NATURAL GAS

1 WHERE DOES IT COME FROM?

A LONG TIME AGO, MANY TINY PLANTS AND ANIMALS LIVED ON EARTH. AS THEY DIED, LAYERS OF SAND, DIRT AND MUD COVERED THEM.

AFTER 100's OF 1000's OF YEARS THE MUD CHANGED TO ROCK AND THE BURIED PLANTS AND ANIMALS DECAYED INTO TINY BUBBLES OF ODORLESS, COLORLESS GAS, TRAPPED UNDER HEAVY ROCK...

2 HOW WE FOUND IT

SOMETIMES A TINY AMOUNT OF GAS ESCAPED THROUGH A SMALL CRACK IN THE ROCK. WHEN MIXED WITH AIR, GAS CAN BURN. ONCE IN AWHILE, FLAMES IGNITED BY NATURAL PROCESSES WERE SEEN BURNING ON THE SURFACE OF THE GROUND OR WATER. PEOPLE IMAGINED MANY WAYS THEY COULD USE THE FLAMES' HEAT AND LIGHT AND EXPERIMENTED WITH THESE FLAMES. THEY LEARNED HOW TO IDENTIFY AND USE THE BURNING GAS AND STARTED TO LOOK FOR MORE.

3 HOW WE GET IT

AT ONE TIME THE SEARCH FOR NATURAL GAS BEGAN WITH GEOLOGISTS LOCATING THE TYPES OF ROCK THAT USUALLY ARE FOUND NEAR GAS DEPOSITS. TODAY OTHER WAYS, LIKE SEISMIC SURVEYS, ARE USED TO FIND THE RIGHT PLACES TO DRILL DEEP WELLS. WHEN GAS IS FOUND, IT FLOWS UP THROUGH THE WELL TO THE SURFACE OF THE GROUND AND INTO LARGE PIPELINES. THEN THE DIFFERENT KINDS OF GASES ARE SEPARATED AND CLEANED. MERCAPTAN, A DISTINCTIVE SMELL, IS ADDED TO THE OTHERWISE ODORLESS GAS AS IT FLOWS THROUGH THE PIPELINE TOWARD THE COMMUNITIES WHERE IT WILL BE USED.

PROPANE

BUTANE

4 STORAGE

SOME OF THE GAS PIPED TO TOWNS AND CITIES IS NOT USED RIGHT AWAY. THE GAS COMPANIES SAVE IT IN HUGE STORAGE TANKS OR UNDERGROUND IN OLD GAS WELLS. THEY ADD IT BACK INTO THE PIPELINE WHEN PEOPLE BEGIN TO USE MORE GAS AS THEY DO IN THE WINTER TO HEAT HOMES.

NATURAL GAS CHANGES INTO A LIQUID WHEN CHILLED TO VERY COLD TEMPERATURES, AND CAN BE STORED IN THIS FORM.

5 INTO THE COMMUNITY

NEAR THE TOWN WHERE IT WILL BE USED, THE GAS IS MEASURED AS IT FLOWS INTO SMALLER PIPELINES CALLED "MAINS." GAS MAINS DIRECT THE FLOWING GAS TO HOMES, BUSINESSES AND INDUSTRY WHERE THE EXACT AMOUNT ENTERING EACH PLACE IS MEASURED. PEOPLE PAY THE GAS COMPANY ONLY FOR THE AMOUNT THEY USE.

NATURAL GAS BURNING IN A FURNACE HEATS HOMES, AND IN OTHER APPLIANCES, IT DRIES CLOTHES, COOKS FOOD AND HEATS WATER. INDUSTRY USES THIS HEAT ENERGY TO MANUFACTURE GOODS LIKE CARS AND STEEL AND TO BAKE FOODS LIKE BREAD AND COOKIES. NATURAL GAS ALSO WORKS AS A BUILDING BLOCK WITH OTHER INGREDIENTS TO MAKE PLASTIC, ANTI-FREEZE FOR CARS, PAINT, FERTILIZER THAT FARMERS PUT ON THEIR CROPS AND MANY OTHER PRODUCTS.

