NATURAL GAS AND THE ENVIRONMENT

THE ATMOSPHERE

As an energy source serving communities, businesses, and industries, natural gas is clean and safe. It adds neither visible nor particulate pollution to the atmosphere.

TRANSMISSION & DISTRIBUTION

After recovery and processing, natural gas is transported through underground pipelines to the local gas company's "city gate" and distributed to our homes, businesses and industries.

MANUFACTURING

Natural gas is used in producing building materials, paper, fabrics, and even in the processing of food.

TRANSPORTATION

Vehicles fueled by natural gas (NGVs) create less pollution and cost less to operate.

HOME COMFORT

Central heating and cooling, cooking, heating water, drying clothes, and making life more comfortable are benefits of clean natural gas.

RENEWABLE ENERGY

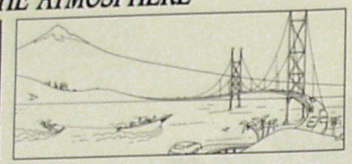
We can use wood, farming silage, organic waste and garbage to create biogas, which can be burned like natural gas.

Natural Gas is used for . . .

heating water · *central heating and cooling* · *gas log fireplaces* · *drying clothes* · *cooking food* · *lighting* · *fueling vehicles* · *commercial cooking* · *heating and cooling buildings* · *and generating electric power.*

THE ATMOSPHERE

As an energy source serving communities, businesses, and industries, natural gas is clean and safe. It adds neither visible nor particulate pollution to the atmosphere.



ACTIVITIES

Have your students . . .

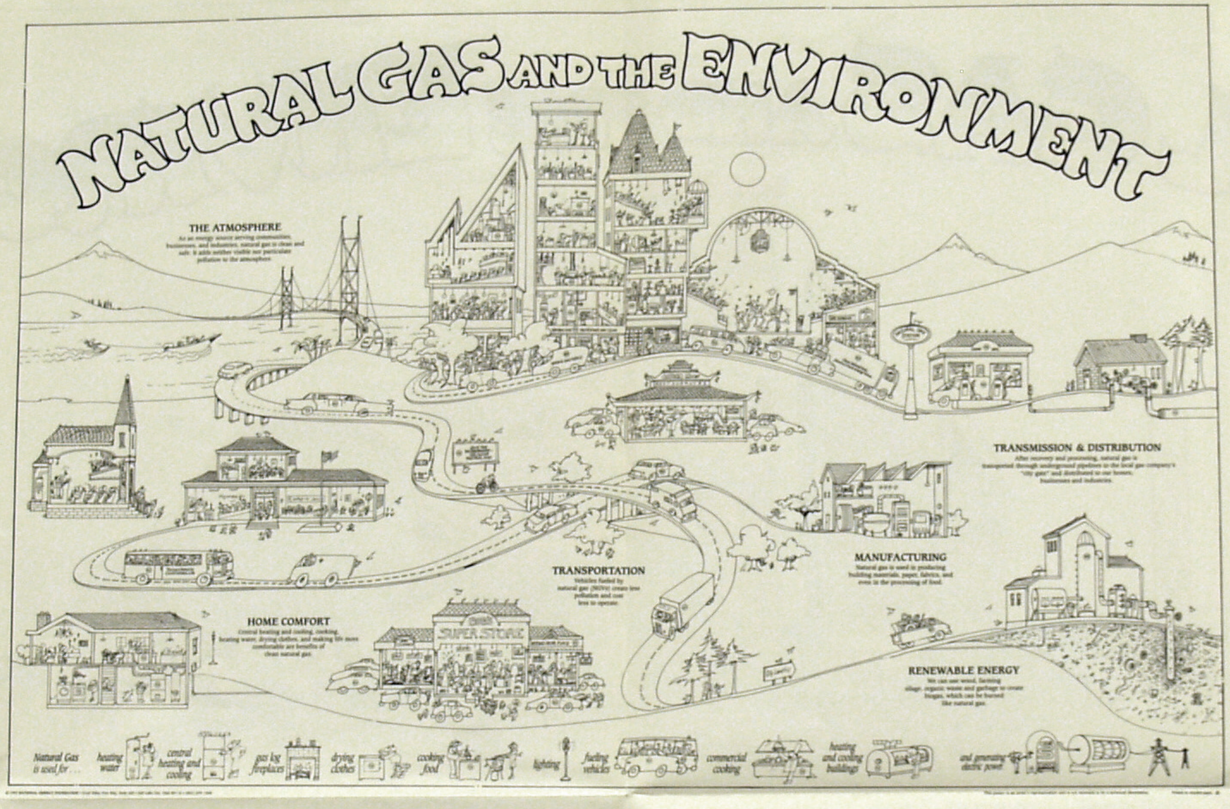
- research various exploration techniques and illustrate on a poster one of those techniques.
- create a model from popsicle sticks of a natural gas drilling rig.
- locate a photo or art of a reclamation and restoration project and share it with the class.
- list three ways a natural gas drilling site may be restored once the drilling operation is completed and the equipment removed.
- contact your local natural gas utility for the names of natural gas exploration companies in the United States and write one of them requesting information on the various methods they have used to reclaim the land at former drilling sites. Compare the methods used by the company you contacted to the methods used by companies contacted by other class members.

