Information on natural gas

Use the navigation bar on the left in order to access the desired information directly.

Site Map

	Environmental Regulations/Kyoto Protocol and Climate Change The Energy Charter Energy Services and World Trade Organization	

Selected Sources of Statistics

British Petroleum (BP-AMOCO)

International Energy Agency

Oil & Gas Journal

World Energy Council

Cedigaz

International Gas Union

Energy Information Administration, Official Energy Statistics from the U.S. Government

Eurostat

References

Some relevant publications among the numerous existing publications related to natural gas are shown below:

BP Amoco Statistical Review of World Energy 2001, British Petroleum

Natural Gas Information 2000 (1999 data), International Energy Agency

Key World Energy Statistics from the IEA 2000, International Energy Agency

World Energy Outlook 2000, International Energy Agency

2001 IGU World Review, International Gas Union

Regulatory Reform: European Gas, International Energy Agency, 2000

Natural Gas Distribution: Focus on Western Europe, International Energy Agency, 1998

Natural Gas Pricing in Competitive Markets, International Energy Agency, 1998

Promoting competition in the natural gas industry, OECD (DAFFE/CLP(2000)18), 2000

Natural Gas Statistics Sourcebook, Oil & Gas Journal, 2000

Energy Statistics Sourcebook, Oil & Gas Journal, 1999

World Commodity Survey 2003-2004, UNCTAD-Cyclope

Natural Gas in the World-2000 Survey, CEDIGAZ

Natural Gas in Power Generation, Cedigaz, 1999

World LNG Outlook-99 Edition, Cedigaz

Natural Gas and Deregulation, Cedigaz, 2000

European Union Energy Outlook to 2020, European Union DG Energy&Transport

Annual Energy Review 2000, European Union DG Energy&Transport

Opening up to Choice: Launching the Single European Gas Market, European Union DG Energy&Transport

Eurogas 1999 Annual Report (incorporating "Natural Gas in Western Europe 2000), Eurogas

Toward a National Energy Strategy, United States Energy Association, February 2001

Fueling the Future: Natural Gas & New Technologies for a Cleaner 21st Century, American Gas Foundation, 2000.

International Energy Outlook 2001, Energy Information Administration

Annual Energy Outlook 2001, Energy Information Administration

International Energy Annual, 1999, Energy Information Administration, February 2001

Natural Gas Annual 1999, Energy Information Administration

Historical Natural Gas Annual: 1930 through 1999, Energy Information Administration

World Petroleum Assesment 2000, United States Geological Survey

The World Gas Handbook 2000, Energy Intelligence Group

Survey of Energy Resources 1998, World Energy Council

The World LNG Source Book 2001, Gas Technology Institute

Competition in the Natural Gas Industry: The emergence of spot, financial and pipeline capacity markets, Public Policy for the Private Sector (The World Bank Group), March 1998

User's Guide to Natural Gas Purchasing and Risk Management, 1/e, William F Payne, Prentice Hall, 2000

Natural Gas Trading in Europe-Liberalization and its impact on long-term contracts, The Europe-Japan Centre, 1998

Gas Trading Manual, Edited by David Long and Geoff Moore, Woodhead Publishing Limited, July 2001

Natural Gas Contracts, Thompson Publishing Group, 2000

Links to main relevant sites

- **Natural gas and energy information**

Natural Gas Information and Educational Resources
The Energy Source Network
Oil and Gas International
Oil & Gas Journal
Alexander's Gas & Oil Connections
Oil Online
Platts Global Energy
Gas (Powered by Worldnews.com)
Energy Intelligence Group
Subject Group for Oil & Natural Gas
Fossil Fuels.org
Petroleum Place
Britannica
Financial Times-Energy and Utilities Review
Gulf Publishing Company
Sheffield Energy and Resources Information Services
Cambridge Energy Research Associates
CMS One Stop Information Shop
About.com
Régie énergie
Geoscopie

- **Natural gas and energy related associations**

International Association for Energy Economics
American Gas Association
American Petroleum Institute
Gas Technology Institute
Interstate Natural Gas Association of America
United States Energy Association
Independent Petroleum Association of America
Natural Gas Supply Association
Gas Industry Standards Board

Canadian Gas Association
Canadian Gas Research Institute
The Australian Natural Gas Industry-Australian Gas Association
Marcogaz (Technical Association of the European Gas Industry)
Mbendi Information for Africa
Regional Association for Oil and Natural Gas Companies in Latin America and the Caribbean
The Alternative Energy Institute
International Association of Natural Gas Vehicles
European Natural Gas Vehicle Association
Natural Gas Vehicle Coalition (USA)
International Cogeneration Alliance
World Fuel Cell Council
Centre for Energy, Petroleum and Mineral Law and Policy
Institut d´economie et de politique de l´energie (IEPE)
Centre for Energy Policy
Pipeline Research Council International, Inc. (PRCI)

International organizations

International Energy Agency
Energy Technology Data Exchange and The Energy Database (IEA)
World Energy Council
International Gas Union
Cedigaz
International Gas Centre
UNECE-Gas Centre (dedicated to European Economies in transition)
Eurogas (European Union of the Natural Gas Industry)
Organization of Petroleum Exporting Countries
International Centre for Gas Technology Information (latest technology information centre for the IEA)
Intergas Marketing
Intergovernmental Panel on Climate Change
United Nations Framework Convention on Climate Change
Energy Charter Treaty
World Energy Assessment
World Bank and Oil&Gas

Government

European Union-DG Energy & Transport
Federal Energy Commission (FEC) of the Russian Federation
U.S. Energy Information Administration
U.S. Department of Energy
U.S. Federal Energy Regulatory Commission
The U.S. Energy Department's Fossil Energy
Strategic Centre for Natural Gas
Alternative Fuels Data Centre
Natural Resources Canada-Natural Gas Division
Pacific Economic Cooperation Council (PECC) Energy Forum
Office of Gas and Electricity Markets (UK)

DTI Oil and Gas Directorate (UK)
Energy Regulators Regional Association CEE/ Eurasia
Norwegian Petroleum Directorate

Markets and exchanges

New York Mercantile Exchange
International Petroleum Exchange
Kansas City Board of Trade
Intercontinental Exchange
Natural Gas Exchange
Canadian Venture Exchange

Price links

Natural Gas Intelligence
EIA Natural Gas Weekly Update
EIA Short Term Energy Outlook
EIA Natural Gas Markets, Status and Outlook:
Eurostat
Energy Intelligence Group
Reuters
CNN
Alaron Trading Corporation
Barchart.com
Bloomberg
World Bank Commodity Price Data (Pinksheet)
Oil and Gas Online
Crude Oil and Natural Gas Prices (worldnews.com)
WTRG Economics
TFC Commodity Charts
Enerdata
Energy Shop
Ino.com
The Heren Report
Energy and Power Risk Management Magazine

Partners

This profile was last updated on August 11th, 2005
The Web pages were checked on June 24, 2005

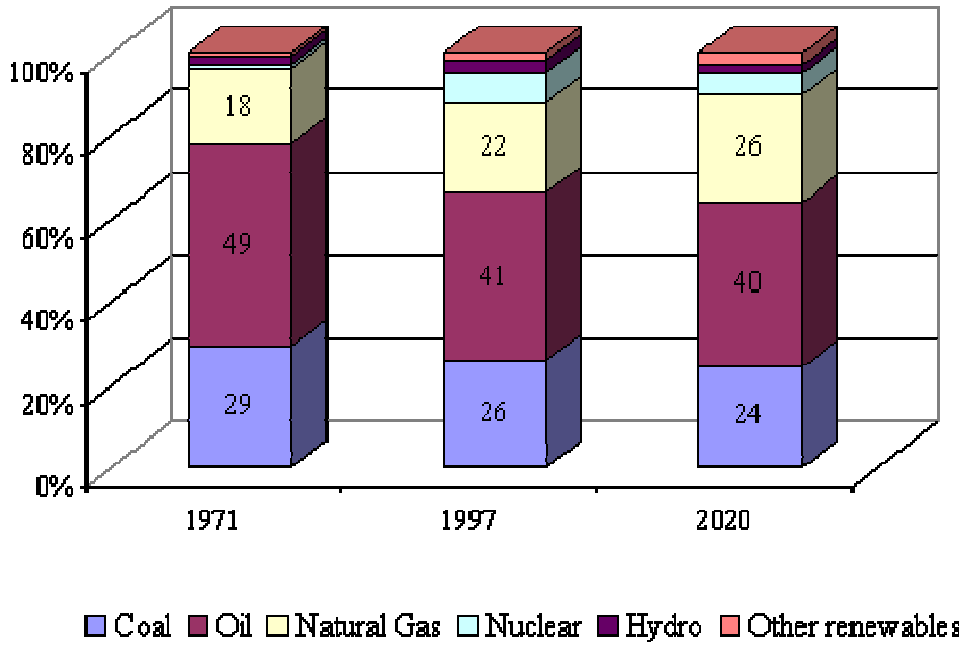
Characteristics

Commodity

Natural gas is a fossil fuel source of energy, which represents more than one fifth of total energy consumption in the world. It has been the fastest growing fossil fuel since the seventies.

Due to economical and ecological advantages that it presents as well as its safety qualities (e.g. reduced flammable range), natural gas is an increasingly attractive source of energy in many countries. At present, natural gas is the second energy source after oil. According to Energy Information Administration, natural gas accounted for 23% of world energy production in 1999. It has excellent perspectives for future demand. Natural gas is considered the fossil fuel of this century, as petroleum was last century and coal two centuries ago.

Total primary energy supply by fuel



Source: World Energy Outlook 2000, International Energy Agency

Natural gas presents a competitive advantage over other energy sources. It is seen as economically more efficient because only about ten per cent of the natural gas produced is wasted before it gets to final consumption. In addition, technological advances are constantly improving efficiencies in extraction, transportation and storage techniques as well as in equipment that uses natural gas.

Natural gas is considered as an environmentally friendly clean fuel, offering important environmental benefits when compared to other fossil fuels. The superior environmental qualities over coal or oil are that emissions of sulphur dioxide are negligible or that the level of nitrous oxide and carbon dioxide emissions is lower. This helps to reduce problems of acid rain, ozone layer or greenhouse gases.

Natural gas is also a very safe source of energy when transported, stored and used.

Although resources of natural gas are finite and natural gas is a non-renewable source of energy, these resources are plentiful all over the world. Natural gas reserves are continuously increasing as new exploration and extraction techniques allow for wider and deeper drilling.

The growing importance of natural gas as a major energy source is shown by the amount of investment devoted to the natural gas industry. The sector shows a great dynamism at the beginning of the new millennium. Increasing demand and prices in the recent past have led to new expansion and exploration projects in the natural gas industry. New pipeline construction projects are developed and planned all over the world. Furthermore, most governments are progressively including natural gas in their energy policy agenda, by following liberalization policies (particularly after the energy shortages of 1970s), in order to open the markets to competition. More and more, energy final users are also showing a preference for using natural gas as a clean, safe, reliable and economical source of energy. Natural gas is used for heating, cooling and several other industry uses, while it is increasingly becoming the favoured fuel for power generation.

