

because **clean air**
and **energy independence**
matter...

**National Alternative Fuels
Training Consortium**
*Alternative Fuel Vehicles and
Why They Are Important*
September 9, 2015

Presenter:

**Judy Moore, NAFTC Assistant Director
Communications and Outreach**

**National Alternative Fuels
Training Consortium**

A Program of

 **West Virginia University**





About the NAFTC



Who We Are



WHO WE ARE

Founded in 1992, the National Alternative Fuels Training Consortium (NAFTC) is the only nationwide training organization dedicated to promoting, supporting, and expanding the use of alternative fuel and advanced technology vehicles in an effort to improve air quality and decrease U.S. dependence on foreign oil.

A program of West Virginia University, the NAFTC is a membership organization consisting of national and Associate Training Centers located nationwide from Maine to California. Each center provides training with impact through its experienced instructors and real-world shop facilities. Numerous other members including non-profit and government agencies, corporations, and small businesses also support the NAFTC's mission.

OUR MISSION

To educate the nation about alternative fuel and advanced technology vehicles through program management, curriculum development, training implementation, and outreach and education activities leading to the decrease of U.S. dependence on foreign oil and the improvement of air quality.



"We have been a member of the NAFTC from the beginning. Our program has used books and media from the NAFTC for many years. The information, literature, media, and classes are second to none. The consortium should be commended for its commitment to the alternative fuels field."
- Steven Klausung, Automotive Division Head, University of Northwestern Ohio



"I have been in the fire service for 28 years and involved with the NAFTC for the past five years providing safety training for first responders when dealing with alternative fuel vehicles. The NAFTC continues to provide cutting edge information that makes these incidents not only safer for first responders but also for the citizens of our communities. My mission is to provide the most current information to first responders so when faced with these incidents, first responders can mitigate them safely and effectively."
- Gary Garrisi, Battalion Chief, City of Yuba City Fire Dept.



2 NATIONAL ALTERNATIVE FUELS
TRAINING CONSORTIUM

❖ Program of West Virginia University, headquartered in Morgantown, WV

❖ Founded in 1992

❖ Only nationwide curricula development and training organization that focuses on alternative fuel and advanced technology vehicles



Who We Are

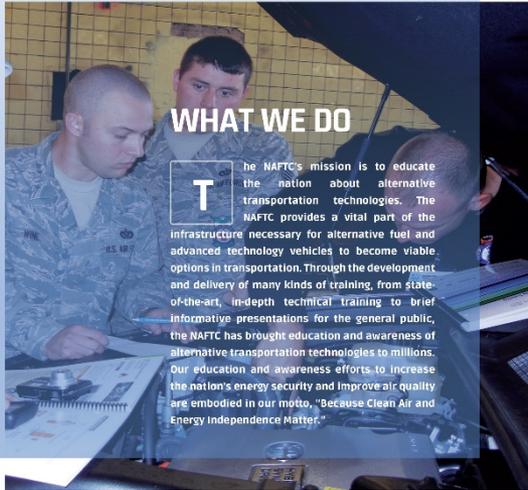
Mission Statement

“To educate the nation about alternative fuel and advanced technology vehicles through program management, curriculum development, training implementation and outreach and education activities leading to the decrease of U.S. dependence on foreign oil and the improvement of air quality.”





What We Do



WHAT WE DO

The NAFTC's mission is to educate the nation about alternative transportation technologies. The NAFTC provides a vital part of the infrastructure necessary for alternative fuel and advanced technology vehicles to become viable options in transportation. Through the development and delivery of many kinds of training, from state-of-the-art, in-depth technical training to brief informative presentations for the general public, the NAFTC has brought education and awareness of alternative transportation technologies to millions. Our education and awareness efforts to increase the nation's energy security and improve air quality are embodied in our motto, "Because Clean Air and Energy Independence Matter."

DID YOU KNOW?

NAFTC training audiences include technicians, first responders and others from industry, academic, and government organizations such as the U.S. Air Force, U.S. Postal Service, U.S. Department of Energy, U.S. Environmental Protection Agency, U.S. General Services Administration, National Park Service, NASA, California Highway Patrol, Baltimore Gas & Electric, Walt Disney World, Atlanta MARTA, City of Phoenix, Phoenix Valley Metro Bus Service, Greater Cleveland Regional Transit Authority, City of Louisville, Kentucky and many other companies, agencies, and government fleets.



"Although alternative fuel and hybrid powered vehicles drive exactly the same as regular vehicles, there are some significant differences that maintenance technicians and public safety officials need to be trained on ... like how to safely work with higher voltage batteries and fuels that react differently than gasoline in case of spills or leakage if the vehicle is in an accident. The expert training that the NAFTC provides is extremely important." - Dennis A. Smith, Director, U.S. Department of Energy Clean Cities Program



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CURRICULUM DEVELOPMENT

NAFTC curricula are developed for a wide variety of audiences, based on the most up-to-date industry information. The award winning, industry recognized curricula undergoes a rigorous examination by professional industry subject matter experts before being released for use.



TECHNICAL TRAINING - COURSES AND WORKSHOPS

Learn the basics or gain in-depth knowledge of alternative fuel and advanced technology vehicles by attending one of more than 35 courses and workshops, at our location or yours. Courses and workshops are customizable based upon audience needs.



GENERAL EDUCATION AND OUTREACH

The NAFTC conducts education and outreach activities, such as its premier event, National AFV Day Odyssey, which is dedicated to promoting cleaner choices in transportation.



PROGRAM MANAGEMENT

The NAFTC has managed more than \$35 million in programs through funding from the U.S. Department of Energy, U.S. Environmental Protection Agency, FEMA, and other government and private sector industry entities.



