Natural Gas

Contributed by Administrator
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Natural gas (commonly referred to as gas in many countries, but note that gas is also an American and Canadian shortening of gasoline) is a gaseous fossil fuel consisting primarily of methane. It is found in oil fields and natural gas fields, as well as—in smaller quantities—in coal beds.

When methane-rich gases are produced by the anaerobic decay of non-fossil organic material, these are referred to as biogas. Sources of biogas include swamps (swamp gas), marshes (marsh gas), landfills (landfill gas), sewage sludge and manure (by way of anaerobic digesters) and flatulence (most notably in cattle.)

Methane is an extremely efficient greenhouse gas which may contribute to enhanced global warming when free in the atmosphere, and such free methane, would then be considered a pollutant rather than a useful energy resource. However, methane in the atmosphere is oxidised, producing carbon dioxide and water, so that the greenhouse effect of released methane is relatively short-lived. Also, natural gas, when burned, produces much less carbon dioxide than more carboniferous fuel sources, such as coal. Significant biological sources of methane are termites, ruminants and cultivation. Estimated emissions are 15, 75 and 100 million tons per year respectively.

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Chemical composition

The primary component of natural gas is methane (CH4), the shortest and lightest hydrocarbon molecule. It may also contain heavier gaseous hydrocarbons such as ethane (C2H6), propane (C3H8) and butane (C4H10), as well as other sulphur containing gases, in varying amounts, see also natural gas condensate.

Organosulfur compounds and hydrogen sulfide (H2S see acid gas) are common contaminants, which must be removed prior to most uses. Gas with a significant amount of sulfur impurities is termed "sour".

Natural gas is tasteless and odorless. However, before gas is distributed to end-users, it is odorized by adding mercaptans, to assist in leak detection. Natural gas is, in itself, harmless to the human body -- unlike carbon monoxide, for instance, it is not a poison. Natural gas can kill, however if it is present in large concentrations -- and thus reduces the amount of oxygen available in the air, such that the amount of oxygen remaining won't sustain life.

Natural gas can also kill through an explosion. Natural gas is lighter than air, and so tends to dissipate. But when natural gas is contained, such as within a house or in a tent, perhaps put over a house for fumigation, gas

concentrations can reach explosive proportions and trigger very powerful blasts that can level houses, and even neighborhoods. Methane has a Lower Explosive Limit of 5% in air, and an Upper Explosive Limit of 15%.

Explosive concerns with compressed natural gas used in vehicles are almost nonexistent, due to the escaping nature of the gas, and the need to maintain concentrations between 5% and 15% to trigger explosions. [edit]

Energy content and statistics

Combustion of one cubic metre of commercial quality natural gas yields 38 MJ (10.6 kWh). Equivalently, one cubic foot of natural gas produces just over 1000 British Thermal Units (BTUs).

In the USA, at retail, natural gas is often sold in units of therms (th), which equals 100,000 BTU. Wholesale transactions are generally done in decatherms (Dth), or in thousand decatherms (MDth), or in million decatherms (MMDth). A million decatherms is roughly a billion cubic feet of natural gas. The U.S. uses roughly 60,000 billion cubic feet, or 60 tera decatherms (TDth), each year. [edit]

Storage and transport Polyethylene gas main being laid in a trench.

The major difficulty in the use of natural gas is transportation and storage. Natural gas pipelines are economical, but are impractical across oceans. Many existing pipelines in North America are close to reaching their capacity prompting some politicians in colder climates to speak publicly of potential shortages.

LNG carriers can be used to transport liquefied natural gas (LNG) across oceans, while tank trucks can carry liquefied or compressed natural gas (CNG) over shorter distances. They may transport natural gas directly to end-users or to distribution points, such as pipelines for further transport. These may have a higher cost requiring additional facilities for liquefaction or compression at the production point, and then gasification or decompression at end-use facitilies or into a pipeline.

In the past, the natural gas which was recovered in the course of recovering petroleum could not be profitably sold, and was simply burned at the oil field (known as flaring). This wasteful practice is now illegal in many countries, especially since it adds greenhouse gas pollution to the earth's atmosphere. Additionally, companies now recognize that value for the gas may be achieved with LNG, CNG, or other transportation methods to end-users in the future. The gas is now re-injected back into the formation for later recovery. This also assists oil pumping by keeping underground pressures higher. In Saudi Arabia, in the late 1970s, a "Master Gas System" was created, ending the need for flaring. The natural gas is used to generate electricity and heat for desalinization. Similarly, some land-fills that also discharge methane gases have been set-up to capture the methane and generate electricity.

