fleets for the future

Gaseous Fuel Vehicle Procurement Best Practices Guide

Preface

Funded by the U.S. Department of Energy (U.S. DOE) Clean Cities Program, the Aggregated Alternative Technology Alliance, known as "Fleets for the Future" (F4F), seeks to achieve nationwide economies of scale for alternative fuel vehicles (AFVs) through aggregated procurement initiatives. F4F plans to accomplish these economies of scale through a coordinated strategy designed to increase knowledge, lower the transaction costs of procurement, achieve better pricing, and address potential challenges arising from large-scale procurement initiatives, thereby increasing the deployment of alternative fuel vehicles in public and private sector fleets. The F4F team is comprised of national and regional partners with extended networks and relationships that can increase and aggregate the demand for alternative fuels and advanced vehicles. The project includes a regional procurement initiative spearheaded by each of the team's five participating regional councils, as well as a national procurement effort.

F4F will enable fleets to obtain vehicles that will both reduce emissions and operate at a low total cost of ownership. AFVs that use electricity, propane autogas, and natural gas all have desirable benefits, including less reliance on foreign petroleum, reduced fuel costs, reduced maintenance costs, and contributions to local air quality improvement. In order to achieve these savings, fleet managers must justify the higher upfront cost of investing in AFVs. By harnessing the power of cooperative procurement to reduce transaction costs and to obtain bulk pricing, F4F aims to reduce the upfront cost premium and make an even stronger case for investing in AFVs.

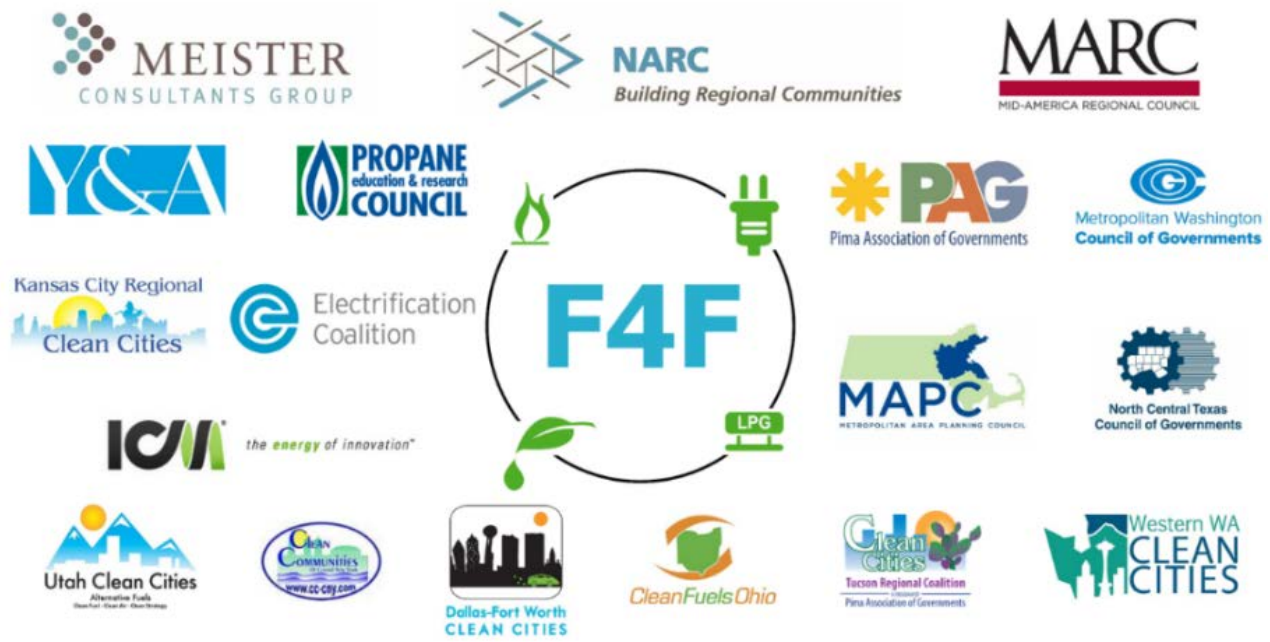
F4F does not detail purchase and use of ethanol, renewable diesel, or biodiesel, which are beneficial for many of the same reasons mentioned above. However, biofuels can be introduced into a fleet with little or no additional cost and require little or no additional technology upgrades to deploy. Hydrogen is not treated herein because the technology does not have a mature market and is not positioned for bulk purchasing.

In order to prepare stakeholders to successfully deploy AFVs in their fleets, the F4F team has compiled fleet management and procurement best practices specifically relevant to alternate fuels. These best practices build upon both the extensive information provided by the U.S. DOE and a number of recent successful case studies. The specific goal of these best practice guides is to educate procurement officers, fleet managers, and other interested stakeholders to plan for a large scale deployment of AFVs.

This document, the *Gaseous Fuel Vehicle Procurement Best Practices Guide*, presents information common to the procurement of AFVs of any fuel type. The F4F companion documents include:

1. *Fleet Transition Planning for Alternative Fuel Vehicles*
2. *Guide to Financing Alternative Fuel Vehicle Procurement*
3. *Electric Vehicle Procurement Best Practices Guide*

Table of Contents



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Introduction

This guide assists fleets and organizers of aggregated purchasing cooperatives in understanding the benefits of deploying vehicles powered by natural gas or liquefied petroleum gas (LPG), often referred to as propane autogas when referring to vehicular use. The deployment of natural gas vehicles (NGV) and propane autogas vehicles continues to grow each year. While still only a small fraction of the total on-road vehicle inventory, the rate of market adoption is accelerating. Vehicle purchasing co-operatives can be an effective way to further accelerate that deployment while achieving 1) reduced pricing through economy of scale, 2) shortened order-to-delivery time frames, 3) improved service/support capabilities, and 4) expanded fueling infrastructure.

This guide briefly summarizes the basic attributes and benefits of both gaseous-fuels and their respective vehicle technologies, then explores best applications and why, highlighting the relationship between upfront premiums, fuel use, and vehicle maintenance to total cost of ownership (TCO). The guide also provides information about fueling infrastructure options and offers planning guidance. It reviews steps that lead organizations will need to undertake to build a successful cooperative purchasing initiative, including how to assess which vehicles/platforms will have the greatest cross-jurisdictional appeal; gaseous fuel-related specification criteria; purchasing processes that may consist of multiple stakeholders and their roles and obligations; potential modifications to maintenance facilities; and suggestions concerning engagement of private sector fleets to identify potential synergies and mutual benefits. While each fuel and vehicle technology type has unique characteristics, the two are similar in many ways and thus discussed jointly in this document.

The motivations and/or decision criteria for deploying alternative fuel vehicles (AFV) varies from one fleet to the next, and even within a fleet from one application to another. Fleet motivations are often a mix of petroleum displacement targets, emissions reduction/air quality (AQ) improvement goals or mandates, economic savings, and/or a desire to show community leadership in advancing alternative fuel technologies. While savings and emissions reductions might be the primary motivations behind a fleet manager's specification of natural gas refuse trucks or propane autogas shuttles, sustainability and leadership by example might be the underlying reasons for deployment of light-duty AFVs as these applications use less fuel, have longer payback periods, and produce less life-cycle savings. This guide does not assume any prioritization of these motivating rationales, merely presents potential options and factual foundations on which to apply evaluation.

A series of supporting appendices delve more deeply into topics covered more broadly in the guide's main body. Links to additional resources have been included throughout for those that need further clarification.

Benefits

The benefits of NGVs and propane autogas vehicles have been widely established and publicized. These include:

- Reduced dependence on foreign oil (based on ample domestic supplies now and for the foreseeable future);
- Better fuel price stability and reduced fuel costs in the long run;
- Reduced tailpipe and well-to-wheel emissions (as compared to gasoline and diesel counterparts);
- Reduced fuel and maintenance expenses, often leading to a lower TCO.

Benefits are explored in more depth below for each fuel type. Additional information is available on U.S. DOE Clean Cities and Alternative Fuel Data Center websites and/or on the websites of their respective national trade organizations: NGVAmerica and the Propane Education and Research Council.

Displacement of Gasoline and Diesel with Abundant Domestically Produced Fuel

The most obvious benefit of using natural gas vehicles (NGVs) and propane autogas vehicles (LPGs) is that they displace gasoline and diesel use, which reduces reliance on crude oil from foreign sources. Diversification of the nation's fuel portfolio and greater use of domestically produced energy resources, strengthens national security, creates jobs, and contributes to the American economy.

Over 98% of natural gas used in the U.S comes from North American wells, supplemented by increasing amounts from renewable sources such as landfills, wastewater plants, and other agricultural waste streams. Over 90% of U.S. natural gas supply comes from the lower 48 states, with the remainder coming from Canada and Mexico. Based on current usage, estimates of natural gas supply exceed 100 years.[1,2]

Propane supply is derived from three sources; naturally occurring deposits deep beneath the earth (along with other high-Btu liquids often found in conjunction with natural gas deposits); as a byproduct of oil refining; and a small but diminishing amount of seasonal imports to serve specific geographic regions. The U.S has been a net exporter of propane since 2011. With the major increase in domestic natural gas drilling over the past seven years, propane production from underground sources now accounts for about 69% of all U.S. supply – up from less than 50% a decade ago, and it is projected to grow even more. While some U.S. propane supply comes from oil refining, no oil is imported for the purpose of producing propane.[3]

[1] U.S. Energy Information Agency (EIA)
[2] 2016 A.G.A. Playbook, American Gas Association
[3] 2016 Propane Market Outlook, PERC

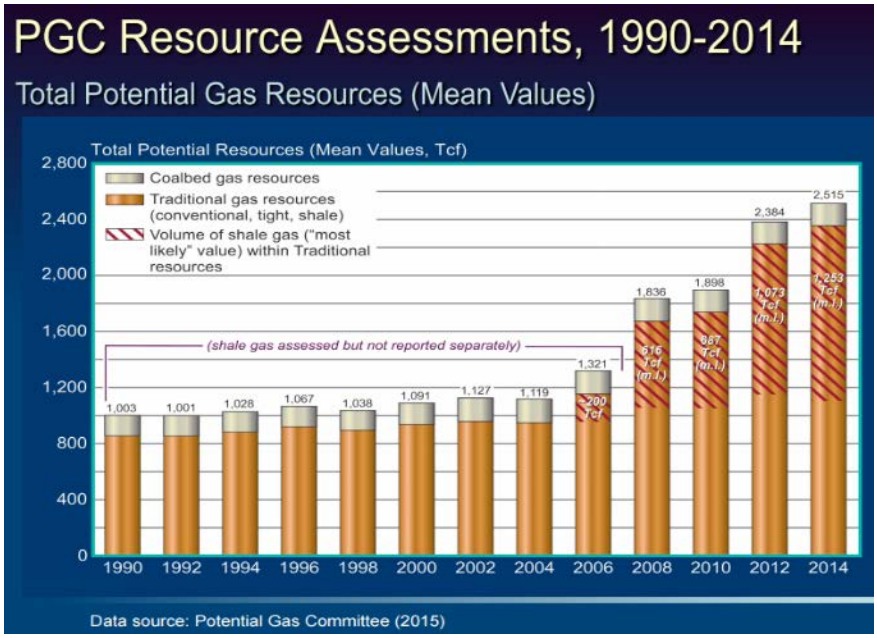


Figure 1: Colorado School of Mines Potential Gas Committee Resource Assessment 1990-2014

Natural gas reserves are estimated at ~2884 trillion cubic feet (Tcf). Annual U.S. consumption is ~27 Tcf/ year, indicating a 100+ year supply.

