
| Number of inhabitants (thous.) | 5251 | 5276 | 5298 | 5283 | 5304 | 5325 | 5347 | 5364 | 5374 | 5388 | 5393 | 5399 |
| Consumtion per cap. (MWh) | 4.2 | 4.2 | 4.2 | 3.9 | 3.6 | 3.4 | 3.5 | 3.8 | 4.1 | 4.0 | 4.0 | 3.9 |

*Sources:Slovenské elektrárne (1995, 1997). Roèenky spotreby elektrickej energie 1994, 1996, 1999*

## Electricity Import / Export

| | | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Consumption | TWh | 28.9 | 31.5 | 31.0 | 29.4 | 28.3 | 24.5 | 25.2 | 27.3 | 28.9 | 28.6 | 28.27 | 27.85 |
| Losses in grid | TWh | | 1.9 | 1.8 | 1.8 | 2.1 | | | 2.1 | 2.0 | 2.1 | 2.0 | 1.8 |
| Import | TWh | 6.3 | 7.5 | 7.0 | 6.7 | 5.9 | 4.0 | 2.4 | 3.9 | 5.9 | 6.8 | 5.3 | 5.05 |
| Export | TWh | 0.4 | 2.0 | 1.7 | 2.4 | 2.5 | 2.9 | 2.8 | 2.5 | 2.3 | 2.7 | 3.1 | 5.093 |

*Sources: Ministry of Economy 1999a (MH 1999a); Slovenský energetický podnik - (SEP 1990,1991,1992,1993); Investconsulta 1990*

## Forecast of Electricity Consumption

| Year | Total consumption of SR | Year | Total consumption of SR | Year | Total consumption of SR | Year | Total consumption of SR |
|---|---|---|---|---|---|---|---|
| . | . | **2001** | 28 591 | **2006** | 31 554 | **2011** | 34 969 |
| . | . | **2002** | 29 103 | **2007** | 32 210 | **2012** | 35 703 |
| **1998** | 28 268 | **2003** | 29 668 | **2008** | 32 878 | **2013** | 36 436 |
| **1999** | 28 098 | **2004** | 30 284 | **2009** | 33 561 | **2014** | 37 193 |
| **2000** | 28 247 | **2005** | 30 913 | **2010** | 34 258 | **2015** | 37 965 |

*Source: Ministry of Economy 1999a (MH 1999a)*

## Natural Gas Consumption

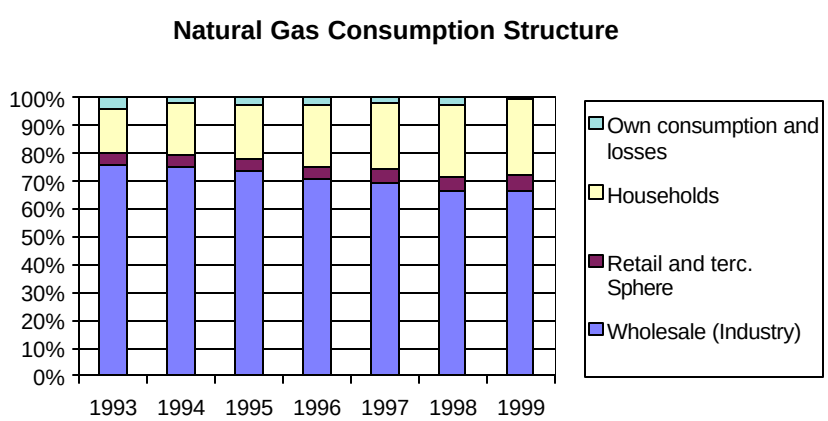
In the period between 1993 and 1999, the total consumption of natural gas grew mostly because of the rising demand in the tertiary sphere, by retail consumers (a 70% increase) and the residential sector, where 1999 consumption doubled when compared to its 1993 levels. On the other hand 1999 natural gas consumption levels of wholesale consumers had dropped, after a rise between 1994 and 1996, to 1993 levels (MH 1999b). In 1999, the demand increased by a further 0.2 Bcm (excluding own consumption and losses). The whole of this growth is attributed to the residential sector (SPP 2000).

Evaluation of natural gas consumption in individual categories of customers (Mcm) is as follows:

## Natural Gas Consumption Structure (Mcm)

| Customer/year | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|
| Wholesale | 4 679.4 | 4 521.8 | 4 761.6 | 4 808.7 | 4 785.6 | 4 679.3 | 4693.4 |
| Retail and terc. sphere | 241.7 | 249.6 | 273.9 | 311.3 | 349.3 | 355.0 | 411.7 |
| Households | 964.7 | 1 119.5 | 1 245.1 | 1 487.9 | 1 643.6 | 1 800.1 | 1929.7 |
| Own consumption and losses | 277.1 | 147.1 | 185.9 | 214.1 | 151.0 | 198.1 | 65.5 |
| **Total consumption** | **6 162.9** | **6 038.0** | **6 466.5** | **6 822.0** | **6 929.4** | **7 032.6** | **7 100.3** |

*Source: Ministry of Economy 1999a, 2000 (MH 1999a, 2000)*



In 1997, the consumption of natural gas represented almost 32% of the primary energy consumed (739 PJ). In recent years, this share has been continually increasing and in 1995 it corresponded to 29.7% of the total.

The projected future development of long-term demand for natural gas will be affected by the decision of the Government regarding the completion or non-completion of units 3 and 4 of NPP Mochovce, the operation of V-1 units of NPP Bohunice and the source of their replacements. Other factors which will influence developments in natural gas demand will be industry revitalization (chemical and metallurgy), a change in the overall social situation of the population and the changes in energy and specifically natural gas prices, which will have a significant impact on any further gasification in communities (territorial gasification).

Due to the slow-down in GDP growth in recent years and the postponement of the construction of new combine cycles power plants, it is expected that the demand for natural gas will decrease until 2010. This fall is predicted to be approximately 8.l5%-12.5% depending on which scenario is recognized (the higher levels will result from an intensive pace of construction of combined cycles, with the lower levels representing a slower pace of construction of combined cycles).

## Prognosis in Natural Gas Demand Development (Mcm)

A/ High scenario

| **Customer/year** | ***Reality*** | | ***Plan*** | | ***Prognosis*** | |
|---|---|---|---|---|---|---|
| | **1999** | **1999** | **2000** | **2005** | **2010** | **2015** |
| Wholesale | 4693.4 | 4 727.2 | 4 800 | 5 850 | 6 550 | 6 850 |
| Retail and tertiary sphere | 411.7 | 353.5 | 390 | 470 | 520 | 570 |
| Households | 1929.7 | 1 851.5 | 2 030 | 2 480 | 2730 | 2 880 |
| Own consumption and losses | 65.5 | 238.3 | 200 | 200 | 200 | 200 |
| **Total demand** | **7 100.3** | **7 170.5** | **7 420** | **9 000** | **10 000** | **10 500** |

B/ Low scenario

| **Customer/year** | ***Reality*** | | ***Plan*** | | ***Prognosis*** | |
|---|---|---|---|---|---|---|
| | **1999** | **1999** | **2000** | **2005** | **2010** | **2015** |
| Wholesale | 4693.4 | 4 727.2 | 4 800 | 4 900 | 5 550 | 5 850 |
| Retail and tertiary sphere | 411.7 | 353.5 | 390 | 470 | 520 | 570 |
| Households | 1929.7 | 1 851.5 | 2 030 | 2 480 | 2 730 | 2 880 |
| Own consumption and losses | 65.5 | 238.3 | 200 | 200 | 200 | 200 |
| **Total demand** | **7 100.3** | **7 170.5** | **7 420** | **8 050** | **9 000** | **9 500** |

*Source: Ministry of Economy 1999a (MH 1999a)*

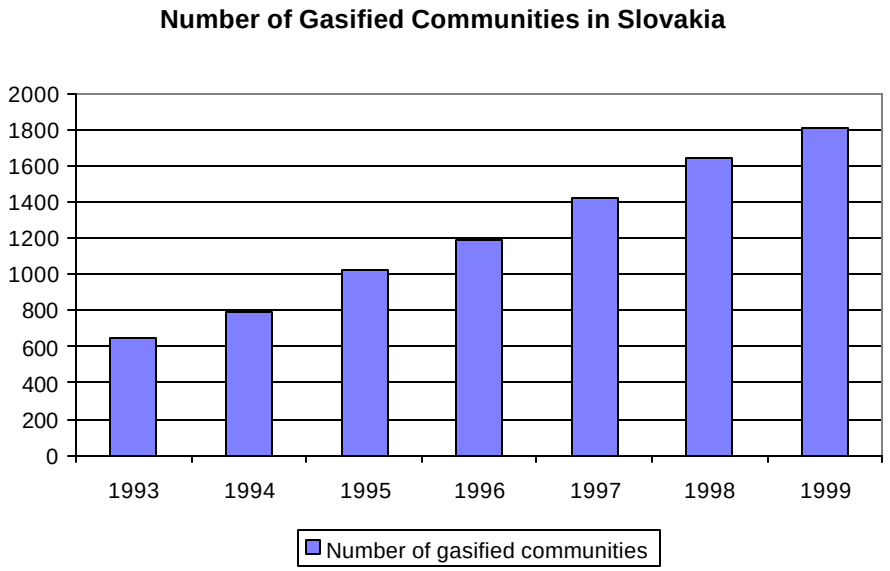
As of 31st December 1999, 90% of the population were connected to the gas network, representing 63% of the communities in Slovakia (1804 out of 2867 communities or settlements were connected to gas distribution network, in 1999 alone 165 communities were connected to the gas network. After the Netherlands, Slovakia has the second densest gas distribution network in Europe.

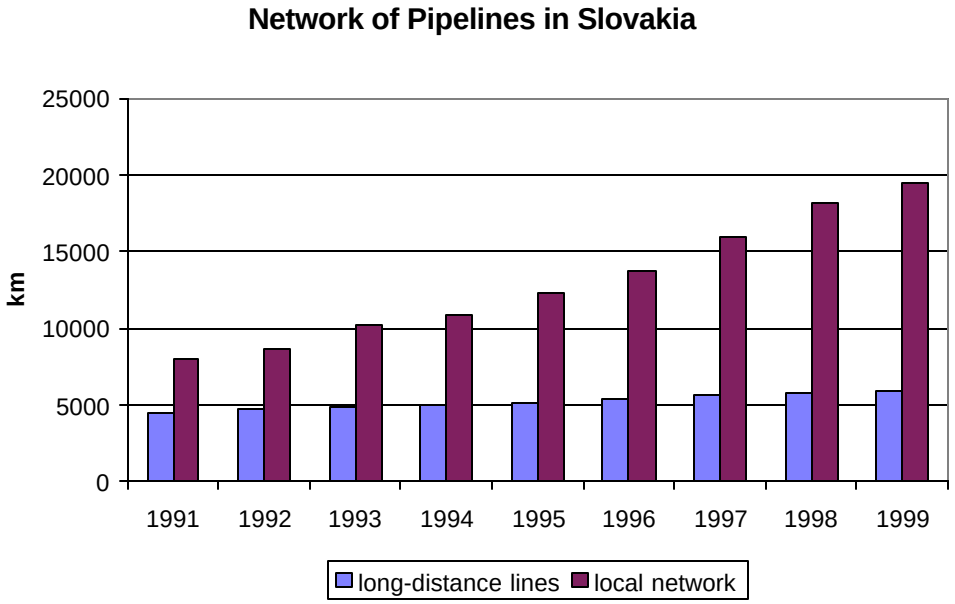
## Development in Gasification

| | | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** | **1999** |
|---|---|---|---|---|---|---|---|---|
| Number of gasified communities | Unit | 651 | 790 | 1023 | 1193 | 1419 | 1678 | 1804 |
| Number of customers – residential | Thousand | 951 | 996 | 1044 | 1100 | 1164 | 1218 | 1256 |
| Number of customers – commercial | Thousand | 33.4 | 35.4 | 37.3 | 39.7 | 44.4 | 47.7 | 49.9 |

*Source: Ministry of Economy 1999a (MH 1999a). SPP 2000*

At the end of 1999, the length of operated inland gas networks was 25,404 km, of which 5,883 km were long-distance networks and 19,521 km (SPP 2000) were part of the distribution network.




Currently, the sale prices of natural gas for retail customers does not cover the supply or import costs. In its gas pricing at the customer level the Ministry of Finance refused to reflect the rapid 1999 global market increase in prices of gas from Russia (related to the increase of crude oil prices). As a result, the profit of SPP decreased from 9.37 bil. SK (218 mil EUR) in the first half of 1999 to 5.77 bil. SK (134 mil. EUR) in the first half of 2000. The sale of natural gas in Slovakia is done at a loss for SPP and is therefore subsidized by he profits from gas transit.

## Transit and Storage of Natural Gas

After Ukraine, Slovakia is the second largest natural gas transit country in the world. The transmission gas pipeline of the Slovak Republic is part of the international gas network. The main route of the transit gas pipeline has four lines, including branches to the Czech Republic. Currently, a fifth line is being constructed, and 255 km has already been completed. In total, these pipelines amount to 2,268 km of transit networks. In 1998, the transit gas-pipeline on the territory of Slovakia transported 84.1 Bcm of natural gas from the countries of the former Soviet Union (SPP 2000). In 1999, this figure rose to 88.3 Bcm. This represents approximately 80% of Russia's total gas exports to CEE countries and 25% of the total gas transported to Western Europe. The capacity of the transit gas-pipeline is currently being expanded by constructing a 5$^{th}$ line (340 km of new pipeline) and through upgrades of the existing compressor stations, so that in 2000 90-92 Bcm of natural gas can be transported.

As a result of their connection to this international transit gas-pipeline, the underground storage tanks in Láb are filled, with a capacity of 2.1 Bcm SPP leases the remaining 1.3 Bcm capacity to foreign companies. The gas from the storage facilities is pumped into the SPP owned pipeline system. These storage tanks can currently cover around 20% of demand. Their potential capacity has been estimated at 6.8 Bcm (MH 1995). Great importance is attached to the expansion of the existing storage facilities for natural gas, in order to cover 22% of the total demand per year. Their volume should more than double after the construction of new underground storage tanks in Láb and Jakubov in 2010, thereby achieving a capacity of over 4 Bcm. As it is expected that 2.2 Bcm will be needed by 2010 there will be an excess of 1.7 Bcm. In 2007, the construction of an underground gas storage facility in Serer is set to begin. In order to integrate with the European gas system, it will be necessary to make a physical interconnection of gas-pipelines with enough capacity to supply gas to Austria and Czech Republic.

**Development of Storage Capacities Potential in Slovakia (in Mcm)**

| **Project/year** | **1999** | **2005** | **2008** |
|---|---|---|---|
| Láb I.-III. | 1750 | 1900 | 1940 |
| Gajary – báden | 150 | 400 | 500 |
| Láb V. | . | 500 | 700 |
| Pozagas | 480 | 780 | 780 |
| **Total capacity** | **2380** | **3580** | **3920** |

*Source: Ministry of Economy 1999a (MH 1999a)*

Slovakia is almost 100% dependent on gas imports from Russia. The associated security of supply risk is mitigated by the size and importance of Slovakia in the transit of Russian gas to Western Europe.