Natural gas is often stored in underground caverns formed inside depleted gas reservoirs from previous gas wells, salt domes, or in tanks as liquefied natural gas. The gas is injected during periods of low demand and extracted during periods of higher demand. Storage near the ultimate end-users helps to best meet volatile demands, but this may not always be practical. [edit]

Natural gas crisis

Many politicians and prominent figures in North America have spoken publicly about a possible natural gas crisis. This includes former Secretary of Energy Spencer Abraham, Chairman of the Federal Reserve Alan Greenspan, and Ontario Minister of Energy Dwight Duncan.

The natural gas crisis is typically described by the increasing price of natural gas in the U.S. over the last few years due to the decline in indigenous supply and the increase in demand for electricity generation. Indigenous supply has not truly fallen -- but it has leveled off (no matter how many new straws we put into the ground, we still get about the same amount of natural gas each year). But because of the continuing growth in demand, and the temporary but dramatic hit to production that came from Hurricanes Katrina and Rita, the price has become so high that many industrial users, mainly in the petrochemical industry, have closed their plants causing loss of jobs. Greenspan has suggested that a solution to the natural gas crisis is the importation of LNG.

This solution is both capital intensive and politically charged due to the NIMBY syndrome and the public perception that LNG terminals are explosive risks, especially in the wake of the 9/11 terrorist attacks in the United States. The U.S. Department of Homeland Security is responsible for maintaining their security, and the security arrangements during the 2004 Democratic Convention in Boston, Massachusetts, home to one of only six LNG terminals in the United States, were extraordinarily tight.

New or expanded LNG terminals create tough infrastructure problems and require high capital spending. LNG terminals require a very spacious—at least 38.5m deep—harbor, as well as being sheltered from wind and waves. These "suitable" sites are thus deep in well populated seaports, which are also burdened with right of

way concerns for LNG pipelines, or conversely, required to also host the LNG expansion plant facilities and end use (petrochemical) plants amidst the high population densities of major cities, with the associated fumes, multiple serious risks to safety.

Typically, to attain "well sheltered" waters, suitable harbor sites are well up rivers or estuaries, which are unlikely to be dredged deep enough. Since these very large vessels must move slowly and ponderously in restricted waters, the transit times to and from the terminal become costly, as multiple tugboats and security boats shelter and safeguard the large vessels. Operationally, LNG tankers are (for example, in Boston) effectively given sole use of the harbor, forced to arrive and depart during non-peak hours, and precluded from occupying the same harbor until the first is well departed. These factors increase operating costs and make capital investment less attractive.

To substantially increase the amount of LNG used to supply natural gas to North America, not only must "re-gasification" plants be built on North American shores -- difficult for the reasons stated above -- someone also must put substantial, new liquification stations in Indonesia, the Middle East, and Africa, in order to concentrate the gas generally associated with oil production in those areas. A substantial expansion of the fleet of LNG carriers also must occur to move the huge amount of fuel needed to make up for the coming shortfall in North America. [edit]

Uses [edit]

Power generation

Natural gas is important as a major source for electricity generation through the use of gas turbines and steam turbines. Particularly high efficiencies can be achieved through combining gas turbines with a steam turbine in combined cycle mode. Environmentally, natural gas burns cleaner than other fossil fuels, such as oil and coal, and produces fewer greenhouse gases. For an equivalent amount of heat, burning natural gas produces about 30% less carbon dioxide than burning petroleum and about 45% less than burning coal. [1] Combined cycle power generation using natural gas is thus the cleanest source of power available using fossil fuels, and this technology is widely used wherever gas can be obtained at a reasonable cost. Fuel cell technology may eventually provide cleaner options for converting natural gas into electricity, but as yet it is not price-competitive. Also, natural gas is said to peak around the year 2030, 20 years after the peak of oil. It is also projected that the world's supply of natural gas should finish around the year 2085. A bus using natural gas in 1980 Romania [edit]

Natural gas vehicles

Compressed natural gas (and LPG) is used as a clean alternative to other automobile fuels. As of 2003, the countries with the largest number of natural gas vehicles were Argentina, Brazil, Pakistan, Italy, and India. The energy efficiency is generally equal to that of gasoline engines, but lower compared with modern diesel engines, partially due to the fact that natural gas engine function using the Otto Cycle, but research is on its way to improve the process (Westport Cycle). [edit]

Residential domestic use Many stoves use natural gas.