Note the impact of shale gas additions from multiple basins since 2006. Abundant, distributed supplies facilitate ability to respond to demand and contribute to price stability.

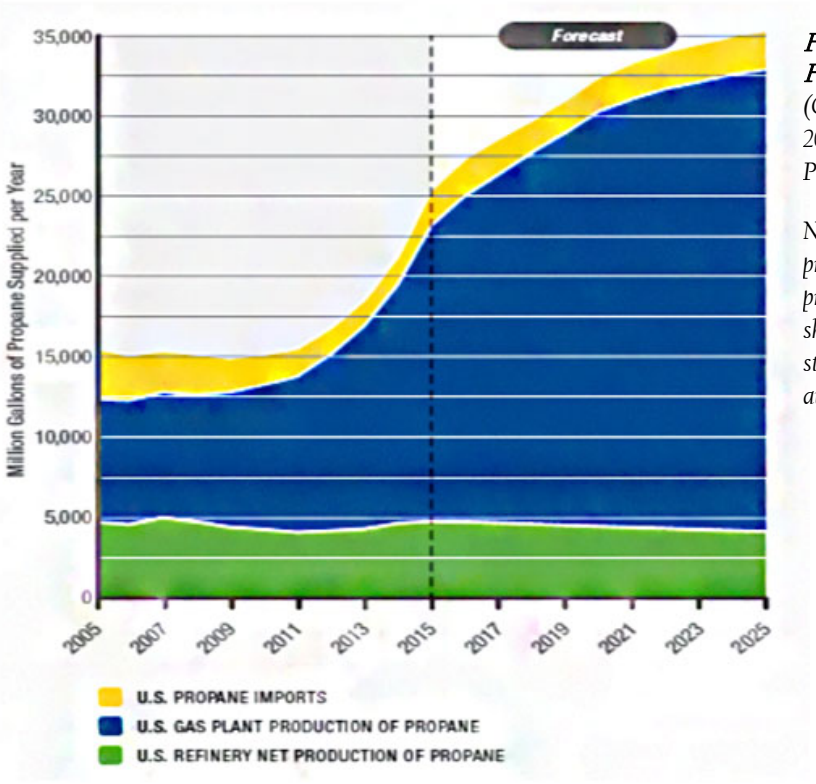


Figure 2: U.S. Historical and Forecasted Propane Supply
(Chart provided courtesy of IFC, 2016 Propane Market Outlook, PERC)

Note the tremendous increase in propane from natural gas liquids processing that began in 2010. This shift in supply portfolio has had a stabilizing impact on propane autogas pricing.

Long term forecasts of American natural gas and propane supply are strong, indicating ample supply. This abundance translates into price stability. Natural gas commodity prices have been low and relatively stable, fluctuating within a limited range since the addition of large amounts of shale gas beginning in 2008. The huge increase in domestic well-produced propane combined with low crude oil prices have substantially reduced the national average market price for propane from previous highs. Currently, national average wholesale propane pricing is a weighted hybrid of oil pricing and natural gas pricing at the major supply points.[4]

The distribution systems for natural gas and propane are both strong. Nearly all natural gas distribution is accomplished through a well-developed network of 300,000+ miles of interstate pipelines traversing the entire continental U.S. These interstate pipelines feed into more than 2.2 million miles of local gas distribution company networks serving 17 million individual customers.[5] Propane distribution also relies partially on interstate pipelines supplemented greatly by rail, barge, and trucking. The sudden increase in total volume and greater geographic diversity of propane supply from natural gas liquids exploration has introduced new distribution channel dynamics that propane industry stakeholders are working out (as of 4th quarter 2016). Development of additional propane storage capacity will provide further supply and price stability to the propane marketplace.[6] It is common in propane autogas fleet applications to enter into long-term fuel contracts, alleviating the risk of price fluctuations.

Reduced Emissions

Emissions reductions are usually viewed from two perspectives: 1) "tailpipe" emissions (i.e. emissions produced by the vehicle) and 2) "well-to-wheel" emissions (i.e. total emissions generated from energy source to end use including extraction, processing, transportation, and vehicle propulsion).

Federal on-road vehicle and engine emissions regulations focus on criteria pollutants, primarily oxides of nitrogen [NOx] and particulate matter [PM], and – in more recent years – greenhouse gases (GHG). As low carbon fuels, both natural gas and propane autogas reduce criteria pollutants and GHGs as compared to gasoline and/or diesel. Light-duty NGVs and propane autogas vehicles produce slightly less NOx and PM emissions than those running on gasoline and, when compared to heavy-duty vehicles running on diesel, provide even more significant emissions reductions.[7] NOx reductions are increasingly important in high-population regions, where nearly half the U.S. population now resides in areas the Environmental Protection Agency (EPA) identifies as being in nonattainment with federal standards.

Vehicles running on propane autogas or natural gas also reduce well-to-wheel GHGs when compared with gasoline or diesel. The amount of GHG reductions for each fuel varies depending on duty cycle, with greater reductions for light-duty vehicles and lesser reductions for heavy-duty vehicles.[8]

[4] 2016 Propane Market Outlook, PERC; supplemented by interviews with T. Perkins, CEO - PERC
[5] 2016 Playbook, American Gas Association
[6] 2016 Propane Market Outlook, PERC; supplemented by interviews with T. Perkins, CEO – PERC and Michael Sloan, ICF International
[7] Alternative Fuels Data Center, U.S. DOE 2016
[8] GHG reduction vary based on the model used. EPA's Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model estimates lower GHG reductions than other models such as that used by the California Energy Commission (CEC), which bases its calculations on different assumptions regarding upstream emissions and the state's petroleum fuels compositions.

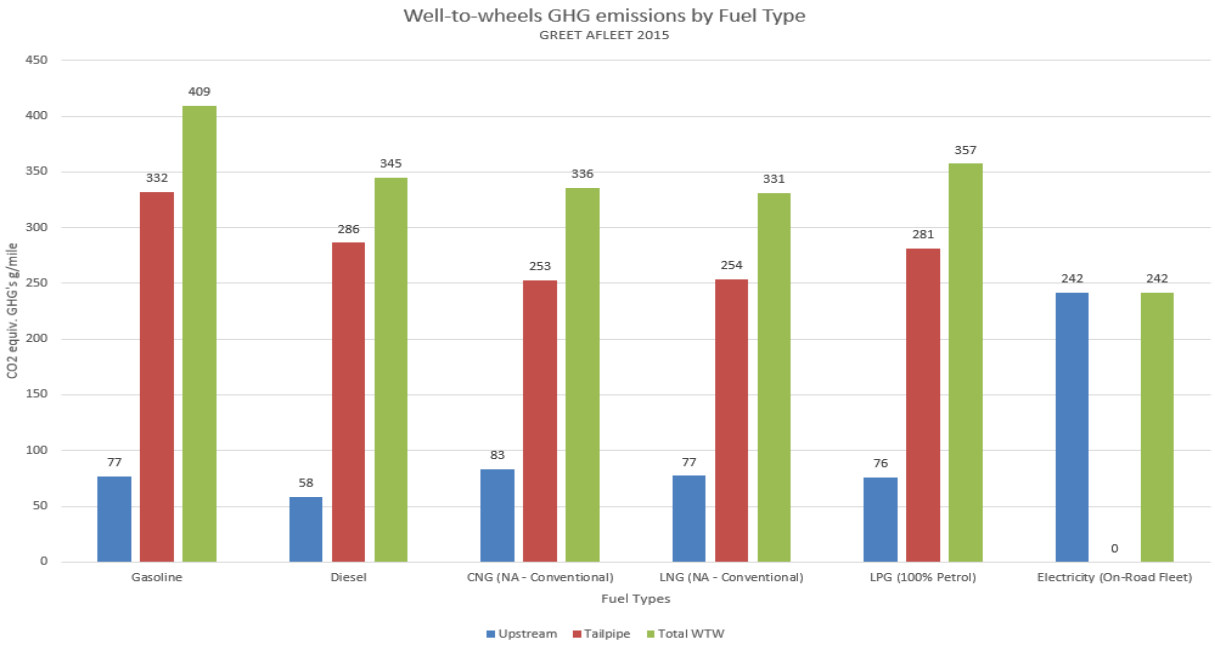


Figure 3: Total GHG Emissions Reductions from Various Fuels from the GREET model, 2015
Wells–to-wheels evaluations of vehicle GHG emissions take into account both "upstream" emissions (related to energy sources such as exploration, production, and transportation) and vehicle emissions (if there are any). Note that the comparison of the emissions profiles of each alternative fuel will vary with geographic location, particularly for electricity.