Natural gas supplies are currently covered by several long-term contracts. In April 1997, SPP and Gazprom signed a long-term contract that covers the supply of gas until 2008. The major part of supply is covered by transit services for Gazexport Moskva and the rest of import is paid in USD. Any gas needed in excess of the amount contracted for would be supplied according to a short term contract that SPP has also signed with Slovrusgas Bratislava (a joint company of SPP and Gazprom) in which 40% of supply will be covered through the export of Slovakian commodities. According to this contract, it is predicted that 350 Mcm will be imported in 2000.

**Volume of Gas Supply Contracted from Russian Federation for the Years 2000 – 2005**

| Year | **2000** | **2001** | **2002** | **2003** | **2004** | **2005** |
|---|---|---|---|---|---|---|
| Volume (Bcm) | 7.7 | 7.7 | 7.7 | 7.8 | 7.9 | 8.0 |

*Source: Ministry of Economy 2000 (MH 2000)*

When looking to reduce Slovakia's dependency on imported gas from a single source it would be desirable to seek other sources or other transport routes. Higher energy security will inevitably require increased costs and each new import route will cause an increase in gas prices. Gas storage facilities currently cover more than 100 days of annual gas consumption. The government strategy, with regard to security of supply, is to secure 5-20% of gas supplies from diversified sources sometime between 2005 and 2007. Realistic considerations for alternate suppliers are Norway and the Netherlands. With such a diversification of supplies, the decisive factor will be efficiency and competitive pricing as compared to the import price from the existing gas suppliers in Russia.

In securing a diversification of gas supplies to the Central European market, the potential cooperation of CE countries (Poland, Czech Republic, Hungary and Slovakia) is also significant. Currently, negotiations are in train relating to the potential construction of a gas pipeline from the Polish border. The Russian exporter Gazprom itself is trying to diversify transit routes, and has been pressing Poland and Slovakia to join in the construction of a new route for the Yamal – Europe transit gas pipeline, which would travel via Belarus and thus avoid Ukraine. Other projects of diversification of supplies are: Adria LNG, Iran Gas Europe and Inter-connector.

## Organizational Structure of the Gas Industry

The Slovak Gas Industry (SPP) is state owned and has a monopoly on transport and distribution. This company is responsible for the purchase and sale of natural gas and for its transit through the Slovak Republic. It also manages high-pressure inland transfers and is responsible for the wholesale and retail distribution of natural gas. SPP operates the high-pressure pipeline system and the local distribution network. This year (2000), SPP has acquired a majority stake in Nafta Gbely, a company that owns the strategically important underground gas storage facilities. While operating the strategic underground gas storage tanks, SPP also cooperates with Pozagas. a.s. Malacky, in which it has a majority stake. The companies belonging to the Nafta. a.s. group also extract local crude oil, gasoline and natural gas in Slovakia (MH 1999b).

From an organizational perspective, SPP is currently made up of 11 subsidiaries who are responsible for the gradual gasification of individual regions and for the sale of gas in these regions. The basis for this organizational structure orginated from a 1999 division that split the company into four divisions, each securing one of the fundamental activities of the company – transit, inland transportation and distribution of natural gas, investment activity and economics, financing and trade.

SPP was originally established for gas distribution. After the division of the Czechoslovak Federation, the Slovak part of the existing company transit gas pipeline, Praha, was integrated into SPP as a separate division, Slovtransgaz (STG).

SPP owns stakes in several companies in Slovakia that deal with the construction of combined cycle power plants, the utilization of natural gas and geothermal energy. SPP also has capital participation in several Czech gas distribution companies. In accordance with Governmental energy policy, the goal of the SPP is to further develop its entrepreneurial activities abroad and its plans to establish the European gas centre in Slovakia (MH 1999b).

These plans may be strongly affected by the planned privatization of 49% of SPP in the coming years. The state has to retain a majority share (51%) in energy companies. To date, several companies have expressed interest in SPP, including Gaz de France, German Ruhrgas and SNAM from Italy, as well as by other, non-European, companies. All deals on privatization are scheduled to be completed during the first half of 2001.

## Environmental Aspects of Natural Gas Consumption

In the Government's energy policy and their projections for the next several years, natural gas is considered as a key source of energy in Slovakia. Its role in electricity production should grow, as new power plants will be based on natural gas. It is expected that the major part of any increase in electricity consumption will be covered by production from independent producers (mainly based on efficient combined cycle power plants and combined heat and power). Their share of electricity production could be increased from 13% to 23% in 2010.

Heat supply represents an important part of the Slovakian energy sector. District heating has become the dominant method of heat supply in Slovakia. Almost 100% of the heat used in apartments, which represent approximately 49% of households in Slovakia, is supplied by heat from district heating. It is expected that the strong role of natural gas in heat supply will continue to grow. The fuel base of district heating plants is comprised of 71.3% natural gas, 16.4% coal, 6.7% fuel oil and 5.6% from other sources. Currently, district heating (DH) covers 38% of total heat supply for households in the service and household sector.

The possibility of using combined heat and power production is an important advantage of district heating. The most significant barrier to a wider implementation of CHP is the distortion of natural gas prices (thus providing an advantage to the construction of individual gas boilers versus district heating and CHP plants). Under market conditions, district heating and CHP are clearly the most efficient, presenting the lowest prices for consumers.

In 1998, more than 30 small co-generation units were in operation in Slovakia, with a total electric capacity of more than 16.9 MW, thereby producing approximately 59.15 GWh (or 0.24% of total annual electricity consumption). 70% of the electricity produced has been used to cover the producer's own consumption and the rest has been supplied to the grid. By 2010 it is assumed that there will 320 MW in the house and 480 MW of CHP (MH 199b)

According to Slovakia's official energy policy, the implementation of measures for the reduction of emissions and of basic pollutants will lead to a higher utilization of natural gas. The pre-condition for the fulfillment of Slovakia's commitment to the Kyoto Protocol is that the average annual value of $CO_2$ emissions from combustion and energy conversion of fossil fuels in the period between 2008 and 2012 will not exceed 51.066 million tons in absolute volume. As demonstrated by the analysis of empirical data, it is mostly the shift of energy sources to natural gas-fired boilers that has enabled a stabilization in the generation of $CO_2$ in the area of combustion and energy conversion of fossil fuels. According to preliminary data for the year 1998, there has been a fall in the use of primary energy resources and a concurrent drop in the generated volume of $CO_2$ to a level equal to 73% of the pre-set reduced limit. This drop can be explained primarily through a decline in the

consumption of brown coal and coke and by an increased consumption of natural gas and of primary nuclear heat (with respect to the commissioning of the 1st block of the Mochovce nuclear power plant). This implies that the largest share of $CO_2$ emissions originates from the end use of energy in industrial processing technologies. The potential for the reduction of emissions is represented mainly by the restructuring of the industrial base to increase the manufacturing sector of the country's economy. The program for the utilization of natural gas automotive fuel should be also adopted (MH 1999b).

The energy policy includes an ambitious program for energy saving and renewables. Two scenarios suppose the increase of electricity generation from renewables, by 2010, to be 63% and 133% of existing energy supply and that heat energy generation should double and respectively triple when compared to 1997 levels. The estimated investment costs are 46.6 (1.1 billion EUR) and 98.3 billion SKK (2.3 billion EUR) respectively. Currently, only 3.33% of the total consumption of primary energy resources are covered by renewables. A long-term goal in the area of the use of renewable energy sources is to attain a higher level. This is comparable to the level of attainment in the majority of EU countries. To achieve this goal it is, above all, necessary to raise fuel and energy prices to create a suitable legislative economic and financial framework and to introduce systematic measures for the support of entrepreneurial activities in renewable energy sources (MH 1999b).

There are no adequate legislative, economic and fiscal instruments in the SR to influence the efficient consumption of energy and for the reduction of the energy intensity of the national economy. The funds allocated in the state budget for the support of rational energy use are only symbolic.

The strong position of natural gas in the fuel mix and the gas industry in the economy of Slovakia may have a negative influence on the introduction of renewable sources and energy saving programs (especially if the prices of natural gas are not be set on a realistic level).

### Effect of the EU Membership on the Slovak Gas Industry

The Slovakian gas transit system is an integral part of the European gas network. Due to its geographical location, natural conditions, and its historical development, Slovakia has become an important European natural gas centre.

Accession into the European Union is dependent on several measures. It requires a restructuring of the energy sector, a new principle of regulation in the energy sector, and a price adjustment, liberalization and opening of the market. The main objective of the government, in preparing to integrate into the European internal market, is the transformation of the energy sector into a competitive sector of the economy that is able and prepared to join the European single market.

According to the official energy policy of Slovakia, the energy sector should be fully compatible and competitive with European energy markets by 2003. According to the current transformation process in the energy sector, this deadline appears very optimistic.

Effective transformation will depend on the fulfillment of four important issues: the restructuring and privatization of energy companies, the establishment of an independent regulatory body, the setting of energy prices on a real level for all consumer categories and the completion of an energy legislative framework.

The energy sector is a monopoly in the electricity and gas sectors. The situation in the gas sector results in a scenario that sees the development of the distribution network being financed from

sources obtained from gas transit. Therefore, it is necessary to unbundle production, transit and distribution. From the point of view of preparation for the EU internal market it is unacceptable to shift the profit or losses between individual basic activities (MH 1999b).

According to the Government, in the gas sector, household prices do not cover the costs of development of the gas supply network and therefore it is suitable to keep the SPP in its current vertically integrated structure. It is necessary to unbundle management and accounting for distribution and transit, as well as other activities. Thus, the required transparency will be achieved and the conditions that require the unbundling of management and accounting of individual activities will be met.

The establishment of an independent regulatory body is a key part of energy sector restructuring. This body would concentrate the current competencies of the Ministry of Finance in price regulation and the Ministry of Economy in issuing licenses and permits on new production capacities and energy facilities. This new regulatory body is expected to start on 1.1.2001.

Therefore, in order for rational market operation, it is necessary to remove as soon as possible, in a socially acceptable way (with possible compensation for low-income households), all types of subsidies to energy prices (including cross-subsidies). Furthermore, it is necessary to co-ordinate this process of price adjustment with an adjustment of the tariff structure so as to ensure that each consumer will pay costs generated by their consumption. For this purpose, the so-called time schedule of adjustment to prices has been prepared

The following table shows the minimum price increases needed to achieve the covering of costs and adequate profit for energy suppliers. Inflation is not included in the figures representing the process of price adjustment in the table and, as a result, these figures will have to be continuously evaluated with regard to the input prices. Beginning in 2000, an independent regulatory body will perform this work. The establishment of this body will require a change in the current legislative framework of the energy sector (MH 1999b).

**Plan of the Energy Price Increases According to the Energy Strategy**

| Year | | 2000 increase in [%] without inflation | 2001 increase in [%] without inflation | 2002 increase in [%] without inflation |
|---|---|---|---|---|
| Electricity | Households | 40 | 20 | 10 |
| | Industry | 10 | 10 | 10 |
| Natural Gas | Households | 30 | 15 | 9 |
| | Industry | 10 | 10 | 6 |
| Heat | Households | 25 | - | - |

*Source: Ministry of Economy 1999b (MH 1999b)*

The Ministry of Economy prepared for the Ministry of Finances, on 30 March 2000, the document “Proposal on adjustment of consumer categories and tariffs in gas and electricity sector”. This differentiated consumer categories and tariffs so as to reflect the share of actual costs for individual groups of consumers and the purpose of energy use in a more objective way. At the same time, it will have an influence on efficient energy use. The Ministry of Finances has not yet released this proposal.

The approximation of the EU's energy legislation is one of the key objectives in the Slovak Republic's preparation to accede into the European Union. In 1998, the basic energy legislation was adopted (i.e. Energy Act No.70/1998 and Act No.130/1998 on peaceful utilization of nuclear energy). It will also be necessary to adopt an Act on natural monopolies regulation, an energy efficiency act and to update the existing Energy Act.

## Conclusions

For both sides, the entry of Slovakia into the EU will be a significant step from a utilization of natural gas and gas industry perspective. In the near future, the country will secure most of the natural gas transit from Russia into the EU countries and will become a part of the EU structure. However, this will increase the dependency of the EU on gas imports from Russia by virtue of gas demand in Slovakia.

An inevitable condition for a successful integration of Slovakia into the EU is a broader interconnection of its energy infrastructures, including gas pipelines, to sources and markets in the current EU member states. In addition, Slovakia needs to diversify its gas supplies and liberalise its internal energy market opening according to the EU Directives. Besides entities from the EU countries (Gaz de France. Ruhrgas. SNAM), Gazprom is also interested in entering the Slovakian market and gaining control over the gas transit routes on the Slovak territory.

The transformation of the gas industry and the entire energy sector in Slovakia is inevitable. Its success will depend on the fulfillment of four important issues: the restructuring and privatization of energy companies (SPP and SE. a.s.), the establishment of an independent regulatory body, the setting of energy prices on a real level for all consumer categories and the completion of energy legislative framework. These goals are also included in official Energy policy.

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# The European Union

Natural Gas is currently the fuel of choice for new build power stations within the European Union. Over the past two decades, its use has increased by around 4% per year and this trend is predicted to continue for some time. Whether this predicted increase comes to fruition will depend on a number of factors. One of the most important factors, which will reflect upon the extent of the use of natural gas, is the impact of the Gas Market Directive. The Directive 98/30/EC concerning common rules for the internal market for natural gas was initially agreed to in 1998 but national transposition of the Directive was only due in August 2000.

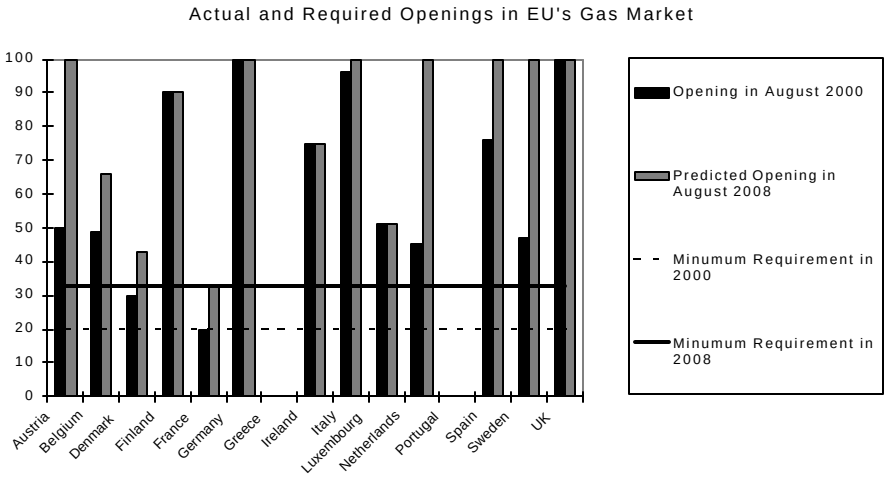
Although the deadline for the transposition of the Gas Market Directive has only just passed, there are already plans to alter its market opening timetable. Experience with a similar Directive for the electricity market has shown that companies and Member States are often keen to move faster than the minimum time limits required by the Directive. Approximately 65% of the current electricity market is open to competition, rather than the 28% required. Given this situation, the European Commission informally proposed at the Lisbon EU summit in March 2000 that full market opening for both the gas and electricity sectors should occur by 2005. This was rejected by some Member States and instead a further discussion on the liberalisation of energy markets will take place at the March EU Summit in Stockholm in 2001 when a revised and accelerated schedule is likely to be approved.