NEW USES FOR GAS, BOTH AS A SOURCE OF HEAT AND AS A CHEMICAL BUILDING BLOCK, ARE DEVELOPED EVERY DAY AND ADD TO THE DEMAND FOR THIS VALUABLE RESOURCE.

6 LOOKING FOR MORE

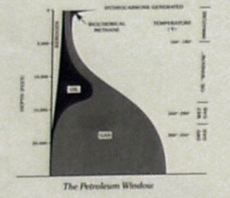
THE SEARCH TO FIND MORE GAS TO MEET THE NEEDS OF GROWING COMMUNITIES CONTINUES ON IN NEW DIRECTIONS. TODAY, PLANT LIFE STILL DIES, BUT WE DO NOT HAVE TO WAIT 1000's OF YEARS FOR IT TO BECOME GAS. MACHINES CALLED "DIGESTERS" PRODUCE GAS FROM PLANTS, GARBAGE AND ANIMAL AND HUMAN WASTES. OTHER MACHINES MAKE GAS FROM COAL AND PEAT. IN THE FUTURE THESE SOURCES OF NATURAL GAS WILL HELP PROVIDE CLEAN, SAFE ENERGY.

POWERED BY NATURAL GAS

COLUMBIA GAS of Ohio

THE ORIGINS OF NATURAL GAS

The prevailing scientific theory is that natural gas was formed millions of years ago when plants and tiny sea animals were buried by sand and rock. Layers of mud, sand, rock, plant, and animal matter continued to build up until the pressure and heat from the earth turned them into a tar-like substance called kerogen. As temperatures continued to increase and the kerogen continued "cooking," more complex compounds of carbon and hydrogen known as oil were formed. Natural gas is generated at the same time as oil, however, peak generation occurs when oil begins to break down because of high geothermal temperatures, e.g. greater than 205° C (400° F). This range of petroleum generation is called the petroleum window.

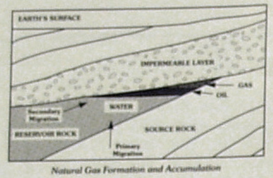


The Petroleum Window

As natural gas molecules form, they migrate from the shale "source rock" into more porous areas such as sandstone. They continue movement to either the Earth's surface–where they escape into the atmosphere, or they are trapped when their path is blocked by non-porous rock. In the latter case, the impermeable rock layers cause a natural gas accumulation to occur.

Deep Gas Theory

In contrast to the biological explanation of the origin of natural gas, the "deep gas theory" speculates that natural gas is derived from non-biological materials that formed the Earth billions of years ago. Thomas Gold, of Cornell University, published the first papers to contend that "on Earth, as on other planets, most hydrocarbons were formed from non-biological sources." The theory proposes that the Earth is made up of primordial materials that combined in space billions of years ago when the basic structure of the Earth evolved. The materials are believed still buried far below the Earth's crust, where they have been trapped for 4.5 billion years. Cracks and fissures in the Earth's crust allow the gases to migrate into reservoirs and to the surface. In this manner, it is believed that the supply of hydrocarbons produced from the primordial materials was instrumental in the creation of the Earth's atmosphere.



Natural Gas Formation and Accumulation

WHAT IS NATURAL GAS?

Natural gas is a combustible, gaseous mixture of simple hydrocarbon compounds, usually found in deep underground reservoirs formed by porous rock. Natural gas is composed almost entirely of methane, but does contain small amounts of other gases, including ethane, propane, butane and pentane. Methane is composed of a molecule of one carbon atom and four hydrogen atoms.

Natural gas may also be categorized according to its composition. It can be a dry gas, containing few liquid hydrocarbons; a wet gas, heavy in hydrocarbon liquids (sometimes containing water vapor); a sour gas, containing hydrogen sulfide; and a sweet gas, which may have a trace of sulfur but no hydrogen sulfide.

