

The Importance of Natural Gas: Awareness and Outreach



The Importance of Natural Gas
Awareness and Outreach

Objectives 2

Why Consider Natural Gas 2

Natural Gas Benefits..... 3

 Health Benefits 4

 Environmental Benefits 4

 Economic Benefits 5

 Energy Security Benefits 6

Natural Gas - Today and Tomorrow..... 6

 The Future of Natural Gas 9

 Suggested Actions 11

Summary 12

Test Your Knowledge 12



Acknowledgments

This material was developed by the National Alternative Fuels Training Consortium (NAFTC), a program of West Virginia University in Morgantown, West Virginia, under a grant from the U.S. Department of Energy (DOE).

Acknowledgment: This material is based upon work supported by the U.S. Department of Energy Clean Cities Program under Award Number DE-EE0001696.

Many individuals and organizations in academia, government, and industry participated in this process.

The NAFTC thanks and acknowledges:

- The Curriculum and Training Development Committee of the NAFTC for review and input throughout the development process.
- The National Research Center for Coal and Energy for oversight and support of the project.

Project management was provided by the National Alternative Fuels Training Consortium (NAFTC), Al Ebron, NAFTC Executive Director and Judy Moore, NAFTC Assistant Director - Communications and Outreach and Clean Cities Learning Program Project Coordinator, West Virginia University, Morgantown, West Virginia.



National Alternative Fuels Training Consortium

A Program of



The Importance of Natural Gas

This material will discuss the importance of natural gas and natural gas vehicles (NGVs). The advantages and reasons to consider adopting NGVs will be explored, as well as a discussion of the health, environmental, economic, and energy security benefits associated with alternative fuel technology. Finally, suggested actions to support and resources to learn more about alternative fuels, such as natural gas will be presented.

Objectives

- Describe how natural gas may help improve public health
- Describe the benefits to the environment
- Explain how natural gas may help stimulate the economy
- Describe what energy security is and how using natural gas can help attain it
- Explain the future of natural gas
- Explain the suggested actions to support natural gas

Why Consider Natural Gas?

Natural gas is exceptionally safe. Since natural gas is lighter than air, in the event of an accident, natural gas will rise if released into the atmosphere away from hot spots of accidents, instead of forming a dangerous flammable pool on the ground like other liquid fuels.

Natural gas is widely available through established distribution networks (such as pipelines and trucks). However, this infrastructure is not widely available to offer CNG and LNG to end users at commercial vehicle fueling stations.

Advantages of Natural Gas

There are many reasons to consider the use of natural gas. One of the primary advantages (see **Figure 1**) of using natural gas vehicles (NGVs) is that they can produce fewer emissions than conventional vehicles. Because of this, CNG cars and LNG buses are widely used in municipal and private fleets, especially in areas where central fueling stations are readily available.

Most CNG used in the U.S. is produced domestically. LNG is also mostly produced domestically. In most places where CNG is sold as an engine fuel, it costs less than gasoline. The U.S. Department of Energy points out that natural gas vehicle engines last longer and require less frequent service than conventional vehicles, which saves consumers money in the long run.

Notes



Health Benefits

Compared with vehicles fueled by conventional gasoline, natural gas vehicles can produce significantly lower amounts of harmful emissions such as particulate matter, carbon monoxide, and greenhouse gases (GHG). These emissions have been linked to the formation of smog and acid rain. Additionally, smog can create or irritate existing cases of asthma, emphysema, and bronchitis.

Since natural gas can produce fewer of these harmful emissions, the effects on individuals that are predisposed to these conditions are reduced. By placing fewer of these emissions into the atmosphere, the effects of global warming can also be mitigated.



Environmental Benefits

While the burning of fossil fuels has been linked to certain environmental issues (global warming, smog, acid rain), the combustion of natural gas can be a cleaner process than the combustion of conventional fuels.

