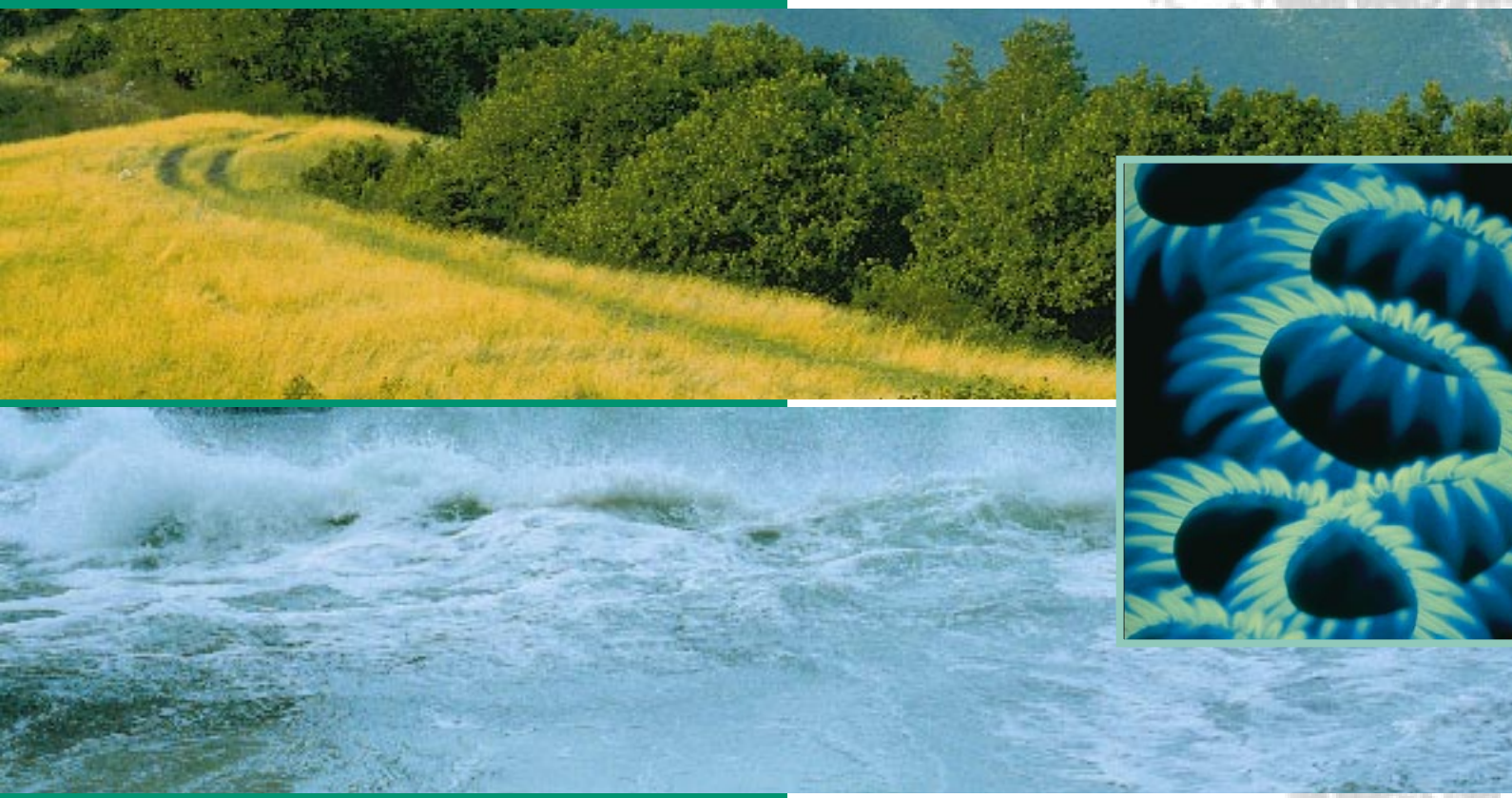
The gas industry and sustainable development



eurogas

Introduction

In 1992 at the United Nations Conference on Environmental Development in Rio, world Governments committed themselves to a process to achieve a balance of economic, social and ecological objectives, in other words **sustainable development**. Agenda 21 adopted at this Earth Summit set a strategy for global growth which would respect the world's environment, also at local and regional level and improve the welfare of its peoples.

> *Sustainable Development : Development which meets the needs of the present without compromising the ability of the future generations to meet their own needs*
> *(Brundtland Report 1987)*

By 2002, there is planned a second UN Conference on Sustainable Development, for which Governments should develop programmes and action plans on achieving this objective.

Since 1992, scientific focus on the harmful impact of anthropogenic activities on global ecology, a foremost concern of which relates to the climate change effect, has further justified and strengthened the policy objective of sustainable development. Public concern and the increasing priority which the public attaches, especially in Europe and other developed countries, to environmental questions reinforce policy makers' drive.

The commitment to sustainable development has been echoed in EU legislation, programmes and statements, and is expected to remain a key element underpinning much European strategic thinking and policy making into the next millennium. The EU treaty declares that policy will pursue the objectives of

- preserving, protecting and improving the quality of the environment;
- protecting human health;
- prudent and rational utilisation of natural resources;
- promoting measures at international level to deal with regional or worldwide environment problems.

Natural gas as the cleanest fossil fuel is uniquely placed to help meet these objectives while at the same time contributing significantly to economic and industrial growth and the comfort of Europe's households.

The environmental advantages of natural gas, its highly efficient use, its competitive price and its large deposits worldwide, make this source of energy an ideal form to meet future energy demand on a sustainable development basis.

