Introduction to the Alternative Fuels Data Center

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Agenda

- Alternative Fuels Data Center (AFDC) Overview
- AFDC Tour
- AFDC in Action
- Questions

The premier information resource for alternative fuels and advanced vehicles

Key Audience: Fleets and other transportation decision makers.

Reach: 1.5 million users annually.

Maintenance: The National Renewable Energy Laboratory reviews and updates content and data on an *ad hoc* basis and at least once annually.
Who Uses the AFDC?

- Fleet managers
- Transportation planners
- Fuel providers
- Utilities
- Clean Cities coalitions
What Does the AFDC Provide?

- Interactive Tools
- Maps & Data
- Case Studies
- Publications
- Alternative Fuels, Vehicles, & Stations
- Fuel Conservation
- Laws & Incentives
Alternative Fuels Data Center

Alternative Fuels and Advanced Vehicles

More than a dozen alternative fuels are in production or under development today. The alternative fuel vehicles and advanced technology vehicles. Government and private-sector vehicle fleets are the primary users for most of these vehicles and fuels, but individual consumers are increasingly interested in them. Using alternative fuels and advanced vehicles instead of conventional fuels and vehicles helps the United States conserve fuel and lower vehicle emissions.

1. Biodiesel
   Biodiesel is a renewable fuel that can be manufactured from vegetable oils, animal fats, or recycled cooking grease for use in diesel vehicles.
   - Diesel Vehicles

2. Hydrogen
   Hydrogen is a potentially emissions-free alternative fuel that can be produced from domestic resources for use in fuel cell vehicles.
   - Fuel Cell Vehicles

3. Electricity
   Electricity can be used to power plug-in electric vehicles, which are increasingly available. Hybrids use electricity to boost efficiency.
   - Hybrid & Plug-In Vehicles

4. Ethanol
   Ethanol is a widely used renewable fuel made from corn and other plant materials. It is blended with gasoline for use in vehicles.
   - Flexible Fuel Vehicles

5. Natural Gas
   Natural gas is a domestically abundant gaseous fuel that can have significant fuel cost advantages over gasoline and diesel fuel.
   - Natural Gas Vehicles

6. Propane
   Propane is a readily available gaseous fuel that has been widely used in vehicles throughout the world for decades.
   - Propane Vehicles

Emerging Fuels

Several emerging fuels are considered alternative fuels under the Energy Policy Act and may be under development or already developed and available in the United States.

Tools

- Vehicle Cost Calculator — Compare costs and greenhouse gas emissions
- Alternative Fuel and Advanced Vehicle Search — Find a hybrid or alternative fuel vehicle

Vehicle Conversions

Conventional vehicles and engines can be modified to operate using a different fuel or power source.

Fuel Prices

Alternative fuel prices can fluctuate based on location, time of year, or political climate.

https://www.afdc.energy.gov/fuels/
More Later!

https://www.afdc.energy.gov/fuels/ethanol.html
Fuel Prices

As gasoline prices increase, alternative fuels appeal more to vehicle fleet managers and consumers. Like gasoline, alternative fuel prices can fluctuate based on location, time of year, and political climate.

Alternative Fuel Price Report

The Clean Cities Alternative Fuel Price Report provides regional alternative and conventional fuel prices for biodiesel, compressed natural gas, ethanol, hydrogen, propane, gasoline, and diesel. The Alternative Fuel Price Report is a snapshot in time of retail fuel prices. Alternative fuel fleets can obtain significantly lower fuel prices than those reported by entering into contracts directly with local fuel suppliers. See all price reports.