The following properties are inherent to natural gas:

1. A flammability range of 5 to 15 percent. This means that any mixture containing less than 5 percent or greater than 15 percent natural gas to air would not support combustion.
2. Absence of color, odor and taste. Mercaptan is added to natural gas during distribution. The mercaptan gives natural gas a distinct, unpleasant odor and acts as a safety device by allowing it to be detected in the atmosphere.
3. A hydrocarbon molecular structure. Almost all components found in natural gas contain only the elements hydrogen and carbon.
4. Non-toxic in nature.
5. Burns with a blue flame, when completely combusted, producing water and carbon dioxide.
6. A boiling point of -161.5° C (-259° F).
7. A heating value of 800 to 1200 Btus per cubic foot.

HOW SAFE IS NATURAL GAS?

For a number of reasons, natural gas is a very safe energy source. First, natural gas is lighter than air. This permits it to dissipate into the air if a leak occurs. Other hydrocarbons like propane, ethane and butane are heavier than air and will "puddle" if leaks occur.

Secondly, natural gas has a higher combustion temperature than other fuels. Natural gas ignites at 649° C (1,200° F) compared to as low as 371° C (700° F) for some other fuels.

A third inherent property of natural gas that helps provide a safety barrier is the flammability range previously mentioned. If the exact mixture of natural gas and oxygen are not met, combustion cannot occur.

Although natural gas is safe when properly used, it exhibits certain characteristics like all sources of energy that make it potentially dangerous. First, if natural gas and the mixture of oxygen are not properly balanced when lit, incomplete combustion will occur and carbon monoxide will be produced. Secondly, if a leak occurs and supplants all the available oxygen, asphyxiation may occur.

Because natural gas is an "odorless" energy source, a special odorant–Mercaptan–has been added to it so that customers can tell if there is a leak of natural gas.

If a natural gas leak is detected, follow these safety precautions immediately:

We can smell natural gas because mercaptan has been added.

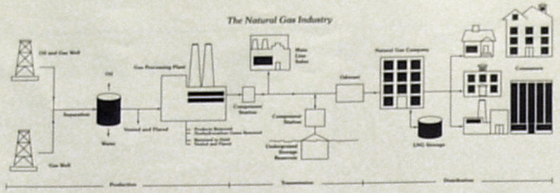
1. Open windows and doors to ventilate the area.
2. Get everyone outside. Using a neighbor's phone, or a phone outside the area, call the natural gas company or other authorized personnel for assistance. **(Do not use a telephone inside your home.** A spark from an electric switch or telephone could ignite the natural gas.)
3. Avoid flames and don't turn electrical equipment or appliances on or off, not even a flashlight. Never look for a natural gas leak with a lighted flame or match.
4. Your natural gas can be turned off at the valve next to the natural gas meter. A quarter turn of the valve in either direction will shut the natural gas off; the raised part of the valve will then be crosswise to the pipe.
5. If there is only a faint odor, it probably means a pilot light is out on an appliance. Check the pilot light on all appliances. To relight the pilot light, follow the instructions in the owner's manual. If you still can't find the source or are unsure of how to relight the pilot light, call your local natural gas company.

Because of the potential hazards, it is important that the user know how to safely use natural gas and care for natural gas appliances. One of the first steps to prevent accidents from occurring is to ensure that natural gas appliances and equipment have been properly installed, adjusted, vented and inspected.

Other safety precautions that should be taken include the following:

1. Follow manufacturer's instruction for the installation, operation and maintenance of gas equipment and appliances.
2. Keep flammable materials (paint, solvents, cloth, paper) away from appliances.
3. Provide proper ventilation in areas around furnace, water heaters, dryers, ranges, etc. Many new appliances use an electronic ignition instead of a pilot light.
4. Teach children how to use appliances safely. Familiarize them with the smell of natural gas.
5. Keep fire extinguishers in the vicinity of appliances with open flames.
6. When lighting a natural gas appliance, always strike the match first, then turn on the natural gas.
7. If the flame goes out, turn the gas off, ventilate the area and notify the natural gas company.
8. Perform or have performed routine maintenance on appliances to keep them clean and in proper working order.