When compared with conventional diesel vehicles, natural gas vehicles emit 75-95% less carbon monoxide and almost no particulate matter. By using natural gas vehicles in their diesel fleets, organizations can reduce their total oxides of nitrogen (NO_x) emissions by 17-80%. These oxides react in the atmosphere hydrocarbon emissions to form smog and acid rain. Natural gas may also reduce non-methane hydrocarbon emissions by 50-75%. The use of natural gas as a vehicle fuel can reduce CO₂ emissions by up to 25% when compared to diesel exhaust, which in turn will decrease the effects humanity has on global warming. The emissions reductions of natural gas are a function of many variables. The ranges are reported examples available on the AFDC website.

Burning fossil fuels has contributed to environmental issues such as global warming, smog, and acid rain. Natural gas, however, is the cleanest of all hydrocarbon fuels and, therefore, offers substantial environmental benefits.

Global warming is believed to be a result of carbon dioxide (CO₂) and other greenhouse gas (GHG) emissions. When used as a fuel, natural gas produces almost 25% less CO₂ than diesel fuel. Coal and oil have a higher **carbon ratio**, meaning they contain more atoms of carbon for each atom of hydrogen, and they also contain sulfur.

Smog is caused by the chemical reaction between carbon monoxide (CO), oxides of nitrogen (NO_x), volatile organic compounds, and ultraviolet radiation produced by the sun. This is why smog is generally worse in cities that have a high percentage of clear, sunny days along with increased vehicle usage. Natural gas usage does not play a significant role in smog formation because natural gas vehicles emit lower levels of NO_x and hydrocarbon emissions compared to gasoline vehicles. Using natural gas vehicles in areas with high vehicle concentrations can help combat the detrimental effects of smog.

Acid rain plagues much of the eastern U.S. and is responsible for damaging crops, forests, wildlife populations, and buildings. It also can cause respiratory illnesses. The reaction of sulfur dioxide (SO₂) and oxides of nitrogen (NO_x) with water vapor in the presence of sunlight leads to the formation of sulfuric and nitric acids. Since natural gas vehicles emit very little sulfur dioxide and NO_x, the use of natural gas does not contribute to formation of acid rain.



Did You Know?

Compared to traditional diesel vehicles, NGVs have reductions in carbon monoxide (CO) emissions of 75-95%, reductions in carbon dioxide (CO₂) emissions of 25%, and nitrogen oxide (NO_x) emissions can be reduced by 17-80%.

Source: AFDC, 2011



Economic Benefits

Most of the CNG used in the U.S. is produced domestically. LNG is domestically produced but also may be imported.

In most places where CNG is sold as an engine fuel, it costs less than gasoline. In the U.S., natural gas is typically at least \$1 less per gallon when compared to conventional gasoline. The DOE reports in the Alternative Fuel Price Report (January 2012) that conventional gasoline costs on average \$3.37 per gallon, while CNG costs \$2.13 per GGE.

With a network of pipelines in place and the ability to use the existing distribution network, there are minimal additional costs to expand the use of natural gas in transportation. This helps lessen the financial burden many states may face in building the necessary fueling infrastructure.

Series of horizontal lines for taking notes.

Notes



Energy Security Benefits

Natural gas is much less utilized than other hydrocarbon fuel, making it significantly cheaper than coal or oil. In addition, it is generally domestically produced and can be farmed from domestic coal deposits. The use of natural gas as a transportation fuel would alleviate some of the nation's dependence upon foreign oil and encourage energy independence.

Harvesting methane from biogas produced from landfills, dairy waste, and agricultural/organic matter is currently being performed in several locations across the country. There are more than 500 landfills in the U.S. that are currently using biogas as an energy source for electricity production, for use in boilers/furnaces, or for vehicle fuel. Developments in natural gas production from waste materials help produce energy as well as nitrogen-rich fertilizer, creating a use for wasted material that had little use before.