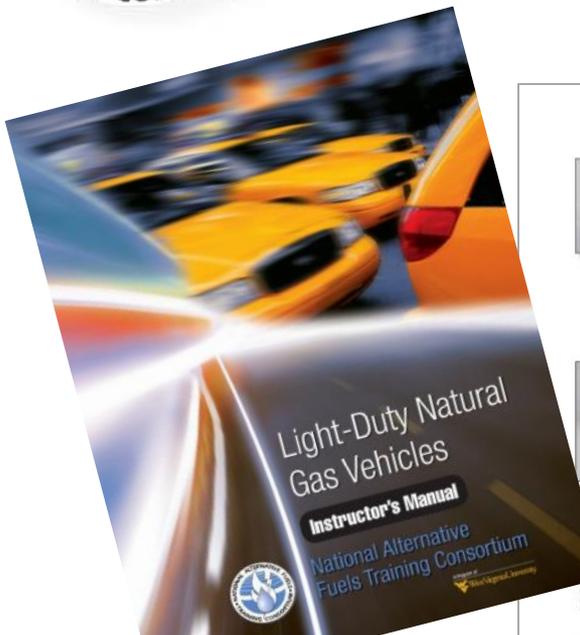
7 NATIONAL ALTERNATIVE FUELS TRAINING CONSORTIUM



- Fuel-neutral, unbiased organization
- Provide education about and promote the use of alternative fuel and advanced technology vehicles –
 - Propane
 - Natural Gas
 - Hydrogen
 - Electric Drive
 - Ethanol
 - Biodiesel



State-of-the-Art Curriculum Development



Chapter 7: Combustion and Engine Design
Light-Duty Natural Gas Vehicle

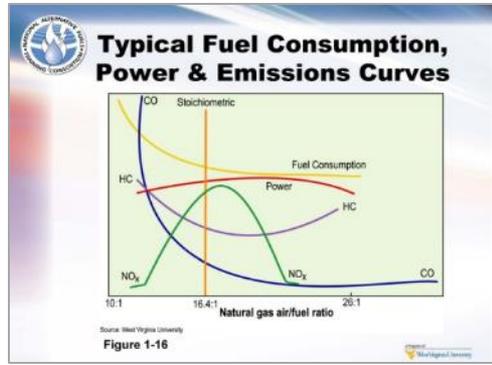
Figure 7-28A: Piston damage caused by pre-ignition leading to detonation of fuel, which burned up the rich cylinder first (the cylinder getting the most fuel).

Figure 7-28B: Lean-burn NG engine piston damage from detonation caused by pre-ignition. Poor cooling, burning of engine lube oil, and a slightly rich mixture contributed to causing pre-ignition.

Figure 7-28C: Exhaust valve damage caused by hot spot on valve or valve seat leading to "blowout" effect. Pre-ignition resulted from hot spot. Valve damage can begin with poor valve seating, inferior valve materials or machining, oil in the combustion chamber, poor cooling in the head, and a rich mixture.

Combustion Chamber Design
Good engine design that allows combustion inside engine displacement, compression and combustion chamber design. Engine displacement is not something the technician easily change. Nevertheless, it is important to know that large-displacement engines with compression ratio and power plants for gaseous fuels because of their inherent efficiency (performance) numbers of propane and methane. The factors to consider with air chambers and operation regarding properties of gaseous fuels are as follows:
 • Lack of lubrication on the valve seat interface—NG and propane are dry fuels.
 • Need for correct air-fuel ratio—rich is better; lean is cooler with gaseous fuels.
 • Need for highly efficient cooling system—no heat of evaporation with gaseous fuels to assist in cooling or to mask other combustion problems.

- ❖ Over 35 courses and workshops
 - Available on all types of alternative fuel and advanced technology vehicles
 - Customizable to meet needs and requirements of the audience





Training

- ❖ Classroom study
- ❖ Lab activities
- ❖ Hands-on shop applications





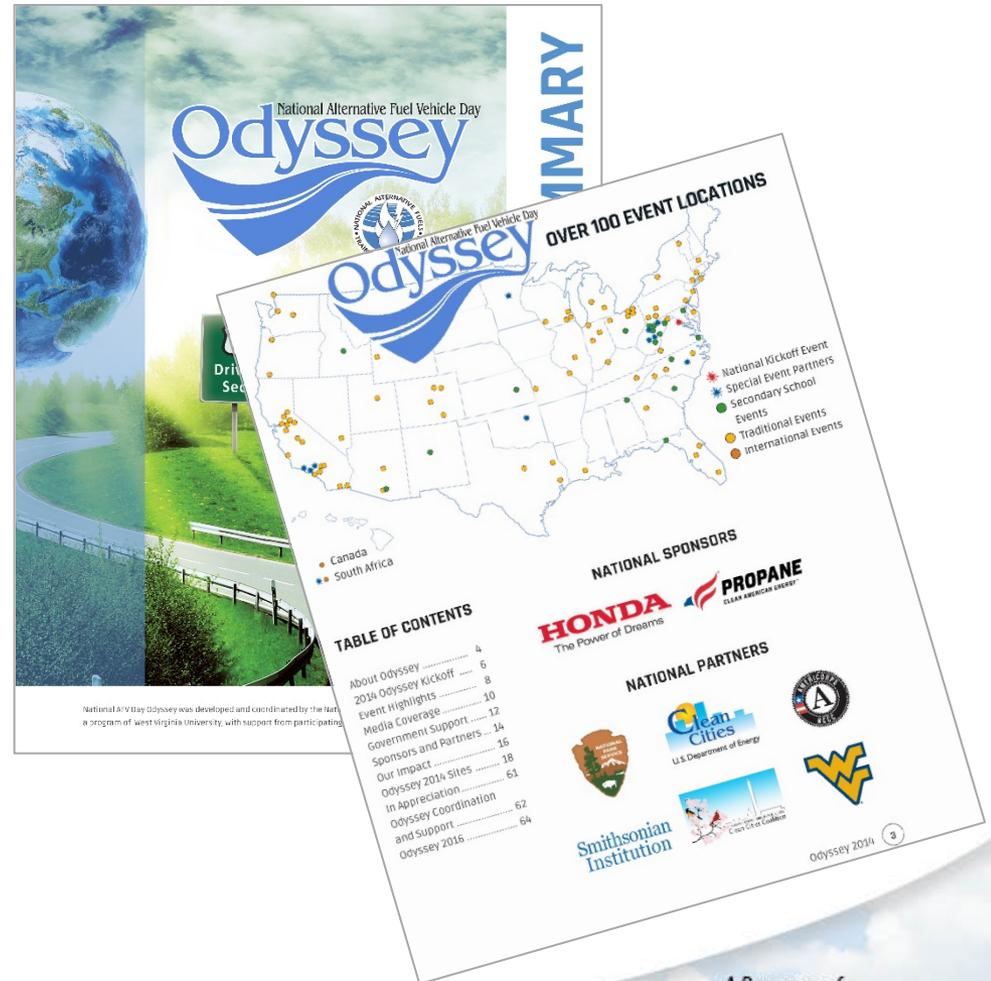
Training Audiences

- ❖ Instructors (Train-the-Trainer)
- ❖ Pre-service and In-service Technicians
- ❖ Fleet Managers
- ❖ Government and Industry Representatives
- ❖ First Responders
- ❖ Students
- ❖ Consumers
- ❖ Others