The Natural Gas Industry



PROCESSING AND DISTRIBUTING NATURAL GAS

Once natural gas has been found, it is necessary to process it and distribute it to users. Centuries ago, the Chinese used bamboo to pipe natural gas directly from their wells to their cooking pots. And in the early 1820s William Hart, the first person to develop a practical use for natural gas in America, used hollow logs to bring natural gas from shallow wells to street lamps and small nearby businesses. But as Hart and others continued to pioneer the uses for natural gas, it was found that higher quality natural gas and more functional and durable distribution networks were needed.

Today, natural gas is delivered to about 175 million American consumers through a 1.3 million-mile network of underground pipe. A total of 285,000 producing natural gas wells, 125 natural gas pipeline companies and more than 1,200 gas distribution companies provide gas service to all 50 states. Natural gas reprocessing plants are used to turn hundreds of thousands of cubic feet of unrefined, wellhead natural gas into high quality, commercial natural gas.

Before natural gas is distributed, it first must be sent to a processing or "stripping" plant where it is cleaned and separated. At the processing plant, the natural gas is first sent through a separator where secondary byproducts including oils, impurities and heavier hydrocarbons such as butane, ethane and propane are removed. Most of these byproducts are reprocessed, packaged and sent to market for a variety of different uses.

As natural gas leaves the processing plant, it enters a compressor station where it is pressurized for transmission. As the pressure is increased, the volume of natural gas is reduced and more natural gas can be filled into the same unit space and the pressure needed to move natural gas through the pipeline is achieved. As natural gas flows through the pipeline, some pressure is lost due to fluid friction caused by the natural gas rubbing against the inside walls of the pipe. This loss of pressure is made up at a compressor sub-station located every 50 to 100 miles along the transmission pipelines. Valves along the pipelines are used to control pressure and cut off flow in an emergency such as a break in the line or a fire.

Transmission pipelines may be as large as 56 inches in diameter, but most are 20 to 30 inches. The diameter is largely a function of the "peak demand," which is imposed by the number of users and the time of year. The pipes must be large enough to handle sufficient quantities of natural gas to meet the needs of consumers during the high peak use periods, which normally occur between October and April when heating requirements go up.

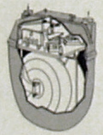
Principal Natural Gas Pipeline System

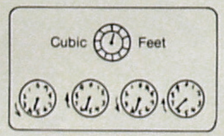
As a pipeline nears a city, some natural gas is diverted through a "city gate," where its pressure is reduced and it is measured and sold to the local natural gas company. From the city gate, the natural gas company distributes the natural gas through an underground network of smaller pipelines called "mains." Smaller lines called "services" connect with the mains and go directly to the end user—home, school, church and business. There, the natural gas flows through a meter which measures the exact amount of natural gas used, and the natural gas company bills the user.

STUDENT ACTIVITY

Reading Your Natural Gas Meter

The dials on your gas meter count the number of times the chambers in the meter are filled with natural gas and emptied. There are four chambers, which are filled with the same volume of natural gas every time. The size of the meter depends on the volume of natural gas needed.





Reading your natural gas meter is simple. You simply record the number the needle has passed on the first three dials. On the last dial, record the number the needle is nearest to. Note that the dials alternate in their direction. To obtain the cubic feet consumed, add two zeros to your reading.

1. Have students record their families' natural gas use each day for one week, at different times of the year (spring, summer, fall and winter). Compare and discuss results.
2. Have students record their families' natural gas use each day for one week. Have students share their data. Discuss natural gas use in relation to family size, size and age of home, weatherization, etc.