Natural gas companies are ready to meet the challenge of a sustainable energy policy. Ensuring the continuing availability of Europe's gas supplies on a competitive basis well into the next century company policies at the same time give high priority to environmental concerns. Research and development into modern gas technologies aim to enhance further the potential environmental benefits of natural gas use. On a competitive basis, companies promote the potential of energy efficiency and rational use of energy which will bring economic benefits to consumers and to the environment. Technological and technical know-how and expertise, sound environmental practice and the highest health and safety standards developed by European gas companies are promoted Europe-wide and internationally.

This brochure explains the advantages offered by natural gas in the context of sustainable development.

THE LOW ENVIRONMENTAL IMPACT OF NATURAL GAS

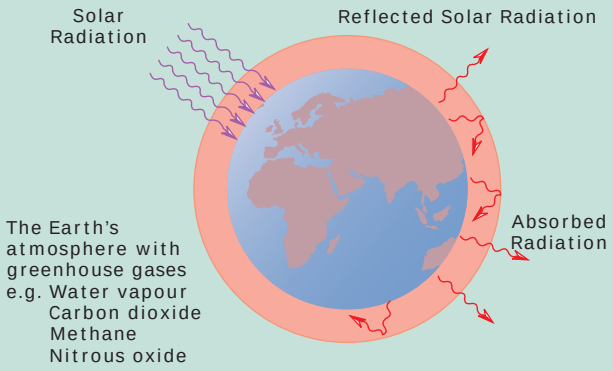
ENVIRONMENTAL EFFECTS

All energy forms have an impact on the environment throughout their various life cycle stages including exploration, production, transmission, storage, distribution, final use and waste. The environmental effects vary between fuels and are different within each stage of the energy life cycle. The impact of natural gas, however, is much less than that of other fossil fuels. Consequently their substitution by natural gas leads to improvements for the environment generally, especially through reduced greenhouse gas emissions and less pollution in the air we breathe.

Environmental effects can occur on a local scale (noise, urban air pollution and changes in the landscape); on a regional scale (acid deposition); and on a global scale (potential global warming and ozone-layer depletion).

The use of natural gas, the combustion of which has lower emissions and can be used very efficienctly, gives an important contribution to the reduction of these environmental effects.

THE GREENHOUSE EFFECT

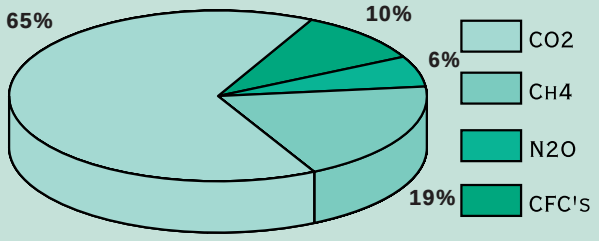


The science of climate change continues to evolve; much is still not known about the rate or degree of change over the coming decades. The Intergovernmental Panel on Climate Change (IPCC), however, has concluded that **there is a discernible human influence on global climate.**

There is increasing scientific evidence that emissions of greenhouse gases – mainly carbon dioxide (CO_2) - have an influence on climate change.

On the basis of data presented by IPCC, the relative contribution of anthropogenic emissions to the enhancement of the greenhouse effect is estimated to be : CO_2 65%; CH_4 19%; CFCs 10%; N_2O 6%.

Man-Made Influence On The Greenhouse Effect(*)

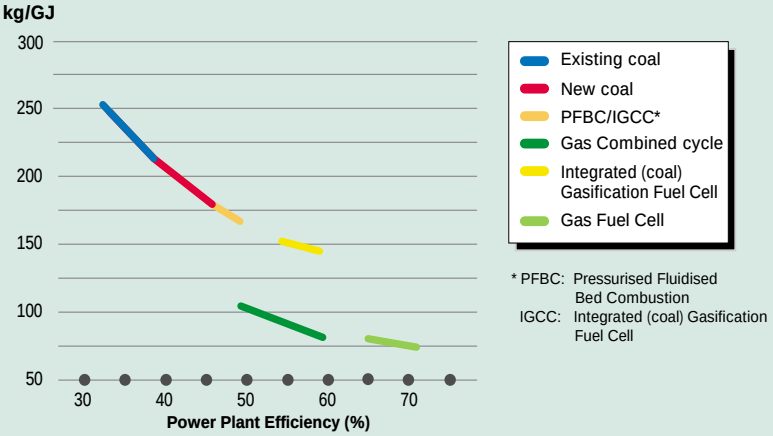


Source : IPCC

The combustion of fossil fuels is responsible for 75-90 % of all anthropogenic emissions of CO_2.

Because, however, of the higher hydrogen to carbon ratio in the composition of natural gas, the CO_2 produced by natural gas combustion is 25-30% lower than petroleum products and 40-50% lower than coal, for the same energy input.