- July 2018
- April 2018

National Average Price Between July 1 and July 30, 2018

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biodiesel (B20)</td>
<td>$3.06/gallon</td>
</tr>
<tr>
<td>Biodiesel (B99-B100)</td>
<td>$3.55/gallon</td>
</tr>
<tr>
<td>Electricity</td>
<td>$0.13/kWh</td>
</tr>
<tr>
<td>Ethanol (E85)</td>
<td>$2.35/gallon</td>
</tr>
<tr>
<td>Natural Gas (CNG)</td>
<td>$2.22/GGE</td>
</tr>
<tr>
<td>Liquefied Natural Gas</td>
<td>$2.60/DGE</td>
</tr>
<tr>
<td>Propane</td>
<td>$2.81/gallon</td>
</tr>
<tr>
<td>Gasoline</td>
<td>$2.88/gallon</td>
</tr>
<tr>
<td>Diesel</td>
<td>$3.24/gallon</td>
</tr>
</tbody>
</table>


Average Retail Fuel Prices in the U.S.

https://www.afdc.energy.gov/fuels/prices.html
Hybrid and Plug-In Electric Vehicles

Hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), and all-electric vehicles (EVs)—also called electric-drive vehicles collectively—use electricity as their primary fuel or to improve the efficiency of conventional vehicle designs.

Hybrid Electric Vehicles

HEVs are powered by an internal combustion engine and an electric motor that uses energy stored in a battery. The battery is charged through regenerative braking and by the internal combustion engine and does not plug in to charge.

Plug-In Hybrid Electric Vehicles

PHEVs are powered by an internal combustion engine and an electric motor that uses energy stored in a battery. The vehicle can be plugged in to an electric power source to charge the battery. Some can travel nearly 100 miles on electricity alone, and all can operate solely on gasoline (similar to a conventional hybrid).

All-Electric Vehicles

EVs use a battery to store the electric energy that powers the motor. EV batteries are charged by plugging the vehicle into an electric power source.

Tax Credits and Incentives

Plug-in hybrids and all-electric vehicles qualify for a $2,500 to $7,500 federal tax credit.

Electric Vehicle Community Readiness

The U.S. Department of Energy funded 16 electric vehicle projects in 24 states and the District of Columbia to help communities prepare for plug-in electric vehicles and charging infrastructure.

Email Updates

Subscribe to receive email updates about electric vehicle community readiness.
Emissions from Hybrid and Plug-In Electric Vehicles

Hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), and all-electric vehicles (EVs) typically produce lower tailpipe emissions than conventional vehicles do. When measuring well-to-wheel emissions, the electricity source is important for PHEVs and EVs, part or all of the power provided by the battery comes from off-board sources of electricity. There are emissions associated with the majority of electricity production in the United States.

Electricity Sources and Emissions

EVs and PHEVs running only on electricity have zero tailpipe emissions, but emissions may be produced by the source of electrical power, such as a power plant. In geographic areas that use relatively low-polluting energy sources for electricity generation, PHEVs and EVs typically have a well-to-wheel emissions advantage over similar conventional vehicles running on gasoline or diesel. In regions that depend heavily on conventional fossil fuels for electricity generation, PEVs may not demonstrate a well-to-wheel emissions benefit.

Compare Electricity Sources and Annual Vehicle Emissions

Select a state to see a breakdown of the electricity sources used to charge EVs and PHEVs on a local grid and compare the annual emissions generated from vehicles using electricity from the grid, gasolin, or a combination of the two.

National Averages

Electricity Sources

- Natural Gas: 31.62%
- Coal: 30.19%
- Nuclear: 20.14%
- Wind: 6.3%
- Hydro: 7.3%
- Biomass: 1.66%
- Solar: 1.32%
- Oil: 0.55%

Annual Emissions per Vehicle

- All Electric
- Plug-in Hybrid
- Hybrid
- Gasoline

Assumptions
Strategies to Conserve Fuel

More than 250 million vehicles consume millions of barrels of petroleum every day in the United States. On-road passenger travel alone accounts for more than 2.5 trillion vehicle miles traveled each year. Vehicle fleet managers, drivers, corporate decision makers, sustainability managers, and public transportation planners can use the following strategies to conserve fuel.