Description/Technical Characteristics

Natural gas is colourless, odourless, tasteless, shapeless and lighter than air. It is gaseous at any temperature over -161º C. When it is at its natural state, it is not possible to see or smell natural gas. For safety reasons, a chemical odorant that smells a little like rotten eggs, Mercaptan, is added to natural gas so that it can be smelled if there is a gas leak.

Natural gas is a mixture of light hydrocarbons including methane, ethane, propane, butanes and pentanes. Other compounds found in natural gas include CO2, helium, hydrogen sulphide and nitrogen. The composition of natural gas is never constant, however, the primary component of natural gas is methane (typically, at least 90%), which has a simple hydrocarbon structure composed of one carbon atom and four hydrogen atoms (CH4). Methane is highly flammable, burns easily and almost completely, while it emits very little air pollution. Natural gas is neither corrosive nor toxic, its ignition temperature is high, and it has a narrow flammability range, making it an inherently safe fossil fuel compared to other fuel sources. In addition, because of its specific gravity of 0.60, lower than that of air (1.00), natural gas rises if escaping, thus dissipating from the site of any leak.

The carbon and hydrogen in natural gas are thought to have originated from the remains of plants and animals that were accumulated at the bottom of lakes and oceans over millions of years. After having been buried under huge layers of other sediments, the organic material is transformed into crude oil and natural gas as a result of the high pressure from the layers of sediments and the heat from the earth's core. The oil and gas are then squeezed out of the marine shales in which they were deposited, and from there go into porous sedimentary rocks. Oil and gas migrates upward through the porous rock, as it is less dense than the water, which fills the pores. Several different types of oil and gas "traps" exist.

Natural gas is found throughout the world in reservoirs deep beneath the surface of the earth and floor of the oceans. It forms as pockets of gas over crude oil deposits or is trapped in porous rock formations. Natural gas can be found in oil deposits, as associated natural gas, although non-associated natural gas is often found without the presence of oil.

When natural gas is cooled to a temperature of approximately -260°F at atmospheric pressure, it condenses to a liquid called liquefied natural gas (LNG). One volume of this liquid takes up about 1/600th the volume of natural gas. LNG weighs less than one-half that of water, actually about 45% as much. LNG is odourless, colourless, non-corrosive, and non-toxic. When vaporized it burns only in concentrations of 5% to 15% when mixed with air. Neither LNG, nor its vapour, can explode in an unconfined environment. Since LNG takes less volume and weight, natural gas is liquefied for ease of storing and transporting.

Natural gas is considered as a clean fuel because of its environmentally friendly properties: commercialised natural gas is practically sulphur free and thus it produces virtually no sulphur dioxide (SO2), natural gas emits lower levels of nitrogen oxides (NOx) emissions than oil or coal and emissions of carbon dioxide (CO2) are less than those of other fossil fuels (According to Eurogas 40-50% less than coal and 25-30% less than oil).

* For more detailed properties of natural gas and comparisons with other fuels, see Alternative Fuels Data Centre, Gas Energia or http://www.naturalgas.org

Origin and history

The discovery of natural gas dates from ancient times in the Middle East. Thousands of years ago, it was noticed that natural gas seeps ignited when lightning and created "burning springs". In Persia, Greece or India, people built temples around these "eternal flames" for their religious practices. However they did not recognize the energy value of natural gas. It was done in China around 900 BC. The Chinese drilled the first known natural gas well in 211 BC.

In Europe, natural gas was unknown until it was discovered in Great Britain in 1659 although it was not commercialised until about 1790. In 1821 in Fredonia, United States, residents observed gas bubbles rising to the surface from a creek. William Hart, considered as America's "father of natural gas", dug there the first natural gas well in North America.

Throughout the 19th century, natural gas was used almost exclusively as source of light and its use remained localized because of lack of transport structures, making difficult to transport large quantities of natural gas through long distances. There was an important change in 1890 with the invention of leak proof pipeline coupling. However, existing techniques did not allow for gas going further than 160 km. and it was mostly flared of left in the earth. Transportation of natural gas to long distances became practical in the 1920s as a result of technological advances in pipelines. It was only after World War II that the use of natural gas grew rapidly because of the development of pipeline networks and storage systems.

In the early days of oil exploration, natural gas was often an unwelcome by-product, as natural gas reservoirs were tapped in the drilling process and workers were forced to stop drilling to let the gas vent freely into the air. Now, and particularly after the oil shortages of the seventies, natural gas has become an important source of energy in the world.

The gas industry has been highly regulated for many years mainly as it was regarded as a natural monopoly. In the last 30 years there has been a move away from price regulation and towards liberalization of natural gas markets. These movements have resulted in greater competition in the market and in a dynamic and innovative natural gas industry. In addition, thanks to technological advances natural gas can be better explored, extracted and transported to consumers. Innovations also help to improve natural gas applications and create new ones. Natural gas is increasingly used for power generation.

Quality

Quantities of natural gas are measured in cubic metres (at a pressure of 75,000 Pascal and a temperature of 15º C) or in cubic feet (at the same pressure and temperature). Normally, gas production from wells and supplies to power plants are measured in thousands or millions of cubic feet (Mcf and MMcf); resources and reserves are calculated in trillions of cubic feet (Tcf).

The amount of energy that is obtained from the burning of a volume of natural gas is measured in British thermal units (Btu). The value of natural gas is calculated by its Btu content. One Btu is the quantity of heat required to raise the temperature of one pound of water of 1 degree Fahrenheit at atmospheric pressure. A cubic foot of natural gas on the average gives off 1,000 Btu, but the range of values is between 500 and 1,500 Btu.

Energy content of natural gas is variable and depends on its accumulations which are influenced by the amount and types of energy gases they contain: the more non-combustible gases in a natural gas, the lower the Btu value. In addition, the volumic mass of energy gases which are present in a natural gas accumulation also influences the Btu value of natural gas. The more carbon atoms in a hydrocarbon gas, the higher its Btu value.

Btu analyses of natural gas are done at each stage of the supply chain. Gas chromatographic process analysers are used in order to conduct fractional analysis of the natural gas streams, separating natural gas into identifiable components. The components and their concentrations are converted into a gross heating value in Btu-cubic foot.

The composition of natural gas varies depending on the field, formation or reservoir from which it is extracted. The different hydrocarbons that form natural gas can be separated using their different physical properties as weight, boiling point or vapour pressure. Depending on its content of heavy components, natural gas can be considered as rich (five or six gallons or more of recoverable hydrocarbons per cubic feet) or lean (less than one gallon of recoverable hydrocarbons per cubic feet).

Normally, natural gas as it is when extracted is not suitable for pipeline transportation or commercial use before being processed. Natural gas for commercial distribution is composed almost entirely of methane and ethane, while moisture and other components have been removed. Pipelines set their specifications for the quality of natural gas. In any case, natural gas must be processed in order to remove unwanted water vapour, solids or other contaminants and to get those hydrocarbons that have a higher value as separate products.

Uses

Natural gas is a versatile source of energy, which can be used by different actors. Heating and electricity generation have been the main traditional uses. Increasing environmental concerns may lead to a greater use of natural gas in transportation.

Residential users

Residential applications are the most commonly known use of natural gas. It can be used for cooking, washing and drying, water warming, heating and air conditioning. Domestic appliances are increasingly improved in order to use natural gas more economically and safely. Operating costs of natural gas equipment are generally lower than those of other energy sources.

Commercial users

Main commercial users of natural gas are food service providers, hotels, healthcare facilities or office buildings. Commercial applications include cooling (space conditioning and refrigeration), cooking or heating.

Industry

Natural gas is used as an input to manufacture pulp and paper, metals, chemicals, stone, clay, glass, and to process certain foods. Gas is also used to treat waste materials, for incineration, drying, dehumidification, heating and cooling, and cogeneration.

Power Generation

Electric utilities and independent power producers are increasingly using natural gas to provide energy for their power plants. In general, gas fuelled power plants have lower capital costs, are built faster, work more efficiently and emit less pollution than other fossil fuel power plants. Technological improvements in design, efficiency and operation of combined cycle gas turbines and co-generation processes are favouring the use of natural gas in power generation. A combined-cycle power plant uses waste heat to produce more electricity, while natural gas co-generation, also called combined heat and power, produces power and heat that is useful for industry as well as commercial users. This cogeneration reduces pollution emission considerably.

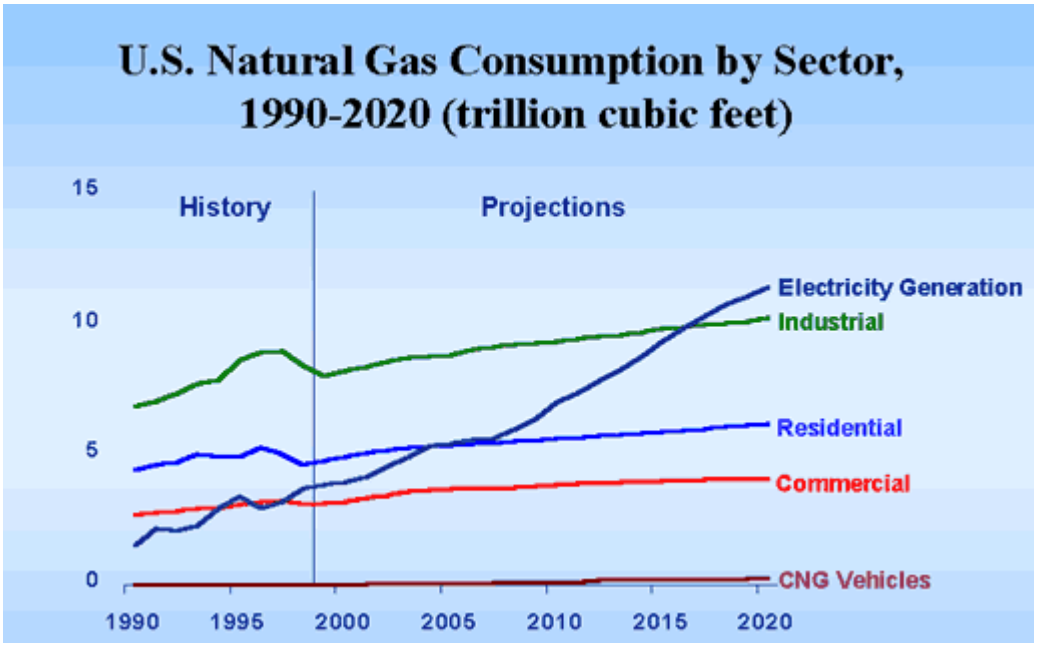
Natural Gas Vehicles (NGVs)

NGVs are natural gas powered vehicles. Natural gas can be used as a motor vehicle fuel in two ways: as compressed natural gas (CNG), which is the most common form, and as liquefied natural gas. Natural gas vehicles fleet accounts for about one and a half million vehicles worldwide (according to the International Natural Gas Vehicles Association). Concerns about air quality in most parts of the world are increasing the interest in using natural gas as a fuel for vehicles. Cars using natural gas are estimated to emit 20% less greenhouse gases than gasoline or diesel cars. These vehicles are not a new technology since they have been used since the 1930s. In many countries NGVs are introduced to replace buses, taxis and other public vehicle fleets. Natural gas in vehicles is inexpensive and convenient.