## Gas Market Directive

The Gas Market Directive, as with Electricity Market Directives, requires the restructuring of the gas industry and changes in regulatory and operational practices. The main requirements of the Directive are: -

### Market Opening

The Directive requires that, at the least, all gas fired power station generators, irrespective of their annual consumption, and all other final customers who consume more than 25 Mcm of gas per year must initially be eligible to choose their gas supplier, as of August 2000. This is merely the initial requirement and, over time, the threshold for choosing the gas supplier is scheduled to reduce. By 2003 the threshold level for choosing a gas supplier will be 15 million cubic metres and by 2008, 5 Mcm. However, as stressed, this is the minimum requirement and countries are free to accelerate their market opening, as many have done or intend to do. The graph below shows the extent of the accelerated market opening. The European Commission already believe that, by its formal deadline for implementation, the Directive will already have encouraged up to 78% of the Gas market (by volume and not by customer numbers) to be open to competition, rather than the minimum requirement of 20% delineated in the Directive.




*Source: European Commission 2000*[22]

**System Access**

The Directive allows Member States to choose between different systems through which to access the gas system. Member states are allowed to choose either negotiated or regulated access, or a combination of both. It is interesting to note that there is not a third access model, as allowed under the Electricity Market Directive of Single Buyer. Currently, it appears likely that no country will adopt a purely negotiated access, but rather there will be tendency for fully or partial regulated accession.

**Unbundling**

One of the key points for the development of a single European electricity market is the unbundling of the different parts of the gas industry, in particular the separation of supply from transmission. The Directive does not require the legal separation of these functions, but Member States must at least ensure that there is separation within companies of these departments. A number of countries, Belgium, Denmark, Germany, Finland and France all require only this minimum opening.

**Access to Storage**

To ensure the smooth running of a Gas system, there is an essential need for access to storage systems. The Gas Directive provides for access to storage in cases where it is technically necessary for an efficient access to the system.

**Reciprocity**

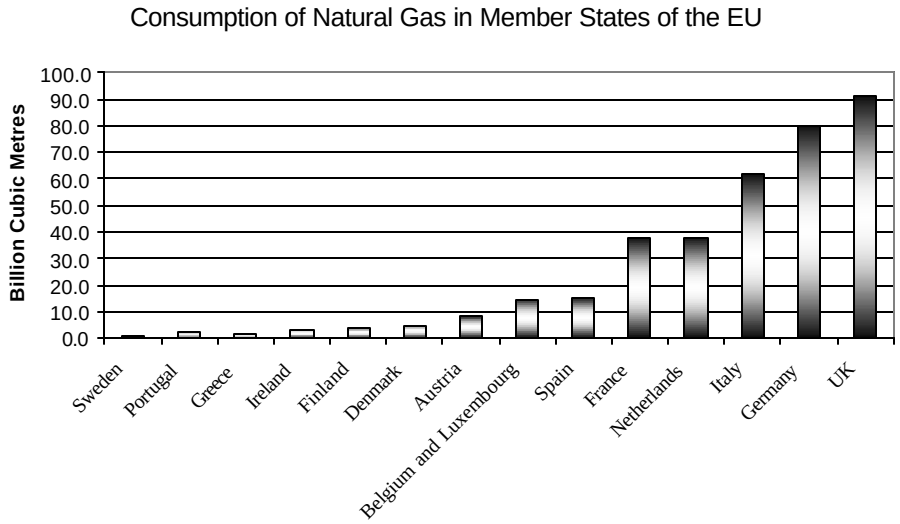
The majority of States (Austria, Belgium, Denmark, Germany, Ireland, Luxembourg, Netherlands, Spain and Sweden) have, or are likely to introduce, reciprocity clauses in their legislation. These clauses would allow Member States to refuse access for utilities from other countries to their own markets if there is not similar levels of market opening or environmental standards in the exporting country.

## Past and Current Use of Natural Gas in EU

The use of Natural gas is increasing within the EU both as a means to generate electricity and for direct heating. The graph below shows the variations in the amount of gas used that exist between Member States. As this shows, there are still a number of countries (Sweden, Portugal and Greece) which hardly use any gas, while others (the UK, Germany and France) consume

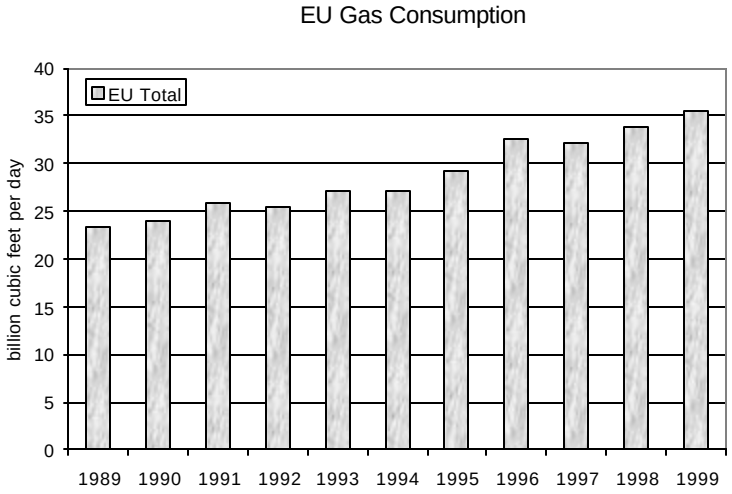
[22] State of implementation of the EU Gas Directive (98/30/EC) An Overview, State of Play by the end of May 2000, Prepared by Directorate General for Energy and Transport, European Commission.

large amounts.




*Source: BP Statistical Review 2000*

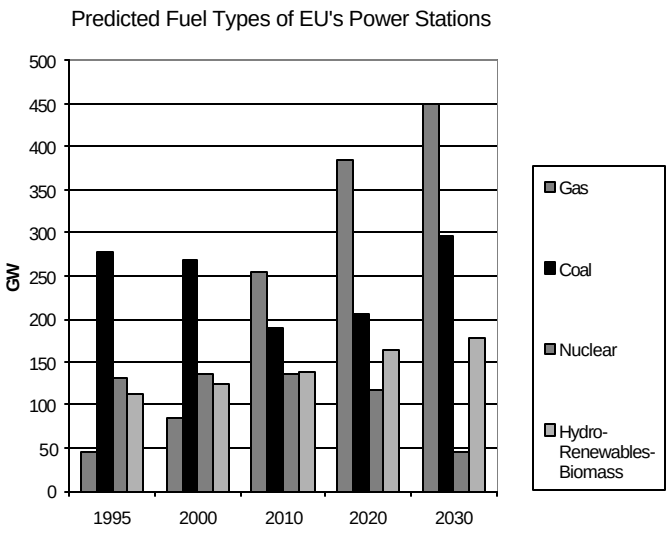
As has been mentioned, over the past few decades there has been a growing use of gas within the EU, in particular for the power sector. However, this growth has not been restricted solely to the EU, and is also occurring in North America, Asia and CEE. The graph below shows the past growth in the EU.




*Source: BP Statistical Review 2000*

## Future Use of Gas

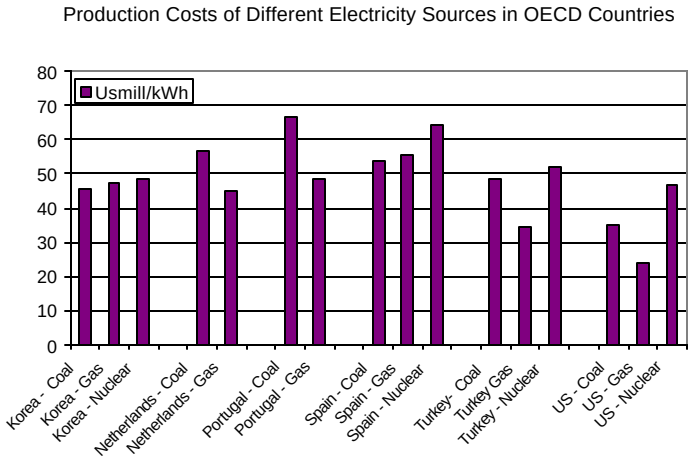
All current indicators suggest that the use of natural gas will continue and eventually become the dominant fuel within the EU. Analysis undertaken for the European Commission suggests that its installed capacity will increase from 45 GW in 1995 to a staggering 450 GW in 2030, a ten fold increase. Gas power stations will be used to meet new demands and to replace coal and nuclear power plants as they are closed down or phased out, as can be seen in the graph below.




Over this period, gas's contribution to primary energy consumption in the EU is predicted to increase from 20% in 1995 to 27% in 2020.

## Reasons for Dominance of Gas

The main area of increased use of gas is in the power sector. Gas fired power stations are being used to replace coal and to some extent nuclear power stations as they close, and to take up the shortfall as power demand increases. At current prices for fuel, gas can produce cheaper electricity than its main competitors, coal and nuclear based electricity generation. Research published by the International Energy Agency in 1999 confirms this, as can be seen in the graph below.




*Source: International Energy Agency 1999*[23]

An interesting study conducted by the French Ministry of Interior, who are not conventionally noted as opponents of nuclear energy, suggested that, at an intermediate load, gas is highly

[23] Projected Costs of Generating Electricity - Update 1998 – International Energy Agency, *ISBN* 92-64-16162-7, October 1998, figure 9b

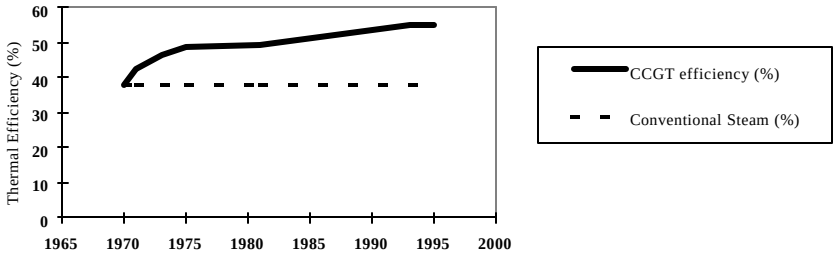
economically competitive when compared to other conventional sources. Electricity from CHP plants cost 25-30 centimes per kWh while power generated from CCGT costs 26-37 centimes per kWh, and nuclear generation costs are 36-37 centimes per kWh. Further analysis undertaken by Cogen Europe, a lobby group representing over 70 European energy companies, estimates that electricity generated by a 75 MW industrial CHP plant costs 0.027 euro/kWh, a 250 MW CCGT costs 0.034 euro/kWh while a 500 MW coal plant produces electricity at 0.044 euro/kWh. However, the final cost price of the electricity is not the only factor in consideration. Gas's other main advantages over other sources are: -

**Construction Costs and Times:** Gas fired power stations, in particular the modern, modular Combined Cycle Gas Turbines (CCGT), have much lower construction costs than other conventional power stations, around 50% less than other fuels. Similarly, the construction times are also much less when compared to the approximately two years it takes to construct Gas fired power stations and at least double this for other sources. In the current market environment of the power sector, these differences are of fundamental importance when investors are making decisions on what energy source to choose. Gas power stations will require lower upfront investments and give a far quicker return on the investment.

**Environmental:** The coal burned in the UK has a carbon value of approximately 0.85 kg of $CO_2$ per kWh, however the same value for Gas is around 0.49 kg of $CO_2$ per kWh. Modern CCGT power stations are far more efficient at converting the heat generated into electricity. The current CCGTs being produced have efficiencies of around 57%, which is continually increasing, compared to the efficiency of modern coal stations that rests only around 38%.

Therefore a gas station has two advantages in that it uses less carbon intensive fuels and it uses them more efficiently. The result is that the CCGT produces only 38% of the $CO_2$ of a coal plant per unit of electricity - a ratio of 2.5:1. The European Union agreed to lower its $CO_2$ emissions within the Framework of the Kyoto Protocol on limiting human impact on the World's climate. As a first step, the EU must reduce its total emissions 8% from 1990 levels by 2010. Many see the lower $CO_2$ emissions from Gas stations as an important step in reaching this target.

A gas station will also produce much less $NO_X$, $SO_2$ and particulates than most coal stations. Finally, the environmental impact of gas stations is gradually decreasing as they become more efficient, and thus more economical. The relatively large number of gas stations being ordered and built, when compared to coal stations, means that more research and development funds can be used to increase the efficiency of gas stations and thus their overall negative environmental impact will decline. This can be seen in the graph below which shows the gradual improvement in gas station efficiency when compared to coal's static efficiency levels.




*Source: Dr Jim Watson, Sussex University*

## Energy Prices

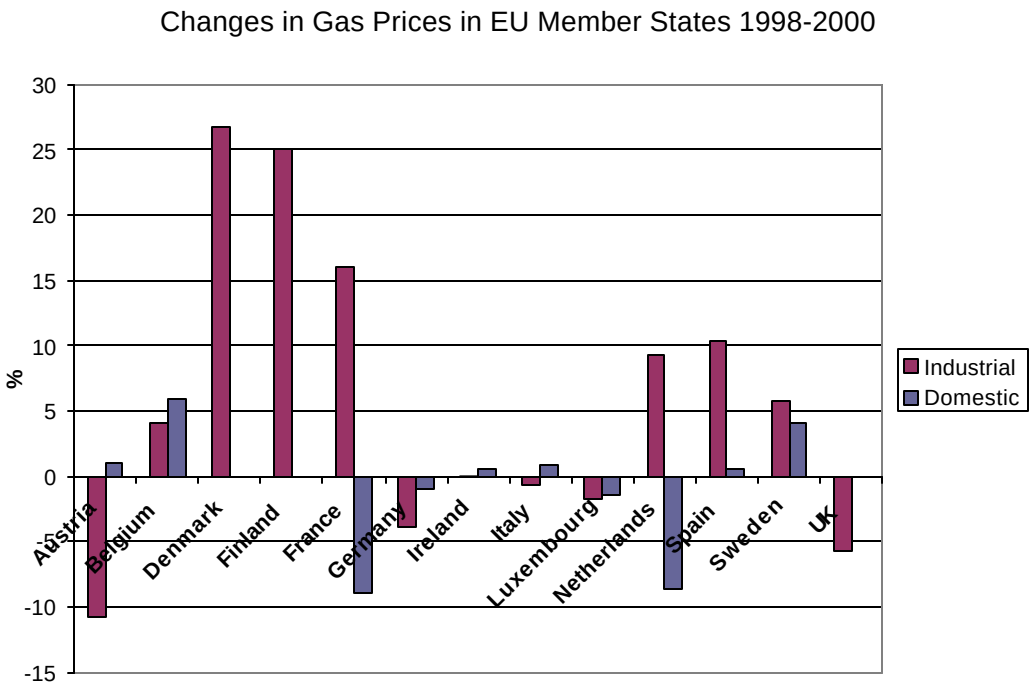
The liberalisation of Europe's electricity market began much earlier than in the gas sector. The EU's Electricity Market Directive was supposed to have been implemented into national legislation

by Member States by February 1999. In almost all cases this occurred, as only France and Luxembourg had failed to meet this deadline (although both have now, at least in part, done so).