Natural Gas – Today and Tomorrow

Since natural gas is produced domestically and the fuel is produced at plants in this country—the use of natural gas promotes energy self-sufficiency and creates new jobs in America. Today, the natural gas industry has contributed significantly to the domestic economy.

Today, around 13 million natural gas vehicles are being driven worldwide. The move toward cleaner-burning, less expensive fuels has resulted in the development of a huge market for natural gas across the country. The number of natural gas vehicles on the road will only increase from this point forward.

According to EIA, natural gas accounts for nearly 25% of the total energy used in the U.S. – 34% goes to residential and commercial uses, such as heating and cooking; 27% to industrial uses; and 31% to electric power production. Only about 1% is used for transportation fuel (see **Figure 2**).

Due to its efficiency, cleanliness, and reliability, natural gas is growing increasingly popular. The DOE predicts that consumption of natural gas will increase 11% by 2030.



Did You Know?

Natural gas is primarily a domestic energy source. In 2010, 87% of the natural gas consumed in the U.S. was produced domestically. The remaining gas supply came from Canada (11%), with 2% imported as liquefied natural gas (LNG).

Source: American Gas Association, 2011

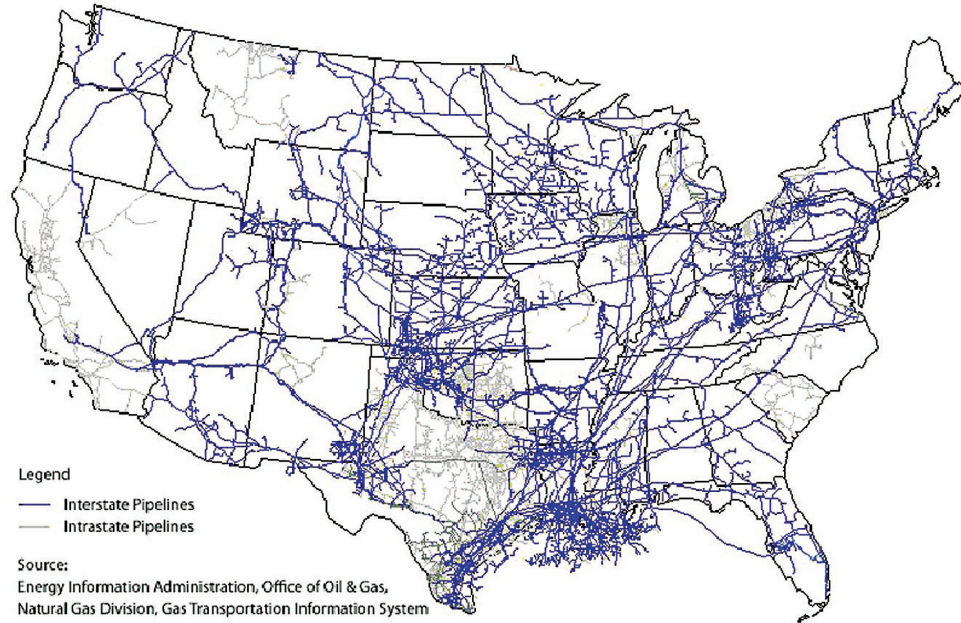


Figure 3: Natural gas pipeline system. Source: EIA.

According to Natural Gas Vehicles for America, there are about 112,000 NGVs on U.S. roads today. Compressed natural gas (CNG) fueling stations can currently be found in most major cities and in several rural areas, and are usually found side-by-side with gasoline and diesel pumps at many service stations. According to the DOE, there are currently over 1,000 CNG and LNG fueling stations in the U.S. Communicating to local communities what fueling stations are available to them would greatly encourage the use of natural gas vehicles. The DOE's Clean Cities program supports infrastructure projects that put alternative fueling stations along major travel corridors, enabling alternative fuel vehicle drivers to travel long distances using alternative fuels.

The natural gas infrastructure has met the needs of consumers for many years. However, it must evolve and develop further to fully support the level of operations necessary to achieve the associated benefits.