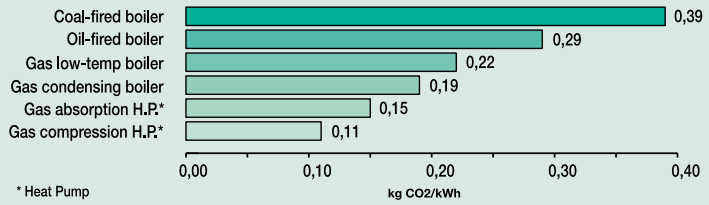
Carbon Dioxide Emissions Formed By the Combustion of Fossil Fuels



For a given energy performance, less energy supply is required with natural gas owing to the high energy efficiency of natural gas fired technologies :

- *easy processing*
- *efficient combustion*
- *clean combustion gas for high heat recovery and protection of process equipment*

CO_2 Emissions from Heat Supply Systems



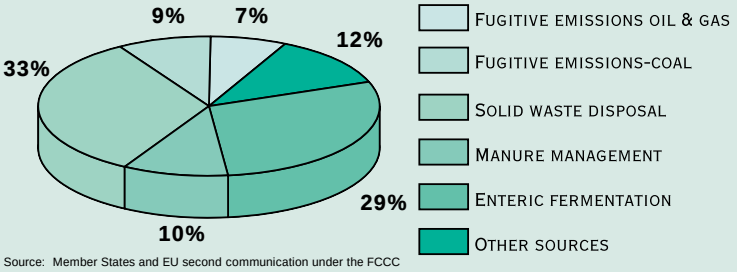
Carbon dioxide emissions per unit of energy output can be further reduced by using natural gas in high efficiency applications and technologies such as combined cycles for the production of electricity. Co-generation of heat and power is also a very efficient way to use gas and achieve a large reduction of CO_2 (and pollutants) to the atmosphere.

95% of the influence of energy industry activities on the greenhouse effect is due to carbon dioxide emissions, while other gases emitted by the energy industry only account for about 5%. One of these other gases is methane produced by natural sources as well as anthropogenic activities.

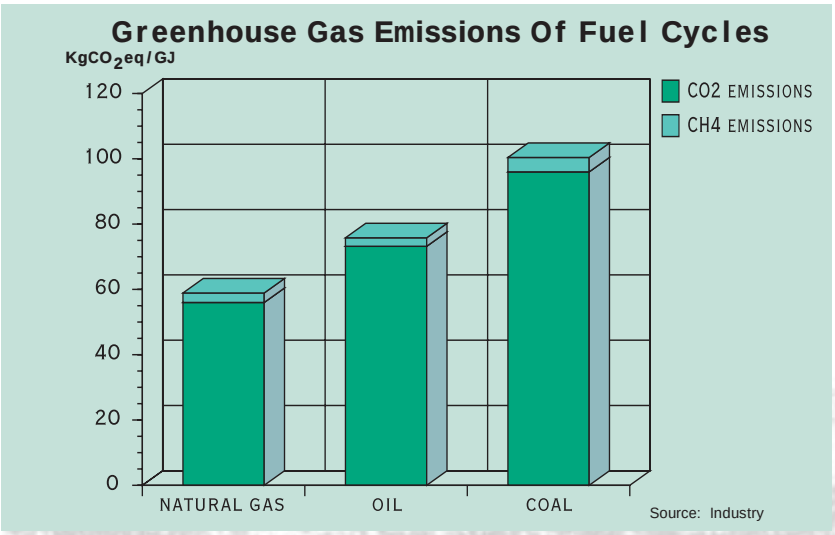
Emissions from gas industry activities are insignificant compared with emissions of methane from other anthropogenic sources.

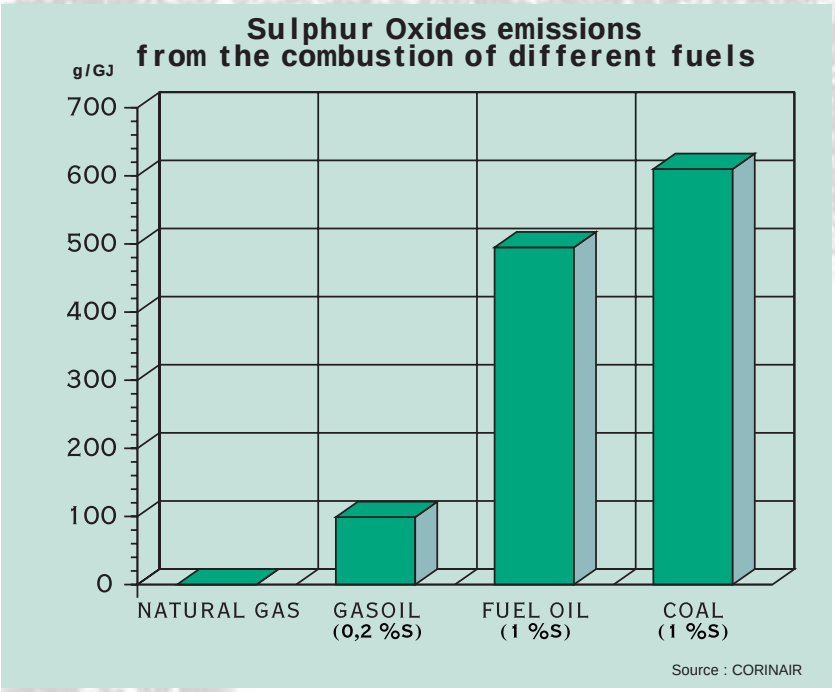
Estimates of the world-wide and EU leakage rate of natural gas, respectively at 1.3% and less than 0.7% of throughput, are well below the level of methane losses which would negate the climate change advantage of natural gas.