One of the most notable consequences of the liberalisation process is the general reduction in the price of electricity. The European Commission has estimated that there has been an average 6% decrease in prices over the last three years. However, as can be seen, the reductions have not occurred uniformly, with some falling by up to 20% in this period and others increasing.

Over largely the same period (1998-2000) gas prices across Europe have fluctuated more widely and in recent months have risen considerably. The greater variations can be attributed to the very early stages of the liberalisation process and the impact of the increasing price of oil, to which gas is still rather strangely linked. Attempts are now being made to reduce these links. For instance, Germany's utilities, such as Wintershall and Gasag have been, in recent months, proposing to peg the price of gas to the electricity price as both a recognition of their connections and to increase stability.

In Denmark during the same time-period, industrial consumers had a 25% increase in prices, while in Finland the increase varied between 16-25%. Strong industrial consumer price increases were also seen in France and Ireland however, in Austria, prices fell. Domestic consumers fared much better during this period, with price drops recorded in France, Netherlands, Germany and the UK, but in Belgium and Sweden there was an overall increase. The graph below demonstrates these variations.

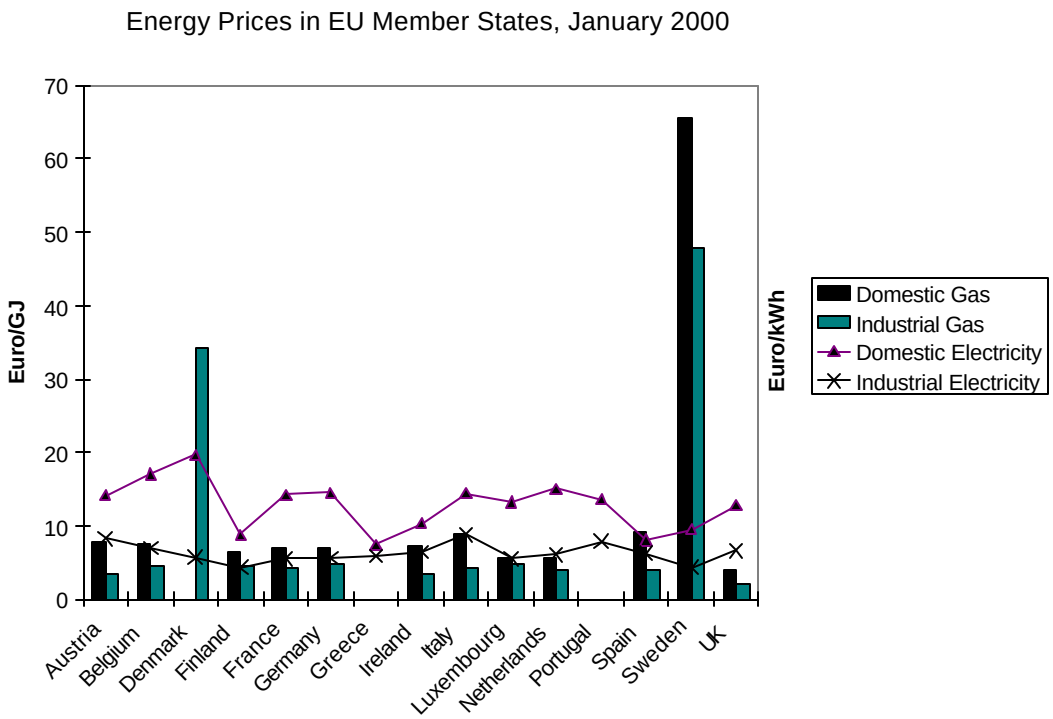



*Source: Eurostat 2000*[24]

The graph below looks at electricity and gas prices across the EU. The most notable difference between the two sectors is the much larger variations in gas prices. Particularly in Finland and Sweden, domestic and industrial gas prices are significantly higher than in the rest of the EU, and are ten times higher than those of the other countries. Such regional variations are not seen

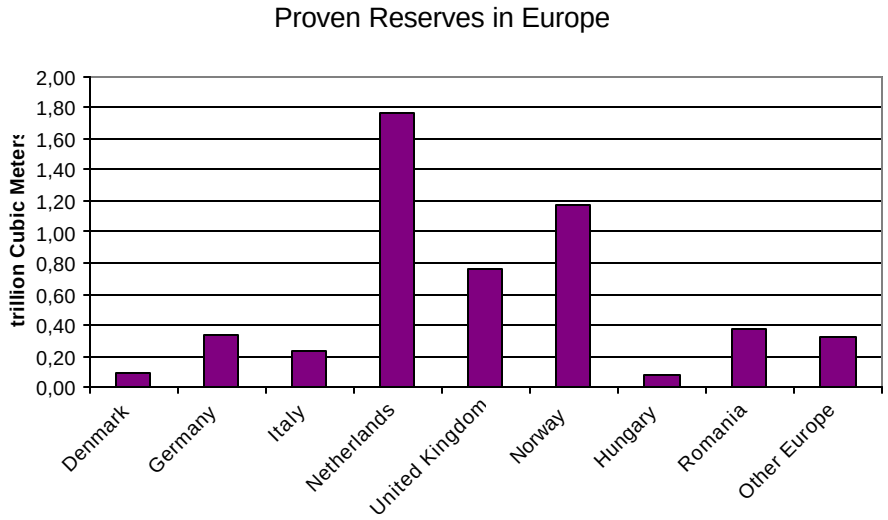
[24] Eurostat, Statistics in Focus, Environment and Energy, No 8 "Gas Prices for EU Industry on 1st January 2000: strong upward trend", and no 7 "Gas Prices for EU households on 1st January 2000: upward Trend". July 2000.

within the power sector.



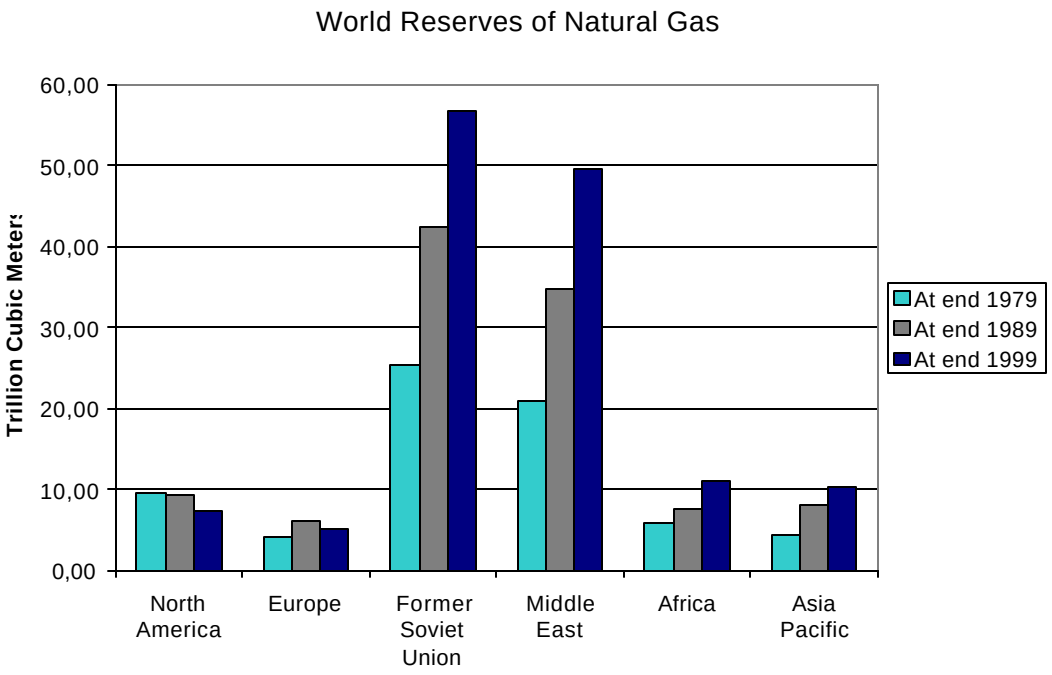

## Gas Sources

There are a number of countries within the EU that have access to considerable reserves of gas. The most significant are Netherlands and the UK, whose combined reserves are about three times larger than all other reserves in the EU. The graph below shows the extent of these and other non-EU European reserves.

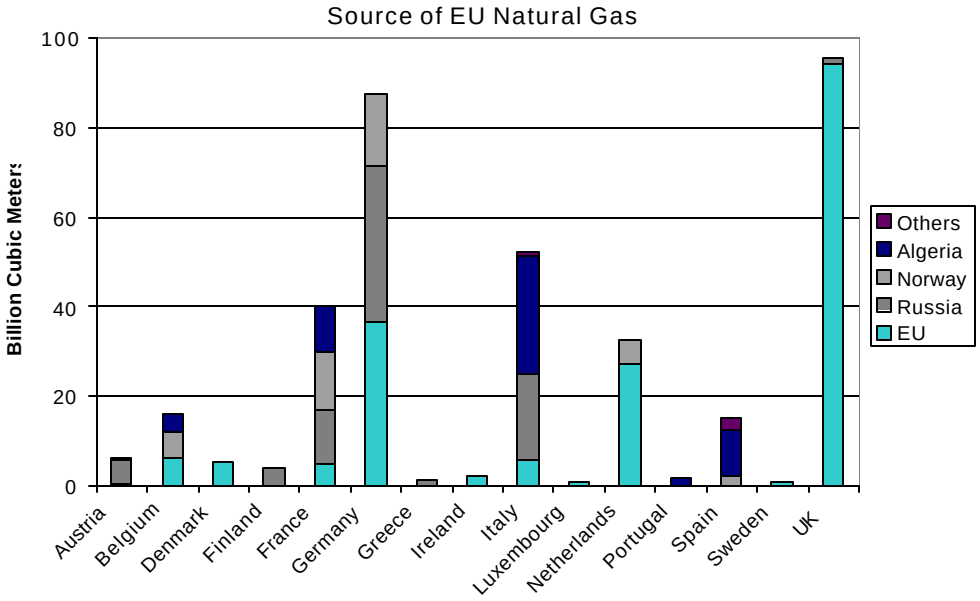



*Source: BP Statistical Review 1999*

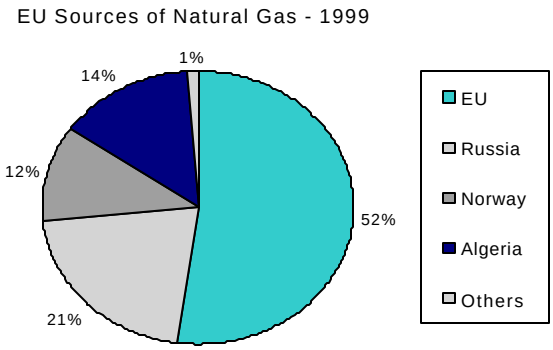
Although it is clear that Europe does have considerable gas reserves, they are relatively small when compared to world totals. The graph below demonstrates both the true extent of world reserves and how continual exploration is resulting in upward revisions of the total estimated reserves.




Europe remains the main source of gas for EU Member States. The graph below show the sources of gas for individual Member States and the major suppliers of gas to the EU as a whole.




*Source: BP Statistical Review 2000*



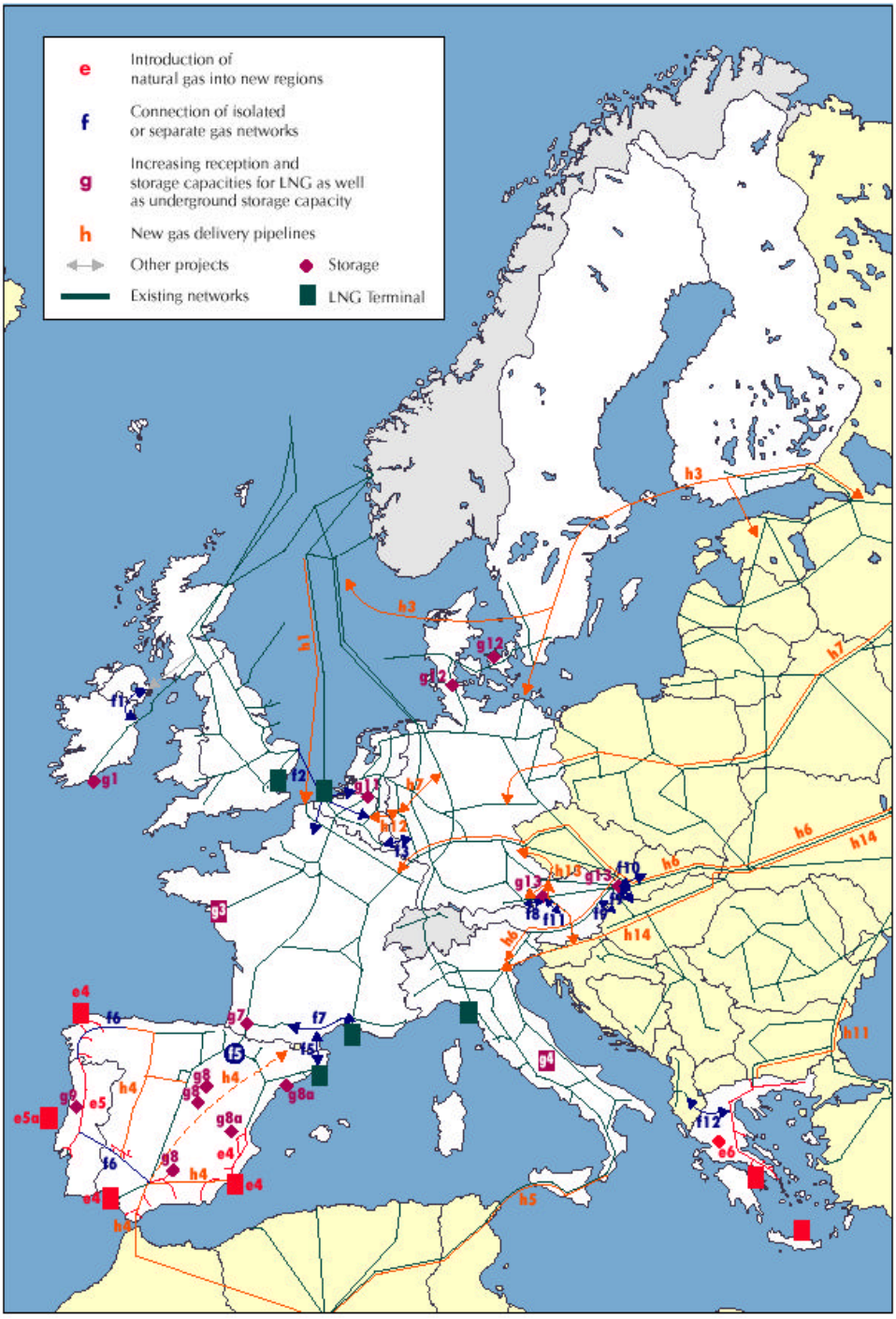

## TransEuropean Networks

In order to increase the diversity of gas supplies, the European Commission, through the Trans-European Networks (TENs) program, is helping to fund the further development of a Europe wide gas network. The map below, published by the European Commission in 1997[25], shows both the extent of the existing networks and the plans for the expansion of the pipelines.

