

# Clean Air and Energy Independence

## Clean Air and Energy Independence

An Overview of Alternative Fuels  
and Advanced Technology Vehicles

### Instructor's Manual



**National Alternative Fuels  
Training Consortium**

Headquartered at

 **West Virginia University®**





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An Overview of Alternative Fuels and Advanced Technology Vehicles



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## DAY AGENDA

1	Module 1: Why Do We Need Alternative Fuels?	1:40
	Module 2: Laws, Regulations, Programs & Incentives	1:15
	Module 3: Propane Vehicles	1:00
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2	Module 5: Ethanol, Methanol, and Synthetic Fuels	1:30
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3	Module 9: Hydrogen Powered Vehicles	1:30
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	Module 11: What Is Next?	1:00

## Instructor Notes:



*This information does not appear in the Participant's Guide. You should customize the course agenda to meet your specific requirements.*

*Specific agendas for each module appear in the Instructor's Guide in the introductory material for the module.*

*This course is designed to take 2½ days to complete. Instructional time is understood to be 6.5 hours per day, which allows for a 15-minute break in the morning and afternoon, and one hour for lunch each day.*

## A Note About NAFTC Curriculum Materials

Clean Air and Energy Independence

In order to meet the needs of its member institutions, the NAFTC produces training materials of the highest quality—following training industry standards for instructional design, printing, and delivery techniques.

This Instructor's Guide contains many teaching aids to help the instructor and learner. The Participant's Guide contains the same information, but without the instructor's notes and teaching aids.

The design of this course is modular, allowing the instructor to include or exclude modules and lessons, as needed.

It is expected that the instructor will use the accompanying Microsoft® PowerPoint presentation, along with this Instructor's Guide (and with the learners using the Participant's Guide).

Finally, the PowerPoint presentation is designed to offer only “talking points.” For the full detail of any topic, always refer to the printed texts. Most NAFTC instructors teach from the PowerPoint presentation, with the printed text open in front of them (and the learners). That way, learners can follow the text, make appropriate notes, and refer to the text when answering Module Review Questions.





### **Letter from the Director**

Energy consumption is increasing at a dramatic rate everywhere in the world. The extent of this consumption is directly proportional to each society's economic and industrial development. It is a well-established fact that petroleum is one of the most widely-used fuel resources in the world today. As more and more countries grow and prosper, we will see accelerating depletion of the traditional energy sources used for transportation.

Energy independence is becoming a critical factor affecting homeland security in the United States and all other developed countries. An adequate and reliable fuel supply is a critical component of any strategic plan for economic development and national security. In every nation, the choice of fuel has assumed serious economic and environmental consequences in the forms of budget deficits caused by oil imports and ecological degradation caused by pollution.

Air pollution in some metropolitan areas has reached alarming levels. In response to this pollution, environmental concerns have contributed to the improvement of fuel quality. Over the past decade, the possibility of substituting cleaner-burning alternatives for gasoline and diesel has drawn the attention of the automobile industry, as well as federal, state, and local governments. Even though it is well known that alternative fuels create less pollution and help states and metropolitan areas to meet stringent environmental requirements, gasoline and diesel remain the most common transportation fuels in the United States. Additionally, alternative fuels have marked benefits beyond air quality: New fuels in the marketplace offer consumers new choices and can decrease the country's dependence on imported oil.

Alternative fuel vehicles are becoming more readily available to consumers and fleets. Their widespread use in the near future is not only feasible, but necessary. To enable the transition to alternative fuels, technologies must be refined so that vehicles can achieve optimum performance and emissions characteristics. New infrastructures must be developed and supported.

Using less-expensive alternative fuels and advanced technologies—including electricity, hydrogen, fuel cells, biodiesel, natural gas, and propane—has the potential to significantly reduce this country's transportation costs. Using less-polluting fuels will also help meet government-mandated emissions requirements and contribute to a cleaner environment, as well as help to lessen our dependence on foreign oil imports.

These are compelling reasons to educate the general public, government officials, and business executives and to create a pool of properly-trained technicians to service these vehicles. The goal of this course is to meet these needs.

The National Alternative Fuels Training Consortium, working in cooperation with the U.S. Environmental Protection Agency, is pleased to provide this course, Clean Air and Energy Independence: An Overview of Alternative Fuels and Advanced Technology Vehicles.

Sincerely,

A handwritten signature in black ink, appearing to read "Al Ebron".

Al Ebron  
Executive Director  
National Alternative Fuels Training Consortium  
West Virginia University

# Acknowledgments

Clean Air and Energy Independence

This course was developed by the National Alternative Fuels Training Consortium (NAFTC), headquartered at West Virginia University in Morgantown, West Virginia, under a Cooperative Agreement with the United States Environmental Protection Agency. Many individuals and organizations in academia, government, and industry participated in this process.

The NAFTC thanks and acknowledges

- Wake Technical Community College of Garner, North Carolina, for its support and assistance in the pilot test of this course
- 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 Al Ebron, Executive Director; Bill Davis, Program Manager; and Tom Hudson, Curriculum Developer of the NAFTC, West Virginia University, Morgantown, West Virginia. Rich Cregar, NAFTC Instructor, served as subject matter expert and conducted the pilot test. Design and development was done by Sealund and Associates of Clearwater, Florida.





The number of vehicles powered by alternative fuels is growing every year. Mandates such as the federal Energy Policy Act and the California Federal Pilot Program require most large private and government fleets to include alternative fuel vehicles in ever-growing numbers.

This means that the interest in alternative fuels is timely and growing rapidly. The general public wants basic information to help them make informed decisions; automotive technicians need a solid foundation, followed by in-depth training in specific fuels and vehicles; and those responsible for acquiring and managing such vehicles need details regarding their performance, service, maintenance, and infrastructure. It is the goal of this course to provide that information.

