

COMMERCIAL TRUCK ALTERNATIVE FUEL BUYERS GUIDE



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Ford is a LEADER

With Many **ALTERNATIVE FUEL CHOICES**

Industry-Leading Technology

Ford is recognized as the industry leader in the development of commercial truck chassis with alternative fuel capabilities. As a result, Ford can offer customers an unmatched selection of vehicles to meet their alternative fuel requirements.

FORD COMMERCIAL TRUCK Alternative Fuel Choices at a Glance

FUEL TYPE	TRANSIT CONNECT Van/Wagon	E-SERIES Cargo Van/Wagon	E-SERIES Cutaway Chassis	E-SERIES Stripped Chassis	F-SERIES SUPER DUTY® Pickup	F-SERIES SUPER DUTY Chassis Cab	F-650/F-750 Chassis Cab	F-53 & F-59 Stripped Chassis
Flex Fuel (E85)		✓	✓	✓	✓	✓ (1)		
Biodiesel					✓	✓	✓	
CNG/LPG (2)	✓	✓	✓	✓	✓	✓	✓ (4)	✓
Hybrid (3)			✓				✓ (5)	
Battery Electric Vehicle (3)	✓							

- (1) F-350 Chassis Cab w/6.2L V8 engine only.
- (2) Capable of conversion to CNG/LPG when equipped with optional prep engine.
- (3) Upfitted by third-party modifier on Ford products.
- (4) 6.8L CNG/LPG Gaseous Prep Package available first quarter 2012.
- (5) 6.7L Diesel.



	TRANSIT CONNECT Van/Wagon	E-SERIES Cargo Van/Wagon	E-SERIES Cutaway Chassis	E-SERIES Stripped Chassis	F-SERIES SUPER DUTY Pickup	F-SERIES SUPER DUTY Chassis Cab	F-650/F-750 Chassis Cab	F-59 COMMERCIAL Stripped Chassis
GVWR	4,965 lbs. (Wagon) 5,005 lbs. (Van)	8,520 - 9,500 lbs.	8,600 - 14,500 lbs.	9,000 - 14,500 lbs.	9,900 - 13,300 lbs.	9,800 - 19,500 lbs.	20,500 - 37,000 lbs. (Diesel) 20,780 - 36,000 lbs. (Gas)	16,000 - 22,000 lbs.
GCWR	N.A.	11,500 - 18,500 lbs.	9,600 - 22,000 lbs.	13,000 - 22,000 lbs.	19,000 - 33,000 lbs.	19,000 - 35,000 lbs.	26,000 - 50,000 lbs.	23,000 - 26,000 lbs.
MAXIMUM PAYLOAD	1,600 lbs.	4,050 lbs. (Van) 3,010 lbs. (Wagon)	4,318 - 9,040 lbs.	5,368 - 9,747 lbs.	7,110 lbs.	Per Application	Per Application	15,685 lbs.
ENGINE	Engine 2.0L Gas Duratec® I-4 Electric Drive Motor with 28kWh Lithium-Ion Battery Pack	4.6L Gas V8 FFV 5.4L Gas V8 FFV 6.8L Gas V10	4.6L Gas V8 FFV 5.4L Gas V8 FFV 6.8L Gas V10	5.4L Gas V8 FFV 6.8L Gas V10	6.2L Gas V8 FFV 6.7L Power Stroke® V8 Turbo Diesel	6.2L Gas V8 FFV 6.8L Gas V10 6.7L Power Stroke V8 Turbo Diesel	6.8L Gas V10 (F-650)	6.8L Gas V10
TRANSMISSION	4-Speed Automatic Overdrive	4-Speed Automatic 5-Speed Automatic TorqShift® w/ Overdrive (6.8L)	4-Speed Automatic 5-Speed Automatic TorqShift® w/ Overdrive (6.8L)	4-Speed Automatic 5-Speed Automatic TorqShift® w/ Overdrive (6.8L)	TorqShift® Heavy-Duty 6-Speed SelectShift Automatic®	TorqShift® Heavy-Duty 6-Speed SelectShift Automatic 5-speed Automatic TorqShift® with Overdrive	Allison Transmission™ 2000 and 3000 Series 5- or 6-Speed	TorqShift® 5-Speed Automatic

Ford Sustainability Strategy: NO COMPROMISE.