USE ENERGY EFFICIENTLY

Conserving energy is very dependent upon the consumer's "common sense." For example, energy is saved when a home is insulated and weatherized, when a leaky hot water faucet is repaired, when the hot water heater temperature is properly set, when a shower is taken instead of a bath, when food is cooked in a pressure cooker rather than in an open pan, and when lights in unoccupied rooms are turned off. What other things can you do to conserve energy?

STUDENT ACTIVITY

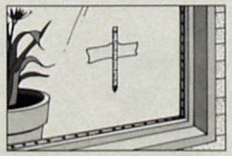
Curtains For Efficiency

It is important that everyone helps to conserve natural gas, so that it will be available for many years to come. Conduct the following experiment to find out one way you can help conserve energy in your home.

You will need four room thermometers. Follow the directions for the climate temperature that best fits your location when you do the experiment:

COLD MONTHS

1. Tape one thermometer to the inside of your bedroom window or a convenient window in your house. Tape a second thermometer to the window covering (curtains, levelors, etc.). Place a third thermometer outside on the window ledge, and a fourth thermometer in the room.



2. On sunny days, open the window coverings. Close the window coverings at night. In the afternoon, record the temperatures of each thermometer. Find the difference in temperatures.
3. Repeat the procedure for four days, at the same time each day. Construct a line graph for each thermometer. Calculate the average temperature for each thermometer.

WARM MONTHS

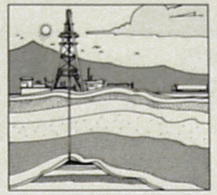
1. Follow step one above.
2. Close the window coverings during the day. Record the thermometer temperatures in the late afternoon. Take the reading at the same time each day.
3. Follow step three from the COLD MONTH instructions.

Share your findings with your family, and discuss how window coverings can be used as an insulator to conserve energy.

A RULE TO REMEMBER

In the winter, open window coverings on sunny days; close them at night.

In the summer, close window coverings when the the sun is shining directly in the windows.



Natural Gas Exploration

ENVIRONMENTAL ASPECTS OF NATURAL GAS

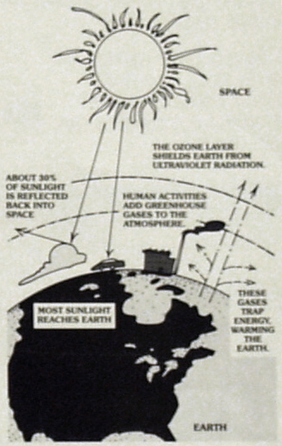
Of the three fossil fuels, natural gas may be considered the ideal fuel. Its production doesn't disturb the surrounding area, and the site is quickly restored to its original state once production ends. It has very few pollutants present as it comes from the ground, and those few are removed before it enters the pipeline. It poses no threat of a "spill" in offshore drilling; it merely bubbles to the surface and dissipates in the atmosphere, and does not pollute the water around the drill site. It is primarily methane and burns simply and cleanly; its combustion results in a fraction of the emissions of either coal or oil.

ENERGY IMPACTS ENVIRONMENT

In this last decade of the twentieth century, it is hard to imagine that there is anyone who does not recognize the relationship between man and the environment. Our society relies heavily upon natural resources to supply the energy for our highly industrialized way of life. In the United States, 75 percent of our energy demands are met by burning fossil fuels—coal, oil, and natural gas. Our environmental and energy concerns have grown directly out of this energy demand and fossil fuel combustion.

Our "environment" is everything that surrounds us—it is the Earth and the atmospheric environment which rotates with the Earth. The atmospheric environment includes not only the air around us but also the stratosphere. Some ten to twenty five miles above us is the diffuse ozone layer that filters out damaging ultraviolet rays. Without the protection of the ozone layer, life as we know it on the globe could not exist. Human activities, however, are believed to affect that layer and the global composition of the atmosphere by the increased release of "greenhouse" gases such as CO_2 (carbon dioxide), CH_4 (methane), N_2O (nitrous oxide), and the CFCs (chlorofluorocarbons).