[25] Trans-European Energy Networks, Policy and Actions of The European Community, Directorate General for Energy (DG XVII), September 1997

TRANS-EUROPEAN ENERGY NETWORKS: POLICY AND ACTIONS OF THE EC

## NATURAL GAS NETWORKS: GENERAL MAP



# Russia and Gazprom

Russia has over 56% of the world's proven gas reserves, conservatively put at over 50 Trillion cubic meters (Tcm). This is enough to supply total European demand for at least 30 years. Gazprom, the state gas company which controls Russia's entire gas supply network, sells gas to Europe through its subsidiary, Gas-export and provided 126.8 Bcm in 1999, a 5% increase on the 1998 figure. Exports are predicted to increase by some 10% a year, virtually doubling by 2010, with 240 Bcm a year the highest quoted overall estimate.

Historically, the gas consumed in the states of Central and Eastern Europe has originated from Russia. However, since 1998, that monopoly has been challenged in a number of ways. Firstly, Norway aims to increase its sales of gas into Europe as a whole. The Czech Republic has imported Norwegian gas, transited through Germany, for the past two years. The gas transited through Poland, Hungary, Slovenia, the Slovak and the Czech Republics brings valuable tariff income to the major gas players in eastern and central Europe.

Gazprom has become a serious continental operator with equity in the UK-Belgium Interconnector, and holdings in a range of gas companies in Eastern Europe and the Baltic States. The company has also concluded a series of strategic, commercial alliances with major gas players such as Gazunie, Eni, Ruhrgas and Shell, thus constituting a radical reorientation of policy for the company. Exports to the European market have made Gazprom a highly profitable concern, earning the equivalent of $8 billion from gas sales during 1998, when the company sold 120.5 Bcm of natural gas to 19 European countries. 1999 evidenced a further increase with deliveries of 126.8 Bcm during the year.

**Table Gazprom' Gas Exports to Central and Eastern Europe, 1997-2000., Bcm**

| | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|
| Czech Republic | 8.4 | 8.6 | 7.8 | 8.3* |
| Hungary | 6.5 | 7.3 | 7.4 | 8.0* |
| Poland | 6.5 | 6.9 | 6.1 | 6.1* |
| Slovenia | 0.5 | 0.5 | 0.6 | 0.8* |
| Estonia | 1.0 | 1.0 | 1.0 | 1.2* |
| Bulgaria | 4.9 | 3.6 | 3.2 | 3.5* |
| Latvia | 1.2 | 1.25 | 1.25 | 1.3* |
| Lithuania | 1.2 | 1.7 | 1.8 | 2.0* |
| Romania | 5.1 | 4.8 | 3.2 | 3.5* |
| Slovakia | 7.1 | 7.1 | 7.5 | 8.0* |

*Source Gazprom* ** - Projection*

Unlike a number of state oil concerns in Russia, Gazprom was not dismantled during the Russian privatisation process and, in the early part of the 1990s, the company continued to be run on a highly centralised basis. This was a key factor in Gazprom's survival during the turbulent years Russia experienced throughout most of the last decade of the century. The low ruble exchange rate actually worked to Gazprom's advantage as it is a major exporter, and, during Russia's privatisation programme, the company invested much of its foreign exchange earnings in a variety of enterprises unconnected with the energy sector.

Gazprom has over 350,000 employees and has diversified interests in banking, oil developments and the Russian military/industrial complex. This has given the company enormous political power, particularly since its ex-President was former Prime Minister Chernomyrdin who commanded considerable influence and respect within Russia. Scandal soured the image of

Gazprom in early 1997, with suggestions of impropriety over a trust management agreement, and in spring 1997 the Russian government demanded a thorough reorganisation of the company.

The restructuring of the company involved the creation of three separate divisions. The first, Transgas, was an amalgamation of 17 separate organisations and was given the responsibility to run Gazprom's 148,200-km network of gas transmission pipelines. Upstream operations were delegated to Burgaz, which was made up of 4 regional bodies responsible for drilling activities. Marketing activities were allotted to Mezheregiongaz, a division with 60 offices scattered across the Russian Federation.

The reorganisation of Gazprom's operations reflected the realisation that the Russian domestic market would, in the long term, be of enormous value. While Gazprom exports over 200 Bcm of Russia's overall annual production of over 600 Bcm (with 60% of that total going to European countries) Russia's domestic and industrial consumption, currently put at 368 Bcm, is estimated to increase to 404 Bcm by 2010. Thus, home consumption could become Gazprom's most important income stream, particularly with improvements such as flexible billing and price discounts.

Access to Gazprom's export pipelines remains problematic, given that the company retains the final say on such access, which is largely dependent upon spare capacity in its pipelines. Thus, Gazprom's own production inevitably takes priority. Terms for the third party access to Gazprom's pipeline network in the Russian Federation were defined by a law passed during 1997, specifically resolution No 858. Third Parties are deemed to be any company involved in gas production or trading within the Russian Federation. One important caveat in the legislation was that it became permissible for third parties to establish a Russian trading company at border locations offering access to Russian export pipelines.

The most notable gas trading company to take advantage of this opportunity has been Itera, which in 1999 supplied over 60 Bcm of gas to the various states of the FSU. While foreign companies notably producers operating in the Central Asian States of Turkmenistan, Uzbekistan and Kazakhstan, have not been able to obtain access to Gazprom's export pipelines, Itera, which has a close working relationship with Gazprom, has gained a niche position in supplying gas to countries in both the FSU and in Eastern Europe.

While the production costs of Russian gas are extraordinarily low by world standards – on average some $4.50 per 1,000 Mcm – given the enormous distances involved in transporting gas from the far reaches of the Russian Federation, transit tariffs constitute a key element in the final cost of gas to consumers, whether within the Russian Federation or for European importers. Transit tariffs are set by the Federal Energy Commission, and were originally enumerated in resolution No 109, passed in autumn 1997.

Significant variations exist in the costs of gas from the various gas-producing regions of the country. Gazprom operates in six distinct regions of Russia- West Siberia, Urals, NorthWest, Volga, Centre and South. A breakdown of costs, provided in the table below, shows the variation in profits a gas producer in West Siberia might expect to receive in selling supplies either in the Ukraine or to Russian consumers in the Volga and Urals regions. Although current production costs are only $4.50 per Mcm, tariff levels would make it difficult for any independent gas producer to make a profit selling West Siberian gas any further west than the Urals.

**Comparisons of gas transport cost within the FSU, 2000, $/Mcm**

| Sales Destination: | Ukraine | VoIga | Urals |
|---|---|---|---|
| Gas price | 80.00 | 50.40 | 46.07 |
| Transit tariff | (43.38) | (28.34) | (17.41) |
| Excise tax | (33.43) | (21.60) | (19.74) |
| Production cost & profit | 3.19 | 0.46 | 8.91 |

*Source: Gazprom*

Most apparent from the chart above is the high tariffs and taxes charged by Ukraine for transited gas due, in part, to its historically strategic position within the Former Soviet Union. With the Brotherhood and Soyuz gas export pipelines passing through its territory, it has direct influence on the major conduits of gas from Russia westwards. The delivery cost of gas to Europe via the Ukraine is currently $58 per Mcm, whereas the cost for supplies routed through Belarus is only $49.60. Therefore, Gazprom plans to make major investments to improve the gas transmission network within the Russian Federation, with particular emphasis on export routes through its own territory and Belarus as an alternative to the Ukrainian option.

Current volumes of gas transited through the Ukraine incur high charges. While countries such as Poland, Slovakia and the Czech Republic receive gas to the value of 10% of gas transported, the Ukraine charges 28%. At the same time, with a large domestic market, there is a great temptation for some Ukrainians to interfere with gas in transit. Gazprom claims that during the winter of 1999/2000 150 Mcm of gas piped through the Ukraine was illegally siphoned off each day. Gazprom is still likely to use pipelines through the Ukraine to supply gas to Romania, Bulgaria and Greece, although these countries also suffer problems with transit losses.

Such is the scale of Russian gas reserves that the country has adopted an approach no other competitor would countenance: associated gas produced from existing oil developments attracts no charges within the Russian Federation. Currently, associated gas must be sold on the Russian domestic market but if the idea were applied to gas for export to Europe, then even supplies from "deepest Russia" would become commercially viable, depending on the accounting principles and tariff levels. A breakdown of current and projected spare pipeline capacity of the Gazprom network suggests, for exports to Europe, a ten-fold increase in available space by the year 2010.

Gazprom was one of the few constants in the volatile structure of Russian commercial life during the 1990s and the recent, apparent stabilisation of the Russian political scene has served only to enhance the value of gas as one of the country's major source of foreign currency earnings.

## The Yamal Pipeline

Of crucial importance to the gas sectors of the economies of Eastern Europe is the Yamal pipeline, which will have a capacity to transmit 67 Bcm of gas a year, bringing gas from the Yamal Peninsula in northern Siberia to western Russia, through Poland and onward to Western Europe. Gazprom exports over 200 Bcm of Russia's overall annual production of over 600 Bcm, with 60% of that total going to European countries. The EBRD has provided a $225M loan for Gazprom to improve and expand its gas transmission network.

The Yamal gas pipeline will stretch for more than 2,500 miles across Russia, Belarus and Eastern Europe, carrying natural gas supplies from Siberia to Germany and other Western European countries. The total cost of the project was projected to be $35 Billion and an agreement was signed in August 1994 between the Polish and Russian governments which determined the tendering process for the selection of construction companies and suppliers, with precedence given to Polish and Russian firms.

Russia has exported gas to Italy since 1974, when the Trans-Austrian pipeline became operational. Since then, volumes have increased from 6 Bcm a year to a current level of some 15 Bcm a year. An alliance between Gazprom and Eni, concluded in early 1998, aims to raise volumes to over 20.5 Bcm a year by 1999. The agreement covered deliveries over the next 20 years, with targets of 28 Bcm a year envisaged from 2008.

According to the terms of the alliance, increased supplies from Russia will be delivered by a second pipeline link. The Volta pipeline, which the Italian company, Edison, are willing to finance, will be capable of transporting 14 Bcm a year through Hungary and Slovenia, connecting up with the Yamal line, which, when completed, will carry Russian gas to Germany through Poland.

The construction of the 425-mile long Polish section of the Yamal pipeline is currently being undertaken by EuropolGaz, a Russo-Polish joint venture created in 1993 involving the State-owned Polish Oil and Gas Company with a 48% stake, Gazprom with an identical share and the Polish company, Gas Trading, with a 4% holding. The Yamal double pipeline should have a maximum capacity of 67 Bcm a year, of which at least 14 Bcm will be consumed in Poland, according to the terms of a 25-year contract agreed to in 1996.

In all, the total construction cost of the Polish section of the pipeline is put at $2.5 Billion, the largest infrastructure investment in Poland since the collapse of the Soviet bloc. The Polish section of the pipeline will run from Kondratki, on the Polish border with Belarus, to the German border town of Gorzyca. The construction of the first 66 miles stretch of the pipeline going from Gorzyca to Lwowek, near Poznan, was completed in October 1996 at a cost of $400 Million. Work on a second part of the pipeline, from Lwowek to Wloclawek, which will employ five compressor stations to pump gas through the Polish section of the pipeline, is well underway. Two parallel gas pipelines are to be built, each 425 miles long, with the first coming into operation in 1999 and the second in 2010.

### Security of Supply

A key concern for the states of Eastern Europe and the EU is the dominant role held by Gazprom as the major source of gas imports. Given the restructuring of the company currently underway and proposals for its privatisation by certain interest groups within Russia, it is clearly crucial to identify the likely position of the company in the coming decade, and evaluate the possible risks involved in relying too heavily on a single gas supplier. Fortunately, there are ample alternative sources able and willing to challenge Gazprom's dominant position in the Eastern European gas market.

The Russian government retains a 38% stake in Gazprom, and five of the company's nine directors are appointed by the government. Gazprom's chief executive, Rem Vyakhirev is noted for his aggressive management style. In summer 2000, Russian President Vladimir Putin showed his keen interest in the destiny of Gazprom with the appointment of two of his closest allies to the company's board. Deputy head of the Kremlin administration, Dmitri Medvedev, has taken

the place of former Prime Minister, Victor Chernomyrdin, while the current Economics Minister, German Gref became a director.

One important commercial consideration arises from Ruhrgas's 4% stake in Gazprom, acquired in 1998. This, combined with Germany being the Russian company's largest customer as well as the biggest gas consumer in Europe, indicates that the flow of Russian gas is likely to continue as they are too important a customer to remove.

### Environmental Problems

Russia and the former Soviet Union have had unparalleled environmental disasters in the energy sector, with the most notorious being the accident at the Chernobyl nuclear power plant in Ukraine. However, lack of investment, poor management and low prioritisation of environmental protection continues to result in a poor environmental record across the Energy sector in Russia. The Gazprom and its associated operators are no exception.

Most notably, from an environmental perspective, are the levels of routine leakage that occur with oil and gas during their extraction, production and transportation. A report recently produced by Greenpeace suggests that, annually, the total leakage of oil corresponds to around 10-20 Million tons, the total leakage of gas equalling between 6-50 Bcm and an additional 18 Bcm of gas that is burned on the extraction sites[26].

[26] Russia: No Oil and Gas Leaks – No Nuclear Power Plants, Organes Targulian, Dr Helmut Hirsch, Greenpeace, April 2000.

# Implications of an Enlargement of the European Union on the Gas Sector

The potential for gas merchants, power companies and investors arising from the liberalisation of the gas markets of Eastern Europe is enormous. The EU Gas Directive, which became law in June 1998 and has been ratified by energy ministers from all 15 Member States, is aimed at opening the entire European gas market to free competition over the next 10 years. The proposed expansion of the EU to 21 members is scheduled to take place early in this decade, and original proposals envisaged a "first wave" of entrants including the states of the Czech Republic, Hungary, Poland, Slovenia, Estonia and Cyprus. The high levels of gas penetration in a number of these countries should give an added impetus to the liberalisation of the European gas market.