Fuel Cells

A fuel cell is an electrochemical device that combines hydrogen fuel and oxygen from the air to produce electricity, heat and water. Fuel cells operate without combustion, so they are virtually pollution free. Since the fuel is converted directly to electricity, a fuel cell can operate at much higher efficiencies than internal combustion engines, extracting more electricity from the same amount of fuel. The fuel cell itself has no moving parts, making it a quiet and reliable source of power. Natural gas is one of the multiple fuels on which fuel cells can operate.

As an illustration, the following graph shows natural gas use history and prospects in USA:



Source: Energy Information Administration

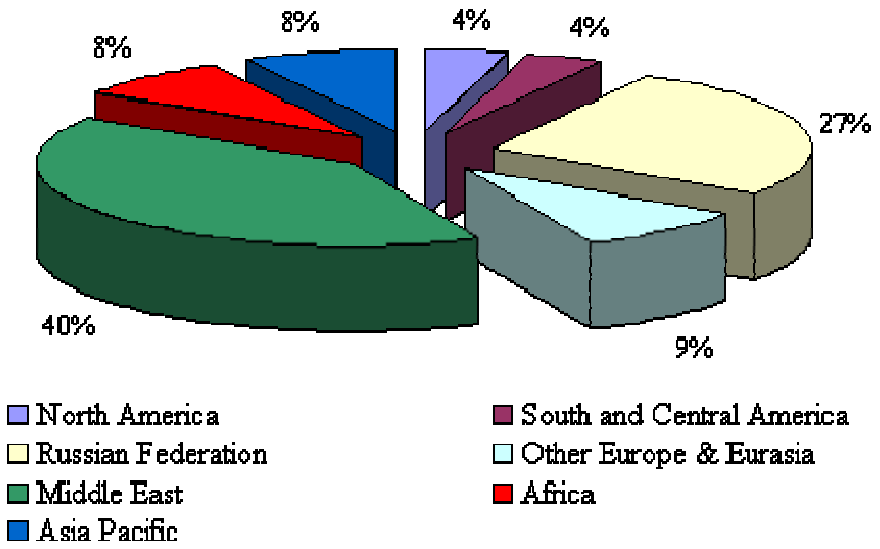
* For more information on natural gas uses, see: Naturalgas.org or American Gas Association

Market

Natural Gas Reserves

World's resources of natural gas, although finite, are enormous, while estimates of its size continue to grow as a result of innovations in exploration and extraction techniques. Natural gas resources are widely and plentifully distributed around the globe. It is estimated that a significant amount of natural gas remains to be discovered.

Distribution of proved natural gas reserves (%) in 2004



Source: UNCTAD based on data from BP Amoco, Statistical Review of World Energy 2005

Proved reserves are those that could be economically produced with the current technology.

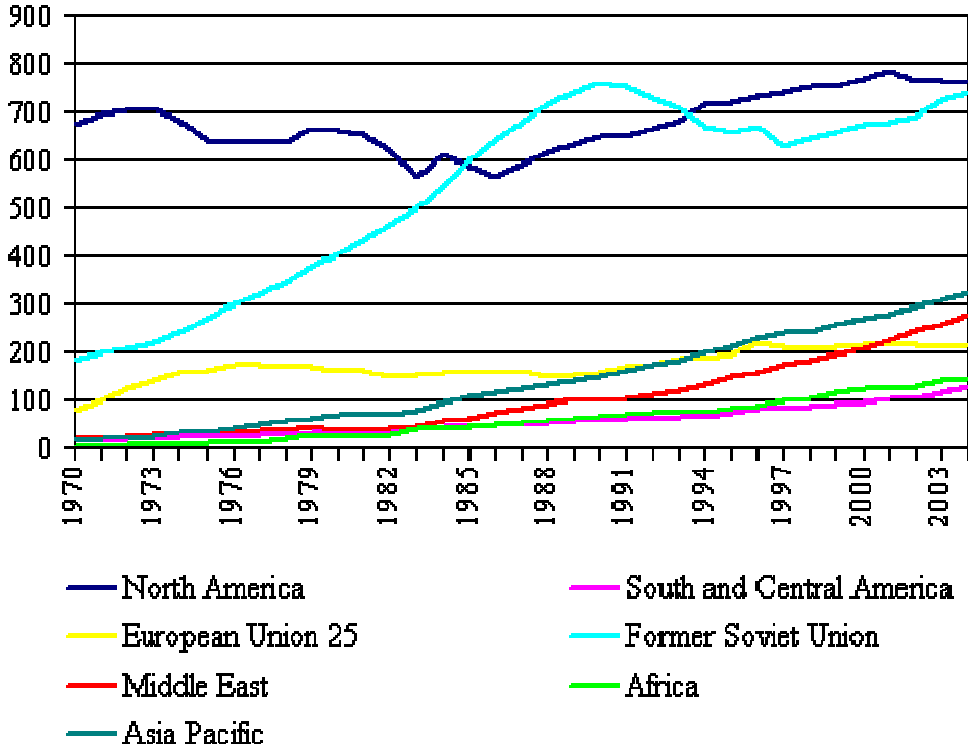
The former Soviet Union holds the world's largest natural gas reserves, 38% of the world's total. Together with the Middle East, which holds 35% of total reserves, they account for 73% of world natural gas reserves.

In 2000 total world reserves were 150.19 trillion cubic metres. Global reserves more than doubled in the last twenty years.

World's ratio of proven natural gas reserves to production at current levels is between 60 and 70 years. This represents the time that remaining reserves would last if the present levels of production were maintained.

Natural Gas Production

Natural gas production (billion cubic metres), 1970-2004



Source: UNCTAD based on data from BP Statistical Review of World Energy June 2005

World main producing countries in 2000 were United States (22.9 % of world production) and the Russian Federation (22.5 of total production). Other major producing countries are Canada, United Kingdom, Algeria, Indonesia, Iran, Netherlands, Norway and Uzbekistan. These ten countries alone accounted for more than 86% of total natural gas production in 2000. North America and the Former Soviet Union together accounted for 59% of global production.

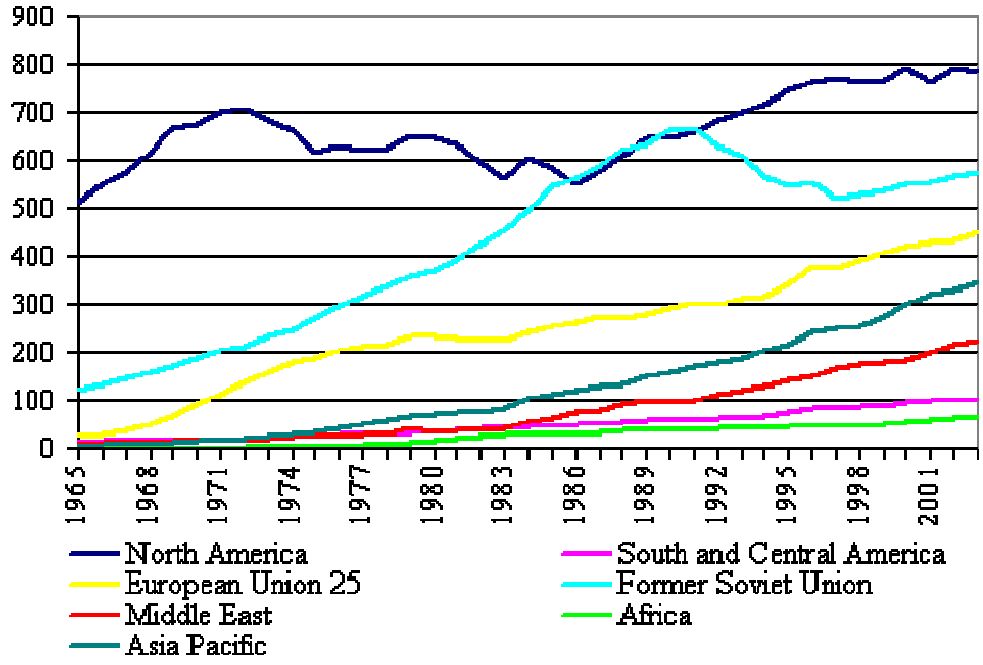
Total world production in 2000 was 2422.3 billion cubic metres. Production growth in 2000 was 4.3%, a significantly higher growth that the 1990-2000 annual average. Although production increased in all regions, the faster growth was recorded in the Middle East and Africa. During the nineties production rose in all regions but the Former Soviet Union.

World natural gas production is expected to grow in the future as a result of new exploration and expansion projects, in anticipation of growing future demand.

Natural Gas Consumption

Natural gas accounts for almost a quarter of world's energy consumption. As clearly shown in the graph below, consumption of natural gas has increased considerably in the last 30 years.

Natural gas consumption (billion cubic metres), 1965-2004



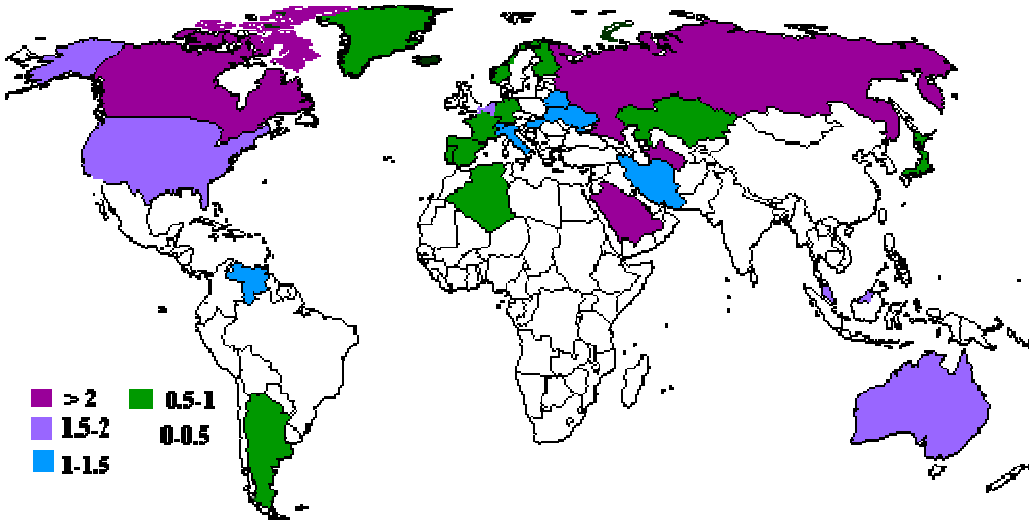
Source: UNCTAD based on data from BP Statistical Review of World Energy June 2005

World main consuming countries in 2000 were United States, accounting for 27.2% of total consumption, and the Russian Federation, with 15.7% of total consumption. North America and the Former Soviet Union together consumed 55% of total natural gas. The share of Europe in total natural gas consumption was 19.1%. These three areas account for three quarters of global consumption.