Notes



Figure 4: Global natural gas supply – conventional gas reserves vs. recoverable shale-gas reserves. Source: EIA Annual Energy Review.

Industry data shows that vehicular natural gas usage nearly doubled between 2003 and 2009. In 2010, natural gas displaced more than 350 million gasoline gallon equivalents (GGE).

Transit buses now account for about 62% of all vehicular natural gas use in the U.S. (see Figure 5). According to the American Public Transit Association, 26% of all new transit bus orders in 2009 were for natural gas. In 2009 about 18% of transit buses operated on natural gas.



Figure 5: Transit bus fleets throughout the country have made the shift to natural gas. Source: NAFTC.

Waste collection and transfer vehicles also account for about 12% of total natural gas vehicle use in the U.S. and are the fastest growing NGV segment. For example, Waste Management, Inc. based in Houston, Texas, deployed its 1,000th natural gas-powered truck in 2011. Waste Management was one of the recipients of the 2011 NGV Annual Achievement Awards by Natural Gas Vehicles for America. Nationwide, Waste Management's natural gas fleet displaces eight million gallons of diesel fuel each year, eliminating 45,100 metric tons of greenhouse gas emissions.

Currently, more than 35 airports in the U.S. have natural gas vehicles in their fleets and/or have policies encouraging use by private fleets operating on their premises, making this sector the third largest with about 9% of total natural gas vehicle use.

The International Association of Natural Gas Vehicles estimates that there will be more than 50 million natural gas vehicles worldwide within the next 10 years – giving consumers more options in the vehicles they drive.

Suggested Actions

In an effort to reduce America's dependence on foreign oil, reduce emissions and greenhouse gases, the federal government, state governments, and even regional and local governments have implemented incentives to encourage the purchase and use of NGVs.

Individuals are encouraged to use public transportation systems to support the ongoing growth and use of natural gas in local public transportation systems. In fact, public transit systems such as Washington Metropolitan Area Transit Authority (METRO), in the Washington, D.C., metro area, offer incentives for free service throughout the year. Initiatives such as this raise awareness for alternative fuels and strive to encourage the public to take METRO Bus, which runs on CNG.

Other incentives include tax deductions/credits, reduced license fees, reduced vehicle sale taxes, and lower registration fees. Some states also permit certain alternative fuel vehicles to operate in high occupancy vehicle (HOV) lanes during peak rush-hour periods.

The DOE's Alternative Fuels Data Center (AFDC) maintains a list of state, federal incentives, and laws for HEVs and alternative fuel vehicles.



Notes

Summary

Alternative fuel and advanced technology vehicles have the potential to virtually eliminate high gasoline prices, but the industry needs qualified, trained automotive service technicians to understand, diagnose, and maintain these vehicles to keep them on the road. Furthermore, it is imperative that everyday consumers understand how natural gas and natural gas vehicles work and the benefits that these alternative fuel vehicles offer to human health, the environment, and the economy.

Natural gas and natural gas vehicles utilize an existing distribution network and agricultural supply to ensure America's energy independence.

Upon completing this material, can you

- Describe how natural gas may help improve public health?
- Describe the benefits to the environment?
- Explain how natural gas may help stimulate the economy?
- Describe what energy security is and how using natural gas can help attain it?
- Explain the future of natural gas?
- Explain the suggested actions to support natural gas?



Test Your Knowledge

- 1) Give an example of a natural gas vehicle that is successfully reducing carbon emissions.
- 2) **True or False:** An extensive natural gas pipeline and distribution network already exists.
- 3) What is one of the biggest challenges for encouraging the use of NGVs and their increasing demand?
- 4) **True or False:** There are many tax incentives for alternative fuel vehicles but none for CNG.

Answers: 1) Public transit bus fleets, 2) True, 3) There are very few public fueling stations for CNG/LNG, the majority are privately owned for companies and fleets, 4) False — there are tax incentives for CNG.