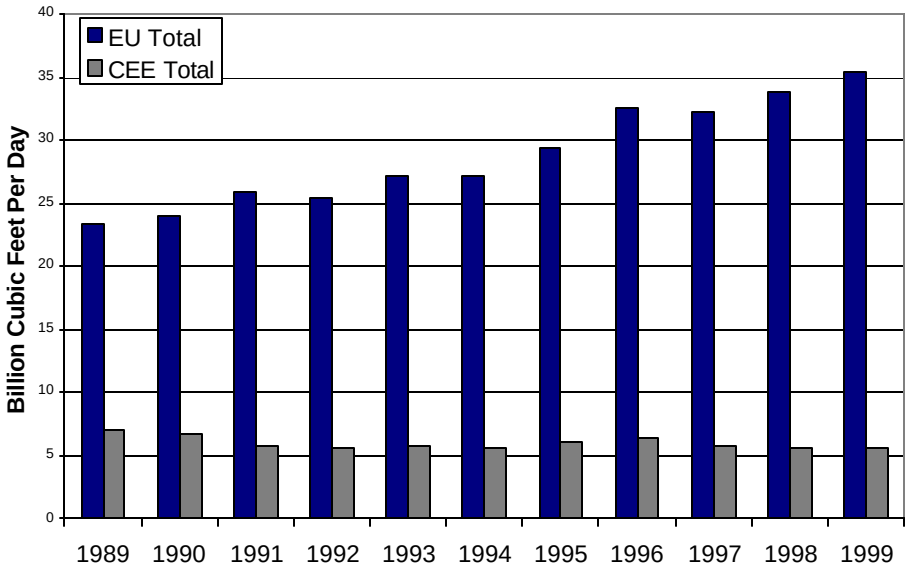
The further expansion of the EU to 27 members, including the states of Bulgaria, Latvia, Lithuania, Malta, Romania and Slovakia should foster still further gas penetration across the continent. Turkey has recently been given a provisional green light on EU candidacy, which, with its predicted consumption of up to 56 Bcm a year by 2010, offers huge potential for the growth of the gas market encompassed by the community. With the proposed enlargement, the population of the EU would increase from its current 375 million to over 550 million people.

An important element in the rationale behind the application of market liberalisation in Europe has been the visible effects of the policy elsewhere, first in the US (since 1985) and subsequently in the UK (since 1990). Benefits have included a steady growth in traded volumes, robust competition with transparent spot prices offering cost reductions for industrial and domestic consumers, as well as, in the longer term, increased stock values for the players involved. Liberalisation in the UK raised issues such as the unbundling of transportation and storage of gas from trade in the "commodity" itself, third-party pipeline access and transparency of accounting to prevent discrimination.

Equally important was the realisation of the crucial role to be played by regulatory bodies in ensuring the successful operation of a competitive market. As in the FSU, a tradition of high levels of energy use, low efficiency and subsidised prices pervades the countries of Eastern Europe, and has only been partially addressed. Instrumental in reducing energy consumption levels across the whole region was the general decline in economic activity caused by the collapse of many traditional industries throughout the former Soviet Bloc. This phenomenon was exacerbated by the freeing of controls on energy prices and consequently, much restructuring of the energy industries in individual states has been required, with Hungary and the Czech Republic being the first countries to introduce legislation to promote competition and privatisation in their energy sectors.

It is widely expected that Member State's use of natural gas will increase significantly in the coming years. This increase will occur both as a result of an increase in demand within the Union and gas being used as a replacement when the older, nuclear and coal, power plants are closed. A similar and accelerated scenario is expected within Accession countries. The graph below shows the historical development of gas use in both the CEE and the EU.

Gas Consumption in CEE and EU

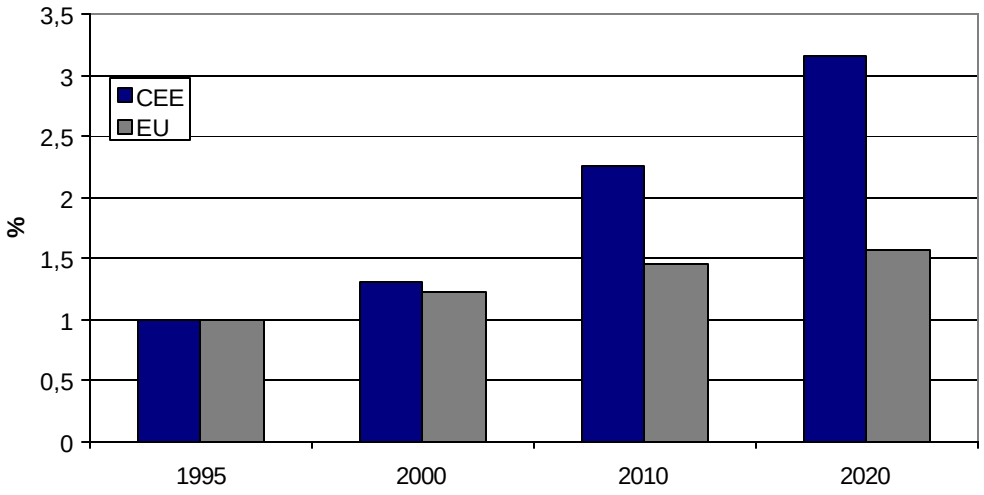



*Source: BP statistical review 2000*

Of interest to note is the huge variation between consumption levels in the two regions, with the CEE currently using only one seventh the amount of the EU, despite having 25% of the total European population. Also, during the 1980s gas use in CEE declined by only 20%, which is somewhat surprising, as this was a similar decline in energy use as a whole. Given that much of the gas had to be imported at high cost to the national economies of CEE, it is surprising that there was not an even greater decline in its use.

Looking to the future, it is possible to see that this difference, in percentage terms, is declining. The figure below demonstrates how, in CEE, the percentage increase in gas use in the future is expected to be larger than in EU countries. This figure represents the total use within the regions and not just the power sector. Within the CEE, use of natural gas will increase nearly three fold over the next two decades while, in the EU, the increase is predicted to rise to less than a quarter of this. Within the power sector, natural gas use is expected to increase from 77 Mtoe in the EU in 1995 to 186 Mtoe in 2020, while in the CEE, over the same time period, the increase will be from 8.5 Mtoe to 47.2 Mtoe. Once again, there is a much greater rate of increase within the CEE, with, on average, an annual increase of 7.1% compared to 5.0% in the EU.

Relative Increase in Natural Gas Use in EU and CEE Countries
Between 1995-2020




*Source: European Commission 2000*[27]

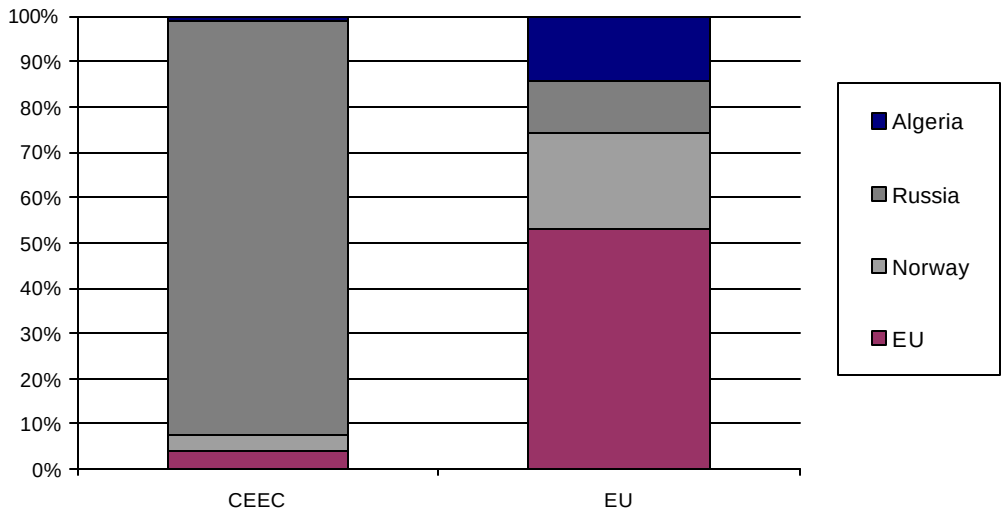
The relatively large percentage increase in gas use in CEE is due to a number of factors. Firstly, in the CEE, much of the region experienced a significant slowdown in their economies during the early 1990s. In many cases, growth in the economy has begun again and resulted in an increase in demand. Although there remains an over-capacity of power plants, this capacity is expected to be utilized to meet increased demand, to be used for electricity export, or be abandoned on economic and environmental grounds. Furthermore, some of the existing power sector is expected to be closed during the accession process, in particular the nuclear and power generators. Finally, to date, in CEE relative to the EU, there is little gas used purely for power generation. As there is an increasing harmonisation of the power sector in Central Europe and the EU, this is expected to change.

### Gas Sources

Due to its historical links and its geographical location, most of the gas supplied to CEE countries comes from Russia. This comes largely through the Brotherhood pipeline, which runs via Ukraine, Slovakia, Hungary and Czech Republic. There is an additional series of transmission pipelines to supply Western European consumers. Considerable investments are being made to diversify the supply routes for Russian gas. Currently under construction is the Yamal pipeline which will have the capacity to carry 67 Bcm per year and is proposed to run from Northern Siberia to Western Russia and on to Western Europe via Poland. The other major Russian project is the Blue Stream pipeline, which, if constructed, would allow significant export of gas from Russia to Turkey and then into South Europe.

[27] European Union Energy Outlook to 2020, Energy in Europe, Special Issue November 1999, ISBN 92-828-7533-4, tables 2-10 and 3-3

Comparison of Gas Sources of the EU and CEE Regions




*Source: BP Statistical Review 1999*

In addition to the diversification of supply routes from Russia, new sources are being introduced into the region. In 1997, the Czech Republic first started getting gas from Norway and is currently receiving 1.6 Bcm per year. Similarly, Poland is looking to increase its diversification by also obtaining gas from Norway. Hungary is currently importing some of its gas (0.5 Bcm per year) from France, while Germany is currently supplying small amounts of gas to Hungary, Poland and Romania. The graph above highlights the current dependency of CEE countries on Russia, in particular when compared to the EU.

There remains some domestic production of gas within CEE but actual production levels and the overall significance continues to decrease. In the Czech Republic, domestic production is used to cover around 2% (500 million cubic meters) of total demand. In Hungary, once a large producer, domestic production has fallen to around 3 Bcm per year. Poland is becoming increasingly active in the gas field and has signed a number of joint venture deals in recent years, although its current production is not yet significant. The only country in the region with any relatively significant production is Romania, which is currently producing around 15 Bcm per year. Other very small scale production takes place in Bulgaria and Slovakia.

Therefore, unless there is a rapid, and highly unlikely turnaround in the production rate of gas in Accession countries, the enlargement of the European Union will lead to an increase in import dependency for the Union as a whole. Currently, within the EU, around 40% of gas is imported, while in CEE the level of import is around 70%, 92% of which comes from Russia. Regardless of enlargement, the level of gas imported into the EU is expected to rise to 67.3% by 2020, a total import of around 320 Bcm per year. By the same time, gas use in CEE is expected to have reached around 100 Bcm per year, of which imports will account for at least 80%.

## Gas Pricing and Demand in the CEE

The graph below highlights the price difference that exists between EU and CEE countries at present.

**The Czech Republic**

During 1999, industrial consumers in the Czech Republic paid the equivalent of $140 per Mcm of gas, while domestic customers were charged $155. In summer 1998, gas prices for domestic consumers had been raised by 27%, with industrial users facing a 10% increase. A further increase of 15% was approved by the Czech cabinet in November 1999, and would take effect from the beginning of 2000. At the same time, two more price rises were confirmed for the household sector, 10.7% in 2001 and 7.5%, industrial prices are likely to rise by 4%, in 2002. These adjustments will bring the cost of gas in the Czech Republic more closely in line with current European levels, with cross subsidies between the gas and power sectors abolished by 2003.

The United Nations Economic Commission for Europe, (UNECE) estimates that, by 2010, domestic demand for gas in the Czech Republic could reach 12 Bcm a year. The body also suggests that the Czech Republic's dependency on supplies of Russian gas will fall from its current level of 85% to 73% by 2010. In contrast, the import dependency of the states of the EU is predicted to increase from its current level of 39% to 53% by the end of this decade.

**Hungary**

One of the major tasks of the Hungarian Energy Office (HEO) has been to supervise a series of painful increases in domestic gas prices during 1996 and 1997, in order to bring Hungarian charges into line with world prices, although they remain far below the European average. During 1999, industrial consumers in Hungary paid the equivalent of $90 per mcm of gas, while domestic customers were charged $125. The Hungarian government sets the level of gas and electricity prices, with the latter being raised by 8.1% in summer 1999, and both now reflect European levels more completely. Gas prices had not been increased since 1997 when they were reduced by 3% in July 1999, keeping in line with the decline in the price of imported gas.

The UNECE estimates that Hungary's dependency on supplies of Russian gas will increase from its current level of 52% to 58% by 2010. The body also suggests that, by 2010, domestic demand for gas in Hungary could reach 17 Bcm a year.

**Poland**

The natural gas market in Poland is relatively small with some 6.7 million household consumers, of which some 4.5 million customers rely on Liquefied Petroleum Gas (LPG). Gas prices are extremely low by European standards, with households paying little more than $2.85 per month for gas supplies. During 1999, industrial consumers in Poland paid the equivalent of $150 per Mcm of gas, while domestic customers were charged $225.

The UNECE estimates that Poland's dependency on supplies of Russian gas will fall from its current level of 59% to 56% by 2010. The body also suggest that, by 2010, domestic demand for gas in Poland could reach 24 Bcm a year.

**Slovenia**

Gas prices in Slovenia are close to the European average, with industrial consumers paying the equivalent of $240 per Mcm of gas in 1999, while domestic customers were charged $320. In autumn 1999, LPG prices were increased by 8.8% to $166.3, the equivalent of 90 cents.

The UNECE estimates that Slovenia's dependency on supplies of Russian gas will increase from its current level of 70% to 78% by 2010. The body also suggest that, by 2010, domestic demand

for gas in Slovenia could reach 2 Bcm a year.

**Estonia**

During 1999, industrial consumers in Estonia paid the equivalent of $140 per Mcm of gas, while domestic customers were charged $155. The UNECE estimates that Estonia will continue to be entirely dependent on supplies of Russian gas throughout this decade. The body also suggests that, by 2010, domestic demand for gas in Estonia will increase to 2 Bcm a year.

**Lithuania**

During 1999, industrial consumers in Lithuania paid the equivalent of $150 per mcm of gas, while domestic customers were charged $240. The UNECE estimates that Lithuania will continue to be entirely dependent on supplies of Russian gas throughout this decade. The body also suggests that, by 2010, domestic demand for gas in Lithuania could reach almost 5 Bcm a year.

**Bulgaria**

Gas prices were increased sharply in 1999, by 15.4% in September and by a further 10% in December. Further increases are planned during 2000. However, non-payment remains a serious problem in the industrial sector, where many of the country's largest enterprises are facing financial difficulties.

The UNECE estimates that Bulgaria's dependency on supplies of Russian gas will fall from its current level of 98% to 95% by 2010. The body also suggests that, by 2010, domestic demand for gas in Bulgaria could reach 7 Bcm a year.

**Romania**

Gas prices are far below the European average, with industrial consumers paying the equivalent of $55 per mcm of gas and domestic customers being charged $60.

The UNECE estimates that Romania's dependency on supplies of Russian gas will increase from its current level of 24% to 56% by 2010. The body also suggest that, by 2010, domestic demand for gas in Romania could reach 23 Bcm a year.

**Latvia**

The UNECE estimates that Latvia will continue to be entirely dependent on supplies of Russian gas throughout this decade. In addition, the body suggests that, by 2010, domestic demand for gas in Latvia could reach almost 3 Bcm a year.