Consumption growth was 4.8% in 2000, with the highest rates of growth registered in Africa (12.8%) and Asia (7.8%). Total world consumption was 2404.6 billion cubic metres.

The most important energy agencies in the world are forecasting important increases in natural gas demand in the next 20 years. The largest increments in future gas use are expected to be in the developing countries.

Consumption per capita by country, tonnes oil equivalent



Source: UNCTAD based on data from BP Statistical Review of World Energy June 2004

International Trade

According to Cedigaz, 26.3% of total world marketed natural gas production was internationally traded. LNG (liquefied natural gas) tankers trade accounted for 21% of total international trade. The low share of international trade is due to the high transportation costs. Natural gas is complex to transport and requires large investments, while many gas resources are far from consuming centres. The construction and management of pipelines also poses legal and logistical problems.

Main exporting countries by pipeline in 2000 were the Russian Federation, Canada, Norway, Netherlands, Algeria and United Kingdom. The main importing area by pipeline, apart from United States, which took hold of all Canadian exports, was Europe.

Most LNG trade takes place in Asia-Pacific, with Indonesia, Malaysia and Australia as exporting countries and Japan as the main importing country. Algeria and Qatar are also major exporters of LNG.

World LNG infrastructure as for World LNG Source Book 2001 (Gas Technology Institute):

- Twelve countries have liquefaction facilities: Abu Dhabi, Algeria, Australia, Brunei, Indonesia, Libya, Malaysia, Nigeria, Oman, Qatar, Trinidad and Tobago, and the United States.

- 38 receiving terminals are operating in ten countries: 23 in Japan, three in Spain, three in the U.S., two in Korea, two in France, and one each in Belgium, Greece, Italy, Taiwan Province of China, and Turkey.

Interactive map - Major trade movements (billion cubic metres), 2004

By pipeline

Canada Netherlands Norway Russian Federation

Liquified Natural Gas (LNG)

Qatar Algeria Indonesia Malaysia

Source: UNCTAD based on data from BP Statistical Review of World Energy June 2005

Regional Markets

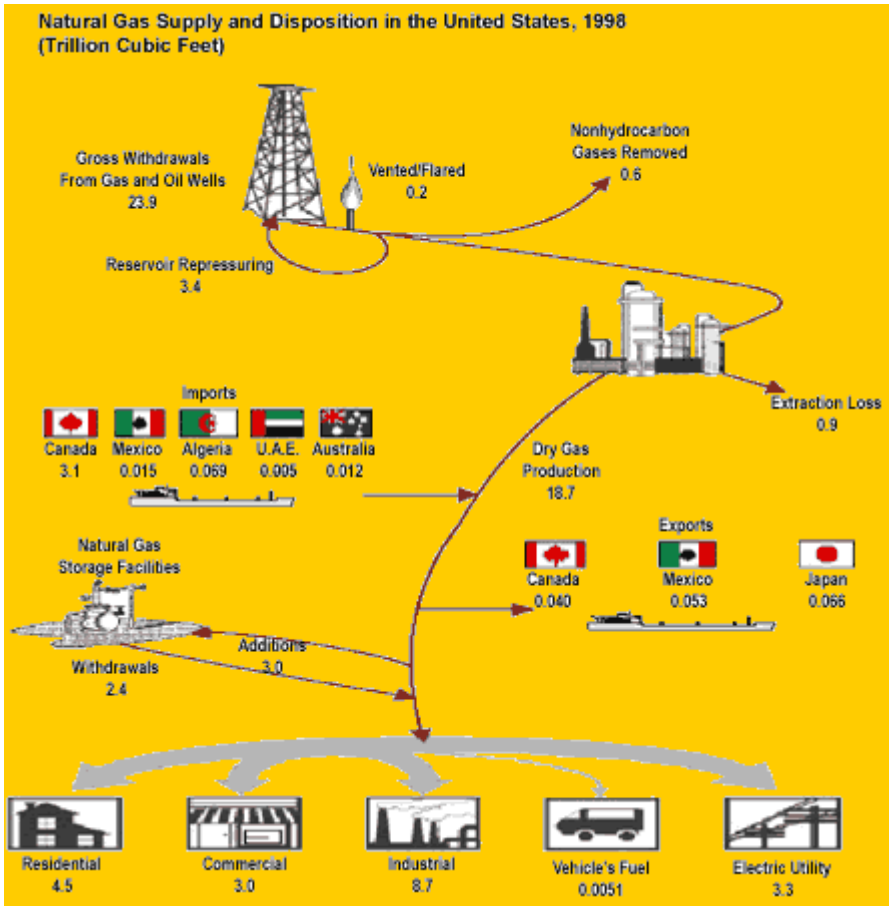
Due to the low weight of international trade in total world production, there is not a globalized natural gas market but rather regional markets, which vary in terms of their organization, maturity and market structures. The main areas are North America, Western Europe and Former Soviet Union. Other regional markets for natural gas are increasing in importance, as the Asian-Pacific or Latin American markets. Gas demand in Africa, South Asia or China is mainly met by domestic or regional sources. The Middle East is primarily a supplier region.

North America

The countries of North America constitute a very integrated and mature market for natural gas. The North American natural gas market is almost self-sufficient. The liberalization process in natural gas market started as early as the seventies in Canada and United States, and they are the countries who have gone furthest in opening the market to competition.

The United States is the first world producer and consumer of natural gas. According to USEA (United States Energy Association) "Toward a National Energy Strategy", the number of natural gas consumers has been growing these last years to reach in 2001 totals nearly 175 million Americans. Natural gas is extracted from 288,000 producing wells and transported by 125 natural gas pipeline companies through a 1.3 million-mile network of underground pipes to more than 1,200 gas distribution companies who provide customer service in all the 50 states. Almost all the gas consumed in the United States is produced in North America. Large deposits of natural gas are known to exist in about half of the 50 states, but just five states (Texas, Louisiana, Alaska, New Mexico and Oklahoma) hold more than one half of the country reserves.

The following graph reflects the functioning of the natural gas market in USA in 1998:



Source: Energy Information Administration

* For detailed information on natural gas markets in North America, see: U.S. Energy Information Administration, Natural Resources Canada-Natural Gas Division

Western Europe

The reserves of natural gas in Western Europe are limited, accounting for less than 5% of global resources. At present, the European market is under structural changes resulting from the liberalization process that is taking place. Main producing countries are Netherlands, Norway and United Kingdom. The gas industry in Europe consists mainly of downstream activities undertaken by transmission and distribution companies.

More than 30% of gas consumption is met by pipeline imports from Former Soviet Union and Algeria as well as LNG imports from North Africa. Import dependence is expected to continue in the future, although supplies are considered to be at reasonable distance. The structure of the natural gas supply and transport system in Europe is shown in the following graph:

Source: Eurogas

* For more information on European natural gas market:
European Union-DG Energy & Transport , Eurogas

Former Soviet Union

The Former Soviet Union holds the largest proved world reserves of natural gas. The Russian Federation is the second major producing country and the world leading exporting country. Natural gas is the predominant fuel in Russia, accounting for nearly half of the country's domestic consumption. The Russian Federation exports all the gas that is not consumed domestically. Before the break-up of the Soviet Union, the majority of this gas was exported to Eastern Europe. Since then, Russia has continued to supply to the Commonwealth of Independent States and to Eastern Europe but trying to diversify geographically its exports, with more than 62% exported outside of traditional destinations. Apart from Russia, Turkmenistan is the only significant exporter. Russian natural gas industry is a monopoly run by Gazprom, which controls more than 95% of production.

* For detailed natural gas market overviews on different countries, see:
Oilonline
Energy Information Administration
International Gas Union

Marketing chain

Market structure

The natural gas industry is large, capital intensive and highly concentrated. Since natural gas exploration and production are closely linked to oil exploration and production, major oil companies are involved in the natural gas sector. On the other hand, transmission and distribution of gas are more similar to electricity transmission and distribution.

Traditionally, in a highly regulated natural gas market, natural gas producing companies explored and produced the gas, which was then sold to pipeline companies and transported to local distribution firms who, in turn, put the natural gas in the market for final consumers. The industry was generally vertically integrated and natural gas and transportation services were provided as a "bundle" to end-users. Natural gas industry was a natural monopoly, dominated by State-owned utilities. However, natural gas markets liberalization is changing this situation in many countries, leading to a process of "unbundling" supply from transportation of natural gas and enlarging the choice of consumers. Pipeline or transporting companies are increasingly independent from producers or distributors, although sometimes sell gas directly to large customers.