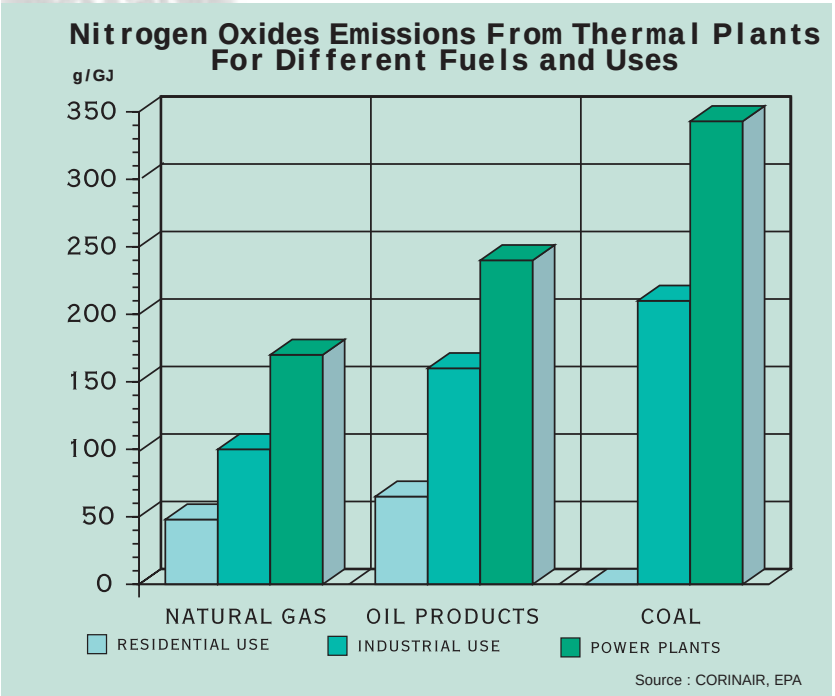
Methane Emissions by Source for EU (Total 21.9 Mt)



Source: Member States and EU second communication under the FCCC







Total greenhouse gas emissions from the natural gas cycle are much lower than those from coal and oil cycles for the same energy input, expressed as CO_2 equivalent emissions and calculated taking into account CO_2 and methane emissions and their global warming potential recommended by IPCC.

The leakage rate of natural gas cycle was assumed to be 0.7% of throughput. Natural gas would lose its advantage in reducing greenhouse gas emissions over the coal and oil cycles only for hypothetical leakage rates of 11% and 6% respectively which are far above the low levels achieved in EU systems. Since natural gas technologies are more efficient than coal and oil technologies, if the efficiency of utilisation is considered, the leakage rates required to lose the advantage of natural gas are even higher.

As natural gas is composed mainly of methane (CH_4), typically between 80-99%, depending on the source, with small amounts of other gaseous hydrocarbons, nitrogen and CO_2, and contains practically no pollutant-forming components like sulphur and its compounds, the exhaust of gas fired combustion plants is virtually free of sulphur oxides, dust and harmful heavy metals compounds.

The emissions of nitrogen oxides (NOx) depend both on fuel properties and on combustion processes because they are formed by the oxidation of molecular nitrogen at high temperature and of nitrogen compounds contained in the fuel. For the same use, NOx emissions increase passing from natural gas, to gasoil, fuel oil and coal. With low NOx combustion technologies these emissions are reduced and the best results are obtained with natural gas.

The combustion of natural gas results in lower levels of emissions compared to oil products and coal. This explains the environmental benefits for urban air quality and for transboundary air pollution of the trend towards increased use of natural gas instead of oil and coal.

Eurogas support for Europe's environmental objectives

Building on the environmental qualities and potential benefits offered by natural gas use the gas sector in Europe is committed to making natural gas a bridge to a sustainable future.

Responding to the increasing urgency of environmental questions the European Union is seeking to combat climate change, eg by promoting energy efficiency, combined heat and power, and renewables. At the same time policy makers seek to tackle the problems caused to the environment by the emissions of pollutants into the atmosphere and to seek to ensure that economic and industrial growth is achieved with respect to protection of natural resources and habitats.

Eurogas supports the direction of these policies which should be complemented by specific recognition of the positive contribution natural gas can make in the different areas.

Climate change

For the year 2000, the EU's objective was to stabilise CO_2 emissions at 1990 levels. Now under the terms of the Protocol agreed at the Third Conference of the Parties to the UN Convention on Climate Change in Kyoto in 1997, the aim is to reduce greenhouse gas emissions measured as CO_2 equivalents by 8% between 1990 and 2008-2012.

CO_2 emissions can be reduced by replacing other fossil fuels which emit more CO_2 per unit of energy produced, by natural gas, in both the production of electricity, and in end use applications.

> *"Switching from coal to oil or natural gas, and from oil to natural gas, can reduce (greenhouse gas) emissions".*
>
> *(Climate Change 1995 : Intergovernmental Panel on Climate Change (IPPC) - Second Assessment Report).*

Eurogas supports the objective of the Kyoto targets to reduce emissions of CO_2 and other greenhouse gases.

> *"The substantial reduction in CO2 emissions in the UK was mainly caused by fuel switching from coal to natural gas".*
>
> *(EEA's Environmental Assessment Report n°2 - European Environment in the EU at the turn of the century).*

natural gas fuelled (NVGs) vehicles produce some 20% less CO2 emissions than petrol driven vehicles.

At the same time, it is the continuing policy of the gas industry for safety, economic, and environmental reasons to prevent fugitive emissions from the gas chain of methane (CH_4) which is also a greenhouse gas. The gas companies make significant technical and financial commitments towards the objective. Depending on technical and operational configurations, companies undertake measures which are the most cost-effective and best suited to their particular circumstances.

Combined heat and power production

EU policy envisages at least the doubling of the current share of CHP in gross electricity generation by 2010 to 18%, with an estimated annual reduction of 150 $MTCO_2$ emissions.

Eurogas welcomes the Commission's initiative to promote CHP, and to dismantle barriers to its development. Natural gas should be the fuel of choice for CHP.