**Slovakia**

The UNECE estimates that, by 2010, domestic demand for gas in Slovakia could reach 9 Bcm a year. The body also suggest that Slovakia's dependency on supplies of Russian gas will stay constant at its present level of 97% throughout the current decade.

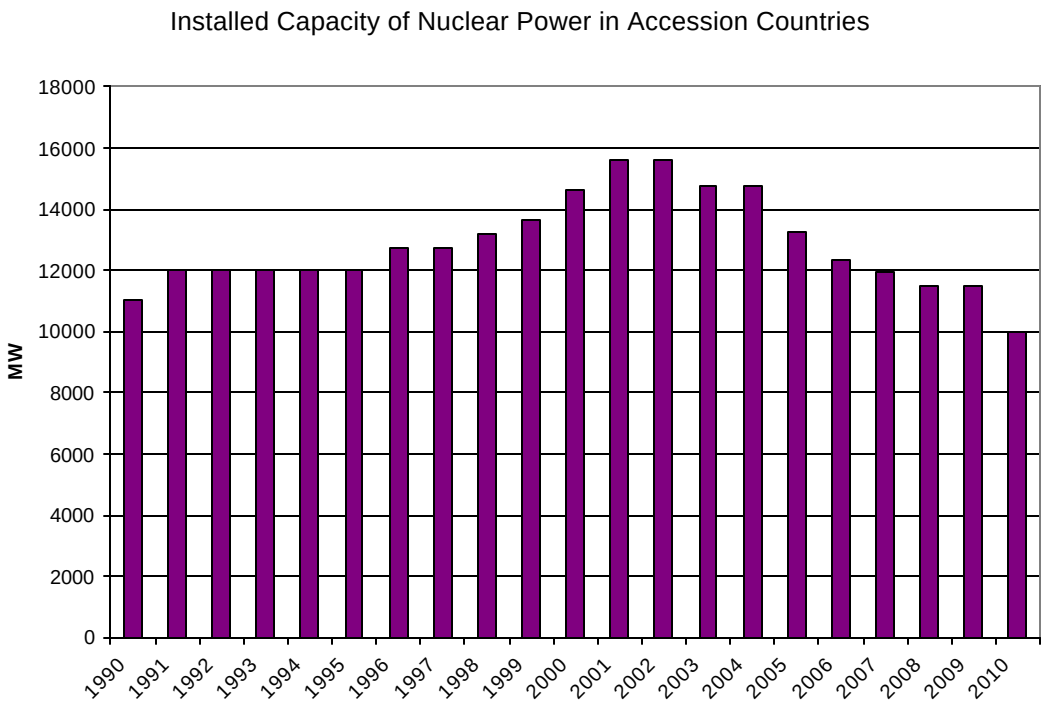
## Closure of Nuclear Power Plants

Within the framework of the accession process, 4600 MW of installed nuclear power capacity is expected to close in the next decade in three countries, Bulgaria, Lithuania and Slovakia. The eight reactors are all of the first generation of Soviet design and have sufficient enough problems that, in the view of the majority of the international community, they pose enough risk that they should not operate in the long term. Consequently, closure agreements were reached in November and December 1999 with these countries, the dates proposed are:

- Bohunice V-1(Slovakia): The two VVER 440-230 reactors are scheduled for closure in 2006-8.

- Ignalina (Lithuania): The closure dates of the first RBMK 1500 MW reactor is 2005, with the second to be decided by 2003, but the European Commission expect this to be in 2009.
- Kozloduy (Bulgaria): Units 1 and 2 are scheduled for closure in 2003, while units 3 and 4 are expected to close by 2006.

Although the stated objectives of these agreements were to rapidly close the reactors, they will still allow operation of some of the reactors for nearly another decade and, furthermore, not all the closure dates have been agreed to. Past experience suggests that unless precise and unambiguous closure dates, particularly those signed with the Nuclear Safety Account, are agreed to, then the reactors will continue to operate. The graph below highlights the impact that this will have on the installed nuclear generating capacity in Accession countries.




Although, in the short term, the three countries, Bulgaria, Lithuania and Slovakia, have sufficiently underused installed capacity to enable these nuclear reactors to be closed without having to build new facilities, their closure will clearly reduce the total installed capacity and advance the date for the need for of new capacity. As each of these countries do not have significant coal deposits (one of the reasons they constructed nuclear power plants in the first place) it is likely that they will follow the trend in the EU and replace their nuclear capacity with gas stations.

## Reduced Reliance on Coal

The Commission outlines its current position on accession and the environment in its document "Guide to Approximation of European Union Environmental Legislation"[28]. This lists the 70 or so Directives and 21 Regulations that make up the body of EU legislation to which new Members will have to align their national legislation and administrative practices - the so-called environmental *acquis.* The Commission initially stated that "while the adoption of the Union's

[28] Guide to the Approximation of European Union Environmental Legislation, Commission of the European Communities, Brussels 25.08.97

environmental rules and standards is essential, none of the candidate countries can be expected to comply fully with the *acquis* in the near future, given their present environmental problems and the need for massive investments".[29] However, in a letter (19/4/2000) to Friends of the Earth Europe, Commissioner Verheugen said that: *"Upon accession, Candidate countries are expected to conform with the acquis communitaire on the internal energy market, in particular the Electricity and Gas Directives. Candidates have started with the preparations to align their legislation with the internal energy market. Some of them are already trading electricity with Member States. However the question of full access of the Candidate Countries to the EU market before accession needs to be addressed. In principle, the EU does not favour transition periods.*

Therefore, although the Commission may not "favour transition periods" it is almost certain that some will occur for the existing power sector. The transition periods are present because of the huge cost that the full adoption of the acquis is expected to incur. The Commission has estimated that the total cost of the environmental *acquis* is ECU 100-200 billion. This cost estimate is very rough and does not include some key areas, including any financial assessment of the costs for the nuclear sector. Despite this, it can be seen that the electricity sector is estimated to already require the largest investment of all sectors, even including the nuclear sector, largely due to the requirements for atmospheric abatement technology to curb air pollution.

**Best Estimates for Total Environmental Investments in the CEE[30]**

| Sector | Total Investment (Billion ECU) | Cost/capita (ECU) | % GDP |
|---|---|---|---|
| Urban waste water | 33.1 | 270 | 0.62 |
| Industrial waste water | 5 | 48 | 0.11 |
| Drinking water | 17.5 | 168 | 0.39 |
| Air | 53 | 483 | 1.07 |
| Waste | 9.7-23 | 93-218 | 0.21-0.5 |
| Total | 122 | 1168 | 2.9 |

Over the past decade, coal consumption has declined significantly across CEE. This decline is, in part, a response to a decline in electricity demand and partly due to restructuring of the energy sectors, resulting in alternative energy sources being used – most notably gas – and some increase in supply and demand side efficiency.

## Impact of Accelerated Use of Gas to Reach Environmental Objectives

Natural Gas has a number of environmental advantages over other conventional sources of energy. The most striking is that its emissions are lower than other fossil fuel power plants. In particular, when burned in a modern CCGT it releases about half the amount of $CO_2$ per kWh of electricity produced than does a modern coal fired power station. Also significantly lower are the emission from particulates, $SO_2$ and $NO_x$, all of which have a negative impact on the local and/or global environment.

Therefore, it is interesting to review the consequences of an increased use of gas, in particular in Accession countries where, relative to the EU, gas is less prevalent in the power sector and where the environmental consequences of the power sector, both coal and nuclear, are more pronounced and visible. The table below shows the sources of energy used to produce electricity in Accession countries in 1996.

[29] Agenda 2000-Volume 1 – Communication: For a Stronger Wider Europe, 15th July 1997, DOC/97/6, page 65
[30] Compliance Costing for Approximation of EU Environmental Legislation in the CEE, EDC Ltd and EPE asbl, April 1997, page 94.

**Amount of Electricity Produced by Different Sources in Accession Countries**

| | Coal | Nuclear | Oil | Gas | Hydro | Other | Import/ Export | Total |
|---|---|---|---|---|---|---|---|---|
| Bulgaria | 20 | 18.1 | 1.0 | 1.0 | 3.0 | - | -0.5 | 42.6 |
| Czech Republic | 46.5 | 12.9 | 0.6 | 1.8 | 2.4 | 0.1 | - | 64.3 |
| Estonia | 8.8 | - | 0.1 | 0.2 | - | 0.0 | -0.9 | 8.2 |
| Hungary | 9.0 | 14.0 | 5.0 | 7.0 | 0.2 | - | 2.2 | 37.4 |
| Latvia | 0.1 | - | 0.6 | 0.5 | 1.9 | - | 3.2 | 6.3 |
| Lithuania | - | 13.9 | 1.3 | 0.7 | 0.9 | - | -5.2 | 11.6 |
| Poland | 136.7 | - | 1.8 | 0.4 | 3.9 | 0.4 | -3.1 | 140 |
| Romania | 20.4 | 1.3 | 6.5 | 16.7 | 15.8 | 1.0 | 2.9 | 64.6 |
| Slovakia | 2.8 | 11.3 | 1.2 | 2.5 | 4.5 | - | 3.6 | 25.8 |
| Slovenia | 3.7 | 4.4 | 0.0 | 0.0 | 3.7 | - | -1.7 | 10.1 |
| **Total- TWh** | **248** | **75.9** | **18.1** | **30.8** | **36.3** | **1.5** | | |

*Source: World Energy Council.*[31]

As can be seen, coal is the dominant source for electricity, although, as demonstrated earlier, this dominance is declining. However, at that time (1996), coal was used to produce more electricity than all other sources put together.

Modern gas, CCGT, power stations produce 0.32 kg of $CO_2$/kWh of electricity produced, compared to 0.85 kg of $CO_2$/kWh in modern coal stations. Even when ignoring efficiency standards that are lower than the EU average and the often more carbon intensive coal sources, each year the coal stations in CEE will produce 210.8 million tonnes of $CO_2$. If, however, the same electricity were produced in gas stations, only 79.36 million tonnes of $CO_2$ would be produced per year, giving an annual reduction in $CO_2$ emissions of 131.44 million tonnes per year. This is a massive reduction in the regions' $CO_2$ emissions, equivalent to around 25% of 1996 levels.

If, however, the nuclear power stations were also replaced with gas, it would have a resultant increase in $CO_2$ of 24.28 million tonnes per year. But, if both processes were undertaken simultaneously, it would result in a reduction of the regional $CO_2$ emissions by 107 million tonnes annually and the virtual removal of the risk of nuclear power. There would, however, be some residual risk associated with managing the existing nuclear waste and the decommissioning of the existing facilities.

However, such a fuel switch would impact upon the total gas use and the balance of payments for the region. Assuming an efficiency of 58% in the power stations and assuming a calorific value of gas of 10.8 kWh/cum (source BP), then the total electricity that needs to be generated to replace the energy produced by nuclear and coal is 323.9 TWh, which will require 51.7 Bcm of gas. This would nearly double the current use of 51.7 Bcm in CEE countries.

[31] http://www.worldenergy.org/wec-geis/

Such a theoretical analysis ignores some key concerns, such as security of supply, balance of payments deficits – as gas is imported while coal is a domestic fuel- and the environmental implications of the use of gas. Such a scenario cannot be viewed as the sole way forward, but nevertheless is does offer an interesting opportunity to consider the full extent of fuel switching to reduce $CO_2$ emissions and nuclear risk.

# Natural Gas Role in a Transition to a Sustainable Energy System

The 1997 Treaty of Amsterdam required all Community policy to contribute to sustainable development. The extraction and use of energy is a key area for creating sustainable development and the need for environmental awareness is now one of the three pillars of the Union's energy policy, which are[32] the following:

- Environmental protection – integrated in both energy production and energy use to maintain ecological and geophysical balances in nature.
- Security of supply – to minimise risks and impact of possible supply disruptions on the EU economy and society.
- Competitive energy systems – to ensure low cost energy for producers and consumers to contribute to industrial competitiveness and wider social policy objectives.

There is a growing recognition that environmental protection will and must take priority over other concerns as, without environmental security, there can be no security of supply and no competitive market.

### Kyoto Targets

At the end of the 1980s, recognition of the potential damage of burning fossil fuels on the World's climate lead two United Nations agencies, the UN Environmental Programme and the World Meteorological Organisation to establish the Intergovernmental Panel on Climate Change (IPCC). The IPCC have produced two reports (or Assessments), one in 1990 and the other in 1995. These reports brought together experts in many different fields associated with climate change. The second IPCC report concluded, "*The balance of evidence suggests a discernible human influence on global climate – that is we are already seeing the first signs of climate change*"

Following the IPCC report, a process called the Kyoto Protocol to the UN Framework Convention on Climate Change established a rolling series of meetings, probably the most well known of which took place in Kyoto, Japan in December 1997. The Kyoto Protocol is of fundamental importance because, for the first time, it introduced legally binding greenhouse gas emissions levels for developed countries, which should lead to an overall reduction in global greenhouse gases of 5% by 2008-12.

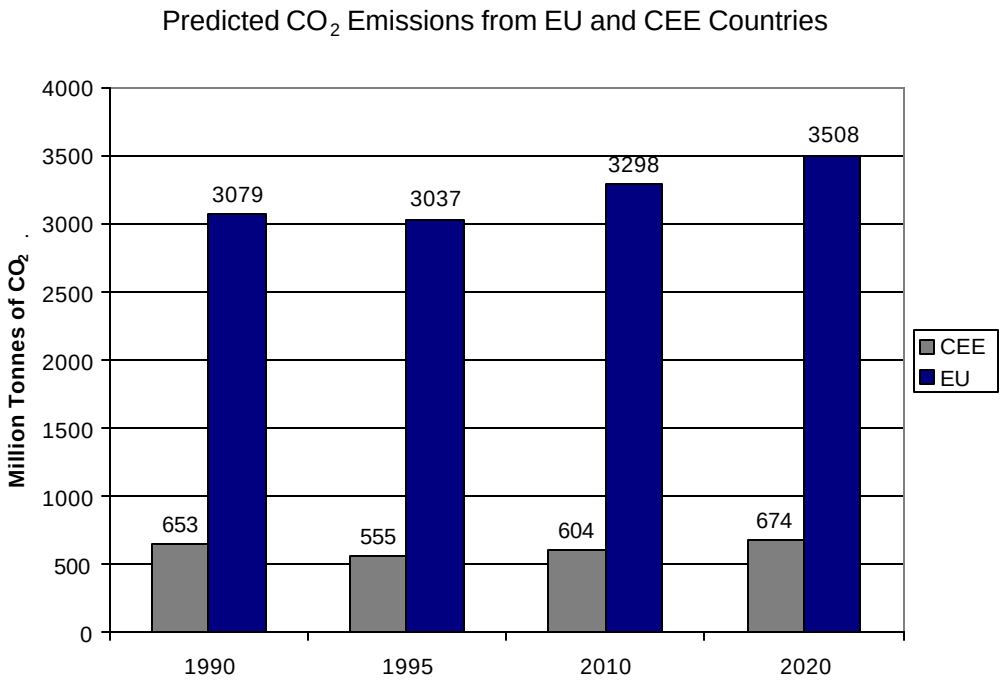
The Protocol requires specific limits on the emission of greenhouse gases from the various industrialised countries (Annex 1 countries) that are party to the agreement. These reductions in emissions are country specific but, on average, are designed to reduce, by 2008-12, the total emissions to 5% below that emitted in 1990. On a national and regional level, specific targets were put forward, and those for the EU and CEE are listed below.