When early humans first used fire to improve their quality of life, they began a dependence upon natural resources for energy. Similarly, our society relies heavily upon natural resources to supply the energy for our highly industrialized way of life. In the United States, 75% 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. This increased energy demand has upset the crucial balances between the emissions of the combustion, and the capacity of natural cycles to handle those emissions.

Even though fossil fuels are very important to our economy, many questions continue to be raised about their relationship to pollution. Fossil fuels have the reputation for emitting harmful pollution into the earth's atmosphere. However, not all fossil fuels produce the same amounts of pollutants. When burned, natural gas emits fewer harmful byproducts than any other fossil fuel.

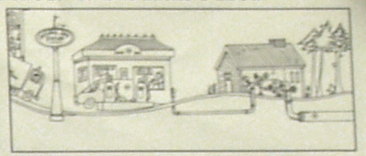
The relatively small amounts of pollutants in natural gas as it comes from the ground are virtually all removed before it is allowed to enter the pipeline. This eliminates the need for pollution control equipment at the site where it is used. In addition, its production involves minimal disturbance of the surrounding area. Once production is completed and the drilling installations are removed, the drilling site is reclaimed and restored. Offshore drilling is also safer with natural gas because there is no chance of a spill; if natural gas leaks, it merely bubbles to the surface and dissipates rather than polluting the water surrounding the drilling site.

NATURAL GAS AND THE ENVIRONMENT



TRANSMISSION & DISTRIBUTION

After recovery and processing, natural gas is transported through underground pipelines to the local gas company's "city gate" and distributed to our homes, businesses and industries.



ACTIVITIES

Have your students . . .

- find out how safety valves or other safety devices are made and used and report their findings to the class.
- identify the primary processes used in biotic ecosystems that are disrupted by the various forms of fossil fuel extraction, transmission and use. Have them create a poster, chart, or illustration of one of the biotic ecosystems or of statistics showing the relationship of a fossil fuel's use and environmental impact.
- trace the path of natural gas from the fuel origin to their home gas meter.
- obtain from your local natural gas company a graph showing the amount of natural gas they have sold during the past twenty years and any explanation for large fluctuations that might have occurred.
- investigate the various jobs involved in the natural gas industry.
- learn to read their natural gas meters and chart their usage for one week.
- draw and color a natural gas flame.

Natural gas is located by sophisticated methods, including: magnetic measurement, satellite imagery, gravity mapping, and seismic sound wave reflection. Once a potential economic trap is identified, a drill site is selected, and a drill rig is contracted to bore through the layers of rock to the desired "target horizon." When natural gas has been found, it must be processed and distributed to consumers. Natural gas reprocessing plants are used to turn hundreds of thousands of cubic feet of unrefined natural gas into commercial, high quality natural gas.

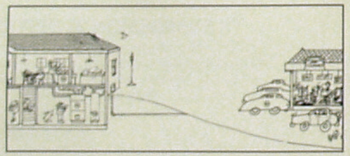
At the processing plant, the natural gas is first sent through a separator where secondary byproducts including oils, impurities, and heavier hydrocarbons such as butane, ethane, and propane are removed. Most of these byproducts are reprocessed, packaged and sent to market for a variety of different uses. As natural gas leaves the processing plant, it enters a compressor station where it is pressurized for transmission.