Energy efficiency

The target of the EU's Energy Efficiency Strategy is to realise the economic potential for energy saving of 18 % of primary energy consumption from 1995 to 2010.

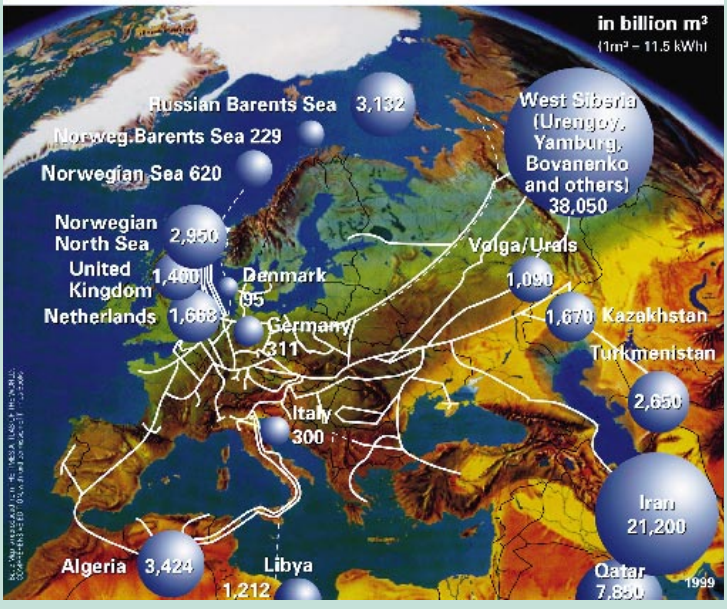
Eurogas considers that the potential offered by more rational use of energy should be developed to realise the economic and environmental benefits it will deliver. Eurogas supports initiatives leading to efficient, economic gas supply and seeks to maximise energy efficient end-use.

Natural gas and renewables

The EU indicative target for the contribution of renewable sources of energy (RES) to the EU's gross inland energy consumption by 2010 is 12 %.

Eurogas supports the initiative to encourage the development of Renewable Energy Sources (RES). The gas industry is exploring the potential of combining the use of gas with different RES.

Gas Reserves in Countries with Export Potential for the European Market



Proven world gas reserves have lifetimes now reaching beyond 2060 and total conventional reserves will last for 175 years at present consumption. Natural gas is the bridge to a cleaner energy future, involving not just renewable energy sources, but also hydrogen based systems.

Air pollution, environment and human health

EU policy identifies clean air as one of our most fundamental needs. Poor air quality affects health, ecosystems, food crops and architectural heritage, with concomitant social and economic impacts.

Pollutants can remain in the atmosphere long enough to be transported thousands of kilometres from the original polluting source. The transboundary transport of atmospheric pollutants has been and remains an important cause of concern in Europe and elsewhere. This has led to International Protocols and agreements requiring reductions of pollutant emissions.

Main air pollutants and their environmental impacts

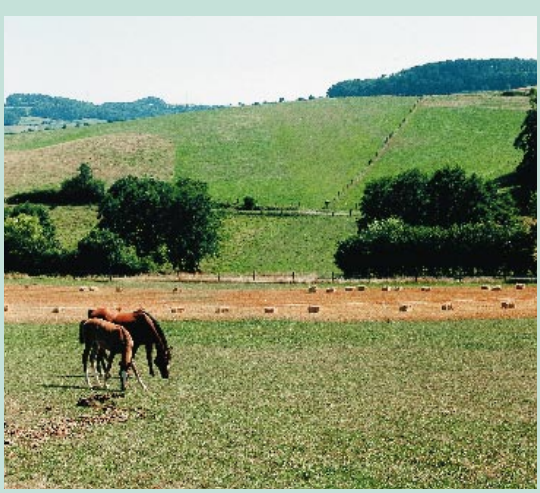
Environmental Impact	Caused by
Acidification	SO_2, NOx, NH_3
Eutrophication	NOx, NH_3
Ozone	VOCs, NOx,
Bioaccumulation of toxic substances	Heavy metals, POPs

The EU aims to combat this problem and meet its international obligations, through a package of measures related to air quality, acidification strategies, acting to reduce emissions of these harmful pollutants by the introduction of stricter emissions' limits and standards generally.

Eurogas aims to encourage the use of gas to improve local air quality conditions by promoting the substitution of more polluting fuels by natural gas, to contribute to the abatement of emissions.

Other ecological impacts

A body of EU legislation aims to maintain the ecology of Europe, protecting its landscape, fauna and flora, and minimising the impact of industrial and economic activity on the quality of life generally.