[32] Energy in Europe, Economic Foundations for Energy Policy, The Shared Analysis Project, December 1999, European Commission, ISBN 92-828-7529-6, page 8.

**European Countries and their Reduction Target, % of 1990 Emissions by 2008-12**

| EU Countries | | | | CEE Countries | | | |
|---|---|---|---|---|---|---|---|
| Austria | 87 | Italy | 93.5 | Bulgaria | 92 | Romania | 92 |
| Belgium | 92.5 | Luxembourg | 72 | Czech R. | 92 | Slovenia | 92 |
| Denmark | 79 | Netherlands | 94 | Estonia | 92 | Slovakia | 92 |
| Finland | 100 | Portugal | 124 | Hungary | 94 | | |
| France | 100 | Spain | 115 | Latvia | 92 | | |
| Germany | 79 | Sweden | 104 | Lithuania | 92 | | |
| Greece | 125 | UK | 87.5 | Poland | 94 | | |
| Ireland | 113 | EU - Total | 92 | | | | |

Current predictions, however, suggest that the EU will not reach its Kyoto Commitments and rather that emissions will increase (by 2010) by 7% over 1990 levels rather than an 8% decline. Although there is no regional target for CEE countries, they have a roughly similar target to the EU, an 8% decline by 2010, but it is predicted that, as a region, CEE countries are likely to meet this target. The main reason for this is that, during the early 1990's, there was a significant decline in industrial activity which lead to a 6% decline in $CO_2$ emissions by 1995 and industrial output only began to increase in the late 1990s. The graph below illustrates these trends.




Similarly, the United States, the world's largest emitter of $CO_2$, has already intimated that it too will not meet is 7% reduction target. The widespread failure to reach even these, relatively unambiguous, targets does not bode well either for the next set of targets, for the post 2010 period, or for the earth's climate. The move toward less $CO_2$ pollution requires a reduction in the use of fossil fuels and an eventual phase out of their exploitation and use. Globally, there is a massive dependency on fossil fuels, and, in 1998, coal, oil and gas met 80% of the world's energy needs. In the EU, the figure was a comparable 79%. However, on the very short term there is also the need to increase the efficiency in which fossil fuels are utilised and to use less carbon intensive fuels, both of which can rapidly reduce $CO_2$ emissions.

Emissions from the power sector are significant contributors to these totals as, in the CEE, they make up around 50% while in the EU around 40% of emissions. This difference is mainly due to the higher emissions from the transport sector in the EU, where it accounts for around 30% of emissions compared to 10% in CEE. In CEE the power sector roughly follows the general $CO_2$ trend and is expected to have fallen from 1990 levels by around 5%. However, in the EU, overall emissions from the power sector are expected to be roughly at 1990 levels in 2010.

## Opportunities for Fuel Switching

The Power sector is the largest single source of $CO_2$ emissions, currently contributing around 40% of the total, equalling around 1.2 billion tonnes of $CO_2$ per year.

**Table Showing Electricity Produced by Different Power Stations in Different Member States**

| Country | Coal | Nuclear | Oil | Gas | Hydro | Other | Import/ Export | Total |
|---|---|---|---|---|---|---|---|---|
| Austria | 5.3 | - | 1.9 | 10.8 | 35.6 | 1.3 | 0.9 | 55.8 |
| Belgium | 18.2 | 41.1 | 1.3 | 11.0 | - | 1.1 | 4.4 | 77.1 |
| Denmark | 23.0 | - | 1.1 | 1.0 | 0.0 | 0.7 | 7.1 | 32.9 |
| Finland | 22.0 | 19.0 | 2.0 | 8.0 | 12.0 | 7.0 | 3.6 | 73.6 |
| France | 31.0 | 397.0 | 8.0 | 4.0 | 70.0 | 3.0 | 69.0 | 444.0 |
| Germany | 303.0 | 160.0 | 8.0 | 48.0 | 27.0 | 10.0 | -5.0 | 551.0 |
| Greece | 29.3 | - | 8.5 | 0.1 | 4.5 | `0.1 | 1.4 | 43.8 |
| Ireland | 9.2 | - | 2.7 | 6.3 | 1.0 | 0.1 | -0.1 | 19.1 |
| Italy | 25.0 | - | 117.0 | 50.0 | 47.0 | 6.0 | 37.0 | 282.0 |
| Luxembourg | 0.1 | - | 0.0 | 0.2 | 0.9 | 0.1 | 4.9 | 6.2 |
| Netherlands | 29.0 | 4.0 | 4.0 | 42.0 | - | 0.1 | 11.0 | 90.1 |
| Portugal | 12.6 | - | 6.0 | - | 14.9 | 1.0 | 1.1 | 35.6 |
| Spain | 54.7 | 56.0 | 14.0 | 7.0 | 41.0 | 1.6 | 1.0 | 175.3 |
| Sweden | 3.0 | 75.0 | 5.0 | 1.5 | 52.0 | 10.0 | 6.0 | 152.5 |
| UK | 147.0 | 95.0 | 14.0 | 82.0 | 5.0 | 6.0 | 17.0 | 365 |
| **TWh** | **712.4** | **847.1** | **193.5** | **271.9** | **310.9** | **48** | | |

*Source: World Energy Council*

Despite having signed on to the Kyoto Agreement, it is predicted that the EU is unlikely to meet the commitments on $CO_2$ reductions that it made at Kyoto. Overall emissions are predicted to increase by 7% rather than the 8% reduction of 1990 levels required by 2010. As seen in the previous section, one option available to reduce both $CO_2$ emissions and remove the dangers of the continual operation of nuclear power is to replace both coal and nuclear power stations with gas power.

In the EU, the 712 TWh of electricity produced by coal in 1995 will cause 605 million tonnes of $CO_2$ to be emitted per year[33]. If these power stations were switched to being fueled by natural gas, the total emissions would fall to 227 million tonnes, saving around 400 million tonnes of $CO_2$ per year. However if, as in the CEE scenario, all the nuclear power plants were also closed and replaced by natural gas, this would result in an increase in emissions of 271 million tonnes per year. Therefore, under this maximum gas use scenario, emissions will reduce by 130 million tonnes per year – a 4% decrease from 1995 levels despite the phasing out of nuclear power.

However, such a fuel switch scenario will quite obviously lead to a significant increase in gas use. Under this scenario, an additional 250 billion cubic meters of gas will be needed, the equivalent of about 70% of current use. This will add weight to the arguments that, in the EU, there is a

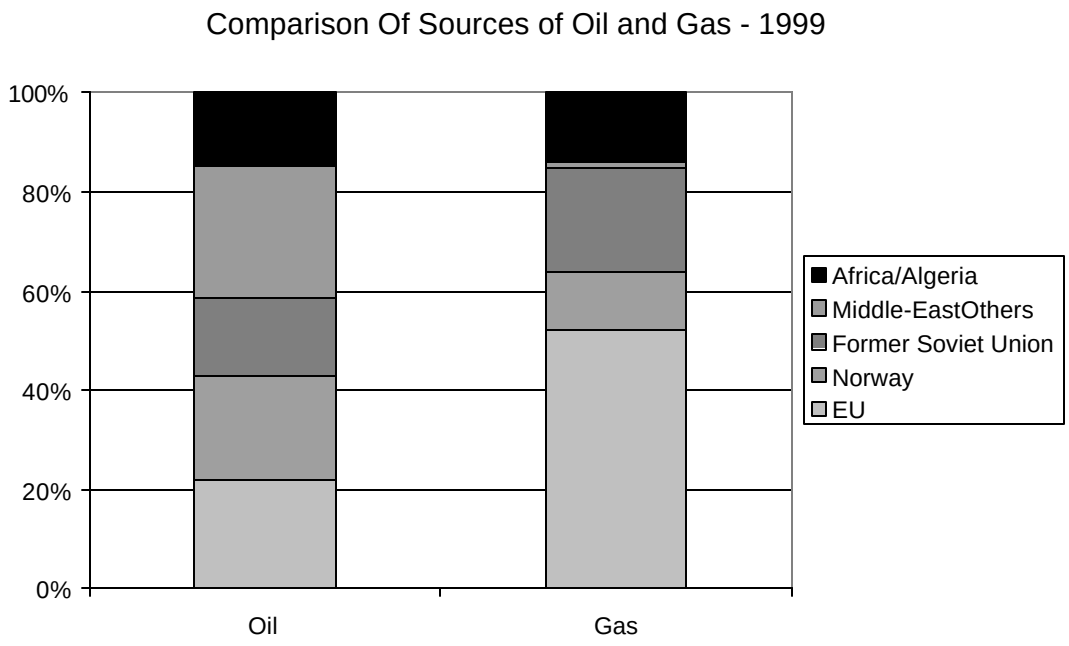
[33] Assuming emissions from Coal stations are 0.85Kg/kWh and from gas stations 0.32 Kg/kWh – Source Dr Jim Watson, Sussex University.

growing problem of over-reliance on imported natural gas and that the enlargement of the EU will add to these problems, especially the problem of over-reliance on gas from Russia.

If the phase-out of nuclear power and coal use is assumed for an enlarged EU, then there would be a total reduction in $CO_2$ emissions of around 230 million tonnes per year, a 6% reduction in the region's emissions, thereby bringing it close to the 8% requirement of Kyoto.

**Security of Supply**

Although the percentage of total gas used that has to be imported is increasing, it is interesting to look more broadly to see if this will cause problems from a security of supply perspective. One useful comparison involves the EU's current dependency on oil. The graph below reveals the differences between oil and gas and shows that oil has five significant supply sources, while gas only has four. However, in current percentage terms, 60% of current requirements come from the EU or Norway while in the oil sector it is only 40%.




If a rapid increase in gas is proposed in order to enable the phase out of coal and nuclear within the EU, and all of this gas had to be imported from outside Western Europe (the EU plus Norway) then the percentage of 'indigenous' gas would fall to around 40%, similar to the current situation with oil.

# Conclusions

Natural gas is not a renewable source of energy and therefore cannot be classified as sustainable. However, it can play a role in the development of a sustainable energy system as, when used efficiently, it produces 2.5 times less $CO_2$ per kWh than coal fired power stations. The clear advantage of natural gas is of particular significance at the present time as the EU is struggling to meet even the first reduction commitment (an 8% reduction of 1990 emissions by 2010). Although it is clear that the $CO_2$ emitted from the burning of natural gas does damage the environment and will negatively impact upon the world's climate, it is also clear that its impact is significantly less than from the burning of coal. Similarly, the particulate emissions and $NO_x$ gases from gas fired power stations are also notably lower than in solid fossil fuel power stations.

However, in the long term the use of natural gas is not sustainable and therefore does not offer the same security of supply as other, equally mature, technologies. Within Europe, and in particular Central and Eastern Europe, where the levels of energy intensity are far higher than in the EU, any sustainable and in the long term secure energy system must use energy more efficiently. This will require efficient use on the demand and supply side and a restructuring and reassessment of energy use systems. In particular, significant attention should be directed towards an increasing of the level of efficiency and towards combined heat and power stations.

In addition to energy efficiency, the use of renewable energy needs to become widespread and universally adopted. Only renewable energy technologies can offer electricity and energy services that are free largely from security of supply concerns and that will not be depleted or cause significant damage to current or future generations.

However, recognising this, in the very short term (within the next decade or so) renewable energy technologies, despite significant improvements in energy efficiency, will not be able to provide the full level of energy services the EU currently enjoys. It will therefore be necessary to use natural gas as a bridging or transition fuel. Consequently, natural gas must be used minimally and respectful of its lasting impact and limited resource base. In particular, the following areas of concern need to be addressed: -

**Liberalisation:** The current trend of liberalisation of Europe's energy markets is not motivated by the desire to reduce their impacts upon their environment. However, the process can have some positive impacts and clearly has some negative effects. In Central Europe, the EU's liberalisation requirements will speed up the dismantling of many countries' energy monopolies, allowing greater competition, freedom of choice and potential opportunity for renewable energy technologies to compete. Furthermore, increased price transparency can and should enable the full environmental costs of different energy sources to be calculated. However, there is a real danger that the liberalisation process will encourage the development of regional energy monopolies whose primary loyalty is to their shareholders and who have less regard for the environment or the consumers that they serve. Furthermore, one of the key problems facing environmental regulators is their lack of political and enforcement power when compared to the large corporations. The development of companies with regional or global interests further reduces the regulators' relative power. The problem of lack of regulation and stringent enforcement can only be further exacerbated by the rapid introduction of a liberalised market.

Due to the rapid introduction of liberalisation of energy markets in the EU, the European Commission is currently preparing a revised and accelerated market-opening timetable for both the electricity and gas markets. The problems that such a timetable may cause for accession countries needs to be taken into consideration in any new framework.

**Security of Supply:** It is clear that within many countries in Central Europe there is a genuine concern of over-dependence on foreign gas suppliers. In Slovakia's case, for instance, 97% of the country's suppliers come from Russia. Russian environmental practises and economic situation further exacerbate this concern. It is clear that a number of measures such as the increased capacity of storage facilities, increased interconnection between countries and diversity of suppliers will all add to the security of supply. However, once again, the primary and most important activity is to reduce demand and thus dependency.

Within the EU, similar concerns have been raised but are, however, far less valid. The EU has significant domestic resources, in particular in the Netherlands and UK, and also receives large quantities from Norway. Furthermore, when compared to other oil the level of security of supply and anticipated demand increase for gas is of far less concern. These factors need to be considered by the European Commission when drafting its Green Paper on Security of Supply, due in late 2000.

**Prioritisation of Investments:** The energy sector, both power and transport, is causing lasting and significant damage to the global atmosphere. This damage is already impacting upon the world's climate. Consumption patterns must change as much the sources of energy. From an environmental perspective, the use of fossil fuels and nuclear power must be phased out. Clearly, this will not occur overnight but further steps must be taken in order to progress to a truly sustainable energy system. Firstly, increased efforts must be made to save energy and to use it more efficiently. Energy efficiency measures can, especially in Central and Eastern Europe, reduce like no other series of measures the impact on the environment. Secondly, renewable energy technologies that are already proven must be more widely adopted. Other potential technologies need further research and refinement, actions that must be taken rapidly. However, recognising that some of these measures may take a number of years to introduce, the use of natural gas should be prioritised over the use of other fossil fuels and nuclear power. Furthermore, the debate on the introduction of fiscal measures, such as energy and $CO_2$ taxes, should be initiated in order to shift the investments towards a more sustainable direction.

**Natural Gas as a Bridging Fuel:** It is clear that the exploration and exploitation of natural gas causes damage to the environment on a local and global level. However, compared to other fuels (most notably coal and nuclear), it is less environmentally damaging if it is extracted and used with the protection of the environment at the forefront of its development. Therefore, natural gas should be used in preference to other fossil fuels and nuclear power as a transition to a sustainable energy world.