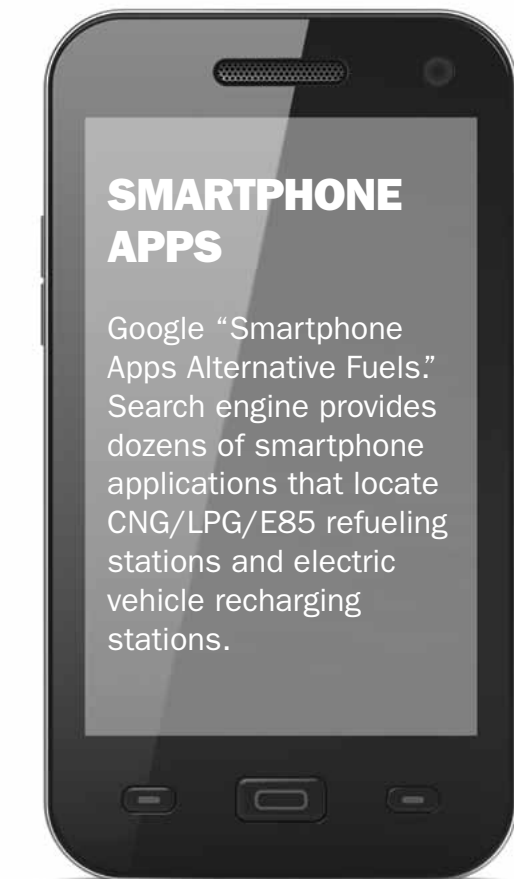
The commercial truck market is composed of many unique vocations and vehicle requirements. One size does not fit all! That's why Ford is collaborating with reliable and qualified upfitters to deliver completed vehicles.

The CNG/LPG Gaseous Engine Prep Packages have been developed and tested by Ford Motor Company. Although vehicles with Gaseous Prep Engines can be driven as delivered on gasoline, most vehicles are transported to endorsed modifiers that install the CNG/LPG tanks and hardware.

Ford has released Upfitter Guidelines and our engineers work with the upfit companies to help ensure consistent and reliable performance.

Ford maintains the Engine and Powertrain Limited Warranty (5 years or 60,000 miles*) and the upfitter is responsible for the system component warranty. Given the number of unique applications, this strategy provides the greatest flexibility of commercial applications – NO COMPROMISE.

*See dealer for details.