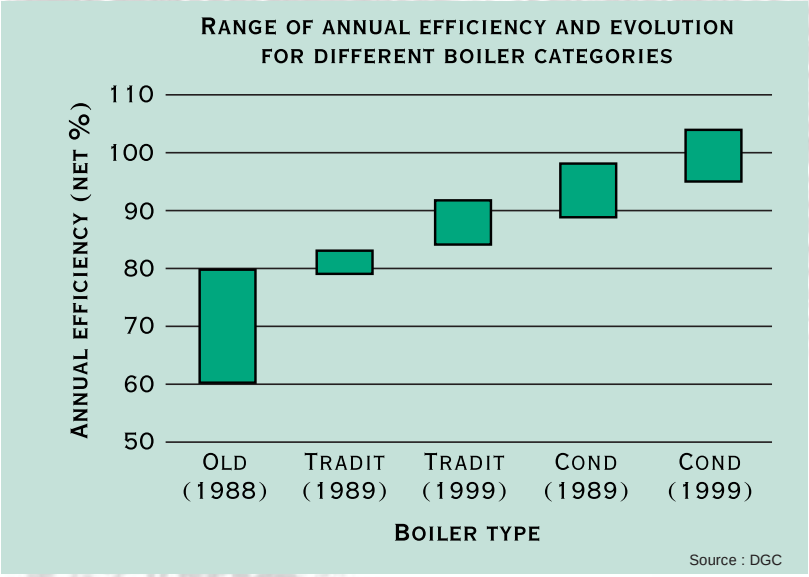
The supply of gas is unobtrusive, especially considering the amount of energy involved. The transport of natural gas is invisible and silent. It does not add to the congestion and pollution of Europe's road network. Natural gas is generally stored underground, minimising further its overall impact. Works cause the least possible disturbance to local flora and fauna; any necessary restoration of the ecology and landscape is carried out to preserve biodiversity.

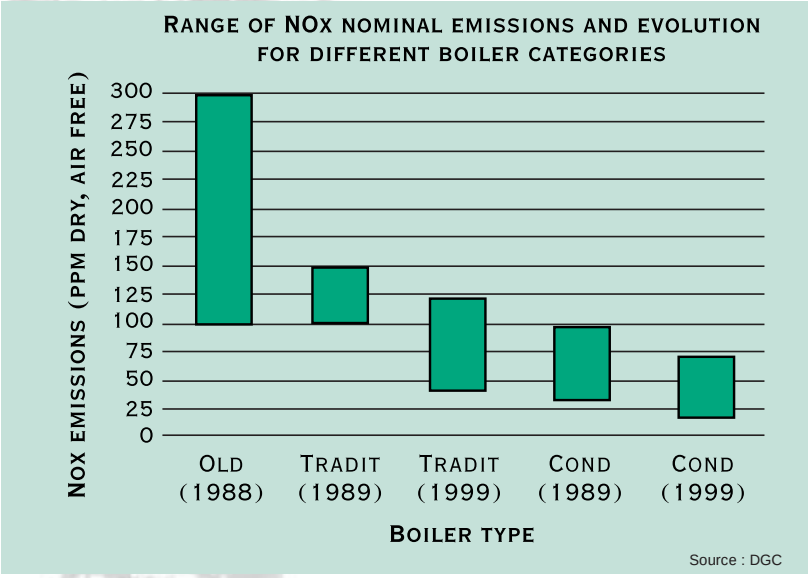
The natural gas industry will continue to build on the advantages of its product, and to aim for all-round improvement. Through the use of natural gas a significant contribution will be made to the achievement of a healthier and pleasanter environment for all as well as economic growth.

HOW NATURAL GAS CONTRIBUTES TO AN IMPROVED ENVIRONMENT • SOME TYPICAL EXAMPLES

Commercial and residential appliances

In the commercial and residential sector natural gas is mainly used for space heating, water heating and cooking but in the last decade new applications have emerged. Comfort cooling, tumble dryers, and micro CHP, are examples of new applications. Micro CHP is an advantageous technology for companies with a constant demand for both low temperature heat and electricity, like hotels, hospitals, etc. Further, the technical progresses achieved on micro CHP may bring combined production of electricity and heat into domestic houses.





The main advantages offered by natural gas solutions in the commercial and residential sectors are the compact nature of the installations, high efficiency and little demand for maintenance.

Gas boiler efficiencies have improved considerably during the last decades as a result of the co-operation of the manufacturers and the natural gas industry. Condensing boilers, which are now penetrating the European markets, make optimal use of the fuel due to the heat release by condensation of water vapour. This energy is otherwise wasted in conventional heating systems. Energy savings reach up to 40 % when replacing an old gas-fired boiler. In combination with the new generation of modulating and low-NOx burners, gas technology offers the environmentally optimal solution for heating and hot water production for the near future.

Systems using the gas-solar combination have been developed to meet the upcoming focus on Global Warming policy.
Solar panels can be fitted to the roofs of both commercial and domestic properties to supply hot water and electricity. Within the domestic market they are then combined with high efficiency gas boilers, used for heating.

Other Domestic Appliances

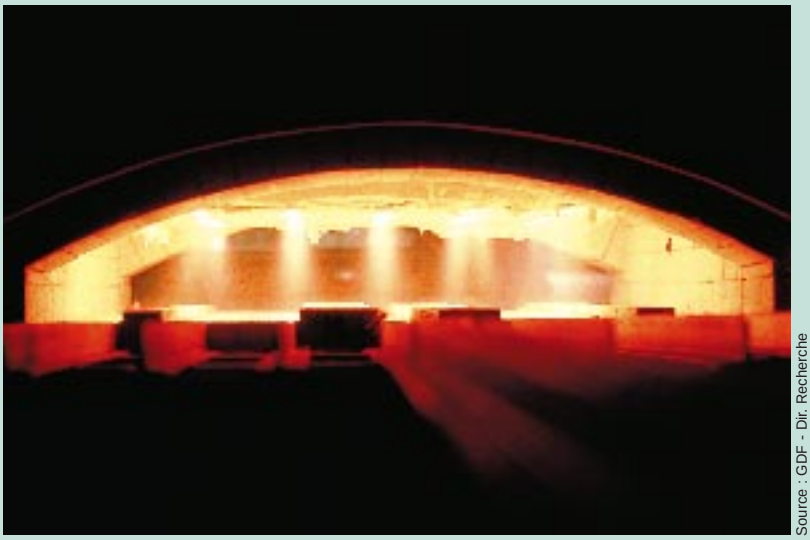
Natural gas offers a variety of appliances in households besides space/water heating and cooking, e.g. for washing machines, dishwashers, tumble dryers and refrigerators. With regard to the primary energy consumption of gas and electric stoves, the use of natural gas provides up to a 50 % saving.