Outreach and Education

- ❖ National AFV Day Odyssey - a nationwide, biennial outreach event – the largest of its kind – establish to promote the use of alternative fuel vehicles
- ❖ The NAFTC also attends, exhibits, and presents at numerous conferences, workshops and meetings





Why Alternative Fuel Vehicles (AFVs) Are Important



Why We Need AFVs



Economic Benefits



Health Benefits



Environmental Benefits

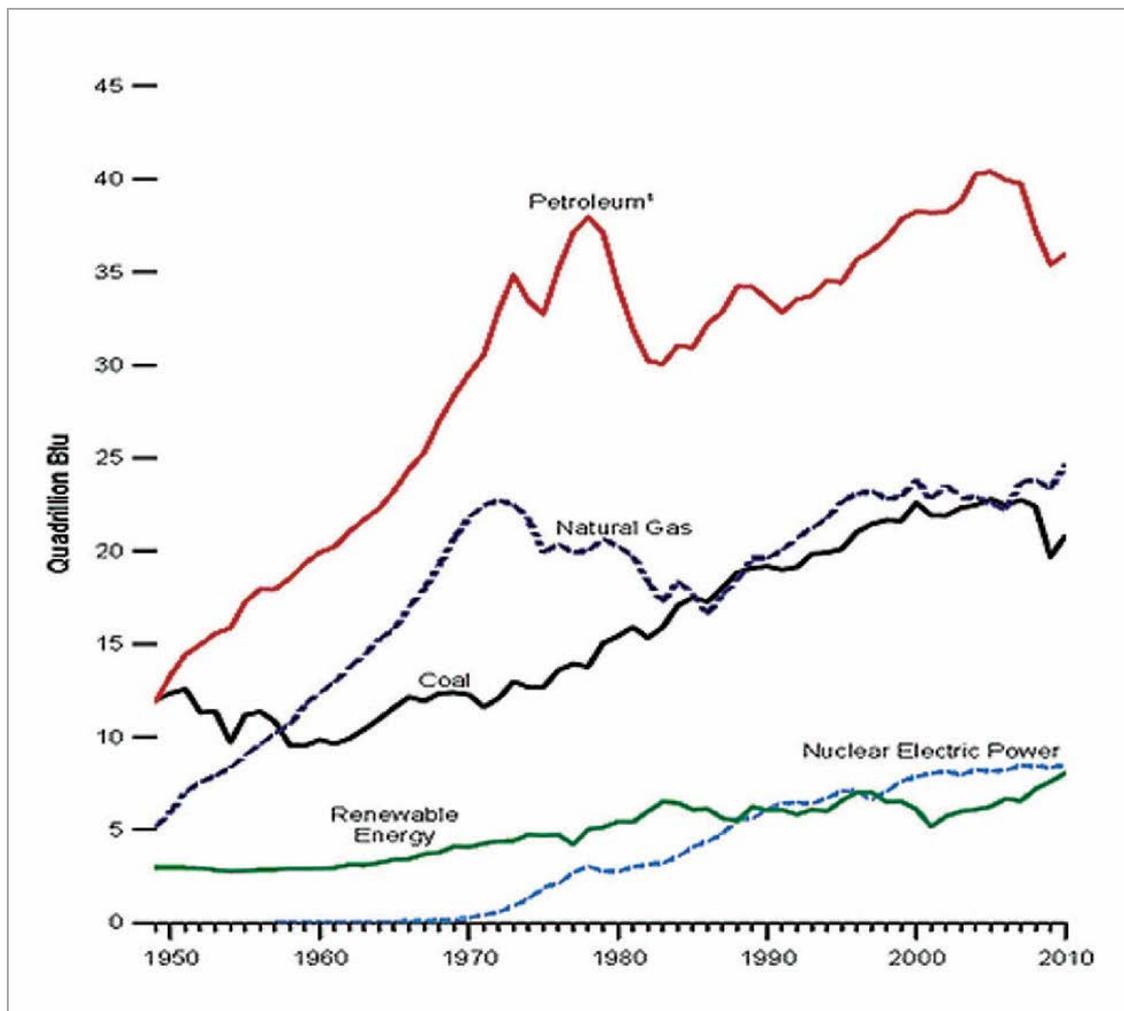


Energy Security Benefits



Importance of Energy Independence

- World oil reserves
 - U.S. owns 2-3%
 - U.S. uses 18%
- Rising (fluctuating) petroleum prices
- Volatility of petroleum market
- Emissions and air quality
 - Environment
 - Health