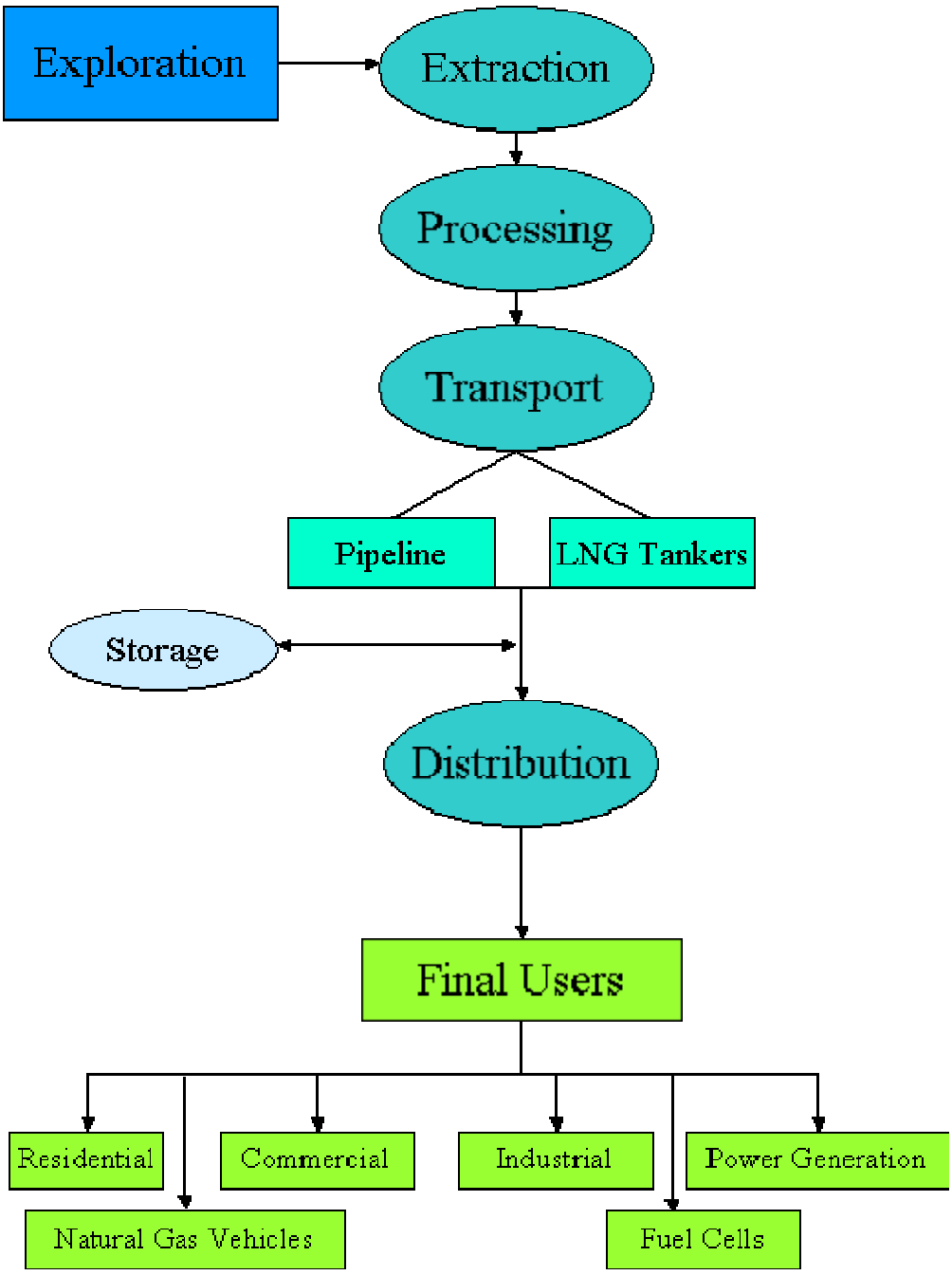
The structure of the natural gas markets is experiencing challenging mutations in the age of liberalization. The natural gas sector is undergoing fundamental restructuring, which is linked to the opening up of world gas markets to giant multi-energy companies, for whom natural gas will play a key role. There is fierce competition among energy companies for entering the market and operating resources and markets. The industry is witnessing mergers and acquisitions, restructuring and regrouping, with the creation of multi-utilities and services businesses as well as re-focused gas enterprises with international extension of gas companies' participations and activities and the arrival of newcomers across borders and across sectors. Vertical integration has therefore been reduced and there has been increasing horizontal integration in the energy sector

In the US market, for example, where the liberalization process of natural gas markets has gone further, there has been a move away from a market of stable but controlled prices and long-term contracts. The natural gas is now a dynamic, highly competitive business with flexible pricing, an active spot market, and widespread use of short- to medium-term contracts. This is causing a fundamental change in the way each of the traditional participants of the industry operates: producers, pipelines, gas utilities, and industrial users. New market participants as the natural gas marketers, who link buyers and sellers of natural gas, have emerged.

Delivery of natural gas to customers is normally made by local distribution companies (LDCs), which may be owned by investors or by municipalities (public gas systems). For many years they have had exclusivity on distribution to specific areas. However, reforms in natural gas markets are opening them to competition. End users are allowed to buy gas directly from producers, pipelines, marketers and other LDCs. They can also have different

contracts for storage and other services as well as get discounts if they gather with others. Most large natural gas users tend to buy gas directly from producers or marketers, while residential, commercial and industrial customers continue with LDCs.

Natural gas chain



Source: UNCTAD Secretariat

Processing operations

The process of natural gas is simple and similar to that of oil. Gas is extracted from the earth or the oceans by drilling from a well and then moved by pipeline or boats to a cleaning and processing plant and then to a gas grid or storage facility.

Exploration

Searching for natural gas is a very important stage of production. In the early years of the natural gas industry, when there was little understanding of natural gas, wells were dug only by intuition. However, at present, since costs of extraction are extremely high, companies cannot risk drilling in the wrong place. Geologists now play a central role in identifying natural gas formations. In order to find an area where natural gas is most likely to be discovered, they evaluate the structure of the soil and compare it with other areas where natural gas has been found. Later, they carry out specific tests as studying above ground rock formations where natural gas traps may have been formed. Prospecting techniques have evolved through the years in order to provide valuable information on the possible existence of deposits of natural gas. The more accurate these techniques get the higher the probability of finding gas when drilling.

Extraction

Natural gas is captured by drilling a hole into the reservoir rock. Drilling can be onshore or offshore. Equipment used for drilling depends on the location of the natural gas trap and the nature of the rock. If it is a shallow formation a cable drilling can be used. It raises and drops repeatedly a heavy metal bit into the earth's surface. In deeper formations rotary drilling rigs are used. Drilling rigs are used in most of the wells at present. This method consists of a sharp bit to drill through earth and rock layers.

Once natural gas has been found it has to be recovered efficiently. The most efficient recovery rate is characterized by the maximum quantity of gas that can be extracted during a period of time without damaging the formation. Several tests must be taken at this stage.

Most often, the natural gas is under pressure and will come out of the hole on its own. In some cases, pumps and other more complicated procedures are required to remove the natural gas from the ground. The most common lifting method is rod pumping.

Processing

Natural gas processing implies the gathering, conditioning and refining of raw natural gas in order to convert it in useful energy for its different applications. This processing involves first the extraction of the natural gas liquids from the natural gas stream and then the fractioning of the natural gas liquids into their separate components.

Transport and Storage

Once natural gas is processed it goes into a transmission system in order to be transported to the area where it will be used. It can be transported by land through pipelines, which are normally made of steel piping and measure between 20 and 42 inches of diameter. Since gas is moved at high pressures, there are compressor stations along the pipeline in order to maintain the level of pressure needed.

Compared to other energy sources, natural gas transportation is very efficient because the portion of energy lost from origin to destination is low. Pipelines are one of the safest means of distribution of energy because the pipeline system is fixed and underground.

Natural gas can also be transported by sea. In this case, it is transformed into liquefied natural gas (LNG). The liquefaction process removes oxygen, carbon dioxide, sulphur compounds and water. A full LNG chain consists of a liquefaction plant, low temperature and pressurized transport ships and a regasification terminal

Before natural gas reaches consumers it can be stored in underground reservoirs so that the natural gas industry can meet seasonal demand fluctuations. They are usually located close to market areas. Thus, natural gas distribution companies can rely on stored gas in peak demand periods and service their customers continuously and on time. They can also sell natural gas in the spot market during off-peak periods.

* For detailed information on the natural gas line: http://www.naturalgas.org

Companies

Selected companies involved in the natural gas industry:

Gazprom: http://www.gazprom.com/
Lukoil: http://www.lukoil.com/
Yukos: http://www.yukos.com/
Sonatrach: http://www.sonatrach-dz.com/
Enron International: http://www.ei.enron.com/index.html
Louis Dreyfus Natural Gas: http://www.ldng.com/
CMS Energy: http://www.cmsenergy.com
El Paso Corporation: http://www.elpaso.com
Duke Energy: http://www.duke-energy.com
Williams Energy Services: http://www.williamsenergy.com/
Phillips Petroleum Company: http://www.phillips66.com/index1.htm
Triton Energy: http://www.tritonenergy.com/
Dynegy: http://www.dynegy.com/
TXU Corporation: http://www.txu.com/
Amerada Hess Corporation http://www.hess.com/
Embridge: http://www.enbridge.com/
BG Group: http://www.bg-group.com/index.html
ExxonMobil: http://www.exxon.mobil.com/index_flash.html
BP Amoco: http://www.bp.com
Shell: http://www.shell.com
Texaco: http://www.texaco.com
Chevron: http://www.chevron.com/
Conoco: http://naturalgas.conoco.com
TotalFinaElf: http://www.totalfinaelf.com/ho/fr/index.htm
Repsol-Ypf: http://www.repsol-ypf.com
Pemex Gas: http://www.gas.pemex.com/
Anadarko Petroleum Corporation: http://www.anadarko.com/
Apache Corporation: http://www.apachecorp.com/
Aurora Power: http://www.aurorapower.com/
PanCanadian: http://www.pcp.ca/
Westcoast Energy: http://www.westcoastenergy.com/index2.html
EnergyEast: http://www.energyeast.com/index.html
Cabot: http://www.cabotog.com/
Gateway Energy Corporation: http://www.gatewayenergy.com/
Unocal: http://www.unocal.com/
Marathon: http://www.marathon.com
Swift Energy: http://www.swiftenergy.com/Default.htm
Sempra Energy: http://www.sempra.com/
Equitable Resources: http://www.eqt.com/
NRG Energy: http://www.nrgenergy.com/
Kinder Morgan: http://www.kne.com/
Altagas: http://www.altagas.ca/
Alberta Energy Company (AEC): http://www.aec.ca/
Talisman Energy: http://www.talisman-energy.com/
Aeco Hub: http://www.aecochub.com/

Sabine Pipe Line (Henry Hub): http://www.sabinepipeline.com
Dominion: http://www.dom.com/
Equitrans: http://www.eqt.com
Exelon: http://www.exeloncorp.com
Production Gathering Company (PGC Gas): http://www.pgcgas.com
Atlantic LNG Company of Trinidad and Tobago: http://atlanticlng.com/
Rasgas: http://www.rasgas.com/
Gas Energia: http://www.gasenergia.com.br
Petrobras: http://www2.petrobras.com.br/ingles/1024x768.htm
Petroleos de Venezuela: http://www.pdvsa.com/en/
Ecopetrol: http://www.ecopetrol.com.co/
Norsk Hydro: http://www.hydro.com/
Statoil: http://www.statoil.com
Eni: http://www.eni.it
Edison: http://www.edison.it/english/
Gas Natural: http://www.gasnatural.com
Enagas: http://www.enagas.es/index.jsp
Centrica: http://www.centrica.co.uk
BC Gas: http://www.bcgas.com
Ruhrgas: http://www.ruhrgas.de/englisch/
Eon Group: http://www.eon.com/online/Push/en/start/8520270145/home
VNG: http://www.vng.de
Wintershall: http://www.wintershall.de
Distrigas: http://www.distrigas.be/
Tractebel: http://www.tractebel.be
Gas de France: http://www.gazdefrance.com
Suez Group: http://www.suez.fr/group/english/index.htm
Gas de Portugal: http://www.gdp.pt/
Italgas: http://www.italgas.it/
Gasum: http://www.gasum.fi/gasum/gasumint.nsf/WWWindexLan2?OpenPage
Gasunie: http://www.gasunie.nl/
Energiened: http://www.energiened.nl
Eneco: http://www.eneco.nl/
Svensk Naturgas: http://www.svensknaturgas.se/
Fortum: http://www.fortum.com/main.asp?path=1
Itera: http://www.iteragroup.com/english/new_design_index1e.htm
Ramco: http://www.ramco-plc.com/
Botas: http://www.botas.gov.tr/
Perenco: http://www.perenco.com/
Sasol: http://www.sasol.com
CEF: http://www.mbendi.co.za/cef/
Kogas: http://www.kogas.or.kr
Petronas: http://www.petronas.com.my/
Pertamina: http://www.pertamina.com
China National Offshore Oil Corp. (CNOOC): http://www.cnooc.com.cn
Petrochina: http://www.petrochina.com.cn/english/index.htm
Gas Authority of India: http://gail.nic.in/
Oil and Natural Gas Corporation: http://www.ongcindia.com/
Oman LNG: http://www.omanlng.com/
Kuwait Petroleum Corporation: http://www.kpc.com.kw/