How The Greenhouse Effect Works



STUDENT ACTIVITY

What Is Natural Gas?

MATERIALS

- baby food jars
- vegetable scraps (carrot peels, lettuce, stems, grass clippings, etc.) to total about one-third cup per baby food jar.
- soil, about one-fourth cup per baby food jar
- balloons (should be strong enough to stretch over the mouth of jars)
- clear tape
- one plastic spoon per jar

PROCEDURE

Use one jar per two to three students.

Have the students fill the jar with the scraps and soil and stir to mix well.

Mark the level of the mixture with the tape.

Fix the balloon tightly over the jar opening. Use rubber bands if necessary for an airtight seal.

Place the jars in different locations around the room where they can be left undisturbed for one week (or longer if possible), i.e., in direct sunlight, in a warm area but out of direct sunlight, in a cool light area, in a cool dark area, in the refrigerator, etc.

Additional variables could be the type of vegetable scraps used.

Have the students record each day what is happening to their jar. At the end of the week put all of the jars together and discuss the results.

EXPLANATION

The jars in the warmer areas should show the greatest inflation. The vegetable scraps produced a gas called Methane which inflated the balloon. Methane is the main ingredient in natural gas. Notice it is not liquid or solid. It is an invisible gas.

Methane from Biomass is being recovered today from more than 20 sanitary landfill sites in this country. The largest of these, in Staten Island, New York, recovered about 1,100,000,000 cubic feet of gas in 1985.

CAREERS IN THE NATURAL GAS INDUSTRY

The natural gas industry offers many kinds of jobs. Whether you like science and math, reading and writing, drawing, helping people or even working outdoors, you can find a career that matches your interests.

Some examples of jobs for people who enjoy science and math are: engineer, computer programmer and accountant. Two of the various types of engineers are operations engineer, who designs the important pipeline facilities that bring natural gas to customers, and industrial marketing engineer who helps new industrial and commercial customers understand the benefits of using natural gas. A computer programmer helps other people in the company understand and use computers for their jobs. An accountant gathers and analyzes financial information.

Reading and writing are important in every job, but they are especially important in fields such as communications, law and marketing. Drafting technicians and graphic designers use drawing abilities in their jobs. Customer service representatives and human resource managers like helping people. Pipe fitters, meter readers and leakage inspectors enjoy working outside.

Although each job demands specific skills, all of them require an ability to communicate well and an ability to work well with others. Most jobs also require computer literacy, and problem-solving skills.

Leakage Inspector

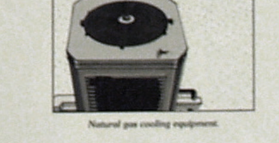
Drafting Technician

NATURAL GAS BURNS CLEANLY

Because natural gas is the cleanest burning fossil fuel, it can help improve the quality of air and water, especially when used in place of other, more polluting energy sources. Natural gas combustion results in virtually no atmospheric emissions of sulfur dioxide (SO_2) or small particulate matter, and far lower emissions of carbon monoxide (CO), reactive hydrocarbons, nitrogen oxides (NO_x) and carbon dioxide (CO_2) than combustion of other fossil fuels.

Natural Gas vehicles can reduce our urban pollution.

A major cause of urban pollution is the carbon monoxide produced by our automobiles. Imagine powering those cars with a fuel that produces only 1/2 of 1 percent of the carbon monoxide of gasoline powered vehicles. We can! There is a growing use of natural gas as the energy source for vehicles. Many fleet vehicles already display the little blue flame to denote an NGV (Natural Gas Vehicle).



Cogeneration

Burning natural gas simultaneously or alternately with coal or oil in the same boiler–*co-firing*–can also reduce the fossil fuel pollutants. A similar helpful use of natural gas is *co-generation*: a process by which electricity and useful heat are produced from a single source, reducing both waste and pollution.

The increased use of natural gas in such innovative ways can significantly improve our environment.