Lower and More Stable Fuel Costs

Two key determinants of TCO are fuel and maintenance expenses. Natural gas and propane autogas have a history of lower fuel prices than gasoline and/or diesel and are projected to be lower than these conventional fuels in the future. Over the last seven years (2010–present), the range of savings has been as little as 15% to as much as 60% or more. The amount of savings provided by each fuel varies regionally and the relative advantage shifts over time. Furthermore, which fuel provides the greater fuel savings advantage shifts from time to time as the underlying component costs of each fuel type is quite different.

While comprehensive independently-verified comparative maintenance cost datasets across multiple vehicle platforms are not available, anecdotal information shared by fleets over many years indicates that light- and medium-duty NGVs and propane autogas vehicles have lower maintenance expenses than their gasoline and diesel counterparts. Observations by heavy-duty sector fleets have been mixed; some high-annual-mileage over-the-road Class 8 tractor fleets report slightly higher NGV maintenance costs than diesel ($.015–.02 more per mile), while waste and transit fleets often cite maintenance costs less than diesel by as much as five to seven percent.[9] The differences in maintenance costs are typically associated with natural gas engines' use of spark plugs, valve lashing adjustments, and more costly low-ash oil, partially or completely offset by lower exhaust after treatment system expenses (i.e. natural gas units' use of stoichiometric cooled exhaust gas recirculation (EGR) combustion and maintenance-free three-way catalyst exhaust system as compared to diesel units' requirement for periodic cleaning of diesel particulate filters and selective catalytic reduction (SCR) system sensor repairs/replacements).

Simply stated, fuel cost savings is the difference between using alternative fuel (propane autogas or natural gas) to do the same job as conventional fuel (gasoline or diesel). Inherent in that calculation is normalizing

[9] Anecdotal information culled from interviews with municipal fleet managers (Culver City CA, Montgomery County MD, Dallas TX, Columbus OH, Pensacola FL), APTA Clean Propulsion Committee transit members, Waste Management, Republic Services.

for energy equivalence[10] and adjustments that may be appropriate to account for differences in engine efficiency.[11] Forecasting fuel cost savings requires speculation about future fuel costs over the projected life of the vehicle or, at the very least, over the time frame that the analysis is to be applied, such as the fleet's usual vehicle replacement timeline or "disposition" mileage benchmark. For this reason, it's important to understand the component costs of each fuel and how shifts in their respective component costs impact pump price.

The stability of natural gas and propane autogas fuel prices is due to the pricing structure, as will be explored below.

Components of Natural Gas Pump Price: CNG and LNG

Most natural gas for vehicular applications is compressed natural gas (CNG). This section will describe the components of CNG prices at the pump to demonstrate the reasons for its price stability relative to gasoline and diesel. CNG component costs are very different from conventional fuels and even from liquefied natural gas (LNG).[12] Figure 4 shows the theoretical breakdown of the components of CNG pricing, using a sample retail price of $2.15/GGE and the following assumptions: a NYMEX cost of natural gas at $2.80/MMBtu, a local gas company distribution tariff of $.20/therm, and a state tax of $.217/GGE.

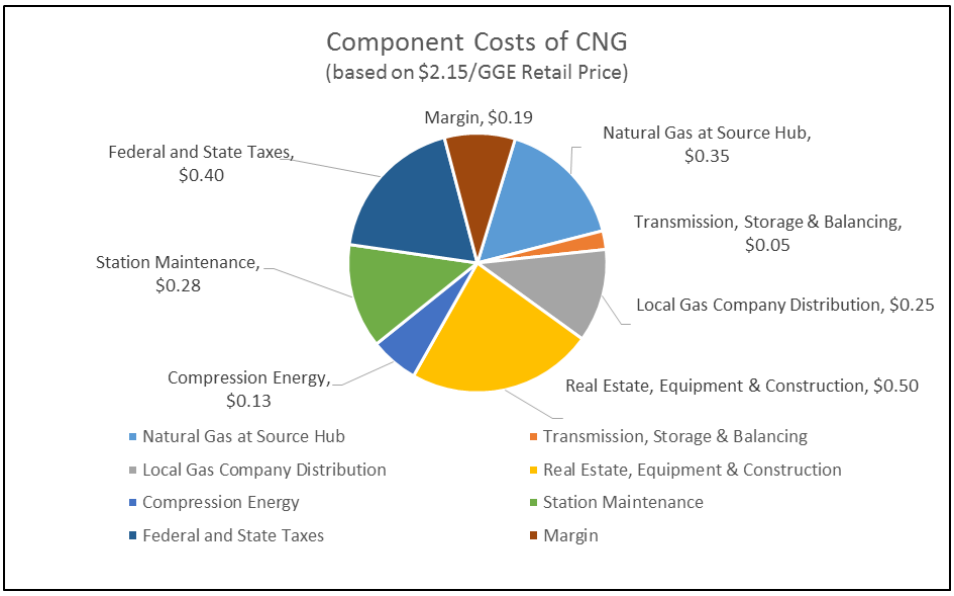


***Figure 4**: Example of CNG Component Costs*

Under the assumptions of Figure 4, the commodity price of natural gas at the hub ($.35 per GGE based on $2.80/MMBtu) accounts for only 16.25% of the total CNG pump price. Even in the unlikely event that the free market hub price of gas were to double to 5.60/MMBtu, the price at the pump would likely only

[10] Due to molecular structure, propane autogas has a lower Btu content per liquid gallon of fuel, which must be normalized against the US DOE-recognized Btu content of gasoline to create an apples-to-apples comparison of fuel economy. Natural gas is sold in energy equivalents (e.g. gasoline-gallon-equivalents (GGE) and diesel-gallon-equivalents (DGE)).
[11] An example is spark-ignited heavy-duty natural gas engines, which have lower engine efficiencies than their diesel counterparts due to lower compression ratios; the amount varies between 2-15% depending on application duty-cycle.
[12] LNG component costs include fuel production, storage, and transportation to the end use location and associated on-site storage and dispensing equipment costs. Production costs for LNG are based on cost of the natural gas, typically tapped off a high-pressure transmission pipeline at very high volume discounted rates, and the amortized costs of the cryogenic liquefaction plant. Because LNG liquefaction plants require significant investment (hundreds of millions if not several billion dollars, depending on capacity), there are a limited number throughout the U.S. Distance between the production plant and end-use site combined with related transportation costs become a primary determinant of the economic viability of an LNG application.

increase by $0.35 per GGE. This is an important distinction from petroleum-based liquid fuels, which are far more impacted by the volatile fluctuations of crude oil pricing.

Price components are the same from station to station, but the component costs vary widely. This is due to regional natural gas hub and pipeline transportation pricing, local gas and electric utility tariffs, local and state policies for incentivizing alternative fuels for transportation, fuel sales volume, and other regional anomalies.

Components of Propane Autogas Pump Pricing

The components of propane autogas pricing (see Figure 5) comprise production; terminal bulk storage; transportation by pipeline, rail, and barge between production/storage sites and terminal hubs; transportation by rail or truck from terminal hub to the regional/local distributor's secondary storage facility; and the distributor's fees for fuel handling and delivery to a retail propane autogas station or – as is more often the case – to the fleet customer's on-site tank. Depending on distances and volumes, especially for fleets committed to a propane autogas supply agreement, the distributor's cost component adds $.25 to $.55 to the terminal hub price.[13]

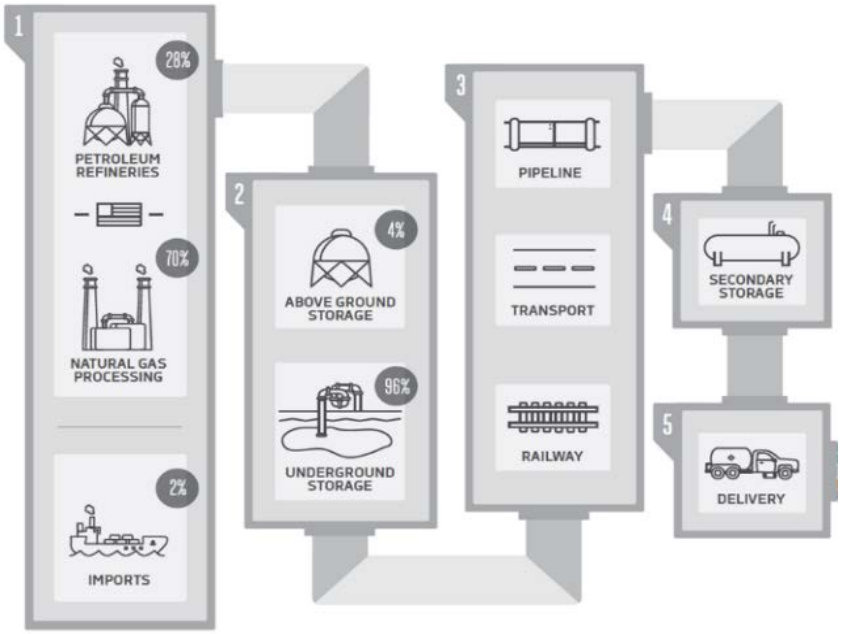


***Figure 5**: Propane Supply – Production, Storage and Distribution (Credit: PERC)*

Terminal hub pricing varies based on proximity to supply points such as natural gas liquids processing facilities and oil refineries. The price at the Mt. Belvieu, Texas terminal hub – the propane industry's benchmark supply point against which most other supply hubs index their pricing – presently hovers around $.50/gallon (Figure 6 on the next page). When propane autogas' lower Btu content per liquid gallon is factored (91,333 versus 120,405Btu for gasoline), [14] the present gasoline-gallon-equivalent (GGE) price of propane autogas paid by large fleets under contract supply agreement averages $0.85 to $1.05 before taxes.

[13] Interviews with M. Sloan, ICF International; T. Perkins, PERC; Alliance Autogas customers under contract pricing;
[14] http://www.eia.gov/energyexplained/index.cfm?page=about_energy_units.

