

## Flexible Fuel Vehicles: Providing a Renewable Fuel Choice

Today, more than 6 million vehicles on U.S. highways are flexible fuel vehicles (FFVs). These vehicles can operate on E85—a blend of 85% ethanol and 15% gasoline. The ethanol component of this renewable fuel offers significant advantages. It is manufactured predominantly in the United States, made from home-grown feedstocks, and is cleaner burning than gasoline.

### What is an FFV?

An FFV, as its name implies, has the flexibility of running on more than one type of fuel. FFVs can be fueled with unleaded gasoline, E85, or any combination of the two. Like conventional gasoline vehicles, FFVs have a single fuel tank, fuel system, and engine. And they are available in a wide range of models such as sedans, pickups, and minivans. These light-duty FFVs are designed to run on at least 15% gasoline in the fuel, mainly to ensure they start in cold weather.

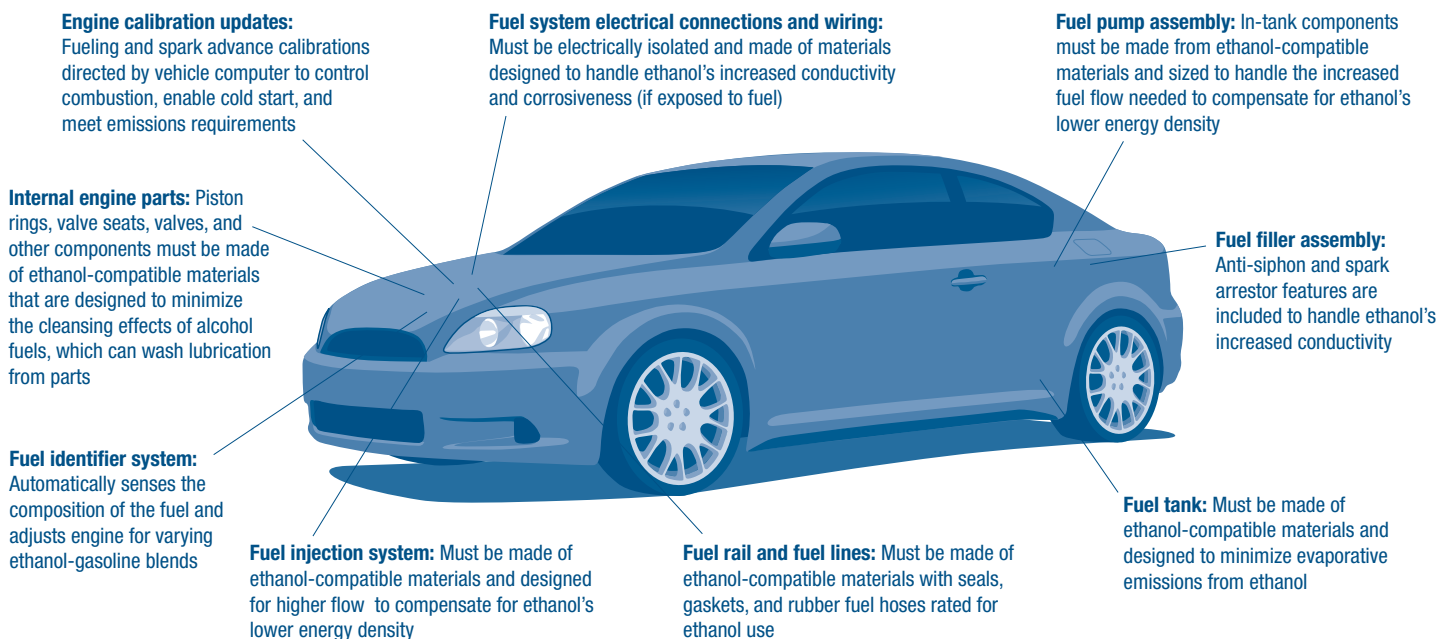
FFVs differ from conventional vehicles in some ways. They are equipped with modified components designed specifically to be compatible with ethanol's chemical properties. In the car illustration below, major modification requirements for FFVs are described. These modifications ensure seamless operation and a long useful life across a wide range of ethanol blends.

Clean Cities posts a list of alternative fuel vehicles, including FFVs, on its Alternative Fuels and Advanced Vehicles Data Center (AFDC) Web site. To find out about available models, visit [www.eere.energy.gov/afdc/progs/vehicles\\_search.php](http://www.eere.energy.gov/afdc/progs/vehicles_search.php).

### Can existing vehicles be converted to FFVs?

Converting a conventional gasoline vehicle to one that runs on E85 is technically possible. FFV conversions need to be done by authorized companies and require

### Flexible Fuel Vehicle Features



certification by the U.S. Environmental Protection Agency (EPA) or the California Air Resources Board. Using non-certified conversions is illegal and may affect warranties.

For more information on the vehicle conversion process, refer to the EPA's Updated Certification Guidance for Alternative Fuel Converters on its Web site at [www.epa.gov/otaq/cert/dearmfri/cisd0602.pdf](http://www.epa.gov/otaq/cert/dearmfri/cisd0602.pdf).

