



Alternative Fuel
Information Series

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U.S. DEPARTMENT of ENERGY,
OFFICE of ENERGY EFFICIENCY and RENEWABLE ENERGY

Alternative Fuels and Vehicles Offer Solutions to Imported Oil, Air Pollution, Climate Change

As Americans, we're becoming increasingly concerned about our nation's dependence on foreign oil, the threat of global warming, and the poor quality of the air we breathe. Yet the cars and trucks we drive, mostly powered by petroleum-based fossil fuels like gasoline and diesel, are a major source of these problems. The good news is that alternatives are available *today*. Some people are choosing to drive vehicles that run partially or completely on non-petroleum fuels. Alternative fuel vehicles (AFVs) lessen the problems associated with petroleum, and usually draw on domestically produced energy resources.

Federal legislation defines an AFV as a vehicle designed to run on one of a specific set of fuels that are substantially non-petroleum. Most major automakers produce AFVs, including cars, light- and heavy-duty trucks, shuttle and transit buses, off-road vehicles, and even boats. Many AFVs are sold as fleet vehicles, but some are also available to the public. You may, in fact, already own an AFV. Many popular models are "flexible-fuel vehicles" (FFVs) capable of running on any combination of E85 (a blend of 15% gasoline and 85% ethanol) and gasoline. Check your owner's manual to see if your vehicle has this feature.

Why Drive An AFV?

Transportation accounts for 67% of the oil we consume in the United States. Our nation produces only 46% of its own oil supply, and the Energy Information Administration (EIA) estimates that this could shrink to less than 38% by 2010 (source: *EIA Annual Energy Outlook 2002*). Because AFVs can operate on domestically produced fuels, they can be instrumental in our efforts to reduce dependence on imported oil.

EPAct defines alternative fuels as natural gas, ethanol, methanol, hydrogen, battery-electric power, biologically produced diesel or "biodiesel" fuel, and liquefied petroleum gas (LPG), commonly called propane.

Another benefit of AFV use is a potential reduction in air pollution, which is associated with many human health problems including cancer, heart disease, asthma, and emphysema. According to the U.S. Environmental Protection Agency (EPA), cars and trucks have been responsible for 51% of carbon monoxide (CO₂) emissions nationwide, plus 33.8% of oxides of nitrogen (NO_x) and 29.2% of volatile organic compounds. Fossil fuel combustion has also been linked to global climate change, due to increased emissions of so-called "greenhouse gases" including carbon dioxide (CO₂). For more information on greenhouse gases, please visit www.eia.doe.gov/oiaf/1605/ggcebro/chapter1.html. Information on emissions trends can be found in the *Transportation Energy Data Book*, published by the U.S. Department of Energy (DOE). It is available at www.cta.ornl.gov/data.

Not only do AFVs make sense for our nation, but many fleet operators are required by law to purchase the vehicles. When Congress passed the Energy Policy Act (EPAct) in 1992, it required certain types of users—including fleets operated by federal and state government agencies—to acquire specific proportions of light-duty AFVs. EPAct also covers certain fleets in private industry—specifically those operated by alternative fuel providers. Covered fleets must choose vehicles that can run on approved alternative fuels (see box, above).

To help communities integrate AFVs locally, DOE created the Clean Cities Program. Clean Cities is a government–industry partnership with coalitions nationwide. Its 4,700 stakeholders include government agencies, state and local health departments, transit authorities, utilities, auto dealers, school districts, and other private businesses. Together, they work to build the AFV market and expand fueling infrastructure.

What Types of AFVs Are Available?

AFVs come in three basic configurations: flexible-fuel, bi-fuel or dual-fuel, and dedicated-fuel.

Flexible-fuel Vehicles

An FFV has one tank and can run on any mixture of gasoline and E85. DOE has also approved “P-Series fuel” to run in FFVs (see page 3).

Bi-fuel or Dual-fuel Vehicles

Bi-fuel vehicles have two tanks for two separate fuels. Gasoline is commonly paired with CNG or propane. A switch is used to choose between the two fuels.

Dedicated-fuel Vehicles

Dedicated AFVs use one alternative fuel full-time. Currently available are vehicles designed to run on propane, electricity, compressed or liquefied natural gas, and battery-electric power.