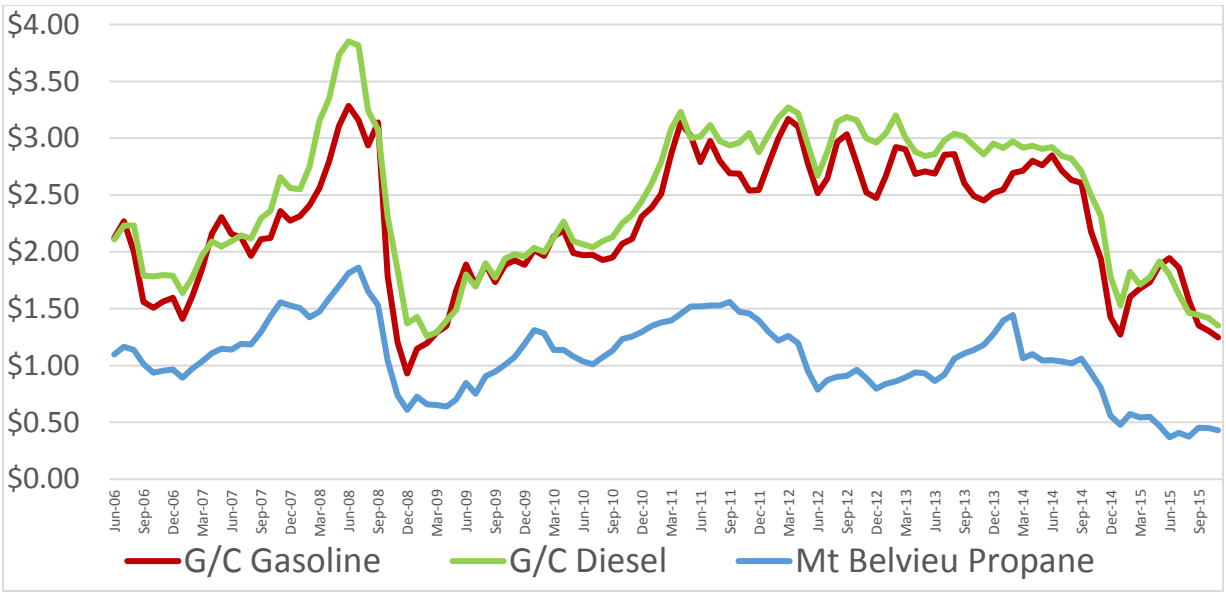


Figure 6: Supply Terminal Price Comparison of Propane, Gasoline and Diesel: 2006-2015
Note that propane pricing began to partially "decouple" from petroleum fuels beginning in late 2010/early 2011, when the majority of supply shifted from oil refineries to natural gas liquids processing plants. Propane and petroleum fuels still exhibit some linkage, but far less so than in previous years; industry analysts expect that propane pricing will increase only somewhat when petroleum prices rebound.

The last components of propane autogas price are costs associated with fuel station storage and dispensing equipment and motor fuels excise taxes. These may be borne directly by the fleet via purchase and installation of an on-site station and payment of appropriate federal and state taxes, or embedded into the propane autogas distributor's bundled cost per gallon for leased skid-mounted stations, as is discussed further in the *Fueling Infrastructure* section.

The challenge for fleet managers and fuel procurement officers is forecasting future pricing, especially for liquid petroleum fuels, which can be volatile because crude oil accounts for as much as 65-70% of the pump price of gasoline or diesel, with the remaining 30-35% attributed to refining/processing, transportation, marketing, and taxes. In contrast, CNG or LNG pump prices are far less volatile because of natural gas hub price stability, and, for CNG, the fact that the base commodity accounts for only 15-20% of the pump price. The degree of decoupling of propane autogas prices from crude oil prices has yet to be tested because of how recently the propane supply portfolio has shifted from oil refineries, but industry analysts project that crude oil price fluctuations will have much lower impact than they did in the past.[15] When crude oil prices rise, as is predicted in most experts' models, gasoline and diesel fuel price differentials with natural gas and propane autogas will increase.

Lower Maintenance Expenses

NGV and propane autogas vehicle maintenance is similar to maintenance performed on gasoline or diesel vehicles. While engine oil, fuel filters, brake system components, and other normal wear-and-tear items need periodic inspection and replacement, the engine oil specifications and types of fuel filters used will differ. Some maintenance tasks will be eliminated while others will be added. For example, heavy-duty spark-ignited NGVs do not use diesel particulate filters, SCR-injection systems, or related DEF fluids, but they do require spark plug changes and valve lash adjustments. Additionally, NGVs have coalescing filters that need to be drained periodically. The tools needed for NGV and propane autogas vehicle maintenance and repairs are essentially the same, and technician training is required to familiarize technicians with the

[15] 2016 Propane Market Outlook, PERC, ICF International

two technologies' unique fuel properties, fuel systems, and components, with special emphasis on safe practices for working with fuels at elevated pressures.

One major advantage of natural gas and propane autogas is that they are both very low carbon fuels that, when combusted, produce very little soot. This reduces engine wear. For heavy-duty vehicles such as shuttles, buses, and trucks, this often translates into longer engine life. Less combustion soot can extend engine oil change intervals by as much as twice the usual interval. It's recommended that fleets use oil analysis – not oil appearance – to ensure appropriate lubricity or viscosity properties remain.

Figure 7: *Maintenance on NGVs and propane autogas vehicles is similar to gasoline and diesel vehicles. Maintenance costs are also similar or even less, depending on specific duty cycle and engine platform.*

Applications Best Suited for Gaseous Fuel Vehicles and Why

The list of available NGVs and propane autogas vehicles fitting applications and duty-cycles from Class 1 to Class 8 continues to grow as new engine platforms are introduced. The power and performance of these latest offerings is on par with their gasoline and diesel counterparts. These vehicles are available either through original equipment manufacturers (OEM) or manufacturers of certified aftermarket retrofit systems (sometimes referred to as "conversion" systems), many of whom have cooperative relationships with OEMs and their dealer channels. This is true for both natural gas and propane autogas, although each fuel has its own strengths in terms of depth of available vehicles and platforms.

Heavy-duty buses, vocational work trucks, and freight trucks have dozens of natural gas options but only a few propane autogas options, because heavy-duty propane autogas engines are currently limited. Conversely, there's a far greater selection of light-duty propane autogas vehicle options, especially sedans, compact SUVs, and crossovers. Available space for fuel storage on light-duty propane autogas vehicle platforms is limited and, as a liquid fuel, propane autogas fuel tanks require much less space than natural gas cylinders. For both fuels, there's a comparable and well-developed selection of light-duty pick-ups and medium-duty work truck and shuttle platforms. Both fuels also offer options for the school bus market. More information about which vehicles/platforms and fuel options are available from OEMs or aftermarket suppliers is provided in *Appendix A*.[16]

[16] NGVAmerica; PERC; EPA list of available light-duty vehicle and heavy-duty engine certifications

Figure 8: Typical Municipal NGV and Propane Autogas Vehicles
The selection of OEM and aftermarket NGVs and propane autogas vehicles continues to expand as new engines and platforms are introduced.

Duty-cycles, Fuel Use, Range, and Fuel Capacities

The biggest barrier to wider adoption of NGVs and propane autogas vehicles is fueling infrastructure; however, station counts for both fuel types are growing and many fleets' fuel use and utilization patterns justify the investment. NGVs and propane autogas vehicles are best suited to applications with repetitive routes and/or operating territory where existing or planned fueling infrastructure can be located at or near the vehicles' home base or along regularly traveled routes. Range is not an issue for metro area-oriented fleets. By the very nature of their geographic boundaries, most municipal fleet vehicles' daily fuel use does not exceed standard onboard propane autogas or CNG storage capacities in a single day. Exceptions to this general rule are applications that may operate round-the-clock or on double-shifts (e.g. transit, shuttle, police patrol). However, fueling between shifts is a common practice for conventional fuels and is no different for alternative fuels.

Whether the rationale for deploying an AFV is environmental or economic, the benefit is directly proportional to the use of alternative fuel. For public organizations, the most common large fuel use applications are refuse, transit, shuttle, police patrol, and street sweepers.

- **Class 3-5 utility trucks** are typically the next highest fuel users due to the vehicles' lower MPG ratings and/or auxiliary loads that require the vehicles to idle for many hours (e.g. to operate utility buckets or other non-mobility related power requirements).
- **School buses** have similar fuel use, consuming 2200-2800 diesel gallon equivalents per year, depending on district geographic size and routing practices.
- Most **light-duty vehicle** applications other than police patrols have relatively low fuel use, which can extend the return on investment (ROI) time frame for incremental purchase price premium or retrofit cost, and limit overall life-cycle savings. With that caveat noted, the best light-duty applications are those where employees travel much of the day, such as social services workers, building code inspectors, transit supervisors, and interdepartmental couriers. These work best because the user travels throughout the day from one appointment to the next.

Private and public fleets' use of light-duty AFVs is often a publicly visible extension of their sustainability initiatives and a demonstration of leadership by example. For some fleet operators, use of light-duty AFVs (including propane autogas vehicles or NGVs) may be economically "supplemented" by the department's other higher fuel using AFVs, such as shuttle buses or trash trucks, which generate substantial savings.

Municipal Applications Best Suited to NGVs and Propane Autogas Vehicles

It is recommended that fleet managers reference EPA's website to stay abreast of the latest additions to the list of approved emissions certificates.

- Light-duty vehicle certification information, including links to alternative fuel conversion/retrofit systems: https://www3.epa.gov/otaq/cert.htm
- Heavy-duty engine certification information: https://www3.epa.gov/otaq/certdata.htm
- Models and fuel options presently available: See *Appendix A*

Table 1 lists common types of vehicles that can be replaced with CNG and propane autogas.

Table 1. Common Vehicle Applications for Gaseous Fuels

Vehicle Type	Configurations	Providers	Fuel Options
Sedan/SUV/crossover	Sub-compact through full size; police pursuit vehicle option	Aftermarket	CNG or propane; Bi-fuel or dedicated
Pickup trucks	½-ton, ¾-ton, 1-ton, with multiple cab-chassis and bed configurations	Aftermarket[17]	CNG or propane; Bi-fuel or dedicated
Light duty vans (Class 1-2)	Multiple cab-chassis and cutaway options; cargo and passenger configurations	Aftermarket	CNG or propane; Bi-fuel or dedicated
Class 3-6 work trucks (e.g. utility trucks, dump-plow trucks, service step-vans)	Cab-chassis, cutaway and strip-chassis configurations for additional upfitting	Aftermarket	CNG or propane; Mostly dedicated
Class 4-6 shuttle buses	Cab-chassis and cutaway configurations; strip-chassis options for trolleys	Aftermarket	CNG or propane; Mostly dedicated
School buses	Type A, C and D	OEM	CNG or propane; Dedicated only
Refuse trucks	Cab-forward (CF), cab-over-engine (COE) and conventional	OEM	CNG only; Dedicated only
Transit buses	30', 35' and 40' transit buses, 60' articulated buses and 45' commuter coaches	OEM	CNG for all types, propane for buses less than 35'; Dedicated only
Street sweepers		OEM	CNG or propane; Dedicated only

[17] With the exception of the Ram 2500 CNG, there are no light duty pickup options currently directly available from OEMs.