Micro-CHP can be realized through gas engines or gas turbines. While driving an electricity generator, both technologies give off waste heat in the form of heat coming from the process itself as well as exhaust heat.

Industrial appliances

Natural gas is used in a variety of manufacturing processes. It offers improved product quality, higher energy efficiencies, lower emissions, and savings in operational and maintenance costs.

The properties of natural gas and the relatively clean combustion gases make direct gas firing an ideal option for instance in the metal, glass and ceramics industry. Direct heat recovery from flue gases is possible, as the flue gases do not contain corrosive sulphur compounds and particulates.



Source : GDF - Dir. Recherche

Gas oven

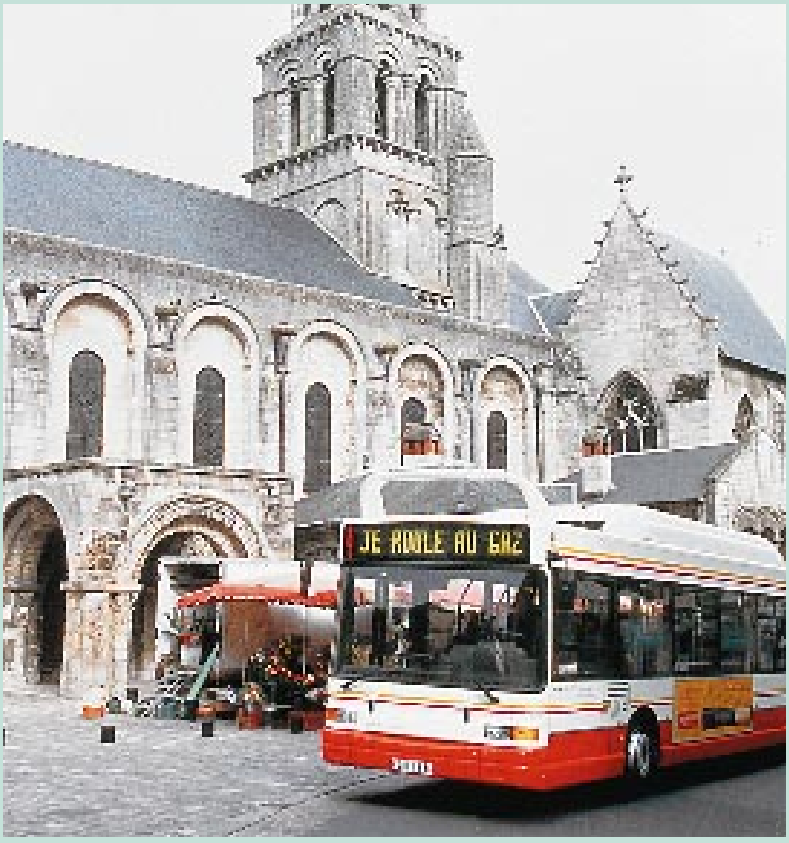
Burners can be tailored to the specific needs in the processes and heat recovery units and integral furnaces are continuously being developed to improve energy efficiency and reduce NOx emissions. Overall energy efficiencies to above 80% have been demonstrated, when the outgoing flue gases are used for preheating incoming air and thereby raising the temperature of the flame. New burners have been introduced for high temperature furnaces, which dramatically reduces NOx emission by more than 60% applying flameless oxidation.

Infra-red burners are used in low temperature applications, where fast heat-up is obtained by efficient radiation of heat to the product, this in combination with a remarkably low NOx emission. The technology is particularly applied to increase productivity in textile and paper drying as well as for curing powder coating.

Indirect gas firing, for steam and hot water production, accounts for the greater part of energy use in the industrial sector. The development in industrial boiler technology has resulted in more compact designs, higher energy efficiencies (more than 90%) and NOx emissions which can reach 50 ppm by the use of low-NOx combustion technologies.

Natural Gas Vehicles

Emission tests have now demonstrated that natural gas powered vehicles provide an economically viable and socially acceptable way of reducing both greenhouse gas emissions and significantly improving air quality. Even taking into account unburned methane from non-optimised engines and catalyst systems, an independent test has demonstrated an overall percentage reduction in equivalent CO_2 emissions of some 20% compared with petrol.

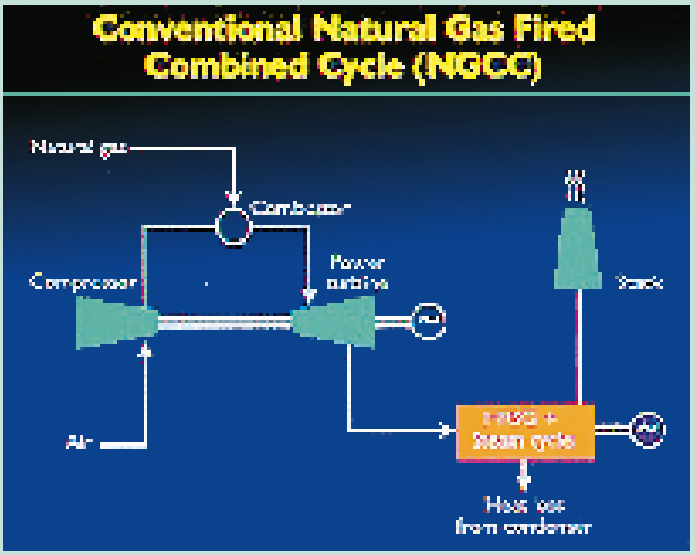


The range of toxic emissions associated with diesel and petrol engines are either eliminated or dramatically reduced. Similarly, the Natural Gas related emissions provide a substantial reduction in ozone forming potential whilst significantly reducing other pollutants such as Nitrogen Oxides. Natural Gas fuelled vehicles are even capable of environmentally out-performing those powered by LPG engines. Taking all factors into account there are substantial environmental benefits in the use of Natural Gas.