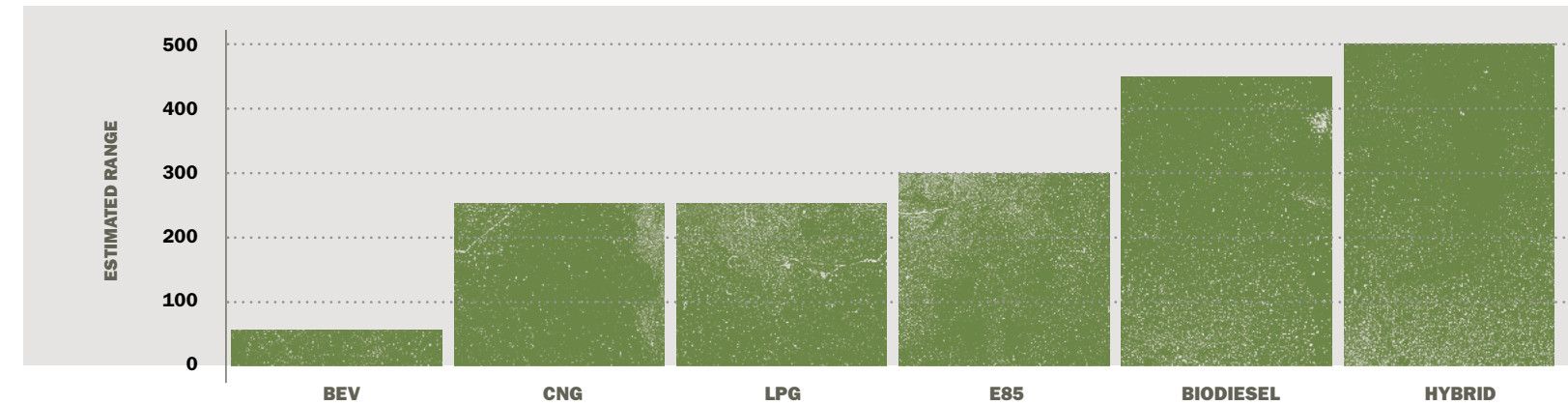
FORD IS EASY TO WORK WITH

From dealer order through customer delivery

- 1 Dealer and customer determine appropriate vehicle based on application, payload and range.
- 2 Dealer places vehicle order, and vehicle is delivered to upfitter.
- 3 Upfitter installs alternative fuel components and system.
- 4 Vehicle is delivered to dealer and dealer delivers vehicle to customer.

ESTIMATED RANGE

Mileage estimates are based on the operator's drive cycle (range, cargo and daily drive routine), vehicle and tank size. The following charts can help select the appropriate technology.



PAYLOAD WEIGHT

	TRANSIT CONNECT Van/Wagon	E-SERIES Cargo Van/Wagon	E-SERIES Cutaway Chassis/Stripped Chassis	F-SERIES SUPER DUTY Pickup	F-SERIES SUPER DUTY Chassis Cab	F-SERIES SUPER DUTY Stripped Chassis F-53/F-59	F-650/F-750 Chassis Cabs
GVWR Range (lbs.)	Wagon: 4,965 ↓ Van: 5,005	8,520 ↓ 9,500	8,600 ↓ 14,500	9,900 ↓ 13,300	9,800 ↓ 19,500	16,000 ↓ 26,000	20,500 ↓ 37,000
Payload Range (lbs.)	Wagon: 1,417 ↓ Van: 1,600	3,260 ↓ 4,050	4,318 ↓ 9,747	2,320 ↓ 7,110	2,554 ↓ 12,692	9,795 ↓ 19,073	Per Application

*Does not include upfit weight. See dealer for revised payload based on upfit package.

REFUELING STATIONS

The alternative fuel industry is growing rapidly. Information about current refueling stations can be found at the following Internet sites:

www.drivealternatives.com
Largest online database of LPG, CNG, E85 and hydrogen refueling stations.

www.cngnow.com
Provides a "Locator" for CNG refueling stations, and is a great source for CNG information.

www.ev-chargeamerica.com
This website provides information about electric vehicle charging stations, along with a list of dealers that can install both home and commercial chargers.

www.cleanenergyfuels.com
One of the leading providers of natural gas fuel in North America.

www.roushcleantech.com/content/propane-
Provides a "Locator" for propane refueling stations, and is a great source for propane information.

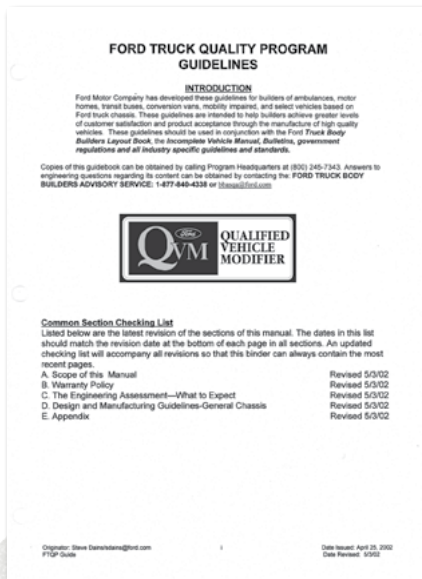
FINANCIAL INCENTIVES AND REBATES

There are a number of financial incentives for purchasing and operating alternative fuel vehicles. Information regarding federal and state incentives can be found at the following websites:

www.fueleconomy.gov
Information about federal and state tax incentives for purchasing alternative fuel vehicles.