Applicability of Aftermarket Retrofits

Many NGV and propane autogas vehicles are offered directly by OEMs, but nearly all light- and mid-duty vehicle options are installed after leaving the factory by aftermarket retrofit system suppliers and their preferred installer networks. Aftermarket retrofit systems may be applied to existing on-road vehicles already in service, but most fleets and most NGV and propane autogas retrofit system suppliers prefer to modify vehicles immediately after or soon after they leave the factory or dealer lot, and usually no more than several months after delivery or while the vehicle still has very low-mileage.

The *Technical Considerations for Deployment of Gaseous Fuel Vehicles* section of this guide provides information on stakeholders potentially involved in vehicle retrofit and delivery, retrofit system specification guidance, warranty obligation impact, vehicle servicing, and technician training considerations.

Economic Analysis as a Tool for Comparing and Prioritizing AFV Options

Since organizations use different economic metrics in their budgets, definitions of fleet savings will vary. Some use life-cycle cost analysis, taking into account all expenses from purchase through retirement of the asset, including purchase price, operation and maintenance (O&M) expenses, and residual value to come up with a net total cost of ownership (TCO) over the life of the vehicle. For others, capital budgets are separate from O&M budgets so their focus tends to be on lowest O&M for the life of the vehicle. Still others may apply a mix of financial criteria and require that simple payback is achieved in no more than "X" years or "Y" mileage.

Generally speaking, the greater the fuel use of a specific vehicle application, the better the economic case. Assuming that the vehicle specified can do the same job with no net increase or decrease in productivity, a TCO economic case for most AFVs (including NGVs and propane autogas vehicles) typically takes into account the following:

- OEM incremental charge or cost of retrofit (including opportunity cost)
- Operation and Maintenance (O&M) expenses
- Residual value (if the vehicle is projected to be sold rather than driven until scrapped)

Vehicle Premiums: OEM Incremental Charge, Aftermarket Retrofit Cost

NGV and propane autogas purchase premiums are expressed either as the incremental charge by the OEM for their factory-built units or the price of the aftermarket system retrofit. Fuel capacity has the greatest impact on CNG incremental charge or upfit price, accounting for 50-75% of the premium. That's why it's imperative to not over-specify fuel capacity beyond needs. Generally, propane autogas vehicle premiums are equal to or slightly less than their NGV counterparts. This is because, as a low-pressure liquid fuel system, propane autogas tanks require less space and cost less than comparable amounts of CNG. However, propane autogas vehicles usually come with larger fuel capacities than otherwise comparable NGVs, thus prices are similar. The latest generation liquid propane injection (LPI) engine systems cost more than traditional vapor propane injection systems. Sample cost premiums:

Representative NGV premiums for select vehicle classes [18]

OEM incremental charges for 2015 models:

- Ram bi-fuel CNG2500 pick-up truck with 18.2GGE CNG/9 gasoline gallon fuel storage: ~$9,100;
- GM 2500 bi-fuel pick-up truck with 17.3GGE CNG/36 gallon gasoline fuel storage: ~$9,600;
- Peterbilt LCF 320 refuse truck with 8.9L engine and ~45DGE fuel storage: ~$28,000-34,000;

Aftermarket retrofit prices for 2015 models:

- Chevrolet dedicated CNG Trax with 8.3GGE CNG fuel package: $8,200;
- Chevrolet bi-fuel Tahoe SUV with 5.3L with XXGGE CNG/YY gasoline fuel storage: $9,000;
- Ford dedicated CNG F250 pick-up truck with 23GGE CNG tank: $9,800;
- ***Ford dedicated CNG E450 cutaway shuttle with 39DGE CNG fuel package: $22,000;***
- ***Ford bi-fuel F550 utility body truck with 40 GGE fuel package: $24,000.***

Representative propane autogas premiums for select vehicle classes

OEM incremental charges for 2015 models:

- GM dedicated G4500 cutaway with 6.0L liquid propane injection (LPI) engine and 33 gallon propane autogas tank: ~$7,500;
- Blue Bird Vision school bus with 6.8L LPI engine and 98 gallon propane autogas tank: ~$10,000
- FCCC dedicated S2G work truck chassis with 8.0L LPI engine and 70 gallon propane autogas tank: ~$10,000.

Aftermarket retrofit prices for 2015 models:

- Ford bi-fuel Explorer PPV with 20-48 gallon propane autogas tank: $7,000-$10,000;
- Chevrolet bi-fuel Silverado 1500 pick-up with 6.0L LPI engine and 30 gallon propane autogas tank: ~$5800;
- Ford bi-fuel Transit with 3.7L LPI engine and 20-48 gallon propane autogas tank: $7,000-$10,000;
- Ford dedicated F450 cab-chassis utility truck with 6.8L LPI engine and 25-38.5 gallon propane autogas tank: $8,000-$12,000.

Operations and Maintenance (O&M) Expenses

O&M expenses include fuel, maintenance, and various peripheral expenses such as insurance and registration. The baseline against which an AFV option is compared to is typically the conventional fuel vehicle it will replace, but may be another AFV option if transition away from conventional fuels is already determined.

The first step in determining fuel cost savings is to calculate the fuel needed by each AFV option to accomplish the same task as the vehicle it replaces, taking into account energy equivalents as previously noted. Next, multiply these projected fuel amounts by their estimated prices over the life of the vehicle, and compare total fuel costs. This calculation requires forecasting future fuel costs per gallon, either through estimations or via quoted contract pricing. Note that three-to-five year contract pricing is available from many natural gas and propane autogas suppliers while petroleum contract pricing is usually much shorter term – rarely more than a year and often far less – placing the fleet at greater risk of potential price increases in out years.

Gaseous fuel vehicle maintenance expense comparisons should take into account the benefits of cleaner combustion (e.g. potential for extended oil change intervals, less fouling of fuel injectors and spark plugs;

[18] OEM websites and interviews with aftermarket natural gas and propane retrofit system suppliers; NGVAmerica; PERC

for heavy-duty vehicles, maintenance-free exhaust after-treatment systems). They should also include pricing for gaseous-fuel-specific parts and supplies, such as fuel filters, engine oils, and spark-plugs. For CNG vehicles, the cost of periodic fuel system inspections should also be included.

In regards to insurance, registration, and other peripheral administrative expenses not associated with the vehicle duty cycle, these should be comparable to those incurred for their gasoline or diesel counterparts. A possible exception is insurance for an AFV, as it may be slightly higher based on its higher replacement value.

Residual Values

Residual value refers to the money a fleet may recover via sale at the end of a vehicle's planned deployment. For example, a fleet may determine that a sedan will be sold after five years of use or at a predetermined mileage benchmark, such as 75,000 miles. The proceeds of sale are usually subtracted from the total of the incremental or retrofit cost plus O&M expenses to determine TCO. There is little empirical data available about residual values of gaseous fuel vehicles. The few studies that have been done, albeit on small samples in limited geographic areas,[19] have shown that gaseous fuel vehicles have residual values either comparable to – or slightly better than – their conventional fuel counterparts. Anecdotal information produces two observations worth mentioning. First, residual values of gaseous fuel vehicles tend to be better in areas where fueling infrastructure is ubiquitous. This is especially true for low-mileage light-duty sedans, SUVs, and pick-up trucks, as these vehicles are popular with both consumers and small businesses. Second, residual values of refuse trucks tend to be higher than their diesel counterparts in areas where there are mandates or incentives for AFV use, driven by demand from smaller independent contract haulers who may not be willing or able to afford a new alternative fuel truck and for which a used vehicle allows them to compete with the major waste haulers who have already committed to AFV use.

When calculating gaseous-fuel vehicle TCO, it is important to take into account the potentially extended life of these clean combustion vehicles. Calculations using a longer life cycle lower the amortized capital cost per mile. If using a simple payback analysis, longer vehicle life translates into additional years of fuel cost savings after the initial purchase price premium is recovered.

Technical Considerations for Deployment of Gaseous Fuel Vehicles

A fleet manager or procurement officer who wishes to purchase NGVs and propane autogas vehicles must understand several basic technical considerations in order to ensure that the fleet uses only legal and safe AFVs that are appropriate to the fleet's needs, have adequate warranty provisions, and can be properly maintained. Furthermore, fleet managers must understand the stakeholders involved in the vehicle supply chain and the roles and obligations of each. The following sections will describe the essential knowledge for the successful deployment of NGVs and propane autogas vehicles in a fleet.

[19] Results of a privately-funded independent study of resale values of American Honda Civic Natural Gas Sedans in California (presented by Westport Innovations at a NAFA I&E Conference/Expo, 2010) showed comparable resale values to gasoline Civics of similar age and trim package. The sample size was described as "small" and included only sales in California. According to the former fleet manager, annual auctions of CNG vans conducted by the Newspaper Agency Corporation (JOA of the *Salt Lake Tribune* and *Deseret News*) garnered premiums above Kelly Blue Book value; the area has a well-developed CNG station network and some of the lowest CNG prices in the country. Similar claims have been made by utility fleet managers in Long Island and Southern California. South Coast Air Quality Management District requirements of municipal refuse contractors produces a steady supply of used CNG refuse trucks in the secondary market, most which sell for prices comparable to or at a premium to diesel trucks of similar capacities in other markets.