**Idle Reduction**
Find ways to save fuel and money by idling less.

**Driving Behavior**
Learn strategies and techniques to improve driving behavior, conserve fuel, and save money.

**Parts and Equipment**
Learn about outfitting your fleet’s vehicles with devices that save fuel.

**Fleet Rightsizing**
Evaluate your vehicle needs to build and maintain a more sustainable, fuel-efficient fleet.

**Vehicle Maintenance**
Discover ways to improve your fleet’s fuel economy through vehicle maintenance.

**Transportation System Efficiency**
Find ways to conserve fuel by reducing vehicle miles traveled and improving transportation system efficiency.

https://www.afdc.energy.gov/conserve/
5.5 million station searches per year!

New Corridor Tool: www.afdc.energy.gov/corridors

https://www.afdc.energy.gov/stations/#/find/nearest

More Later!
Federal and State Laws and Incentives

Find federal and state laws and incentives for alternative fuels and vehicles, air quality, fuel efficiency, and other transportation-related topics.

Federal laws and incentives

State laws and incentives

Search All Laws and Incentives

Use an advanced or keyword search to find a specific federal or state law or incentive.

View Tables of Laws and Incentives

View laws and incentives sorted by technology/fuel, incentive, regulation, or other.

Read Key Legislation

Read selected legislation summaries about alternative transportation technologies.

Find Local Laws and Incentives

Find local laws and incentives from local governments.

More Later!

https://www.afdc.energy.gov/laws
Maps and Data

Find maps and charts showing transportation data and trends related to alternative fuels and vehicles.

**Browse by Category**

- **All Categories**
- **Fuel Infrastructure**
- **Alternative Fuels**
- **Idem Reduction**
- **Transportation Infrastructure**
- **Clean Cities**
- **Petroleum Use Reduction**
- **Vehicles**
- **AFVs and HEVs**
- **Fuel Consumption and Efficiency**
- **Vehicle Market**
- **Driving Patterns**

**Search**

- **View Graph**
- **Download Data**

**Data Examples**

- **车辆 by Regulated Fleets (by Fuel Type)**
  - EV acquisitions by fuel type from 1992-2014
- **车辆 by Regulated Fleets (by Fleet Type)**
  - EV acquisitions by fleet type from 1992-2015
- **Model Offerings, by Manufacturer**
  - EVs produced by OEMs from 1991-2016
- **Fuel Credits Earned and Used by Regulated Fleets**
  - Fuel credits traded and transactions from 1997-2014

**Additional Resources**

- [https://www.afdc.energy.gov/data/](https://www.afdc.energy.gov/data/)
Natural Gas Fueling Stations by State

Several regions in the United States have fueling stations that provide compressed natural gas (CNG). Roll public CNG stations. To map CNG stations near a specific address or city, use the Alternative Fuels Atlas. Alternative fuels are updated using an established data collection schedule on an ongoing basis.

U.S. Alternative Fueling Stations by Fuel Type

This chart shows the trend of U.S. alternative fueling stations by fuel type from 1992 to 2016. Propane stations were the most numerous until 2011, when they were surpassed by electric vehicle supply equipment (EVSE), or charging units. The growth in EVSE units accelerated starting in 2011, following the 2010 increase of plug-in electric vehicles offered by major automakers. 2016 experienced the largest growth for EVSE in order to support the growing electric vehicle population. As the population of electric vehicles continues to increase, the demand to support with EVSE growth should do the same. The number of E85 stations has been increasing steadily since 2004, as the number of flex-fuel vehicles available from major manufacturers has increased. The number of CNG stations decreased between 2006 and 2007 (despite the increase in CNG sales during this time) largely because the average station size was increasing. The number of CNG stations then increased 2.4X between 2007 and 2016.

Source: Alternative Fuels Data Center (AFDC), either directly (www.afdc.energy.gov/afdc/stations_counts.html) or from historical Transportation Energy Data Book (www.eia.gov/je/tdb.html)

Notes: Data snapshots for each year are based on the federal fiscal year and taken as close to September 30th of the indicated year as possible. All attempts were made to space data samples out one year. However, this was not always possible due to when the TEBE samples were taken. This caused the largest disturbance in 2004, when the sample was taken only five months after the 2004 sample. Therefore, data trends are understated between 2003 and 2004. See Fuel Stations by State for exact sampling dates.