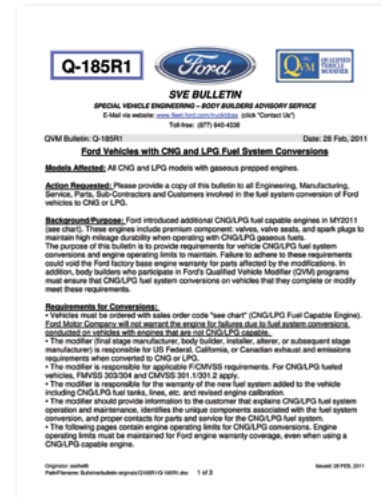
www.afdc.energy.gov/afdc/laws/
U.S. Department of Energy allows you to search its database of federal and state laws and incentive programs related to alternative fuel vehicles.

Ford ENGINEERING SUPPORT



Alternative Fuel QVM Guidelines

Ford has announced the release of Alternative Fuel QVM Guidelines for use by vehicle modifiers. These guidelines are intended to provide recommendations and modification requirements to builders involved in alternative fuel vehicles. Builders that have demonstrated compliance with QVM guidelines are recognized on page 8. As the program evolves, the number of participating modifiers will increase. The Ford Fleet website will recognize new modifiers as they complete program requirements. The purpose of this program is to help modifiers achieve greater levels of customer satisfaction and product acceptance through the manufacture of high-quality vehicles. Ford engineers work on-site with these modifiers to help ensure consistent and reliable performance.



QVM Bulletins for Gaseous Fuel Upfitters

Ford released Qualified Vehicle Modifier (QVM) Bulletin #Q-185 that provides guidance on modifying Gaseous Prep Engines. The bulletin is updated as required and contains the following information:

- Proper engine order codes required for CNG/LPG conversion
- Calibration requirements to maintain factory limited warranty on the base engine
- Modifier is responsible for required government emission and safety (FMVSS 303) certification
- Modifier is responsible for warranty of the new or modified fuel system components
- Modifier must provide information to the customer to explain CNG/LPG fuel system operation and maintenance, identify unique components associated with the CNG/LPG conversion, and provide contacts for parts and service of the CNG/LPG fuel system

QVM Bulletin #Q-185 can be found on the Ford Fleet website: www.fleet.ford.com/truckbbas, refer to Bulletins tab.



QVM Installation Review



Engine dynamometer and calibration tests. 6.8L V10 engine shown.



Alternative Fuel System DEVELOPERS

Current Engine and Vehicle Developers

Ford is working with a number of developers and installers. Developers create the engine calibration, complete the on-dynamometer calibration testing, comply with all Ford engineering requirements (#Q-185) and develop a vehicle component package.

Developers are also installers. A tremendous investment of time and resources is required to develop and test each vehicle package. The chart below lists developers and QVM-qualified vehicle/engine packages. Refer to the Fleet website, www.fleet.ford.com, for new product capabilities and modifiers as they are added.

Alternative Fuel System INSTALLERS

Current Installers

Installers purchase and install kits from developers. Installers provide a finished, ready-to-use vehicle to the dealership. Installers can also provide other equipment required by your commercial customers. Installers might have multiple locations and may offer kits from more than one developer. Refer to the installer's website for qualified QVM installation locations.