Legality: Federal Emissions Requirements; EPA Certificates of Compliance/CARB Executive Orders

Just like gasoline and diesel vehicles, NGVs and propane autogas vehicles have to meet the same stringent federal emissions standards. OEMs test and submit vehicle/chassis or engine emissions data to EPA every year for each model, occasionally extending for a second year if no changes have been made to the engine code or emissions profile from the previous model year. Because retrofit systems modify an OEM vehicle, their manufacturers also have to submit test data to EPA to obtain certificates of compliance (CoC), which document their modified vehicles as meeting or exceeding the OEM's original emissions certification level. And, like the OEMs, aftermarket retrofit system manufacturers have to recertify their systems as the OEM model years change. EPA certification is recognized as a 49 state certification and does not ensure the vehicle can legally be sold in the state of California.

In addition, the California Air Resources Board (CARB) has the right to issue its own emissions requirements. CARB also requires submittal of extensive test data and issues its own certifications, known as Executive Orders (EOs). Other states may elect to follow/require CARB certification on new vehicles as well as CARB aftermarket retrofit system requirements on existing vehicles; these two CARB statutes are distinct. The CARB certification processes for new vehicles and aftermarket retrofit systems do not require that vehicles are "cleaner" than EPA requirements, but are generally regarded as more difficult to obtain (more technically rigorous and more expensive). A number of aftermarket system manufacturers choose not to obtain CARB EOs and thus cannot sell their systems in California. All states, except California, Maryland, and Massachusetts, accept EPA CoCs for aftermarket retrofits, even if the state is considered a "CARB state" for new vehicles. Although neither Maryland nor Massachusetts have adopted CARB regulations governing aftermarket retrofit systems, both states insist on CARB EOs for retrofit vehicles.

EPA CoCs and CARB EOs for past and current model years are publicly available documents. Use of non-compliant aftermarket systems could result in fines and/or the loss of the OEM warranty. When not ordering directly from an OEM, require a copy of the retrofit system manufacturer's EPA CoC or CARB EO for each model of vehicle being retrofitted. Reputable aftermarket systems manufacturers and their installers gladly supply these to customers as proof of compliance with federal law.

Safety: Regulations/Standards Governing Safe Engineering, Design, and Assembly of Gaseous Fuel Vehicles

While EPA and CARB focus primarily on vehicle emissions, the National Fire Protection Association (NFPA), working with NGV and propane autogas industry stakeholders, developed standards (NFPA 52 *Vehicular Natural Gas Fuel Systems Code* and NFPA 58 *Liquefied Petroleum Gas Code*) that include chapters governing the safe assembly and construction of aftermarket retrofit system vehicles. These standards provide guidance concerning all aspects of modification, such as individual component listings, fuel system mounting and protection, electrical systems, and other safety issues. While not federal law, NFPA Standards 52 and 58 are in place to promote safe vehicle modification practices. These model standards are often adopted by state code bodies and cascade down through local jurisdictions. It is imperative that fleet purchasers specify adherence to this safety guideline and verify that the vehicles they receive from suppliers comply with it.

***Figure 9**. Bid solicitations should require suppliers' compliance with NFPA standards guiding component selection, engineering, and assembly.*

Warranty Implications When Modifying an OEM Vehicle

Retrofitting an existing vehicle with an EPA- or CARB-certified system, if properly installed, does not void the OEM's vehicle warranty. When modifying a vehicle's fuel system or powertrain, the same federal regulations that apply to the OEM for engine and emissions issues now fall to the manufacturer of the aftermarket system. All non-gaseous-fuel-related warranty items (e.g. malfunctioning electric locks, leaking water pump, or other non-engine mechanical issues) remain the responsibility of the OEM. Issuance of the EPA or CARB certificate protects the retrofit system manufacturer and their authorized installer from federal anti-tampering regulations, while bestowing emissions compliance responsibilities and obligations originally assigned to the OEM.

Aftermarket systems manufacturers' warranties on non-emissions-related components will vary and should be clearly outlined in the procurement specification and scope of work. Only those emissions-related items falling under federal emissions regulations are required by law to be warranted for periods set by the federal government. If a supplier's base warranty provisions or time frames do not match the OEM's warranty for that same vehicle, then the cost to provide enhanced or extended warranty should be itemized in the bid solicitation and response.

Service covered and performed under warranty may or may not include provisions for transporting the vehicle between the customer and the service provider's location. Furthermore, diagnostic time and additional labor necessary to access components may not be covered. These and other service related provisions should also be spelled out clearly in procurement documents.

Maintenance and Training Considerations for Gaseous Fuel Vehicles

Servicing vehicles that run on gaseous fuels is very similar to servicing vehicles that run on gasoline or diesel with the most obvious differences relating to fuel storage and pressures and, for heavy-duty vehicles, exhaust after-treatment systems.

Figure 10: *CNG/LNG and propane autogas technician training is available from OEMs, aftermarket retrofit system manufacturers, and several independent AFV education organizations.*

For most heavy-duty vehicles obtained through the typical truck/bus dealer channel, service on gaseous fuel systems (engine and/or fuel system) is provided by the authorized OEM dealer. In the case of heavy-duty natural gas engines, service is provided by the regional Cummins Sales/Service Center, as all of these OEM truck engines are built by Cummins Westport Inc. on Cummins engine platforms.

For light- and medium-duty gaseous-fuel vehicles, regular and preventative maintenance service is generally handled through one of three ways:

- The authorized aftermarket retrofit system installer
- The local authorized OEM dealer who is trained by the aftermarket retrofit system manufacturer
- The fleet's own internal technical staff, which is trained by the aftermarket system manufacturer on preventative maintenance requirements and intervals, basic troubleshooting, repairs, and required diagnostic tools.

Regardless of which entity does the service, it is recommended that at least two technicians at that preferred service location be trained in gaseous fuel engine and vehicle technology. While there are no federal CNG or propane autogas technician certification requirements, several states are in the process of

establishing minimum training and state licensing requirements. Training is available from the OEMs, from aftermarket retrofit system manufacturers (often conferring upon graduates their own designation as "authorized" or "certified"), and from several independent AFV education organizations. The National Institute of Automotive Service Excellence (ASE) offers testing and certification in these technologies just as they do other automotive technologies.

Furthermore, when deploying CNG vehicles, fleets are also encouraged to make sure that at least one technician is trained and preferably CSA-certified[20] to inspect CNG fuel cylinders. The current standard calls for an inspection once every 36,000 miles or 36 months (whichever is less) and/or after any fire or accident (even if the incident did not appear to have any impact on the cylinder).

Potential Maintenance Facility Modifications to Accommodate Gaseous Fuels

Working on CNG, LNG, or propane autogas vehicles is neither more nor less dangerous than working on gasoline or diesel vehicles; but, due to differences in the fuels' properties and operating pressures, maintenance facilities where major repair work is to be performed may need to be modified.

Propane autogas is a liquid when stored under fairly low pressures; when exposed to atmospheric pressure, it vaporizes. Because the fuel is denser than air, it sinks to ground level. For this reason, propane autogas behaves much like gasoline or diesel and few facility modifications, if any, are needed. If the facility is code compliant for gasoline and diesel, there are no segregation requirements for minor and major repairs. It is recommended that a service and repair site consider purchasing a fuel tank evacuation and storage system for removing fuel from the tank during repairs. It is recommended that all technicians and drivers receive training in the safe handling of fuels and precautions in the working environment.

Natural gas is lighter than air so it dissipates and rises when released rather than gathering at ground level. Even LNG, a liquid when in its cryogenic storage vessel, vaporizes immediately upon release, acting much like CNG, dissipating and rising. If planning to do major repair work on CNG/LNG vehicles, maintenance facilities should be evaluated for potential modifications to accommodate this work. Per International Code Council (ICC) Fire Code and NFPA 30A *Code for Motor Fuel Dispensing Facilities and Repair Garages*, minor maintenance procedures may be performed without any changes to the facility, assuming the facility meets the basic code for automotive repair facilities.

Figure 11: Modifying Maintenance Facilities
Fleets should consult their Clean Cities Coalitions for assistance in identifying qualified consultants to work with local fire and building code officials concerning potential modifications necessary to accommodate major repairs on CNG/LNG vehicles. Minor modifications or additional defueling equipment may be needed if work on propane autogas vehicles is planned.

Facilities in which major repairs are to be performed usually require changes to ventilation systems and capacities and, potentially, installation of methane detection systems. Some fleets elect to isolate then modify only a portion of their garage, designating that all major NGV

[20] CSA, an independent certification agency, collaborated with other CNG industry stakeholders to establish cylinder inspection protocols and offer a test to certify technician proficiency in cylinder safety inspections. CSA certification is maintained through ongoing registrations of completed cylinder inspections. More information about cylinder safety and inspection training and certification is available at http://ngvamerica.org/pdfs/TechBull.pdf.

repairs be handled in these modified areas. Consult *Appendix D* for more information about the types of NGV work that fall under major repair, minor maintenance, and potential facility modification requirements.

To avoid maintenance facilities modifications altogether, some fleets choose to handle only minor maintenance and repairs in-house and delegate their major CNG/LNG repair service work to OEM dealers, engine service networks (e.g. Cummins Distributors), or authorized aftermarket system installers when an aftermarket system is used. Others choose to enter into a full-service leasing arrangement, thus shifting maintenance, repairs, and potential facilities modifications to the lessor. This is common in the private heavy-duty truck sector where Penske, Ryder, and several other major leasing organizations have embraced gaseous fuels, rolling out vehicles in targeted geographic areas accompanied by the necessary technical support network.

Fuel Configurations

Fleet managers must specify vehicles that fit within budget and meet the operational needs of the fleet. Two areas that significantly impact both cost and fleet operations are 1) whether or not bi-fuel capabilities are required and 2) what total amount of fuel capacity is needed.

Bi-Fuel Versus Dedicated

While specifying only dedicated vehicles can maximize reductions in emissions and petroleum use, opting for bi-fuel capability provides fuel diversity and mitigates risk. For example, bi-fuel capability lowers susceptibility to station outages or fuel delivery interruptions during storms. If vehicles might be lent to other areas in times of need, like for a disaster or storm response, the required AFV fuel infrastructure might not be in place – so having the ability to run on conventional fuels will provide flexibility. If specific vehicles are expected to regularly travel out of the region or far into rural or mountainous regions where the necessary alternative fuel infrastructure is not yet in place, bi-fuel capability provides unlimited range. If electing to specify bi-fuel vehicles, consider putting fueling policies into place that require or encourage alternative fuel use whenever possible.