Adnoc Group: http://www.adnoc.com
Qatar Petroleum: http://www.qp.com.qa/qp.nsf
National Iranian Oil Company: http://www.nioc.org/
Nigeria National Petroleum Corporation: http://www.nigerianoil-gas.com/upstream/nnpc.htm
Egyptian General Petroleum Company: http://www.egpc.com.eg/
Tokyo Gas: http://www.tokyo-gas.co.jp/index_e.html
Osaka Gas: http://www.osakagas.co.jp/indexe.htm
Heren: http://www.heren.com/
WTRG Economics: http://www.wtrg.com/
Mcdermott: http://www.mcdermott.com/
International Gas Consulting: http://www.intlgas.com/
Economatters: http://www.economatters.com
Enerdata: http://www.enerdata.com/
Fame Energy: http://www.fame-energy.com/
Cambidge Energy Research Associates: http://www20.cera.com/
Entergy: http://www.entergy.com
Refco Group: http://www.refco.com
Great Lakes Trading Company: http://www.gltc.com/
Barchart: http://www.barchart.com/
Aquila Energy Corporation: http://www.aquila.com/
Mirant: http://www.mirant.com/
PVM Energy: http://www.pvmenergy.com
Powerline Capital Group: http://www.powerlinecapital.com/
Triple Point Technology: http://www.tpt.com/
APB Energy: http://www.apbenergy.com/
E-futures: http://www.e-futures.com/
Great Pacific Trading Company: http://www.gptc.com/
Strategies and Tactics: http://www.strategies-tactics.com/
Nautica Financial Corporation: http://www.infinitytrading.com/
GSC Energy: http://www.hedger.com/e_lead.htm
Prebon Energy: http://www.prebon.com
Vitol: http://www.vitol.com/
Cargill: http://www.cargill.com/
Trafigura: http://www.trafigura.com/
Energy Shop: http://www.energyshop.com/
Natural Gas Browser: http://www.naturalgasbrowser.com/
Oil Site: http://www.ongc.com/

* For more detailed information on natural gas companies, please refer to: Natural Gas Companies Worldwide: Competition and Performance Indicators, Volume 6, Sheffield Energy and Resources Information, 2001: http://www.seris.co.uk/reports.htm

Technology

Developments in natural gas technology have played a leading role in improving the outlook for natural gas all around the world. Innovations in the natural gas industry occur constantly at any point in the natural gas supply chain as well as in the different natural gas applications. They increase efficiencies in the market, save energy, help to reduce costs and environmental impacts of the energy and allow for bringing the gas closer to the final user.

Exploration

The main technological advance in natural gas prospecting is seismology, which is the study of sound or seismic waves movements. It allows studying the lower layers of the earth´s crust without drilling into them. By analysing the effects of vibrations in the crust, geologists can assess the kind of rock that is present in a certain layer and how deep it can be found. With recent computing technology, the value of seismic data has increased and geologist can create three-dimensional maps of the rock layers beneath the surface. With this 3-D Seismic technology, a computer analyses the data obtained from thousands of seismic measurements and develops a 3-D model.

Geologists can also measure magnetic characteristics of rocks with magnetometers, which are devices whose technology has evolved considerably in order to place them properly in helicopters, airplanes and later in satellites.

Extraction

Innovations in drilling techniques have allowed for gathering more information about wells, drilling deeper and reducing costs. By drilling further into the earth it is also possible to have access to natural gas reserves that could not be reached before. Technological advances in drilling include measurement while drilling, automation of drilling rigs or horizontal drilling.

Processing

The most important methods of processing are the absorption and the cryogenic expander processes. They are sophisticated processes to treat natural gas and separate the natural gas liquids.

Transportation and Storage

The pipeline industry is constantly looking for improvements in capacity, safety, efficiency and cost-effectiveness in order to reduce transportation costs, which are an important proportion of the final price of natural gas.

Supervisory control and data acquisition systems (SCADA) are used to keep accurate and constant information about the pipelines. These are computer systems linked to satellite and telephone communications that allow getting information from the different sections of the pipeline and controlling the flow of gas. Producers can also have access to some of this information. Pipeline companies may also use PIGs (intelligent robotic inspection devices) to inspect pipeline interior walls, measure the interior diameter of remove debris.

Technological advances in the liquefaction process (Gas-to-liquids, GTL), in order to convert the gas in liquefied natural gas (LNG), favour the increase in international trade

Distribution

Research and development in natural gas delivery intends to develop both new gas applications, as the gas fireplace and cooling systems, and new technologies to reduce costs and improve efficiencies. Some of these technologies are flexible distribution tubing, plastic distribution pipe, electronic meter reading systems, computer mapping systems or new trenching techniques.

Distributors also need to control gas flows through computer technologies as valve regulation via satellite telemetry or SCADA (supervisory control and data acquisition).

Uses

Recent residential applications for natural gas are new gas heating and cooling system that uses heat-pump technology, combination space- and water-heater systems, high-efficiency direct-vent furnaces and boilers, gas spa and patio heaters, gas grills and lights, stacked washers and dryers, residential restaurant-type ranges and gas fireplace equipment.

The increasing use of natural gas as a preferred fuel for power generation is due to technological advances based on Combined Cycle Gas Turbines, which is the most efficient fossil fuel based technology for power generation, and on mixed heat and power generation (CHP or Cogeneration). This combination of power and heat increases efficiencies and favours a more rational use of the energy, allowing for reducing costs and environmental impacts. Technical progress is also behind the increasing use of natural gas in fuel cells or in natural gas vehicles.

* For more detailed and up to date information on natural gas technologies:

International Centre for Gas Technology Information: http://www.etde.org/abtetde/icgti.html

Gas Technology Institute: http://www.gri.org/

Strategic Centre for Natural Gas: http://www.netl.doe.gov/scngo

Naturalgas.org: http://www.naturalgas.org

Prices

Benchmark and Price Discovery Mechanism

As the world market for natural gas is fragmented in different regional markets, it is not possible to talk about a world price for natural gas. Although there is a market liberalization trend all over the world, in many countries natural gas markets are still highly regulated. As a result of different degrees of market regulation, natural gas prices differ among countries. In North America, for example, where the market is highly liberalized, prices are very competitive and respond to demand and supply forces. After liberalization, natural gas prices have declined significantly. On the contrary, in the Russian Federation, where there is a clear monopoly, domestic prices are kept artificially low while gas is sold in foreign markets at higher prices in order to recover loses. In Europe, sales price for natural gas is most often based on competition with alternative fuels.

Natural gas prices may be measured at different stages of the supply chain. At the beginning, there is the wellhead price. Prices are also measured for different end-user groups as residential, commercial, industrial consumer or electric utilities. Prices at the wellhead show high volatility depending on weather and different market factors. Increasing efficiencies in transport, storage and delivery allow for consumers to reduce the impact of price volatility.

In general, the main components of natural gas price are:
- wellhead price (the cost of natural gas itself or commodity cost)
- long-distance transportation cost
- local distribution cost

In North America, wellhead prices were the first to be deregulated. Transportation costs are still regulated by National Energy Boards, while local regulatory boards regulate local distribution costs.

According to EIA, in 2000 wellhead price represented 34% of residential natural gas price, while transport accounted for 19% and distribution to customers 47%. The largest share of the final price is made up by distribution costs. As most large industrial and commercial gas users tend to buy gas from producers or market makers, they reduce their price considerably.

The major demand factors are weather and economic activity. Due to the importance of the weather factor, natural gas demand is highly seasonal. Other forces affecting demand are population changes and natural gas user trends. Changes in legislation concerning air pollution control may lead to increasing demand for this clean fuel. Supply factors are transport availability and accessibility as well as the physical amount of natural gas being produced and the level of stocks.

Natural gas competes with other sources of energy as oil, electricity or coal. Natural gas price is particularly pegged to that of oil, since oil is natural gas closest substitute and supply of oil and natural gas are closely linked.

Like most commodities, natural gas prices are cyclical. Their increase as a result of higher demand encourages exploration and drilling (as it happened in 2000). Although it takes some time for the production industry to respond to a price signal, once production increases prices tend to fall. However, market fundamentals indicate that in the future natural gas prices may not fall to the low levels of the past years.

Main international benchmarks for natural gas prices in North America are Henry Hub (New York Mercantile Exchange) in USA and AECO (Natural Gas Exchange) in Canada. In Europe relevant benchmarks at present are the Heren Index (British National Balancing Point) or the Zeebruge Hub (Belgium). IPE (International Petroleum Exchange) Natural Gas futures price is also expected to become an international benchmark as Europe develops competitive markets.

* For more detailed information on natural gas prices see:

- Natural Gas Prices: Overview of Market Factors and Policy Options: ttp://www.cnie.org/NLE/CRS/abstract.cfm?NLEid=16791

- Natural Gas prices in the EU between 1998 and 2000, Eurostat, July 2000, American Gas Association- Issue Focus: Natural Gas Prices: http://www.aga.org

- Natural Gas Prices in Competitive Markets, IEA;1998: http://www.iea.org/textbase/nppdf/free/1990/gp98.pdf

Risk Management Instruments Markets and Contracts

Risk management instruments are well suited to manage the increasing price risk that accompanies the market changes resulting from liberalization.

Natural Gas Futures and Options are mainly traded in New York Mercantile Exchange, International Petroleum Exchange and Kansas City Board of Trade.

- **New York Mercantile Exchange**, NYMEX (http://www.nymex.com)

Nymex launched the world's first natural gas futures contract in April 1990. Options on natural gas futures were launched in October 1992. Open outcry trading is conducted from 9:30 A.M. - 3:10 P.M. After-hours trading in futures and options is conducted via the NYMEX ACCESS® electronic trading system from 7 P.M. to 9 A.M. on Sundays and 4 P.M. to 9 A.M., Mondays through Thursdays. All times are New York times. The market is traded in 10,000 million British thermal unit (BTU) contracts, with a minimum price fluctuation of 0.1 cents per million BTU indicating a change in value of $10.00 per contract.