Station counts include both public and private stations.

* Starting in 2011, electric charge equipment was counted by plug rather than by the geographical location. This is different than other fuels, which only count the geographical location regardless of how many dispensers or nozzles are on site.

** Stations selling low-level biodiesel blends (less than B20) are included in the station listing only for the years 2005-2007.

*** Total is the total number of fuel types sold at stations. Stations are counted once for each type of fuel sold.
Natural Gas Stations Abound on Oklahoma’s Interstate Highway System

Drivers of compressed natural gas (CNG) vehicles along Oklahoma’s interstate highways don’t need to worry about finding a place to fill up—the state now has public CNG stations located every 100 miles.

Learn More

https://www.afdc.energy.gov/case
Publications
Find publications about alternative transportation, including alternative fuels, advanced vehicles, and regulated fleets.

Choose one or more categories to search.
- Biodiesel
- Electricity
- Ethanol
- Hydrogen
- Natural Gas
- Propane
- Methanol
- All-Electric Vehicles
- Plug-in Hybrid Electric Vehicles
- Hybrid Electric Vehicles
- Flex Fuel Vehicles
- Fuel Cell Vehicles
- Propane Vehicles
- Diesel Vehicles

Fuel Economy
Idle Reduction
Vehicle Conversions

Search the AFDC

- Latest Additions
  - Clean Cities Alternative Fuel Price Report, April 2018
  - Using Recent Land Use Changes to Validate Land Use Change Models

- Technology Bulletins
- Newsletters

https://www.afdc.energy.gov/publications/
Vehicle Cost Calculator

This tool uses basic information about your driving habits to calculate total cost of ownership and emissions for makes and models of most vehicles, including alternative fuel and advanced technology vehicles. Also see the cost calculator widgets.

Choose vehicles to compare
Select up to eight vehicles to compare from the makes and models below or create your own custom vehicle.

Tell us how you use your car
Because vehicle efficiencies vary depending on how you use your car; this information allows the tool to more accurately calculate fuel usage.

Normal Daily Use
- Average daily driving distance: 34 miles
- Days per week: 5
- Weeks per year: 49
- Percent highway: 45%

Other Trips
- Annual mileage: 3596 miles
- Percent highway: 0%

https://www.afdc.energy.gov/calc/
<table>
<thead>
<tr>
<th>Vehicle</th>
<th>Annual Fuel Use</th>
<th>Annual Electricity Use</th>
<th>Annual Fuel/Elec Cost</th>
<th>Annual Operating Cost</th>
<th>Cost Per Mile</th>
<th>Annual Emissions (lbs CO2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017 Chevrolet Bolt EV</td>
<td>0 gal</td>
<td>14,937 kWh</td>
<td>$2,826</td>
<td>$6,599</td>
<td>$0.13</td>
<td>13,827</td>
</tr>
<tr>
<td>2017 Chevrolet Cruze Gasoline</td>
<td>1,545 gal</td>
<td>0 kWh</td>
<td>$4,126</td>
<td>$8,572</td>
<td>$0.16</td>
<td>37,091</td>
</tr>
</tbody>
</table>
Electric Vehicle Infrastructure Projection Tool (EVI-Pro) Lite

This tool provides a simple way to estimate how much electric vehicle charging you might need at a city- and state-level.

How Much Electric Vehicle Charging Do I Need in My Area?

- Estimate for a State
- Estimate for a City/Urban Area

https://www.afdc.energy.gov/evi-pro-lite
Your Results

In the Denver–Aurora area, to support 10,000 plug-in electric vehicles you would need:

228 Workplace Level 2 Charging Plugs

176 Public Level 2 Charging Plugs
There are currently 588 plugs with an average of 2.6 plugs per charging station per the Department of Energy’s Alternative Fuels Data Center Station Locator.