GROWING PREFERENCE FOR NATURAL GAS

Natural gas is fast becoming America's most preferred energy source for three main reasons. First, it is the cleanest of all fossil fuels. As natural gas burns it introduces virtually no pollutants into the environment. Second, the delivery of natural gas is efficient, easy and convenient. And third, the cost of natural gas is significantly less than that of comparable fuels having equal Btu values. (British thermal unit–Btu is the amount of energy needed to raise the temperature of one pound of water one degree Fahrenheit.)

Natural gas vehicles (NGVs) are being used successfully all over the world and have been for many years. Worldwide, more than 500,000 vehicles are being fueled with natural gas, and on a national average basis it costs 65 to 80 cents for an energy-equivalent gallon. There are almost 1,000 natural gas refueling stations currently operating in the United States–about half of them are accessible to the public. In addition to the operating cost advantage, factory-built, dedicated NGVs designed to run exclusively on natural gas have the potential to reduce carbon monoxide emissions by 90 percent and reduce reactive hydrocarbon emissions by 80 percent when compared with today's gasoline vehicles.

Today about 30,000 vehicles run on natural gas in the United States, primarily fleet vehicles. There are about 2,000,000 propane vehicles nationwide. If 6,000,000 of the estimated 16,000,000 fleet vehicles ran on alternative gaseous fuels, it could reduce oil consumption in the United States by 650,000 barrels per day, according to the United States Department of Energy.

Natural Gas and propane vehicles perform about the same as gasoline powered vehicles in regard to energy consumption. Gaseous fueled vehicles, however, out perform gasoline vehicles in cold weather starting, and result in less engine wear over the life of the vehicle.

There are about 30,000 NGVs in the U.S. today.

NEW NATURAL GAS TECHNOLOGIES

Gas Heat Pump

A new technology, a natural gas heating and cooling system was introduced in residential markets in 1994. This new technology is a dramatic breakthrough in climate control and efficiency. Natural gas heat pump technology offers cooling at the same cost savings to consumers that gas heating provides, compared with electric heating and cooling systems.

Commercial Cooling

Natural gas cooling offers an increasingly attractive alternative to electric air conditioning because of high electric costs and anticipated capacity shortages during peak demand periods. Using natural gas equipment for commercial cooling can greatly reduce electric peak demand and help defer the need to build more electric generating capacity. Natural gas cooling equipment such as gas absorption and desiccant systems are environmentally preferable to electric cooling systems because these natural gas systems do not use any CFCs (chlorofluorocarbons) or HCFCs (hydrochlorofluorocarbons), which are required for all electric systems.

Natural gas cooling equipment.

Fuel Cells

Fuel cells are high-efficiency devices for generating electricity directly from a hydrogen-rich fuel such as natural gas. These devices operate on an electrochemical process similar to what occurs in a battery. The process does not involve combustion, hence they are quiet and virtually pollution free. However, since they operate at elevated temperatures, they do generate waste heat that can be recovered for water, space or process heating. Their high efficiency and clean, quiet operation were instrumental in the decision to use fuel cells to power many of the spacecraft launched by the United States.

HOW TO USE THIS POSTER

- Before mounting or displaying the poster, make copies of the back panels for use with your students or for preparation of classroom activities.
- Study the poster. Begin with a leisurely observation. The eye flow and arrangement of the poster are somewhat circular, beginning at the upper left , then following the numerical sequence.
- The heavy broken line will guide you from the formation, through the exploration, drilling, processing, storage, and finally to the distribution of natural gas to the community for its use. Notice that the mercaptan is added before distribution to the community as a safety measure.

THE NATIONAL ENERGY FOUNDATION

National Energy Foundation creates and distributes economical instructional materials dealing with a wide range of natural resource topics—energy, water, mineral resources, science, technology, conservation, the environment. NEF is a unique non-profit educational organization devoted to the development of instructional materials and the implementation of innovative teacher training and student programs.

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