## Does E85 affect vehicle performance?

FFVs operating on E85 generally handle and perform just as well as when fueled with gasoline. Sensors in the FFV system automatically prompt adjustments for fuel composition, so emissions and standard performance areas such as power and acceleration are not significantly affected by E85. One difference between E85 and gasoline, however, is fuel economy. Ethanol contains less energy per gallon, which translates into a reduction in fuel economy compared to gasoline. No matter what type of fuel is used, however, fuel mileage is affected by driving habits, weather, and other factors.

Standard testing results for fuel economy of FFVs and their gasoline counterparts are posted on the combined EPA and U.S. Department of Energy Web site at [www.fueleconomy.gov](http://www.fueleconomy.gov).

## What are the costs and benefits of using E85?

Special features enabling vehicles to run on E85 can add a minimal cost to their purchase price. Often these features are standard or even offered as a no-cost option. Because they have a solid performance history, manufacturers provide standard warranties for FFVs equal to those for gasoline vehicles at no additional charge.

Fuel, however, may be a cost factor. E85's reduced energy content compared to gasoline, as explained in the previous section, can increase fuel costs. But this cost differential is highly variable because it is based on ethanol and gasoline price differences. Like gasoline, ethanol prices fluctuate and are set based on market supply and demand. This variability means that a driver may or may not experience a difference in overall fuel costs, depending on local pump prices. To compare the price of fueling with E85 versus gasoline, use the AFDC's Flexible Fuel Vehicle Cost Calculator at [www.eere.energy.gov/afdc/progs/cost\\_anal.php?0/E85/](http://www.eere.energy.gov/afdc/progs/cost_anal.php?0/E85/).

Although your FFV's fuel economy on E85 is somewhat less than when operating on gasoline, a bonus for its use is lower greenhouse gas emissions. Using the GREET model, Argonne National Laboratory indicates in "Ethanol, The Complete Energy Lifecycle Picture", that greenhouse gas emissions are reduced approximately 15% when ethanol

produced from corn is used<sup>1</sup>. Using E85 also reduces CO<sub>2</sub> emissions and provides significant reductions in emissions of many harmful toxics, including benzene, a known human carcinogen. However, E85 also increases emissions of acetaldehyde—a toxic pollutant<sup>2</sup>. Additional testing is being completed to expand the understanding of the emissions impacts of E85.

## How are FFVs identified?

A look inside the fuel door quickly identifies FFVs. Since September 2006, the Energy Policy Act of 2005 requires auto manufacturers to place a label inside the FFV fuel compartment that states the vehicle can run on either E85 or gasoline. Flexible-fuel capability also is outlined in the owner's manual and encoded in the vehicle identification number, or VIN. To help determine if an older vehicle is E85 compatible, visit the National Ethanol Vehicle Coalition Web page on flexible fuel vehicles at [www.e85fuel.com/e85101/flexfuelvehicles.php](http://www.e85fuel.com/e85101/flexfuelvehicles.php).

## Where are E85 stations located?

Stations offering E85 continue to increase across the nation. At the end of 2007, more than 1,300 stations in at least 45 states sold E85. To find E85 stations throughout the country, check out the Alternative Fuel Station Locator at [www.eere.energy.gov/afdc/fuels/ethanol\\_locations.html](http://www.eere.energy.gov/afdc/fuels/ethanol_locations.html), a database maintained by the AFDC. This easy-to-use database allows users to plot routes either across town or across the nation, showing E85 stations along the way.

<sup>1</sup> Wang, Michael. *Ethanol: The Complete Energy Lifecycle Picture*, Argonne National Laboratory, March 2007.

<sup>2</sup> Whitney, Kevin (Southwest Research Institute); Fernandez, Tony (U. S. Environmental Protection Agency). "Characterization of Cold Temperature VOC and PM Emissions from Flex Fuel Vehicles Operating on Ethanol Blends." Presented at the 17th CRC On-Road Vehicle Emissions Workshop, March 26-28, 2007.

## Resources

Alternative Fuels and Advanced Vehicles Data Center:  
[www.eere.energy.gov/afdc/fuels/ethanol.html](http://www.eere.energy.gov/afdc/fuels/ethanol.html)

American Coalition for Ethanol: [www.ethanol.org](http://www.ethanol.org)

Clean Cities: [www.eere.energy.gov/cleancities](http://www.eere.energy.gov/cleancities)

Clean Fleet Guide: [www.eere.energy.gov/fleetguide](http://www.eere.energy.gov/fleetguide)

E85 Fleet Toolkit: [www.eere.energy.gov/afdc/e85toolkit](http://www.eere.energy.gov/afdc/e85toolkit)

U.S. Environmental Protection Agency: [www.epa.gov/otaq/consumer/fuels/altfuels/altfuels.htm](http://www.epa.gov/otaq/consumer/fuels/altfuels/altfuels.htm)

Fuel Economy: [www.fueleconomy.gov](http://www.fueleconomy.gov)

National Ethanol Vehicle Coalition: [www.e85fuel.com](http://www.e85fuel.com)

Renewable Fuels Association: [www.ethanolrfa.org](http://www.ethanolrfa.org)

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[www.eere.energy.gov](http://www.eere.energy.gov)

Prepared by the National Renewable Energy Laboratory (NREL)  
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Operated by Midwest Research Institute • Battelle

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DOE/GO-102008-2595 • Revised June 2008

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