What Are Today’s Alternative Fuel Choices?

Ethanol

The most widely used alternative transportation fuel is ethanol, an alcohol typically made from corn or corn by-products through a process similar to brewing beer. Vehicles that run on ethanol have lower CO and CO₂ emissions than traditional vehicles. In the United States, we blend more than 1.5 billion gallons of ethanol with gasoline each year to produce E10 (10% ethanol and 90% gasoline). Flexible-fuel E85 vehicles can operate using E85, gasoline, or any mixture of the two. E85 is most common in the Midwest but is also available in many other parts of the country.

Biodiesel

Biodiesel is an ester (similar to vinegar) that can be made from substances such as vegetable oils and animal fats. Each year about 30 million gallons of biodiesel are produced in the United States from

recycled cooking oils and soybean oil. At this time, it is used mostly by federal, state, and transit fleets (see www.biodiesel.org). Because biodiesel emits less particulate matter than diesel, interest is growing in using the fuel where workers are exposed to diesel exhaust, in school buses, and in public transportation.

Although vehicles can run on 100% biodiesel with some fuel system modifications, a blend of 20% biodiesel and 80% petroleum diesel (called B20) is more common because it can fuel a diesel engine with minimal modifications.

Natural Gas

Natural gas is a mixture of hydrocarbons, mainly methane. Found in gas wells or produced in conjunction with crude oil, natural gas is a clean-burning, domestically produced fuel that generates significantly less CO, CO₂, particulate matter, and NO_x than similar fossil fuel vehicles. It is used in vehicles as compressed natural gas (CNG) or liquefied natural gas (LNG). Nearly one of every five new transit buses produced for domestic use runs on natural gas. According to the Natural Gas Vehicle Coalition, more than 110,000 natural gas vehicles are on U.S. roads today and more than 1.5 million are in use worldwide.



Warren Gretz/PTX11009

Americans own more than 1 million flexible-fuel vehicles, although many are unaware they can use alternative fuels. Most common are those that can run on gasoline, E85 ethanol fuel, or any combination of the two fuels. Standing beside his flex-fueled Ford Ranger pickup truck is Jim Jones, an employee of the National Renewable Energy Laboratory in Colorado. Jones purchases E85 from at least five stations in metropolitan Denver. When planning a trip, he uses DOE’s fueling station locator online at www.afdc.doe.gov/refueling_mapsite.shtml.



Medford School District/PIX11010

Since 1997, the Medford School District in New Jersey has used a blend of 20% biodiesel and 80% petroleum (B20) in half of its school bus fleet. "If I had my way, we'd start using it in all of our buses," says Joe Biluck, Jr., Director of Operations and Technology for the district.

Propane

Liquefied Petroleum Gas (LPG), commonly called propane, consists mainly of propane, propylene, butane, and butylene in various mixtures. It is a by-product of natural gas processing, and petroleum refining. Propane has been used around the world in both light- and medium-duty applications since the 1920s. A propane-powered vehicle emits fewer reactive organic compounds, less NO_x , and less CO than a similar gasoline vehicle. More than 500,000 vehicles are traveling the nation's highways using propane (source: California Energy Commission: www.consumerenergycenter.org). With fueling stations in all states, propane is the most publicly accessible alternative fuel.

Electricity

Various types of batteries and other energy storage mechanisms are used to store the electricity that powers an electric vehicle (EV). Although the electricity production process may make a small contribution to air pollution, an EV itself does not, resulting in much lower emissions per mile traveled. In 2000, nearly 7,600 on-road EVs in the United States consumed electricity at a rate that displaced about 1.7 million gallons of gasoline.

Hydrogen

Hydrogen has considerable potential as an alternative fuel for transportation, but at this point little market presence. It is used experimentally in internal combustion engines, yielding favorable results such as reduced CO_2 emissions. Hydrogen can be mixed

with gasoline, ethanol, methanol, or natural gas, effectively lowering emissions. Perhaps more significantly, hydrogen is hoped to power electric fuel cell vehicles in the future. Fuel cell cars are in development by most major automakers. But hydrogen lacks a wide distribution infrastructure. The predominant method of making hydrogen today involves using natural gas as a feedstock. Petroleum-based fuels including gasoline and diesel can also be used. But this may compromise a major objective behind alternative fuels—to reduced oil consumption.