33 Public DC Fast Charging Plugs
There are currently 51 plugs with an average of 2.5 plugs per charging station per the Department of Energy’s Alternative Fuels Data Center Station Locator.

Where Do I Start?

Planners may want to prioritize installation of fast charging infrastructure above Level 2 charging.

Build DC Fast First: Establishing fast charging networks that enable long-distance travel, serve as charging safety nets, and provide charging for drivers without home charging is critical to support all-electric vehicles that have no other alternative for quickly extending their driving range.

Build Level 2 Second: EVI-Pro typically simulates the majority of Level 2 charging demand coming from plug-in hybrid electric vehicles which have the ability to use gasoline as necessary for quickly extending driving range.
Fuel Properties Comparison

Create a custom chart comparing fuel properties and characteristics for multiple fuels. Select the fuel and properties of interest.

Select Fuels
- All Fuels
- Gasoline/E10
- Low Sulfur Diesel
- Biodiesel
- Compressed Natural Gas (CNG)
- Electricity
- Ethanol/E100
- Hydrogen
- Liquefied Natural Gas (LNG)
- Propane (LPG)
- Methanol

Select Properties
- All Properties
- Chemical Structure
- Fuel Material (feedstocks)
- Gasoline Gallon Equivalent
- Energy Content (lower heating value)
- Energy Content (higher heating value)
- Physical State
- Cetane Number
- Pump Octane Number
- Flash Point
- Autignition Temperature
- Maintenance
- Energy Security & Impacts

Create my custom chart

More fuel information:

https://www.afdc.energy.gov/fuels/fuel_properties.php
<table>
<thead>
<tr>
<th>Property</th>
<th>Gasoline/E10</th>
<th>Low Sulfur Diesel</th>
<th>Biodiesel</th>
<th>Compressed Natural Gas (CNG)</th>
<th>Electricity</th>
<th>Ethanol/E100</th>
<th>Hydrogen</th>
<th>Liquefied Natural Gas (LNG)</th>
<th>Propane (LPG)</th>
<th>Methanol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gallon Equivalent</td>
<td>97% - 100%</td>
<td>113% of the energy in one gallon of gasoline.</td>
<td>100% of the energy in one gallon of gasoline.</td>
<td>123.57 cu ft of CNG has 100% of the energy of one gallon of diesel.</td>
<td>1 gal = 33.70 kWh</td>
<td>1 gal = 73% to 83% of the energy of one gallon of gasoline (variation due to ethanol content in E85).</td>
<td>1 kg or 2.198 lbs. of H₂ has 100% of the energy of one gallon of gasoline.</td>
<td>100% of the energy of one gallon of gasoline.</td>
<td>21,240 Btu/lb</td>
<td>84,250 Btu/gal</td>
</tr>
<tr>
<td>Energy Content (lower heating value)</td>
<td>12,114 - 116,090 Btu/gal (g)</td>
<td>119,550 Btu/gal for B100 (g)</td>
<td>20,160 Btu/lb (g)</td>
<td>3.414 Btu/kWh</td>
<td>76,330 Btu/gal for E100 (g)</td>
<td>51,585 Btu/lb (g)</td>
<td>21,240 Btu/lb (g)</td>
<td>84,250 Btu/gal (g)</td>
<td>57,250 Btu/gal (g)</td>
<td></td>
</tr>
</tbody>
</table>
Widgets: Bring the AFDC To Your Website

Also: Biodiesel, Flex Fuel, Propane, and Electric Drive

https://www.afdc.energy.gov/widgets/
Data Downloads & APIs: Use & Manipulate AFDC Data

https://www.afdc.energy.gov/data_download/
https://developer.nrel.gov/docs/transportation/
Alexis Schayowitz, ICF
alexis.schayowitz@icf.com
617-250-4281

Technical Response Service
TechnicalResponse@icf.com
800-254-6735
If you don’t have a question, tell us how will you use the AFDC in your day-to-day work.