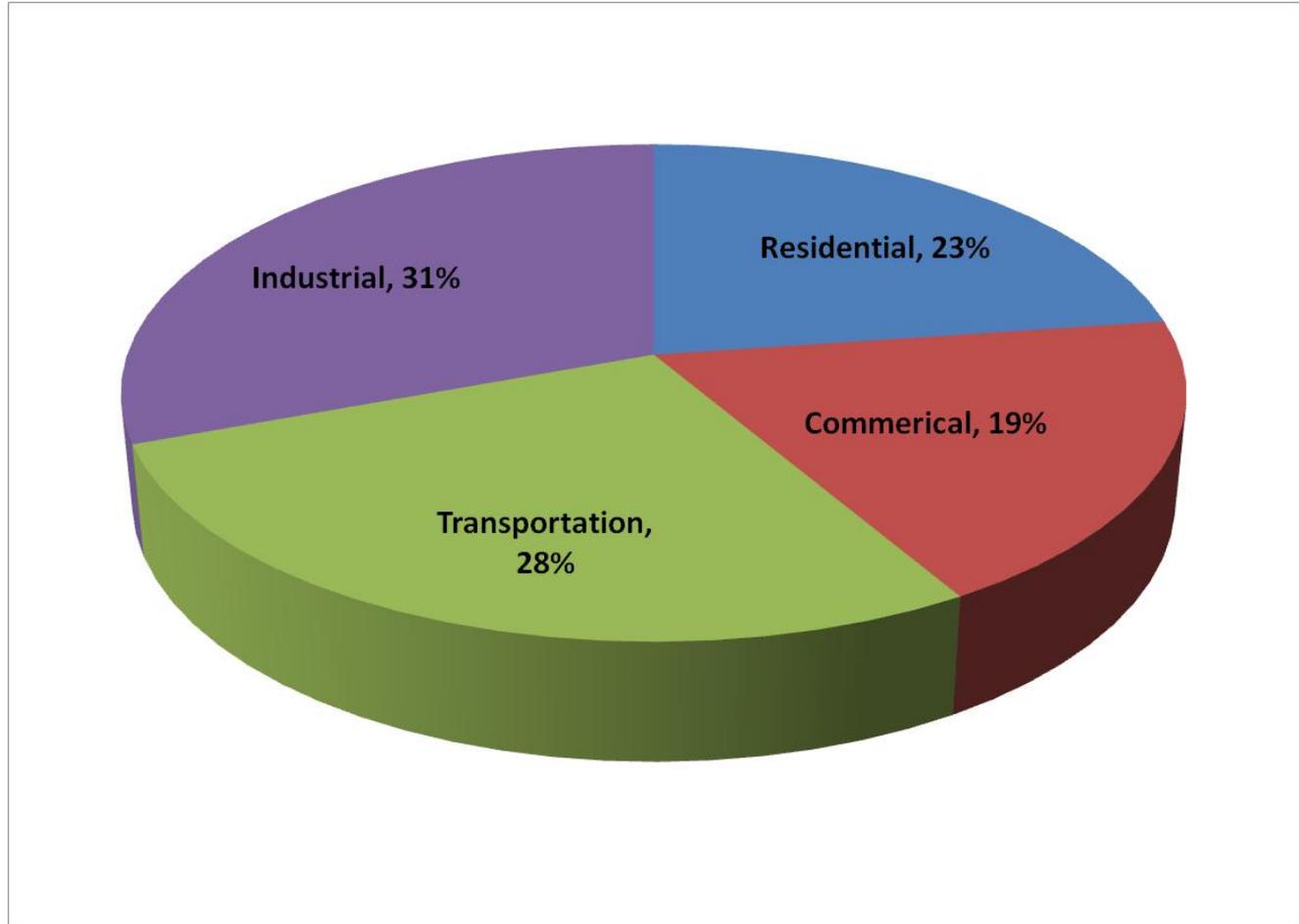


Primary energy consumption by major source, 1949, 2010. Source: EIA Annual Energy Review 2011.



Reducing Petroleum Consumption

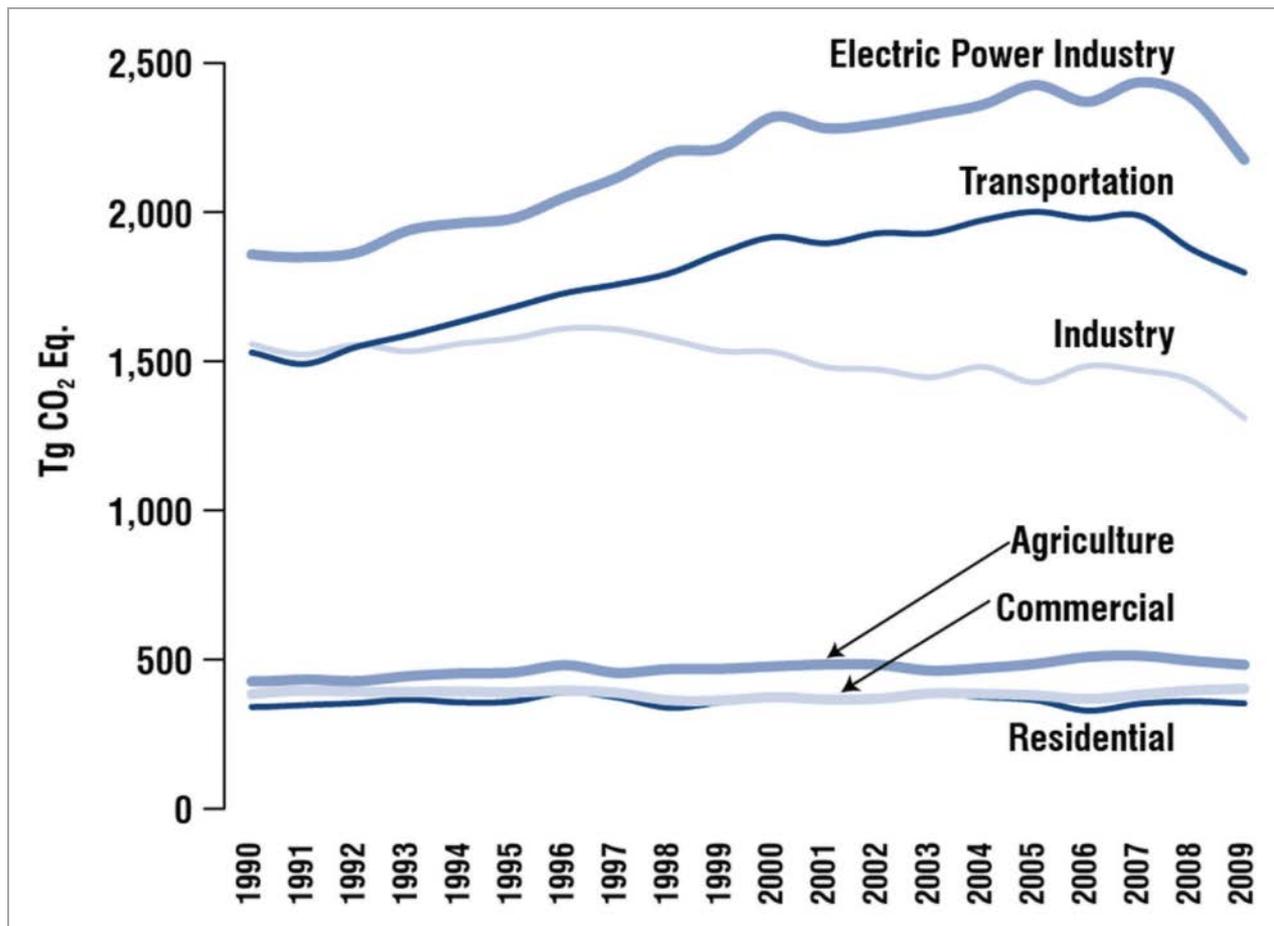
- About half of petroleum used is imported
- U.S. spends
 - \$8.6 billion per week on petroleum
 - \$447.2 billion per year on petroleum



End-use shares of total energy consumption, 2010. Source: EIA Annual Energy Review 2011.



Green House Gas Emissions



Global anthropogenic greenhouse gas emissions in 2004. Source: Intergovernmental Panel on Climate change 4th Assessment.