VEHICLE	ENGINE / SALES CODE	GASEOUS FUEL DEVELOPERS						ELECTRIFICATION	
		BAF	ROUSH CleanTech	LANDI/RENZO	BRC/IMPACO	VENCHURS	WESTPORT	AZURE DYNAMICS	ODYNE
Transit Connect	Gaseous Fuel 2.0L 4V/90G Electrification (2)	✓			✓			✓	
E-Series Cargo Vans	5.4L/6.8L 2V/91G	✓	✓	✓	✓				
E-Series Wagons	5.4L/6.8L 2V/91G	✓	✓	✓	✓				
E-Series Cutaway & Stripped Chassis	5.4L/6.8L 2V/91G	✓	✓ ⁽¹⁾		✓			✓	
F-Series Super Duty Pickup F-350 Chassis Cab	6.2L V8/44P	✓	✓	✓	✓	✓	✓		
F-Series Super Duty Chassis Cabs F-450/550/650/750	6.8L 3V/44T	✓	✓		✓				✓
F-53 & F-59 Stripped Chassis	6.8L 3V/98G	✓							

(1) E-450 6.8L School Bus Package available through ROUSH CleanTech and Micro Bird.
 (2) Available through select Ford Dealers. Refer to Azure website (www.azuredynamics.com).

Below is a list of current modifiers and installers that Ford is working with. Visit their websites to learn more about the specific products and services they offer.

BAF®	www.baftechnologies.com	Developer/Installer	CNG, LPG
BRC/IMPACO®	www.impcoautomotive.com	Developer/Installer	CNG, LPG
Landi/Renzo®	www.landiusa.com	Developer/Installer	CNG, LPG
ROUSH® CleanTech	www.roushcleantech.com	Developer/Installer	LPG
Venchurs	www.venchurs.com/venchurs-vehicle-systems	Developer/Installer	CNG, LPG
Westport	www.westport.com/automotive	Developer/Installer	CNG
Dejana	www.dejana.com	Installer	CNG, LPG
Leggett & Platt®	www.leggettcpu.com	Installer	CNG, LPG
Knapheide	www.knapheide.com/service-and-support/alternative-fuels	Installer	CNG, LPG
National Fleet Services	www.nfsohio.com	Installer	CNG, LPG
OMC (Adrian Steel)	www.adriansteel.com	Installer	CNG, LPG
Azure Dynamics	www.azuredynamics.com	QVM Guidelines Under Development	BEV, HEV
Odyne	www.odyne.com	QVM Guidelines Under Development	HEV

Developer – Calibration and component development/testing.
Installer – Qualified installation facility.

POPULAR ALTERNATIVE FUEL SOURCES



Flexible-Fuel Vehicles (FFV) are alternative fuel vehicles with an internal combustion engine designed to run on more than one fuel, usually gasoline blended with ethanol (E85), and both fuels are stored in the same common tank. Flex-fuel engines are capable of burning any proportion of the resulting blend as fuel injection and spark timing are adjusted automatically according to the actual blend detected by electronic sensors. E85 is the most common flex fuel and many of the Ford engines are capable of using E85.

Biodiesel refers to a plant oil-based or animal fat-based diesel fuel. Blends of biodiesel and conventional (hydrocarbon-based) petrodiesel fuels are products most commonly distributed for use in the retail diesel fuel marketplace. A system known as the “B” factor is used to state the amount of biodiesel in any fuel mix:

- 100% biodiesel is referred to as B100, while
- 20% biodiesel is labeled B20
- 5% biodiesel is labeled B5
- 2% biodiesel is labeled B2



Compressed Natural Gas (CNG) is a fossil fuel substitute for gasoline or diesel. It is generally safer than other fuels in the event of a spill (natural gas is lighter than air, and disperses quickly when released). CNG is made by compressing natural gas, which is mainly composed of methane. It is stored and distributed in hard containers at a pressure of 2,900–3,600 psi. CNG is used in traditional gasoline internal combustion engines that have been modified to operate on CNG.

Advantage – Ethanol/E85 is clean-burning and substantially reduces CO and CO₂ emissions. Compared to gasoline, E85 has a higher octane rating, provides the same or more horsepower and burns cooler. Corn and other cellulosic plants are readily available.

Consideration – E85 produces less energy by volume than gasoline. One gallon of gasoline is the equivalent of 1.56 gallons of E85 used to travel the same distance. Due to the increased volume required and the fact alcohol is corrosive, fuel system components must be upgraded.