Disclaimer

National Alternative Fuels Training Consortium/West Virginia University/West Virginia University Research Corporation Disclaimer

All published versions of this Petroleum Reduction Technologies, including both printed and electronic formats thereof and all associated videos, supplementing documents, and related electronic links, are provided as a public service by the National Alternative Fuels Training Consortium (NAFTC), a program of West Virginia University, under a grant from the U.S. Department of Energy Clean Cities Program under Award Number DE-EE0001696.

The information contained in this manual was obtained from sources believed to be reliable and is based on technical information and experience currently available at the time of writing.

All users of the information contained herein do so at their own risk.

The National Alternative Fuels Training Consortium (NAFTC)—a program of West Virginia University—and its members make no warranty or guarantee regarding the results of the use of this information and assume no liability or responsibility in connection with the information or suggestions herein contained. The NAFTC does not endorse any specific commercial product, original equipment manufacturer, or professional service. Any reference or mention of specific products, manufacturers, or service providers by trade name, trademark, or visual identity does not constitute or imply endorsement or recommendation from the NAFTC.

Moreover, it should not be assumed that every acceptable or necessary commodity grade, test, safety procedure, method, precaution, equipment, or device is contained within, nor that abnormal or unusual conditions or circumstances may not warrant or suggest further requirements or additional procedures.

This document is subject to periodic review and/or revision. Users are strongly cautioned to obtain the latest version.

Comments and suggestions are invited from all users for consideration by the NAFTC in connection with such review. Please send all comments to the NAFTC, to the attention of the Executive Director.

The guidance and information in this guide are not meant to take the place of vehicle or equipment manufacturer guidelines and are not intended to supersede other information, requirements, or regulations provided by manufacturers, the insurance industry, safety officials, or other applicable standards and recommended practices.

This document does not take the place of and should not be confused with federal, state, provincial, or municipal specifications or regulations, insurance requirements, or safety codes.

U.S. Department of Energy (DOE) Disclaimer

This material was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Copyright Notice

This material is Copyright © 2012 by West Virginia University Research Corporation and the National Alternative Fuels Training Consortium, Morgantown, WV. All rights are reserved in all countries. This work is a product of the National Alternative Fuels Training Consortium, a program of West Virginia University. This material has been funded by a grant from the U.S. Department of Energy (DOE) Clean Cities Program under Award Number DE-EE0001696.

Any reproduction, duplication, distribution, or display, by physical, electronic, or other means, without written permission from the National Alternative Fuels Training Consortium, is expressly prohibited.

This work may be quoted briefly, provided that attribution is given to the National Alternative Fuels Training Consortium.

All images, graphs, and photographs are provided by National Alternative Fuels Training Consortium unless otherwise noted in context.

For questions or further information, please contact:

National Alternative Fuels Training Consortium

Attention: Executive Director

1100 Frederick Lane

Ridgeview Business Park

Morgantown, WV 26508

Telephone: 304-293-7882

Fax: 304-293-6944

<http://www.naftc.wvu.edu>

PRINTED IN THE UNITED STATES OF AMERICA
First printing 2012.

Acknowledgment: This material is based upon work supported by the U.S. Department of Energy Clean Cities Program under Award Number DE-EE0001696.



U. S. Department of Energy

The U.S. DOE Clean Cities Program is a government-industry partnership designed to reduce petroleum consumption in the transportation sector by advancing the use of alternative fuels and vehicles, idle reduction technologies, hybrid electric vehicles, fuel blends, and fuel economy measures.

www.naftc.wvu.edu/cleancitieslearningprogram
www.cleancities.energy.gov

The National Alternative Fuels Training Consortium is the only nationwide alternative fuel vehicles and advanced technology vehicle training organization in the U.S.

**National Alternative Fuels
Training Consortium**

Ridgeview Business Park
1100 Frederick Lane
Morgantown, WV 26508



A Program of

West Virginia University