Laws

- Federal Requirements

- CAFE

- Sets fuel economy standards
 - Started during 1973 Oil Embargo

- Energy Policy Act of 1992

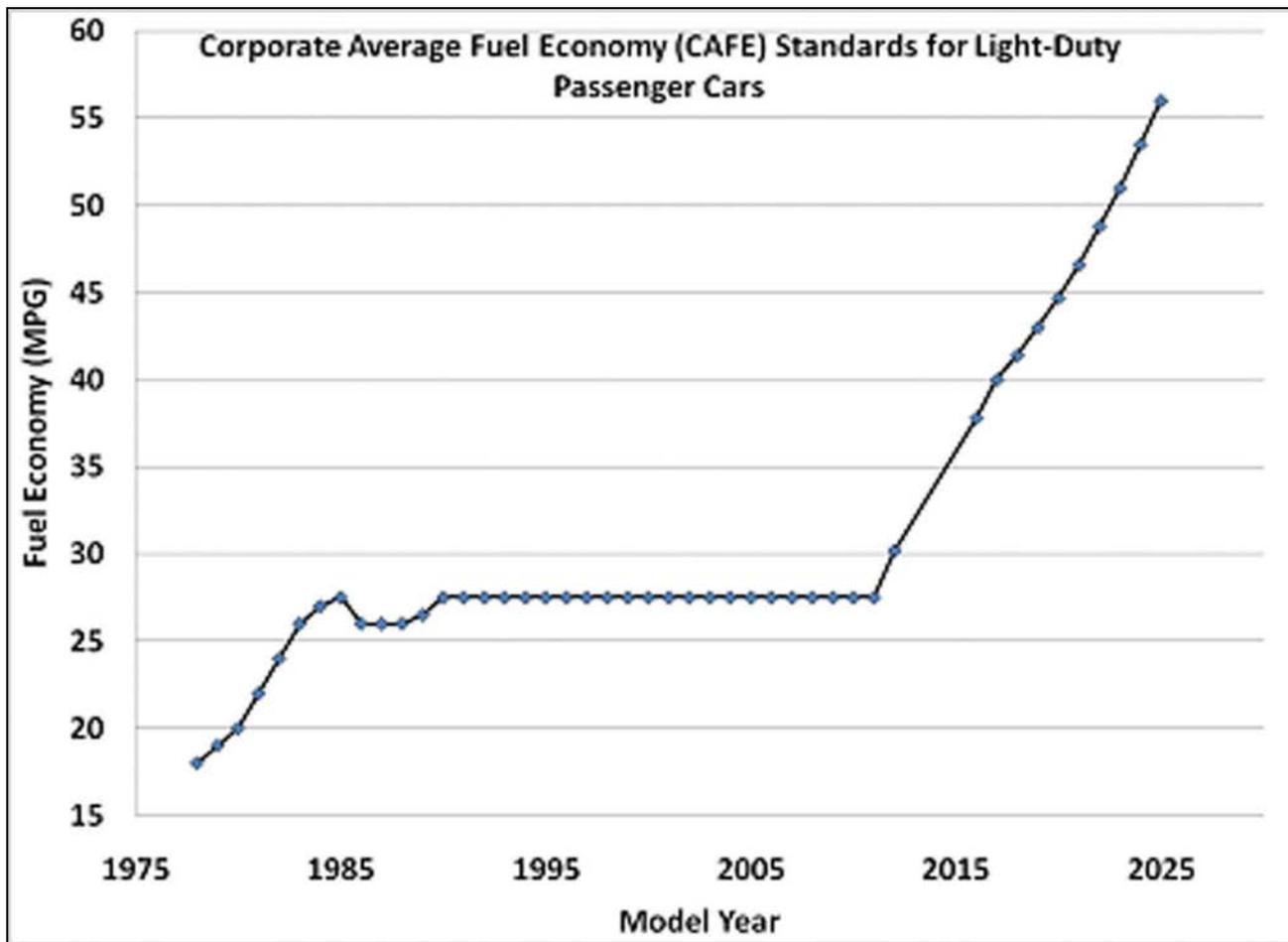
- Reduce U.S. dependence on foreign petroleum
 - Improve air quality
 - Use of alternative fuel and advanced technology vehicles

- DOE Clean Cities Program

- Federal, state agencies



CAFE Standards





EPACT

The Energy Policy Act of 1992 defines alternative fuels as,

- “...methanol, ethanol, and other alcohols; blends of 85% or more alcohol with gasoline (E85); natural gas and liquid fuels domestically produced from natural gas; liquefied petroleum gas (propane); hydrogen; electricity; biodiesel (B100); coal-derived liquid fuels; fuels other than alcohol, derived from biological materials; P-Series fuels (added to the definition in 1999).”



Amendments

- Energy Policy Act of 1992 was amended by
 - The Energy Conservation Reauthorization Act of 1998
 - The Energy Policy Act of 2005
 - The Energy Independence and Security Act of 2007
 - The National Defense Authorization Act of 2008
 - Executive Orders 13149, 13423, and 13514
- Added provisions for new technologies
- Added requirements for federal fleets



State and Local Requirements

- State requirements for fleets
- Differing local regulations
- Regulations depend upon state, county, municipality, city



Consumer Acceptance



Consumer Acceptance

- Reduced petroleum consumption
- Commonality of vehicles
- Familiarity with fuels and technologies



Toyota Prius, the first modern hybrid electric vehicle commonly found on today's roadways. Source: Toyota.