Methanol

Methanol, another alcohol-based fuel, is usually produced from natural gas. Because auto manufacturers are not currently producing methanol-fueled vehicles, its market presence is minimal. Methanol-powered vehicles emit smaller amounts of air pollutants, such as hydrocarbons, particulate matter, and NO_x , than their gasoline counterparts. (For more information on methanol, visit <http://bioenergy.ornl.gov>.)

P-Series Fuel

A blend of ethanol, methyltetrahydrofuran (MTHF), and pentanes (with butane added for blends used in severe cold weather), P-Series is a relatively new alternative fuel. Both the ethanol and the MTHF can be produced from renewable biomass resources, so net emissions from producing and using P-Series are substantially less than those from gasoline. Because P-Series fuel was initially designed to help certain fleets meet AFV purchase requirements spelled out in EPAct, it will initially find its niche in fleets. Eventually it may be available to the public as well.

Making the Alternative Fuels Choice

U.S. automakers and researchers are continually exploring better ways to use fuel cells, alternative fuels, and EV and hybrid electric vehicle (HEV) systems. They are also working on new ways to store energy, and creating lightweight advanced materials to make vehicles that run cleaner and use less fuel. In addition to the technologies available now, researchers are developing new advanced technologies that will steer us toward an even cleaner and more secure domestic energy future.

For anyone interested in AFVs and alternative fuels, there are many ways to investigate the subject. Web addresses for selected Internet-based resources are listed below. Professional and trade organizations provide excellent technical and market information, and are often oriented toward a specific fuel or technology. Independent information is available from



Clean Cities Program/PIX11011

Shelley Launey, Director of DOE's Clean Cities Program, owns and drives a dedicated CNG vehicle. Available CNG vehicles (both dedicated and bi-fuel) include the Honda Civic GX, Ford Crown Victoria, Chevrolet Cavalier, and many full-size vans and pickup trucks. More than 110,000 CNG vehicles are on U.S. roads.

federal and state government agencies. DOE's Alternative Fuels Data Center, for example, includes a searchable online database of pertinent documents, plus DOE-produced information on fuels and technologies.

For anyone considering an AFV purchase, DOE's Vehicle Buyer's Guide is an excellent place to start. It lists all available AFV light- and heavy-duty vehicles, and helps calculate their incremental cost of ownership in comparison with conventional vehicles. It also includes a regularly updated Incentives and Laws section, with information about state legislation such as tax credits. Fleet operators considering the purchase of AFVs should first determine whether they are covered by federal regulations related to EPAct. To find users and advocates of alternative fuels in your area, check out the the Clean Cities Program online, or call its Hotline at 1-800-CCITIES.

Resources

Below are some additional sources of information on alternative fuels, AFVs, and advanced technology vehicles:

U.S. Department of Energy

- Alternative Fuels Data Center (AFDC): www.afdc.doe.gov
- AFDC Vehicle Buyer's Guide: www.afdc.doe.gov/vbg
- Clean Cities Program: www.cities.doe.gov

- EPAct Fleet Information and Regulations: www.ott.doe.gov/epact
- Fuel Cells for Transportation: www.carttech.doe.gov/research/fuelcells/index.html
- Hydrogen Information Network: www.eren.doe.gov/hydrogen

Other

- National Ethanol Vehicle Coalition: www.e85fuel.com
- Natural Gas Vehicle Coalition: www.ngvc.org
- Electric Vehicle Association of the Americas: www.evaa.org
- Propane Education Research Council: www.propanecouncil.org
- National Biodiesel Board: www.biodiesel.org
- American Methanol Institute: www.methanol.org
- Pure Energy (P-Series Fuel): www.pure-energy.com/products/pseries.html



Ferrelgas/PIX09941

Schwan's Sales Enterprises of Marshall, Minnesota has relied on propane (LPG) to fuel its fleet of delivery trucks for more than 22 years. Today, 7,000 of the 7,500 vehicles in Schwan's fleet are dedicated propane medium-duty trucks that deliver frozen foods to customers nationwide.

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