Each module of the **Participant's Guide** contains text, illustrations, explanatory figures and tables, review questions, and learning activities.

Each corresponding module of the **Instructor's Guide** contains everything in the Participant's Guide, plus a detailed daily agenda, teaching suggestions, group discussion topics, guidelines for conducting learning activities, answer keys to review questions, PowerPoint slides, and animated graphics.

The National Alternative Fuels Training Consortium (NAFTC) is pleased to offer this course, *Clean Air and Energy Independence: An Overview of Alternative Fuels and Advanced Technology Vehicles*, which meets the needs of the general public, the automotive technician, the employer, the fleet operator, and the training institution.

# Course Objectives

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## ***Course Objectives***

Upon successful completion of this course, the participant will be able to:

- Explain the environmental impact of pollution caused by motor vehicles
- Describe the consequences of U.S. dependence on foreign sources of oil
- Recognize the efforts to legislate air quality at the federal, state, and local levels
- Define the term “alternative fuel”
- Discuss the sources, uses, advantages, and disadvantages of
  - Propane (LPG or liquefied petroleum gas)
  - Natural gas
  - Ethanol, methanol, and synthetic fuels
  - Biodiesel
  - Battery-powered electric vehicles
  - Hybrid electric vehicles
  - Hydrogen-powered vehicles
  - Fuel cells
- State what actions must be taken in order to work toward clean air and energy independence.

If all modules are included, this course is 2.5 days in length and includes a wide variety of learning activities.

For information about class schedules, pricing, locations, and registration, please contact the National Alternative Fuels Training Consortium at 304-293-7882 or online at [www.naftc.wvu.edu](http://www.naftc.wvu.edu).





**Module Topics****1 Why Do We Need Alternative Fuels?**

Problems associated with vehicle emissions; health effects; environmental damage; oil prices and the U.S. economy; supply and demand; availability concerns; oil as a weapon; benefits of using alternative fuels

**2 Laws, Regulations, Programs & Incentives**

Federal policy efforts; EPA legislation and programs; the role of the IRS; the role of the Department of Energy; the role of the Department of Transportation; state incentives and laws; nongovernmental standards

**3 Propane Vehicles**

What is propane/LPG?; history of propane as a vehicle fuel; technology of propane vehicles; basic principles behind propane vehicles; mechanical differences; advantages and disadvantages of propane vehicles; propane vehicles in use today; performance of propane vehicles; infrastructure requirements

**4 Natural Gas Vehicles**

What are natural gas vehicles (NGVs)?; history of NG as a vehicle fuel; technology of NGVs; basic principles behind NGVs; mechanical differences; advantages and disadvantages of NGVs; NGVs in use today; performance of NGVs; infrastructure requirements

**5 Ethanol, Methanol, and Synthetic Fuels**

What is ethanol?; what is methanol?; what are synthetic fuels?; history of ethanol/methanol as vehicle fuels; technology of ethanol vehicles; basic principles behind ethanol vehicles; vehicle differences; advantages and disadvantages of ethanol as a vehicle fuel; ethanol vehicles in use today; performance; infrastructure requirements

# Module Topics 1

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## 6 Biodiesel

What is biodiesel?; history of biodiesel; technology of diesel vehicles; basic principles behind biodiesel; components of biodiesel vehicles; mechanical differences; advantages and disadvantages of biodiesel; infrastructure requirements

## 7 Battery-Powered Electric Vehicles

What is a battery-powered electric vehicle?; history of EVs; technology of EVs; basic principles behind EVs; components of EVs; mechanical differences; advantages and disadvantages of EVs; infrastructure requirements

## 8 Hybrid Electric Vehicles

What are hybrid electric vehicles (HEVs)?; history of HEVs; technology of HEVs; basic principles behind HEVs; efficiency and components of HEVs; mechanical differences; advantages and disadvantages of HEVs; infrastructure requirements

## 9 Hydrogen-Powered Vehicles

What are hydrogen-powered vehicles (HPVs)?; history of HPVs; technology of HPVs; basic principles behind HPVs; components of HPVs; mechanical differences; advantages and disadvantages of HPVs; infrastructure requirements

## 10 Fuel Cells

What is a fuel cell (FC)?; history of FCs; technology of FCs; basic principles behind FCs; components of FCs; mechanical differences; advantages and disadvantages of FCs; infrastructure requirements

## 11 What Is Next?

Comparison of alternative fuels/advanced technology vehicles; future of alternative fuels

**Glossary**

**Appendix**

**Train the Trainer (Instructor's Guide only)**



**Disclaimer**

The information contained in this guide 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.

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.

# Participant Feedback

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## Notes

PARTICIPANT: Please use this form to notify the NAFTC of any corrections, suggestions, or other observations that you feel may contribute to improving the quality, flow, or learning experience from this course. Please make as many copies of this page as necessary.

Participant Name: \_\_\_\_\_

Telephone Number: \_\_\_\_\_

(This is needed in case we require further clarification.)

Chapter: \_\_\_\_\_ Page: \_\_\_\_\_

Please check one of the following:

\_\_\_ Text \_\_\_ Activity \_\_\_ Note Box

\_\_\_ Figure \_\_\_ Discussion Question \_\_\_ Instructor's Note

\_\_\_ Table \_\_\_ Review Question \_\_\_ Other

Problem, Concern, or Comment: \_\_\_\_\_

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Suggested Solution, Correction, or Improvement: \_\_\_\_\_

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Continue on the back of this sheet if necessary.  
Please mail or fax this form to:

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Telephone: 304-293-7882  
Ridgeview Business Park  
Fax: 304-293-6944  
1100 Frederick Lane  
Morgantown, WV 26508