Figure 12: Fuel Capacity Options
While sedans and SUVs often offer one standard fuel package, fleets will find that bi-fuel options provide greater flexibility in fuel capacity and tank placement.

Fuel Capacity

Consideration of fuel capacity applies more to CNG because propane autogas fuel storage capacity is typically equivalent or near equivalent to gasoline and diesel. Regarding CNG vehicles, don't over-specify; rather than arbitrarily matching the gasoline or diesel quantity of the OEM, calculate the amount of fuel needed including an appropriate "buffer" for unexpected variations in range or duty-cycle. Onboard CNG fuel storage accounts for a significant percentage of a CNG vehicle's incremental or upfit cost. Over-specifying adds additional cost and weight and takes up platform real estate. Most light-duty sedans/SUVs/crossovers are engineered with one fuel capacity option; pick-ups typically have a standard fuel package of 20-22GGE and often have options for more or less fuel. Medium- and heavy-duty vehicles

usually entail a body upfit (e.g. utility body, flatbed, box, step van, dump or refuse package); innovations in fuel capacity configurations provide a myriad of options including frame-rail mount, back-of-cab mount, and integration into the body and/or work space.

Vehicle Supply Chain: Stakeholders Involved

Depending on the size and type of vehicle being procured, a number of different stakeholder suppliers may be involved. These include:

- Vehicle/platform OEMs;
- Alternative fuel systems manufacturers, i.e., the holders of EPA CoCs or CARB EOs;
- Qualified installers of the retrofit system manufacturers including AFV specialty shops;
- Additional upfitters including body manufacturers and their installer representatives and/or CNG/LNG fuel system integrators for large HD truck applications.

Light-duty Vehicles

For most light-duty vehicles in which, typically, there is one standard fuel package specified and engineered for that model, the qualified installer representative of the retrofit system will handle the complete CNG or propane autogas installation including tank(s)/cylinder(s) and related supplies and software updates. In effect, once the gasoline vehicle is ordered through the local dealership, it is drop-shipped or delivered to the retrofitter/installer, modified, then delivered to the customer.

Medium-duty Vehicles

Assembly of medium-duty vehicles often involves multiple suppliers, each coordinating with the other to follow the OEM's guidelines regarding construction, assembly, weight distribution of the various additional components, etc. In many cases, one entity may handle multiple aspects of the vehicle build. For example, when specifying a CNG or propane autogas F450 with utility body, it's possible that the commercial Ford dealer from whom an agency orders the OEM cab-chassis is also a qualified installer of the CNG or propane autogas retrofit system as well as the utility body; in effect, the dealer is a one-stop shop. If not, the vehicle would likely be ordered through the dealer, then drop-shipped to an installer who handles CNG- or propane autogas-related modifications. If additional equipment packages are needed (e.g. utility body, flatbed, box), the vehicle may move to another shop for completion and delivery back to the dealer or customer.[21]

Heavy-duty Vehicles

Most heavy-duty vehicles, freight and vocational trucks, transit buses, and school buses with natural gas or propane autogas engines are ordered directly through the OEM or its dealer, and that engine is installed at the factory. Fuel packages may be installed by the OEM at the factory or, as is often the case with the largest heavy-duty vehicles, at a nearby upfitter that may or may not be affiliated with the OEM. The OEM or its dealer can provide more information about fuel package sizing and installation options.

For example, a bid for a CNG F350 utility truck may be submitted by "ABC Ford Dealer," which has sub-contracted with a local Knapheide utility body installer "XYZ Truck Upfitting" and with CNG system supplier Landi Renzo. It is likely that the Ford dealer would order and dropship the F350 chassis to Landi Renzo's corporate facility (or their nearest delegated Landi Renzo-trained installer, if there is one). Here, the CNG system is installed on the engine and the CNG fuel package components are pre-assembled for inclusion in the utility body. The vehicle and pre-assembled CNG fuel package would then be

[21] Presently, exceptions to this include the Freightliner Custom Chassis step-van (MT) series (available as factory-built units in both CNG and Propane autogas), the Isuzu Commercial Vehicles NPR work truck series (available factory-order CNG and Propane autogas) and the Thomas Bus Type A Minotaur school bus (available as factory-built unit with Propane autogas).

transported to the Knapheide body upfitter for final second stage assembly in close coordination with the CNG system supplier to assure compliance with NFPA 52. The completed vehicle would then be sent back to the Ford dealer for final inspection and prep for delivery to the agency. Another scenario on this bid might be that "ABC Ford Dealer" is an authorized representative and installer of both Knapheide utility bodies and Landi Renzo CNG systems and thus is able to handle the entire assembly/installation process.

Fueling Infrastructure Options

Fleets looking to deploy NGVs and/or propane autogas vehicles have three basic options for fueling:

- **Use Existing Fueling Infrastructure:** If an existing CNG or propane autogas station is: a) sufficient in size, capacity, and flow rate to handle the proposed additional load; and b) close enough that time spent traveling to/from fuel location does not negate savings and/or productivity, then use it – at least until the agency can justify its own investment in fueling equipment or serve as an anchor fleet for development of closer, more convenient fueling infrastructure. An agency may be able to negotiate access to existing CNG or propane autogas fueling infrastructure at a nearby government fleet, private fleet, or public retail location.

- **Consider Mobile Fuel Delivery:** Mobile fueling works well for those agencies whose own fuel use is insufficient to justify a station investment and whose closest CNG or propane autogas station may be too far away to be a productive use of employee time. Their fees per gallon typically incorporate the fuel cost plus a charge for their services based on distance from the customer fleet. CNG mobile fueling vendors may fuel their trailer at their own base location or an existing anchor CNG client for whom they provide turnkey service. Propane autogas mobile fueling is usually an extension of the fuel supplier's service options.

- **Build Fueling Infrastructure at or Near a Fleet Yard:** If choosing this option, seek guidance from infrastructure providers and local Clean Cities Coalitions, as fuel prices vary depending on volume and how the infrastructure is developed and operated. This guidance will help you better understand the basic components of a CNG or propane autogas station and key considerations in selecting the type and design of your station. See *Appendix B* for further details.

NGV Fueling Infrastructure

This section will first describe the considerations that a fleet manager should understand related to NGV refueling infrastructure, and then address considerations for propane refueling.

***Figure 13**: U.S. CNG and LNG Station Growth 2011-2015 (Credit: NGVAmerica).*

CNG and LNG fueling locations have increased over 100% in the last six years and now total more than 1870 locations – more than 55% of all stations (and 70% of new stations) provide public access (Figure 13).[22] The nationwide network of stations is now sufficient to travel interstate between every major metro market, and additional infrastructure now in development will serve exurban and rural areas more fully. Current on-road LNG use is limited primarily to over-the-road Class 8 tractors, western and southwestern transit fleets, and some refuse and street sweeper applications. While additional public agencies could elect to deploy LNG vehicles using the network of highway LNG stations established to serve the over-the-road trucking market, the overwhelming majority of vehicular natural gas fuel use is CNG.

Figure 34: Public access CNG and LNG stations now enable travel between major metro markets across the U.S. (Credit: Greenville Utilities and Clean Energy)

Major metro area CNG station networks are emerging, which is building greater confidence among local and regional fleets, but until CNG stations are as ubiquitous as gasoline or diesel stations, fleet managers must still evaluate geographic drive patterns, locations of existing CNG fueling infrastructure, and the cost-convenience value proposition. For public entities, whose travel patterns are typically limited to nearby geographic region and frequent return-to-base trips, current range between fueling of most NGVs is more than sufficient. Fleet managers may further hedge their options by specifying bi-fuel vehicles.

On an equivalent volume basis, the capital costs associated with CNG compression, storage, and dispensing equipment are greater than costs for traditional liquid fuels and propane autogas. Generally stated, greater CNG fuel production capacity and use drives better economies of scale.

Time-fill Versus Fast-fill Options


Figure 45: Time-fill Versus Fast-fill
Refuse fleets are well-suited to time-fill fueling (left) because they typically sit idle overnight. CNG fast-fill dispensers for public access (right) are required to be National Conference of Weights & Measures-certified.

Many vehicles sit idle for extended periods each evening, which makes the time-fill option viable if public access is not a priority and vehicle operators can adapt to time-fill fueling behavior. Time-fill equipment packages start as small as four GGE per hour and can be as large as a 100 GGE per hour or more for larger fleets. If public access is not planned, weights and measures certified dispensing equipment is not required, and adding limited fast-fill capability is inexpensive. Time-fill station capacity may grow as fuel demand grows. While technically

[22] NGVAmerica analysis based on U.S. DOE data collected by ICF International and published by Alternative Fuels Data Center.

feasible to keep adding compression and dispenser modules, there are limits to the economic viability of this add-on modular approach; eventually, it becomes operationally more cost-effective to replace multiple smaller modules with larger capacity and more efficient equipment.

To provide the greatest fuel flow capacity at the least cost per GGE while also promoting adoption by other local area fleets by offering public access, it is essential to have enough load to justify investment in the public access fast-fill production, storage, and weights and measures certified dispensing equipment. Generally speaking, fast-fill public-access station economics require a critical threshold of 125,000 GGE per year, and preferably more. This roughly equates to six over-the-road Class 8 trucks, 10 transit buses, 13 refuse trucks, 15 shuttle buses, 45 school buses, 75-100 light- and medium-duty vehicles, or a combination thereof. Agencies can achieve this critical threshold volume two ways: a) deploy enough vehicles of sufficient fuel use to collectively reach that target volume or b) open access to the station by nearby fleets (public or private) to increase load.

How Fueling Load Demand Profiles Impact Fast-Fill CNG Station Design

Fast-fill CNG stations do not store large quantities of fuel; they use a combination of compression capacity and storage to meet demand. It is critical for station planners to know projected demand profiles, including daily and hourly demands. It is also important to establish what constitutes "sufficient," "preferable," and "optimal" fueling capability, taking into account the types of vehicles (e.g. light, medium, heavy) and number of dispensers that might be fueling simultaneously.