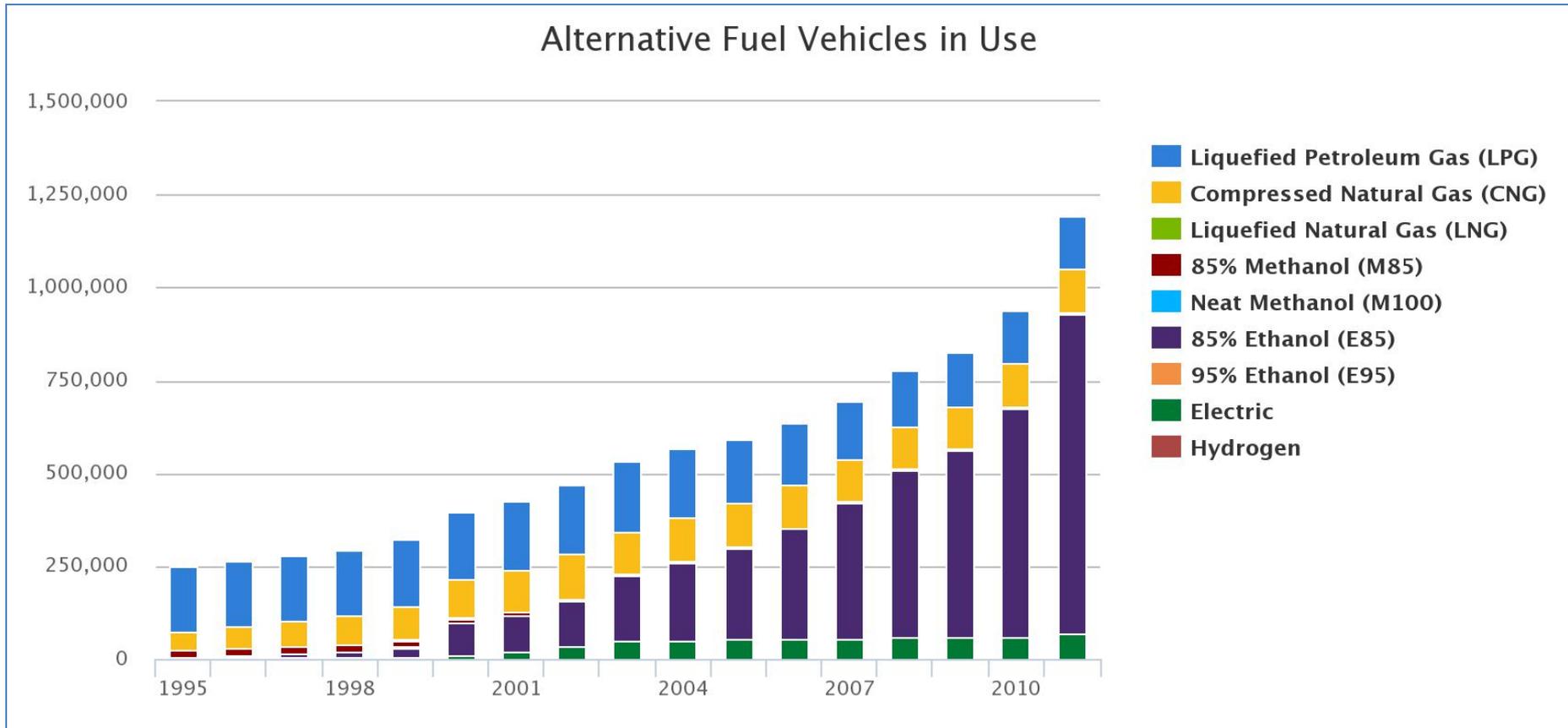


Consumer Acceptance

- Factors peaking consumer interest:
 - Higher conventional fuel costs
 - More vehicle options
 - Improved technology and reliability
 - Increased concern for the environment
- Combination of technologies
- New vehicle applications



AFVs in Use





United States

Alternative Fueling Station Locator

Find alternative fueling stations near an address or ZIP code or along a route in the United States. Enter a state to see a station count.

Find Stations | [Plan a Route](#)

Q address, ZIP, or state... **Go**

All Fuels ▼

[more search options](#)

17,735
alternative fuel stations
in the United States

Excluding private stations

[ABOUT THE DATA](#)

Location details are subject to change. We recommend calling the stations to verify location, hours of operation, and access.

Embed | Submit New Station

Map data ©2015 Google, INEGI | [Terms of Use](#)



West Virginia

Alternative Fueling Station Locator

Find alternative fueling stations near an address or ZIP code or along a route in the United States. Enter a state to see a station count.

Find Stations | Plan a Route

Q WV

All Fuels

[more search options](#)

47
alternative fuel stations
in West Virginia

Excluding private stations

[Download spreadsheet of matching stations](#)

Location details are subject to change. We recommend calling the stations to verify location, hours of operation, and access.