Natural gas is supplied to homes where it is used for such purposes as cooking and heating/cooling. CNG is used in rural homes without connections to piped-in public utility services, or with portable grills. [edit]

Fertilizer

Natural gas is a major feedstock for the production of ammonia, via the Haber process, for use in fertilizer production. [edit]

Other

Natural gas is also used in the manufacture of fabrics, glass, steel, plastics, paint, and other products. [edit]

Sources

Natural gas is commercially produced from oil fields and natural gas fields. Gas produced from oil wells is called casinghead gas or associated gas. Natural gas can also be produced by treating coal chemically, although coal gasification is not economic at current gas prices. The biggest natural gas field is located in Urengoy, Russia, with a reserve of 1013 m^3. See also List of natural gas fields. [edit]

Possible future sources

One experimental idea is to use the methane gas that is naturally produced from landfills to supply power to cities. Tests have shown that methane gas could be a financially sustainable power source.

There are plans in Ontario to capture the biogas, methane gases rising from the manure of cattle caged in a factory farm, and to use that gas to provide power to a small town.

There is also the possibility that with the source separation of organic materials from the waste stream that by using an anaerobic digester, the methane can be used to produce usable energy. This can be improved by adding other organic material (plants as well as slaughter house waste) to the digester.

A speculative source of enormous quantities of methane is from methane hydrate, found under sediments in the oceans. At present (2006), no technology has been developed to recover this source of energy economically. [edit]

Safety

In any form, a minute amount of odorant such as methyl mercaptan, with a rotting-cabbage-like smell, is added to the otherwise colorless and odorless gas, so that leaks can be detected before a fire or explosion occurs. Sometimes a related compound, ethyl mercaptan is used, with a rotten-egg smell. Adding odorant to natural gas began in the United States after the 1937 New London School explosion. The buildup of gas in the school went unnoticed, killing three hundred students and faculty when it ignited.

Although concentrated mercaptan is extremely toxic, it is considered non-toxic in the extremely low concentrations in which it occurs in natural gas delivered to the end user. For example, a safe exposure level to ethyl mercaptan at 5 parts per million over an eight-hour period has been established by the American Congress of Government and Industrial Hygienists (ACGIH). Actual concentrations used by gas companies are on the order of 5 parts per billion (5 parts in 109), one-thousandth the maximum safe limit.

In mines, where methane seeping from rock formations has no odor, sensors are used, and mining apparatus has been specifically developed to avoid ignition sources, e.g., the Davy lamp.

Explosions caused by natural gas leaks occur a few times each year. Individual homes, small businesses and boats are most frequently affected when an internal leak builds up gas inside the structure. Frequently, the blast will be enough to significantly damage a building but leave it standing. In these cases, the people inside tend to have minor to moderate injuries. Occasionally, the gas can collect in high enough quantities to cause a deadly explosion, disintegrating one or more buildings in the process. The gas usually dissipates readily outdoors, but can sometimes collect in dangerous quantities if weather conditions are right. Also, considering the tens of millions of structures that use the fuel, the individual risk of using natural gas is very low.

Some gas fields yield sour gas containing hydrogen sulfide. This untreated gas is toxic.

Extraction of natural gas (or oil) leads to decrease in pressure in the reservoir. This in turn may lead to subsidence at ground level. Subsidence may affect ecosystems, waterways, sewer and water supply systems, foundations, etc. [edit]

See also

- Future energy development
- Carbon dioxide (CO2)
- Liquefied natural gas (LNG)
- Compressed natural gas (CNG) [edit]

External links [edit]

Natural gas vehicles

- International Natural Gas Vehicle Statistics
- Alternative Fuel Vehicle Training From the National Alternative Fuels Training Consortium.
- IANGV - International Association for Natural Gas Vehicles
- Northeast Sustainable Energy Association (PDF) [edit]

North America

- What is Compressed Natural Gas?
- Could CNG work in America?
- Natural Gas Supply Association
- Institute of Gas Technology [edit]

South Asia

- India: How New Delhi used CNG to ease pollution [edit]

Pollution and allergy

- Pollutant chemical pollutant chemical that can worsen both classical allergy and chemical sensitivity.

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