The New York Mercantile Exchange, the world's leader in providing a market venue for trading physical commodities and managing their risk, is introducing a global, neutral,

electronic trading platform destined to become the premier exchange for forward trading and clearing contracts in a wide range of energy and metals products. Enymexsm will provide a one-stop shop for commodity risk management, combining the best of on-Exchange trading with products that were previously only available over-the-counter. By capitalizing upon the Exchange's 128 years of market expertise and more than two decades of designing and offering standardized energy futures and options contracts, enymexsm will eliminate the opaque pricing, lack of liquidity, and counterparty credit risk that exists in the phone-brokered OTC market and on other trading systems.

- **Kansas City Board of Trade** (http://www.kcbt.com)

While natural gas futures originated at the New York Mercantile Exchange, the contract offered there was oriented to the eastern U.S. market, leaving western natural gas marketers--who faced supply and demand situations different from those in the east--without a risk management tool. The Kansas City Board of Trade, following requests from the natural gas industry, stepped in to fill out this vacuum by launching its western natural gas contract.

- **International Petroleum Exchange, IPE** (http://www.theipe.com)

A group of energy and futures companies founded the IPE in 1980 and the first contract, for Gas Oil futures, was launched the following year. In 1997, despite the advantages of open outcry markets, the IPE moved away from tradition when launching its Natural Gas futures contract. This contract is traded through a revolutionary automated energy trading system (ETS) located within customers' offices. Many exchanges are looking into or introducing electronic trading systems in an effort to provide extra services to the market. The IPE is also looking to do this, for example, offering out-of-hours facilities for Members.

The IPE aims to become an integral part of the European natural gas market, as liberalisation and competition become established.

Other important exchanges in this area are:

- **Intercontinental Exchange** (http://www.intcx.com)

The Intercontinental Exchange is an Internet-based marketplace for the trading of over-the-counter energy. It represents the partnership of world leading financial institutions with some of the world's largest diversified energy and natural resource firms.

- **Natural Gas Exchange** (http://www.ngx.com)

NGX, located in Calgary, Canada provides electronic trading and clearing services to natural gas buyers and sellers in Alberta, one of the largest and most significant production areas of natural gas in North America. Since its inception in 1995, NGX has grown to serve over 120 customers with trading activity averaging 200 BCF (211 000 TJ) per month. Among the customers at NGX are most of the major North American players at the energy market. NGX has quadrupled turnover since 1997 and is expected to grow fast in the future on the basis of a new clearing structure and a wider range of products. Electronic trading is provided at the AECO/NGX Intra-Alberta Market Centre, NGX Empress Market Centre and the NGX Union Dawn Market Centre. NGX acquired the AECO "C" & NIT Daily Spot, One-Month Spot, and

Bid-Week Spot gas price indices (Alberta Gas Price Indices) from Canadian Enerdata Ltd. last September. NGX Canada Inc. (NGX) is a wholly owned subsidiary of OM AB (OM).

- **Altra Market Place** (http://www.altra.co.uk)

Formerly known as Altrade™, the Altra Market Place offers real-time online electronic trading for energy commodities where traders actively view and exchange bids and offers quickly and anonymously. Accessible 24 hours a day, seven days a week, the Altra Market Place benefits traders by offering extensive market price and volume discovery, enhanced information about supply and availability, reduced administration costs and reduced transaction risk due to supply and payment guarantees.

* For details on these exchanges and contract specifications, visit their corresponding homepages.

Main Physical Markets

Apart from the use of risk management instruments, natural gas is traded in contracts for physical delivery. There are spot market sales or long-term contracts.

Traditionally natural gas contracts were long-term contracts between integrated natural gas companies and users, with fixed prices, reduced supply and price risks and little flexibility. The importance of these contracts has been reduced as a result of liberalization of the industry, while spot markets have increased their presence. Spot markets allow for greater flexibility to balance supply and demand in order to react to changing market conditions. Participants in the natural gas markets can then form a portfolio of long and short-term contracts. However, most of the gas that is internationally traded is under long-term contracts.

Spot markets are generally created in areas with concentration of buyers and sellers as pipeline interconnections located close to large consuming regions or major terminals of gas producing countries. Spot prices are then set at various locations. Main references for spot prices in North America are: New York City Gate, Henry Hub Louisiana, Chicago City Gate, Katy Hub Texas, So. Calif. Border or AECO Hub (Canada).

Price Links

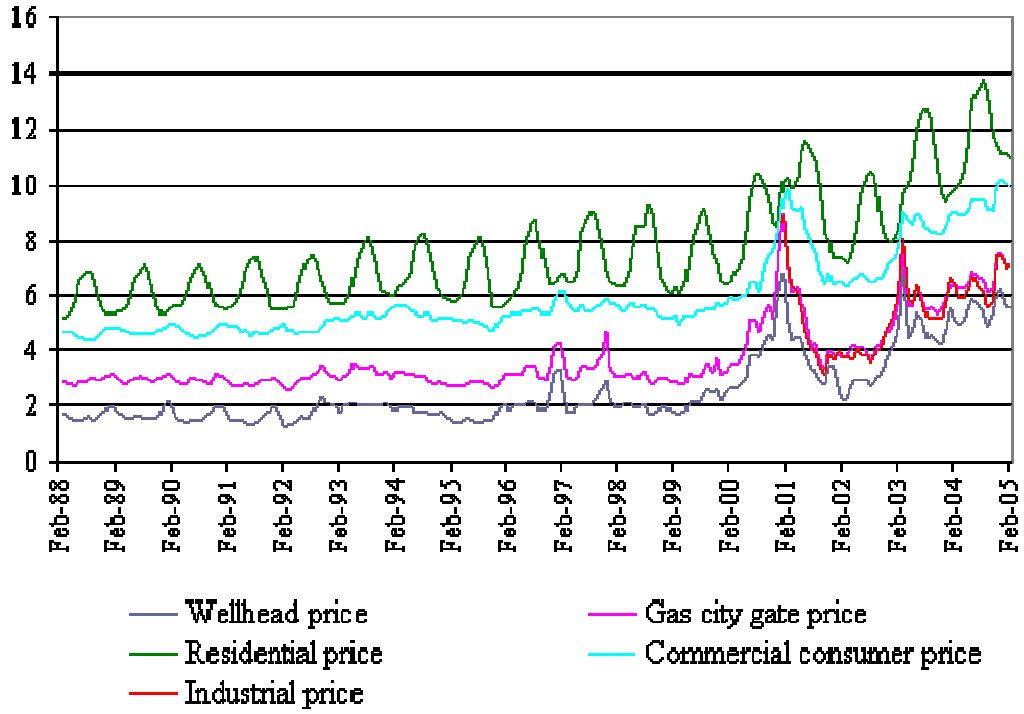
Natural Gas Intelligence
EIA Natural Gas Weekly Update
EIA Short Term Energy Outlook
EIA Natural Gas Markets, Status and Outlook:
Eurostat
Energy Intelligence Group
Reuters
CNN
Alaron Trading Corporation
Barchart.com
Bloomberg

World Bank Commodity Price Data (Pinksheet)
Oil and Gas Online
Crude Oil and Natural Gas Prices (worldnews.com)
WTRG Economics
TFC Commodity Charts
Enerdata
Energy Shop
Ino.com
The Heren Report
Energy and Power Risk Management Magazine

Historical Prices

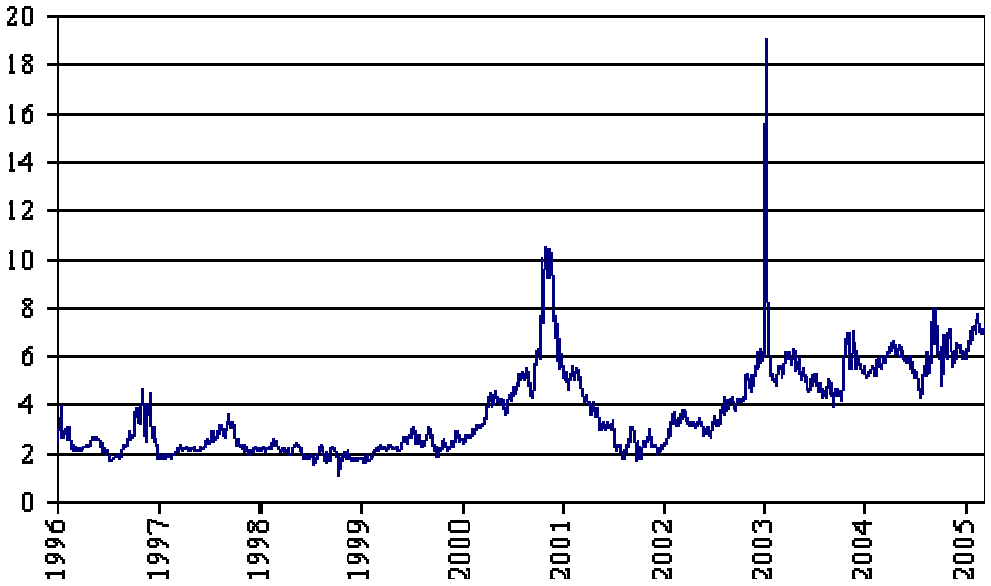
The following graphs illustrate to some extent the evolution and volatility of natural gas prices in the last years.