Embed | Submit New Station

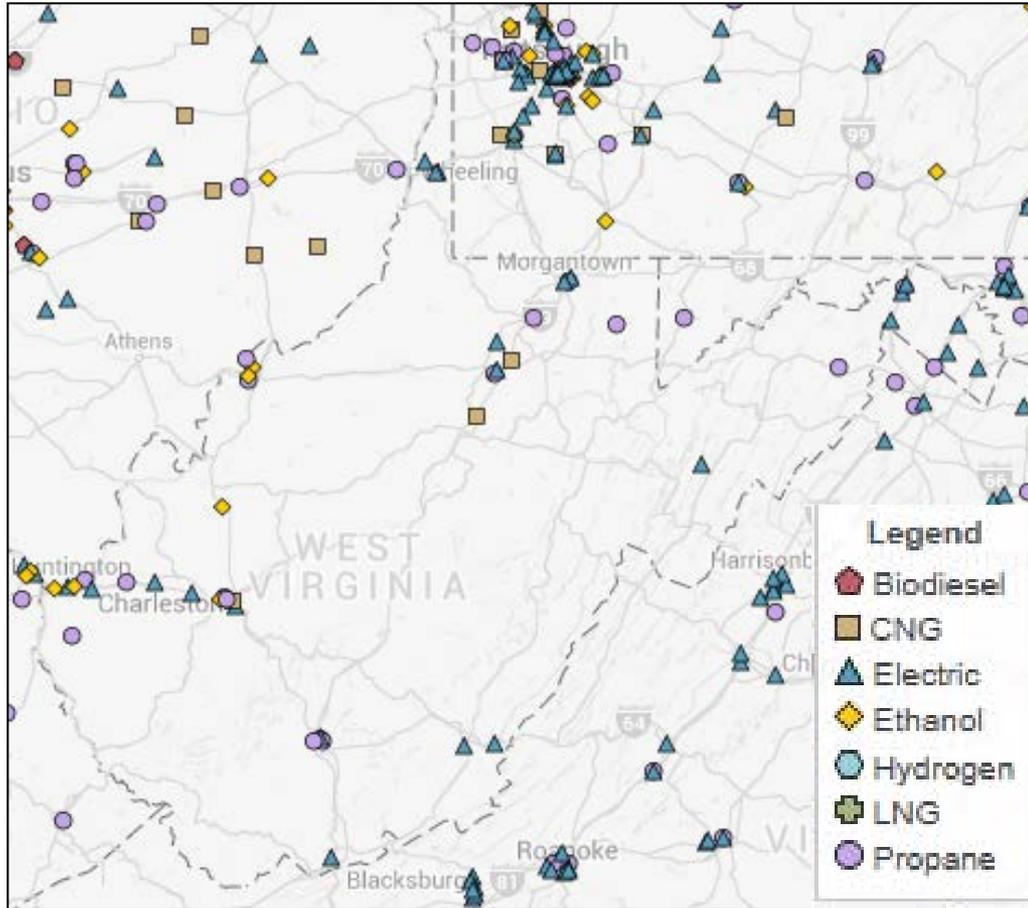
Legend

- Biodiesel
- CNG
- Electric
- Ethanol
- Hydrogen
- LNG
- Propane

Map data ©2015 Google Terms of Use



Available in West Virginia

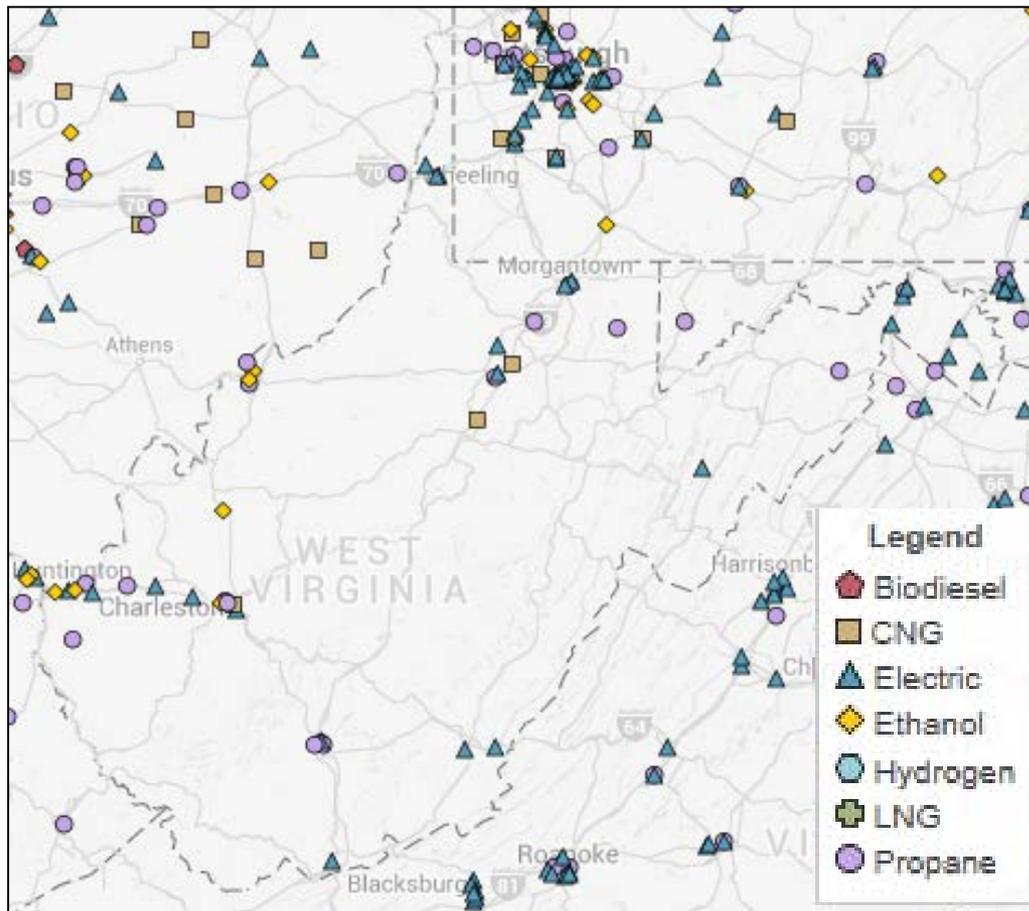


47 Alternative Fuel Stations

Alternative Fuels/Technologies	Available in WV
Biodiesel	
Ethanol	X
Natural Gas - CNG	X
Natural Gas - LNG	
Propane	X
Hydrogen	
Electric Drive	X



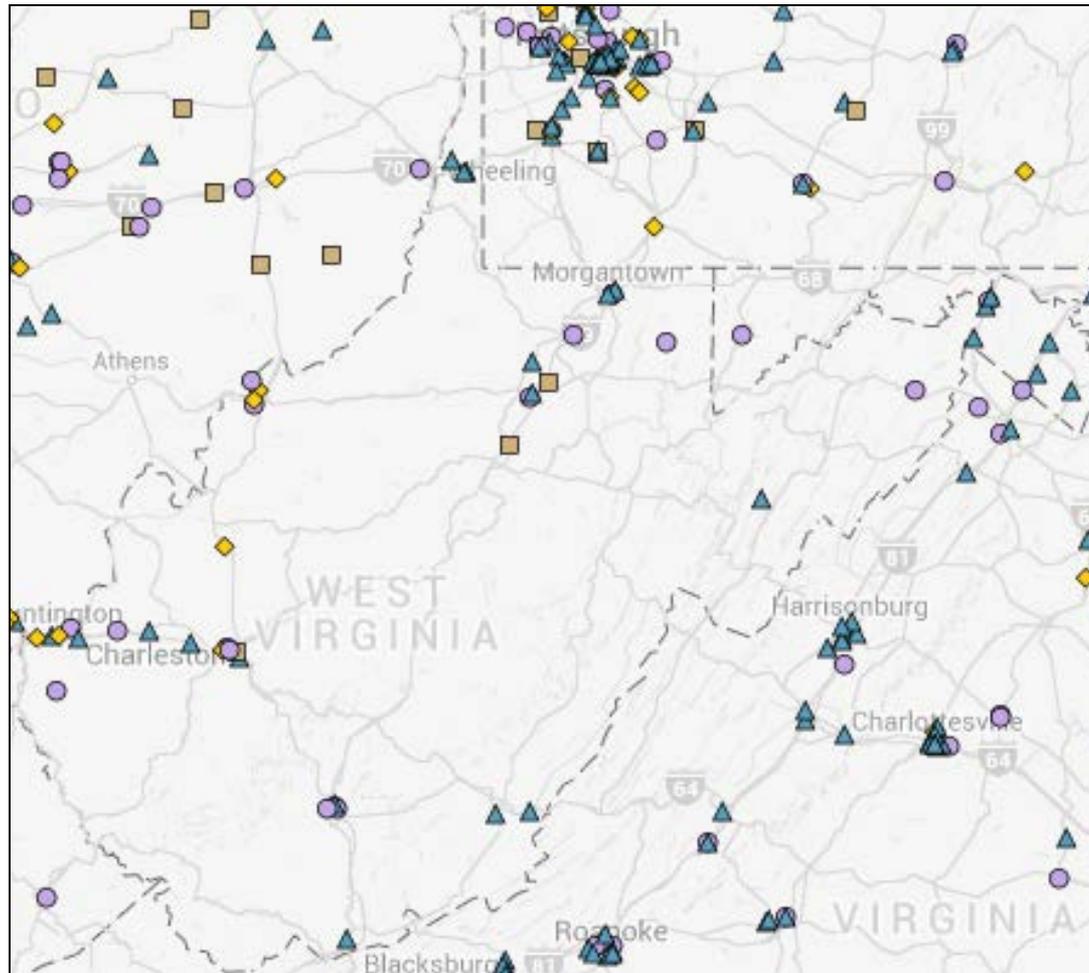
On West Virginia Contract



Alternative Fuels/Technologies	Available in WV
Ethanol	X
Natural Gas - CNG	X
Propane	X
Electric Drive	X



What Alternative Fuel Is Best for You?