Advantage – Biodiesel burns cleaner than petrodiesel, with reduced emissions.

Consideration – Biodiesel may be more expensive than petrodiesel and in low temperatures may require a special additive or fuel tank heater to flow properly.

Advantage – CNG is an extremely clean-burning fuel and significantly reduces CO, CO₂ and NO_x compared to its gasoline counterpart. CNG has an octane rating of 130 and has the potential to optimize the engine’s thermodynamic efficiency by utilizing a higher compression ratio.

Consideration – CNG has slightly less energy than gasoline per unit volume and requires a larger fuel tank/container. Refueling time and infrastructure are also considerations.

Liquefied Petroleum Gas (LPG) is a mixture of hydrocarbon gases, most commonly propane and butane. A powerful odorant, ethyl mercaptan, is added so leaks can be detected easily. As opposed to relying on foreign oil sources, approximately 90 percent of the United States propane supply is produced domestically. 70 percent of the remaining supply is imported from Canada and Mexico. Propane is nontoxic and cannot get into the water table if there is a leak in the storage container. From an economic perspective, propane is an effective alternative to conventional transportation fuels when capital cost (vehicle and infrastructure), operation and maintenance are all taken into consideration. Of all available fuels, propane offers the best mix of vehicle driving range, durability and performance.



Advantage – Power, acceleration, payload and cruise speed are unchanged to an equivalent vehicle fueled by gasoline. Propane has a high octane rating of 104, in between compressed natural gas (CNG) at 130 and unleaded gasoline at 87. Since it burns completely, there is less carbon buildup. Spark plugs, exhaust system and oil changes are needed less frequently. Fuel is typically 30-40 percent less expensive than gasoline, on a per-gallon basis.

Consideration – Because of the low vapor pressure of propane, in extremely cold conditions, starting vapor injection systems could be an issue. Propane autogas has fewer BTUs than gasoline, which results in a loss of mpg of about 10-15 percent.

Hybrids are a type of vehicle that typically utilize an internal combustion engine AND an electric motor to propel the vehicle. Hybrids are split into two groups: HEVs (hybrid electric vehicles) and PHEVs (plug-in hybrid electric vehicles).

HEV – Hybrid electric vehicles combine an internal combustion engine with an electric motor and battery. Electric power is used for vehicle launch and lower-speed operation. The internal combustion engine takes over for higher-demand operation and charges the battery.

PHEV – Plug-in hybrid electric vehicles are similar to conventional hybrids, but they have a larger battery that can be charged by plugging into an electric outlet. PHEVs are usually designed with an electric-only range of 10 to 40 miles, blended with a gasoline engine to achieve higher speeds and loads. After the electric-only range is exceeded, the vehicle continues to operate as a hybrid vehicle using a gasoline engine or generator.



Advantage – Hybrid vehicles offer significant fuel economy advantages over gasoline internal combustion engine vehicles, especially in urban driving situations with lots of stop and go. By substituting grid energy for gasoline, plug-in hybrids can offer an additional improvement in fuel economy and emissions, especially for drive cycles with significant low-speed driving.

Consideration – The vehicle essentially has two powertrains. Combining powertrains increases vehicle weight, and reduces payload and towing capability.



Battery Electric Vehicles (BEV) use chemical energy stored in rechargeable battery packs. As with other electric vehicles, BEVs use electric motors and motor controllers instead of an internal combustion engine for propulsion. The concept utilizes onboard batteries for propulsion and recharges the batteries using the electric grid.

Advantage – Vehicles that run solely on electric power require no warm-up, run almost silently and have excellent performance. Electric vehicles can be recharged at night when generating plants are generally underutilized. Electric vehicles produce zero tailpipe emissions. Even when emissions from the generating plants are factored in, electric vehicles emit less than 10 percent of the pollution of an internal combustion vehicle.

Consideration – Pure electric vehicles still have limited range, typically no more than 100 to 120 miles. Depending on the charge voltage, most vehicles must be plugged in overnight for the battery to fully recharge.