The natural gas transportation and storage network in the United States is a 1.2 million-mile underground pipeline system. Along the pipelines are valves used to control the pressure and cut off flow in an emergency such as a break in the line or a fire. As the pipeline nears a city, some of the 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 consumer: homes, schools, businesses and industry. The consumer's natural gas flows through meters which measure the exact amount of natural gas used, and the natural gas company bills the customer.

HOME COMFORT

Central heating and cooling, cooking, heating water, drying clothes, and making life more comfortable are benefits of clean natural gas.



ACTIVITIES

Have your students . . .

- discuss the concepts of "conservation" and wise energy use of natural gas, and list ten ways they can conserve energy.
- divide into groups. Allow each group to examine the poster for a set period of time (e.g. 1 minute) and then write down all of the ways they observed natural gas being used.
- color or circle on a black-and-white copy of the mini poster as many images as they can find that show natural gas being used. (You will need to copy the mini poster on the back of the large poster for this activity.)
- develop a four panel comic strip showing the wise use of natural gas.
- compare gas bills from several different households to discover why one family may use more natural gas (therms) than does another.
- draw a mural depicting the major means of heating homes in the years 1850, 1950 and 2050.
- list ways in which natural gas consumption can be reduced without decreasing the quality of life.

The natural gas industry is continually searching for new and improved methods to increase the efficiency of energy consuming appliances and equipment. Federal energy efficiency standards for appliances and building construction designs and techniques are also helping in this conservation effort. But conservation depends largely on our daily "common sense" utilization of energy. For example, energy is conserved when a home is insulated and weatherized, a shower is taken instead of a bath, food is cooked in a pressure cooker rather than in an open pan, and leaky water faucets are repaired.

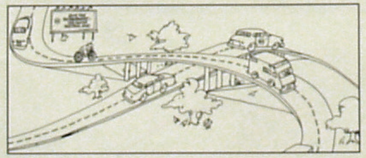
There are certain properties of natural gas which make this energy form extremely safe. First, it is lighter than air, and when not contained (if a leak occurs), diffuses in the atmosphere. In its original state, natural gas is colorless, nontoxic, and odorless. Mercaptan is added to natural gas during 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.

Secondly, natural gas has a higher combustion temperature than other fuels. Natural gas ignites at 6490 C (1,2000F) compared to as low as 3710C (7000F) for some other fuels. A third inherent property of natural gas that helps provide a safety barrier is that if the exact mixture of natural gas and oxygen is not met, combustion cannot occur.

Although natural gas is safe when properly used, it has potentially dangerous characteristics. If natural gas and the mixture of oxygen are not properly balanced when lit, incomplete combustion will occur and carbon monoxide will be produced. Asphyxiation could also occur if a leak develops and displaces all of the available oxygen. Therefore, 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, maintained, and inspected.

TRANSPORTATION

Vehicles fueled by natural gas (NGVs) create less pollution and cost less to operate.



ACTIVITIES

Have your students . . .

- research what environmental legislation has been enacted to encourage the use of natural gas over other fossil fuels for vehicles.
- find out what people in your community think should be done to control auto pollution.

One more way that the use of natural gas can help provide a cleaner environment is to use it to fuel vehicles. Gasoline-powered cars and trucks are the largest single source of many forms of pollution. Vehicles powered by natural gas provide an economic, safe and energy efficient solution to air pollution problems. NGVs have already met the most stringent clean air act emissions standard: the California ultra-low-emission vehicle standard. One such vehicle, the Chrysler B250 natural gas van, has been certified in California with what is believed to be the lowest 50,000-mile NOx and non-methane hydrocarbon emissions ever reported. Carbon monoxide emissions are also dramatically reduced.

MANUFACTURING

Natural gas is used in producing building materials, paper, fabrics and even in the processing of food.

ACTIVITIES

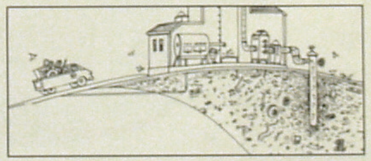
Have your students . . .

- divide into groups and investigate the different processes of burning coal in combination with natural gas. Have a leader from each group report on their findings.

Industry is the largest consumer of natural gas, using 38% of the nation's total annual consumption, compared to the residential sector at 26%, the electric utilities at 20%, and the commercial sector at 16%. Natural gas is used by businesses and industries in many ways, from cooking in restaurants to fueling high temperature blast furnaces for the manufacture of steel. 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.