Let's Discuss These Options

- Ethanol (Flex Fuel) E85
- Compressed Natural Gas (CNG)
- Electric Drive Vehicles



ETHANOL (FLEX FUEL) VEHICLES



Why Consider Ethanol?

- Several manufacturers produce vehicles that are considered flexible fuel (capable of running on E85)
- Ethanol is made from corn, sugarcane, wheat, other agricultural products
- Domestically produced and renewable
- Nontoxic, biodegradable, sulfur-free
- May produce cleaner tailpipe emissions



Why Consider Ethanol?

- All manufacturers approve ethanol blends up to 10%
- 97% of all U.S. gasoline contains some ethanol
- Common blend for FFVs = E85



E85 fueling pump. Source: NAFTC.



Flexible Fuel Vehicles

- Nearly half of all vehicles on the roads are FFVs
- By 2020, GM plans to have over 20 million FFVs on roadways worldwide





NATURAL GAS VEHICLES



Why Consider Natural Gas?

- Clean-burning fuel with fewer emissions than conventional gasoline vehicles
- Established distribution network
 - Pipelines and trucks used for transport
- Produced domestically
 - Often less expensive than gasoline



Natural Gas Forms

- Compressed natural gas (CNG)
 - Natural gas concentrated by pressure
 - Used in light-, medium-, and heavy-duty applications
- Liquefied natural gas (LNG)
 - Natural gas concentrated by extremely cold temperatures
 - Used only in heavy-duty applications at present



Types of CNG Natural Gas Vehicles

- **Dedicated NGVs** – run solely on natural gas
- **Bi-fuel NGVs** – designed with two separate fueling systems that allow them to operate on natural gas as well as conventional gasoline
- **Dual-fuel NGVs** – modified diesel engines that use natural gas for 90+% of combustion and <10% conventional diesel for ignition



The Future of Natural Gas

- Natural gas is a critical element in energy strategy for the U.S.
- Advances in exploration and production technologies have led to new sources of natural gas in U.S.
 - Combined application of horizontal drilling and hydraulic fracturing techniques that have made the country's vast shale gas resources accessible
 - Helps reduce dependence on foreign oil
 - Promotes job growth



Advantages of Natural Gas

- Both CNG and LNG available through established distribution networks
- Most natural gas produced domestically
- CNG often costs less than gasoline where available
- Natural gas vehicle engines often last longer and require less frequent service than conventional vehicles



ELECTRIC DRIVE VEHICLES



- Three groups of Electric Drive vehicles according to U.S. DOE:
 - Hybrid electric vehicles (HEVs)
 - Plug-in hybrid electric vehicles (PHEVs)
 - Battery-powered electric vehicles (BEVs)
- All EVs utilize electric motors and energy storage systems
- Each type offers different advantages



Hybrid Electric Vehicle

- Utilize ICEs along with one or more electric motors.
- Conventional fuels are utilized in the vehicle's ICE.
- Better fuel economy than conventional vehicles.
- Regenerative braking/ICE replenish batteries.
- Limited all-electric range.



Toyota Prius, the first modern hybrid electric vehicle commonly found on today's roadways. Source: Toyota.



Plug-in Hybrid Electric Vehicle

- Use batteries to power an electric motor
- Uses another fuel, such as gasoline, to power ICE
- Batteries are charged when plugged in
- Produce lower levels of emissions (depending on electricity source)



An example of a PHEV, the Chevrolet Volt. Source: NAFTC.



Battery Electric Vehicle

- Use a battery to store the electrical energy that powers the motor.
- Batteries are charged by plugging the vehicle into an electric power source.
- Do not use any other fuel.
- Are also known as all-electric vehicles, or EVs.
- Produce no direct exhaust or emissions so also called zero-emission vehicles.
- Limited battery range depending upon driving factors



An example of a BEV, the Nissan Leaf. Source: NAFTC.



Why Consider Electric Drive?

- Fewer emissions – effects of air pollution and global warming are lessened
- Reduces use of petroleum.
- Domestically produced electricity increases energy independence



Alternative fuel and advanced technology vehicles are as safe as conventional vehicles – they are just DIFFERENT.



The Bottom Line

Gas	Chevrolet Impala LS-1WF19	Large Sedan...FWD or RWD, 5 seats, 4 minimum doors, 111" WB, 4 cyld	\$17,960.00	
Flex Fuel	Chevrolet Impala LS-1WF19	Large Sedan...FWD or RWD, 5 seats, 4 minimum doors, 111" WB, 4 cyld	\$17,960.00	
Hybrid	Chevrolet Impala LS-1GX69	Large Sedan...FWD or RWD, 5 seats, 4 minimum doors, 111" WB, 4 cyld	\$22,739.00	\$ 4,779.00

Gas	Chevrolet Express-CG23406	Full Size Van...4WD or AWD, 12 seats, 6 minimum doors, 134" WB, 8 cyld, Tow Package, Limited Slip	\$25,245.00	
Flex Fuel	Chevrolet Express-CG23406	Full Size Van...4WD or AWD, 12 seats, 6 minimum doors, 134" WB, 8 cyld, Tow Package, Limited Slip	\$26,190.00	
CNG Bifuel	Chevrolet Express-CG23406	Full Size Van...4WD or AWD, 12 seats, 6 minimum doors, 134" WB, 8 cyld, Tow Package, Limited Slip	\$35,236.00	\$ 9,991.00



The REAL Bottom Line

\$4,779.00

\$9,991.00

- Help strengthen energy security by reducing our dependence on foreign oil
- By using a domestically produced fuel you are helping provide American workers with jobs
- And – you are helping to create a better environment for our future generations



Why It's Important





Together We DO
Make a Difference!



Questions?

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