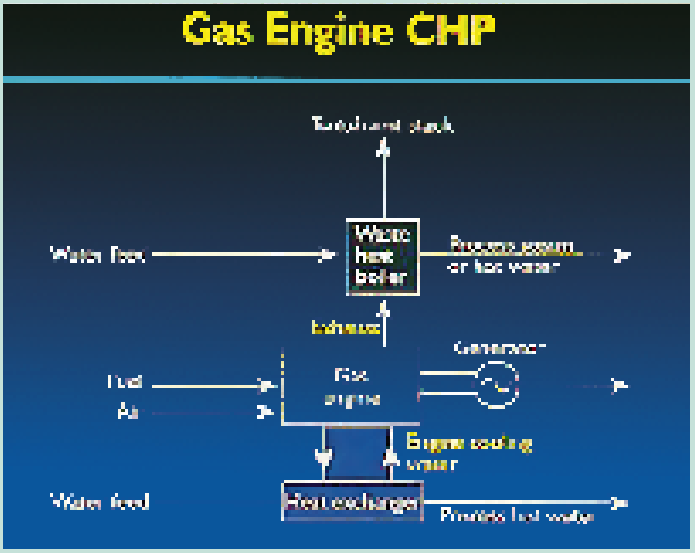
Power generation

For a given energy performance, use of natural gas in power production produces significantly lower levels of CO_2 and of pollutants, because of the high energy efficiency of natural gas fired technologies due to

- easy processing
- efficient combustion
- clean combustion process



Combined Cycle Gas Turbine (CCGT) generators provide the most economically attractive means to build and operate central power stations. Compared with an equivalent coal-fired plant, CO_2 emissions are reduced by some 60%, oxides of nitrogen (NOx) to a quarter and sulphur dioxide (SO_2) to zero. The acid rain problem is largely abated, whilst greenhouse gases are dramatically reduced. CCGT plant also remove the need for ash disposal and the associated concerns over ground and soil water contamination (e.g. potential problems with toxic trace elements such as arsenic and cadmium).



When there is a simultaneous need for electricity and heat that can be produced jointly, natural gas is also an ideal fuel.

Looking at industrial or commercial usage of decentralized combined heat and power (CHP) typically 85-90 % of the primary energy input can be transformed into heat (cold) and electricity. Yet even efficiency rates above 95 % are achieved by smaller systems.

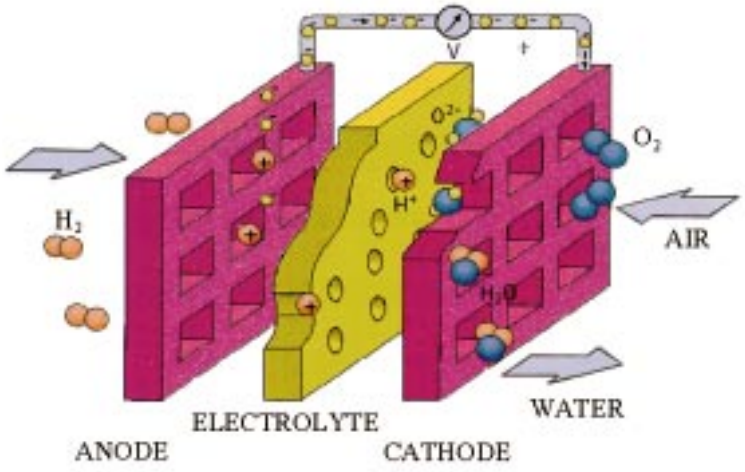
Some renewable energy sources can be used in combination with natural gas, for example it is possible to have a biogas/natural gas CCGT or CHP plant which would run on biogas or natural gas.

Fuel cells

As an alternative to mechanical power generation based on combustion, fuel cells generate electricity and heat from natural gas in an electrochemical process.

Fuel cells convert the chemical energy of hydrogen directly into electric energy, similar to batteries. The reaction of hydrogen with oxygen generates electricity and heat. As opposed to combustion, in fuel cells hydrogen and oxygen must not meet directly, but are separated by an electrolyte. In this way an electric potential difference between anode and cathode is generated. The only products of this reaction are electricity and water. Hydrogen, the fuel for the reaction, must be produced, e.g. cost-effectively from natural gas in a reforming process ($CH_4 + 2\ H_20 = 4\ H_2 + CO_2$). Hydrogen can also be produced with renewable energies, but today that option is still very expensive.

principle of a PEMFC-fuel cell



There are several advantages fuel cells offer compared to thermic power generation in condensing power plants, gas engines etc. One reason is the high electric efficiency ranging from 40 – 65 %. Since fuel cells consist of modules they can easily be adjusted to specific capacity needs. Furthermore fuel cells work with only a few moving elements lowering expenses for maintenance and noise levels.

The typical use for this new technology will be in areas that now are supplied by gas engine CHP, such as office buildings, hospitals, schools and commercial applications.