Distribution of the different gas prices (dollars per thousand cubic feet), from wellhead to commercial consummer, USA, 1988-2005



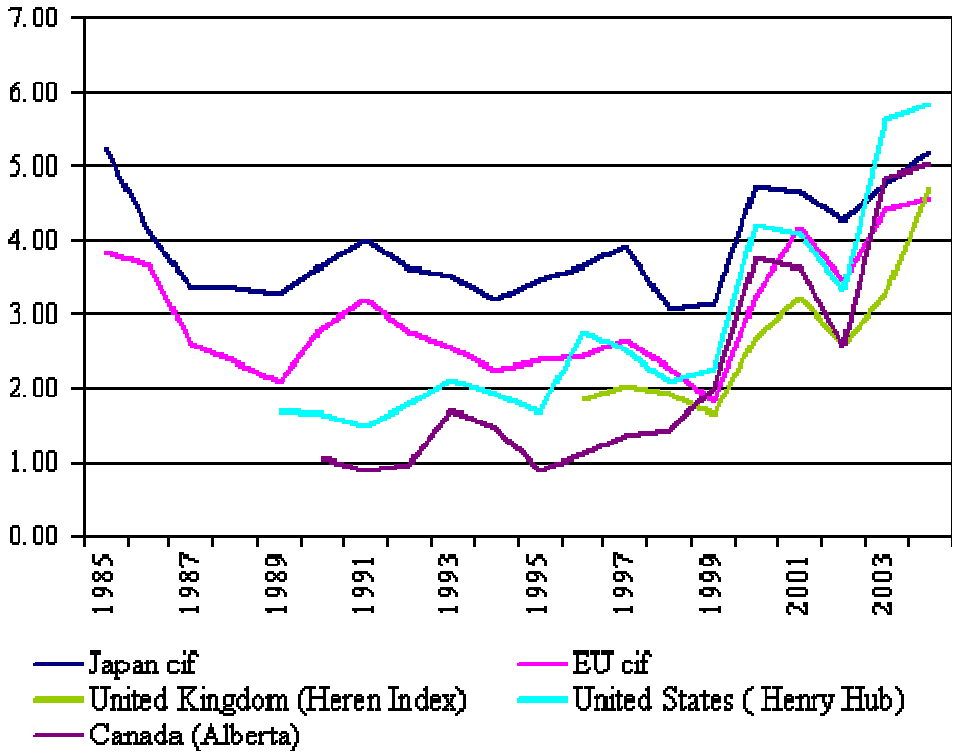
Source: UNCTAD based on data from Energy Information Administration

Natural gas, Henry Hub ($/MMBTU), 1996-2005



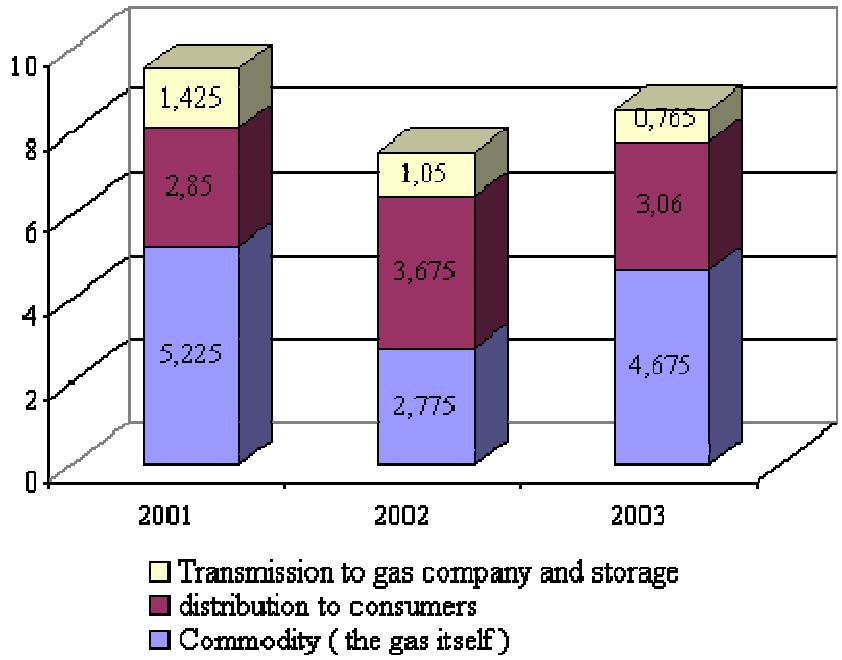
Source: UNCTAD based on data from Thomson Datastream

International gas prices (US $ per million BTU), 1985-2004



Source: UNCTAD based on data from BP Amoco, Statistical Review of World Energy 2005
Note: Japan cif is for LNG

Breakdown of natural gas prices



Source: UNCTAD based on data from Energy Information Administration, natural Gas Monthly May 2003

Economic policies

Natural Gas Markets Liberalization

The main policy trend in natural gas markets in the last two decades has been the liberalization of the market, in both developed and developing countries. This process is often called deregulation, although it does not mean the absence of regulations in the market. Traditionally, governments have considered the energy sector in general as a strategic product and too important to leave it to market forces. Natural gas was regarded as a natural monopoly and stated-owned companies generally run the industry. After the energy shortages of the seventies, the sector has undergone structural reforms to open the markets to competition in order to cut costs and improve economic performance and efficiency. These liberalization policies take different forms and speeds depending on the country. They can include privatisation, introduction of competition based on third party access to gas supply infrastructure, demonopolization or regulatory reforms. The aim is to reduce Governments direct intervention in the markets and to provide efficient, transparent and competitive prices for natural gas, and energy in general. (*Impacts of this liberalization process in the structure of the natural gas markets are presented in the Marketing Chain Section, under Market Structure*)

Liberalization process was initiated a few years ago in countries such as United States, Canada, United Kingdom and Australia. Movements toward liberalization are still ongoing in the European Union and other countries.

In the United States, natural gas industry has gone through a metamorphosis since the enactment of the Natural Gas Policy Act of 1978, changing from an almost totally regulated industry to a virtually free market. The 1992 Order 636 of the Federal Energy Regulatory Commission that required pipelines to unbundle their transportation, sales and storage services was also of great importance. Pipelines moved from being sellers to being primarily shippers of gas. Producers, pipeline affiliates, distributors and marketers can play a larger role in the supply of natural gas to end-users.

In the European Union, governments are revising the regulatory framework of their gas industry, in the context of the EU Natural Gas Directive 98/30 on gas market opening. The Directive establishes some common rules for the transmission, distribution, supply and storage of natural gas. The gas market is to be opened to competition progressively, during a 10 year period, to reach in 2008 at least 33% of total gas consumption. The first stage had to be implemented by 10th August 2000, opening the markets to competition for consumers representing at least 20% of the gas market. Degrees of liberalization vary among countries, being United Kingdom the most liberalized market and France the least liberalized one, as for June 2001.

* A detailed study on natural gas market liberalization is presented in "Promoting competition in the natural gas industry", OECD (DAFFE/CLP(2000)18), 2000 http://www.oecd.org/dataoecd/34/23/1920080.pdf.

Information on US natural gas market regulations as well as the Natural Gas Policy Act of 1978 can be obtained from Federal Energy Regulatory Commission: http://www.ferc.gov. Information on the liberalization process and the single natural gas market in the EU, as well as the full text of the Directive 98/30 can be obtained from European Union-DG Energy & Transport: http://europa.eu.int/comm/energy/en/gas_single_market/index_en.html

Energy Policy

Main objectives of energy policy include: economy, security of supplies, environmental compatibility, quality control and consumer protection. There is a policy move in many countries to encourage a greater use of natural gas within the total energy mix. Environmental and security concerns may result in legislation encouraging an increasing use of natural gas because of its clean-burning properties in relation to other fossil fuels. Natural gas plays an important role for energy diversification.

Natural gas policies are also needed to promote investment and development of natural gas supplies, to facilitate construction of natural gas infrastructure and to develop domestic and cross-border natural gas transport as well as markets for natural gas products and services.

Environmental Regulations

- **Kyoto Protocol and Climate Change**

Climate change is an important and widely discussed international issue. Surveys suggest that human activity, including the release of greenhouse gases, is affecting global climate. One of the steps toward the prevention of global warming was the Kyoto Protocol

The 1997 Kyoto Protocol commits Parties to individual, legally-binding targets to limit or reduce their greenhouse gas emissions, adding up to a total cut of at least 5% from 1990 levels in the period 2008-2012. The targets range from a -8% cut for the EU and several other countries, to a +10% increase for Iceland (Under the terms of the Protocol, the EU may redistribute its target among its 15 member states. It has already reached agreement on such a scheme, known as gas "bubble".) The targets cover emissions of the six main greenhouse gases, namely: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydro fluorocarbons (HFCs), per fluorocarbons (PFCs) and sulphur hexafluoride (SF6).

The ratification process of the Kyoto Protocol is still ongoing. At the Conference of the Parties Sixth Session, part 2 (COP6), held in Bonn in July 2001, the 180 members (excluding United States) of the United Nation Framework Convention on Climate Change reached an agreement on the Kyoto Protocol. Under this agreement, the Protocol shall enter into force and become legally binding after the ratification of at least 55 parties to the Convention, including countries representing at least 55% of the total 1990 carbon dioxide emissions from this group.

A way to reduce greenhouse gas emissions would be to encourage the use of cleaner energy sources. In this context, natural gas, as the cleanest of the fossil fuels, could play an important role in an integrated global greenhouse gas reduction strategy. Natural gas provides energy efficiency and energy saving opportunities.

* For more information on climate change, see Intergovernmental Panel on Climate Change: http://www.ipcc.ch. The full text of the Kyoto Protocol can be obtained from the United Nations Framework Convention on Climate change: http://www.unfccc.de. For natural gas and the environment, see International Gas Union and the Environment: http://www.igu.org or Eurogas: http://www.eurogas.org/natgas/envir.htm

- **The market of greenhouse gas emission rights**

Some European Governments have recently introduced laws for industries producing greenhouse gas. In fact, international agreements set the maximum limits of emissions by country or by regions. As an example, the United Kingdom has introduced in the market the rights to emit gas (each right corresponds to an amount of gas). All the industries that produce this kind of gas have to buy as many rights as they need. Besides, these rights can be resold. In this context, the company Dupont UK, has resold in September 2001 its rights to a Japanese company operating in oil from the North Sea. This has been the first international transaction with this kind of contract. The objective for Dupont is to get back a part of the money paid to the Government, since they had lower greenhouse gas emissions than rights paid, and re-invest the amounts in research in order to reduce other emissions.

The Energy Charter

(http://www.encharter.org/index.jsp)

The Energy Charter Treaty and the Energy Charter Protocol on Energy Efficiency and Related Environmental Aspects were signed in December 1994 and entered into legal force in April 1998. Up to 2001 the Treaty has been signed or acceded to by fifty-one states. The Treaty was developed on the basis of the European Energy Charter of 1991. Whereas the latter document was drawn up as a declaration of political intent to promote East-West energy cooperation, the Energy Charter Treaty is a legally-binding multilateral instrument, the only one of its kind dealing specifically with inter-governmental cooperation in the energy sector.

The fundamental aim of the Energy Charter Treaty is to strengthen the Rule of Law on energy issues, by creating a level playing field of rules to be observed by all participating governments. The Treaty's provisions focus on five broad areas: the protection and promotion of foreign energy investments, based on the extension of national treatment, or most-favoured nation treatment (whichever is more favourable); free trade in energy materials, products and energy-related equipment, based on WTO rules; freedom of energy transit through pipelines and grids; mechanisms for the resolution of State-to-State or Investor-to-State disputes; and energy efficiency and related environmental aspects.

Energy Services and World Trade Organization

As for 2001, energy services are not classified as a specific sector neither in the UN CPC nor in the WTO classification list. In the framework of the ongoing multilateral negotiations on services, some countries (United States, European Communities, Canada, Venezuela, Chile and Norway) have tabled proposals on energy services at the WTO. They aim at a further liberalization in the energy services sector.

* A discussion on this subject is presented in Note by the UNCTAD Secretariat TD/B/COM.1/EM.16/2: Energy Services in International Trade: Development Implications, June 2001. See also Trade Agreements, Petroleum and Energy Policies (UNCTAD/ITCD/TSB/9), 2000.