RENEWABLE ENERGY

We can use wood, farming silage, organic waste and garbage to create biogas, which can be burned like natural gas.



ACTIVITIES

Have your students . . .

- find out why we have to drill deeper to find natural gas today than was necessary in 1950. Discuss the limits of resources.
- consider the environmental issues associated with modern-day exploration by large fossil fuel companies. A local consultant from a geophysics firm or fossil fuel company could serve as a valuable guest speaker.
- list ways that natural gas can reduce society's impact on the environment.
- create a class mural which illustrates how using natural gas can improve the environment.
- list technologies now based upon fossil fuels that will be able to switch to other energy sources in the future.
- describe how man has been able to convert items which were once thought to be waste to useful functions.
- give examples of resources that can last indefinitely if wisely used (renewable).

The U.S. Department of Energy (DOE) estimates the present technologically recoverable domestic resources of natural gas at 1,059 Trillion Cubic Feet (TCF) or a sixty year supply at present consumption rates. In addition to conventional natural gas resources, currently producing unconventional sources include eastern Devonian shales, western tight sands, coal seam methane, and enhanced natural gas recovery. Current calculations show that if only a small percentage of the natural gas found in unconventional sources could be recovered, the United States could more than quadruple its present natural gas reserves. It may be true that eventually we will use all the deposits of fossil fuels which we are able to find and develop, but this appears to be far into the future.

Renewable energy sources such as wood, farming silage, organic waste and garbage can be utilized to create biogas, which can be used like natural gas and extend our future resources. Biogas contains between 50% and 70% methane; whereas, natural gas contains between 89% and 93% methane. The advantages of biofuels over other fuel sources are: domestic production would have a favorable economic impact, as well as a favorable impact on the environment; biomass is low in polluting sulfur; and the energy produced is renewable.

One successful example of renewable biogas is New York's Fresh Kills landfill. After securing recovery rights in 1975, the first volumes of gas were sold to Brooklyn Union Gas in 1982. The well field collection system at Fresh Kills consists of approximately 180 wells, connected by seven miles of polyethylene pipe to the inlet of the methane recovery plant. All 180 wells are drilled to an average depth of sixty feet. The landfill gas is purified to pipeline quality and then transferred to Brooklyn Union Gas who odorizes, monitors, and measures the gas volume. The cost of this facility totalled $20 million. In less than three years of operation, the plant sold in excess of three trillion BTUs of pipeline quality gas, generating a revenue stream of approximately $15 million. Although landfill gas recovery will not be a long-term solution to supplementing our nation's energy reserves, it demonstrates that this wasted energy can be utilized to benefit a community.

How To Use This Poster

Teaching about natural gas and the environment at all grade levels is important and can be done through various disciplines. Each of the aspects depicted in this poster has been further developed by using the activity ideas found on the poster's reverse side. Please photocopy the individual panels with the information and activities as well as the black-and-white mini poster before displaying the poster. We encourage you to use this poster and the activities to support and enhance your regular course of instruction.

Acknowledgements

The National Energy Foundation (NEF) recognizes the American Gas Association, and their education committee, for providing technical expertise and assistance in the preparation of both the front and back of this poster. NEF also recognizes the artist Jon Burton who created the art and other design elements.

For More Information

NEF has developed other instructional materials for educators dealing with fossil fuels and the environment that can be used to supplement teacher's instruction. The materials include: A Conceptual Framework For Natural Gas Energy Education with instructional goals and concepts pertaining to natural gas; Coal, Natural Gas, and Oil Energists, in newspaper formats, which provide background information, lesson materials and activities on each fuel source; full color posters of Coal, Natural Gas, Natural Gas Vehicles, and Oil; and The Science Of Flames poster, which compares the characteristics of common gas and solid fuel flames. For these and other resources for education, contact the National Energy Foundation. For additional information, contact the numerous natural gas companies, governmental and professional organizations, universities, research centers, and individuals interested in and concerned about natural gas.

About the National Energy Foundation

National Energy Foundation creates and distributes economical instructional materials dealing with energy, water, mineral resources, science, technology, conservation, the environment, and other natural resource topics. NEF is a unique non-profit organization, devoted to the development of instructional materials and the implementation of innovative teacher training and student programs. NEF is supported by businesses, government agencies, associations and the education community. The Foundation's materials and programs enhance and supplement existing curricula. NEF invites you to join in the quest to improve education and prepare a scientific and technologically literate public.

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