Demand profile predictability is also important. Stations without public access that control their own fueling patterns through scheduling have greater predictability, whereas stations built for public access will have to incorporate greater flexibility to enable transient loads. A balance of compression and storage that meets the *most likely consistent demand profile* is usually recommended. A well-planned station should be designed to meet 80-85% of potential demand scenarios; planning for 100% tends to result in a station that's oversized and operationally inefficient.

CNG Station Development, Ownership, and O&M Options

Once the decision to build onsite is made, fuel station procurement generally falls into one of the following three models (see *Appendix B* for more in-depth discussion):

- Agency develops, owns, operates, and maintains its CNG station.
- Agency develops and owns station, but contracts out station O&M.
- Agency delegates development/ownership/O&M to turnkey station provider.

The "right choice" for an agency will depend on its available capital, technician/staff capabilities and resources, and the management's risk tolerance. An agency's projected fuel needs and ability to commit to volume purchasing agreements also impacts which option is the most viable. For any model, the station design and construction should be delegated to professionals with the appropriate engineering and construction expertise and capabilities.

Propane Autogas Fueling Infrastructure

According to the Alternative Fuel Data Center (AFDC) and Propane Education & Research Council (PERC), there are approximately 2,500 propane autogas fueling stations in the U.S., with locations in every state. Of these, approximately 500 are public access facilities located at traditional gas stations, U-Haul locations,

propane company depots, and public and private fleet depots. Most major cities have networks of propane autogas fueling stations available, with additional scattered throughout the country.[23]

***Figure 16**: Propane autogas stations may be either private "behind-the-fence" facilities or public access like this station located adjacent to a school bus fleet, which serves as the anchor load.*

Using the AFDC station locator tool, fleet managers can determine whether existing stations can meet their needs. This fueling infrastructure may be a retail location or another fleet's depot where access and payment arrangements have been negotiated. The usual assessment criteria will apply, such as proximity to a fleet's depot, regular travel routes, time-costs associated with travel to/from that location, and whether the existing location has the capability to accommodate the increased load and traffic. An existing nearby business that already sells propane in small volumes for grills or mowers may even be engaged to upgrade their site with a metering dispenser and card readers for payment.

If an existing propane autogas station of sufficient capacity is not near enough to be convenient, contracting with a mobile fueling vendor may be an option worth pursuing. Mobile fueling may be direct from a bobtail truck or mounted on a portable trailer like the units shown in Figure 17. Two key facets of mobile fueling viability are the predictability of the fleet's load profile and whether there's sufficient volume to cover the vendor's transportation costs.

If neither of these two options are suitable, then propane autogas fueling capacity can be installed relatively inexpensively.

Propane autogas infrastructure is very similar to conventional liquid fueling infrastructure in that fuel is delivered to the fueling station by truck, stored either in an aboveground or underground storage container, and the process repeats as fuel is needed. Three key considerations include: 1) volume of fuel needed, 2) time frame for that fuel use, and 3) available space for equipment.

Figure 17: Contracting for mobile fueling services may be a good option for fleets that don't yet have sufficient fuel use to warrant investment in a station, and the nearest existing propane autogas fueling is too far away to be convenient.

[23] As of summer 2016, infrastructure is available within four of the five metropolitan regions that are participating in the F4F project. The one exception is Boston's Metropolitan Area Planning Council region. The closest propane autogas fueling station to downtown Boston is approximately 30 miles away, in Lawrence, MA.

***Figure 58**: Propane autogas fuel stations are scalable from small, skid-mounted packages that include 1000-gallon tank, associated pumps, and dispenser with integrated fuel management system (left), to large built-to-order locations with 18,000-50,000 gallon tanks, multiple dispensers and separate fuel management/payment processing unit (right). Propane autogas fueling stations are governed by NFPA 30A standards governing all fuel stations.*

An analysis of fuel infrastructure needs should include individual vehicle fuel volumes, total fleet fuel use per day, and fueling patterns to identify peak demand periods and dispenser needs. If space is available, sizing storage capacity to accommodate full truckload deliveries from the fuel supplier minimizes fuel transportation costs per gallon. Truckload capacities are 9,000-12,000 gallons for large tanker trucks and 2,800-3,500 gallons for bobtail trucks. While lower volume deliveries are available, each delivery incurs charges to cover driver labor and truck utilization, which increases the fleet's transportation cost per gallon of fuel delivered. Common propane autogas fuel storage tank sizes are 1,000 gallons, 1,400 gallons, and 2,000 gallons, and may be combined to achieve larger storage volumes. For large fleets that use far more fuel, propane tank sizes from 18,000-50,000 gallons are available, although these and other even larger tanks are less common in autogas applications.

If many vehicles are expected to fuel at the same time of day, as may be the case with school buses or shuttles with limited windows of opportunity for fueling, additional dispensers are recommended to reduce staff time waiting. Multiple dispensers also provide redundancy in case of a dispenser or pump malfunction. Furthermore, it's recommended that pump and dispenser gallon-per-minute (GPM) specifications take into account expected fueling time per vehicle to meet expectations.

Propane autogas stations may cost as little as $25,000-$30,000 for a 1000-gallon tank package with a single fuel dispenser, without an integrated fuel management/payment system, and no canopy. For a large canopied station with 30,000+ gallon fuel storage system and multiple dispensers with integrated fuel management/payment system can cost as much as $400,000. Propane autogas suppliers will work with fleets to determine needs, preferences, options, and costs.

Infrastructure costs may be borne by the fleet or fuel provider. Given sufficient volume, a fleet may find it most cost-effective to pay for the site prep and associated storage and dispensing equipment, contracting with a fuel provider for fuel supply only. Another option is to absorb the cost of site preparation but lease equipment from the fuel supplier; a number of pre-assembled skid-mounted station packages comprising tanks and dispenser(s) and/or fuel payment systems are available. Another option, if volume contract commitments are sufficient to justify the arrangement, is to have the fuel supplier embed the cost of infrastructure into the cost of fuel on a per-gallon basis.

Regardless of station size, whenever planning new infrastructure, it is recommended that one engage the fire marshal and other Authorities Having Jurisdiction (AHJ) from the earliest stages of the project to guarantee compliance with NFPA guidance and local requirements.

Procurement of Gaseous Fuel Vehicles

This section focuses on information AFV aggregated vehicle purchasing co-operatives will need to know to garner greater participation and achieve success, including stakeholder engagement in the selection of vehicles to aggregate, opportunities to facilitate collaboration in the supply chain and between regional fleets, and technical considerations.

The primary goals of purchase co-operatives generally include 1) reduced pricing through economy of scale, 2) faster order-to-delivery time frames, 3) improved service/support capabilities, and 4) expanded fueling infrastructure (indirectly). Organizers should focus on a limited number of vehicles/platforms with pre-determined specifications that are most likely to attract the greatest buy-in, and facilitate collaboration of potential stakeholders, including vendors and purchasers.

For gaseous fuels, organizers will need to consider how increased vehicle inventories in a defined area might be leveraged to improve fueling infrastructure, even if the initiative has no direct responsibility for procuring the infrastructure. This includes collaboration with local Clean Cities Coalitions to engage diverse fleet sectors (i.e. government, commercial, industrial) to gauge the potential for NGV and propane autogas vehicle purchases and create fueling infrastructure synergy.

Assessing Best Vehicle/Platforms for Successful Buy-in to Aggregated Purchase Plan

The first step in organizing an aggregated vehicle purchasing initiative is to identify which vehicles are most common across the cooperative partnerships and which specifications have the broadest appeal. Identifying specifications with broadest appeal is especially important when evaluating medium- and heavy-duty platforms as the number of potential specification options multiplies near exponentially and too many options may lead to complexity and loss of economies of scale.

A survey of the primary intended purchasing co-operative participants is one helpful way to gauge interest and assess potential order quantities. A sample survey has been included in *Appendix C*. While the size and scope of the survey may vary depending on resources, it should include queries addressing the following:

- Types of vehicles needed and their primary purpose/duty-cycle/application.
- Preferred powertrain requirements (e.g. 2WD, 4WD, axle load configurations, towing capacity).
- Cab requirements (standard, extended, crew).
- Required/Preferred fuel capacity.
- Potential quantities of each in the current and future fiscal years.
- Perceptions of how convenient existing fueling infrastructure is (e.g. propane autogas, CNG) and what parameters they might apply in making this determination (e.g. “must be on site” or “within 3 miles of depot” and/or “no more than 5 minutes of drive-time”).

It may also be helpful to solicit information about recent past years’ purchases to see if there are patterns that indicate future buying cycles. Once the collective needs of fleets are roughly complied via survey, it is best to cull the list down to a limited number of vehicle platforms. A small sampling of one-on-one interviews with fleet managers may be helpful in identifying which specification concerns are most important and why, so that a more-detailed list with base specifications (and perhaps a limited number of options for each) may be developed.

Promoting "Bundled Services" Responses to Bid Solicitations

As discussed above, light-duty NGVs and propane autogas vehicles are often not available directly from OEMs through their normal dealer channels. In these cases, it is recommended that cooperatives require "bundled" all-inclusive bids for these aftermarket vehicles. In a bundled bid process, one respondent takes the lead, arranging for all of the vehicle build steps, taking responsibility for setting up appropriate service and training, and submitting one proposal in response to the request for proposals (RFPs).

While more desirable, the availability of one-stop shop local dealerships is less likely as promulgation of these relationships is still evolving. Fortunately, there's an emerging short-list of one-stop-shop second stage vehicle upfitters with natural gas and/or propane autogas system experience. These suppliers prefer that agencies procure then drop ship the base vehicle and allow bundling of the rest of the package, rather than shouldering the upfront financial burden of the base vehicle. If required to procure the vehicle, they may work with a dealer located in the market originating the bid solicitation or their own preferred OEM dealer with whom they may have existing relationships and potentially greater volume discount leverage. If the latter, they will still need to engage a local dealer to provide final prep and delivery and, if necessary, get additional training to service the vehicle.

Facilitating Supply Channel Collaboration through Communications

Organizing and managing an aggregated order opportunity requires an understanding of the vehicle specification, assembly and delivery process, after-sale warranty, and service responsibilities described above. While not directly responsible for facilitating relationships between the potential bid partners, it is important that those organizing the bid solicitation (e.g. the regional planning commission) identify qualified suppliers and communicate with them.

Publicizing a bid solicitation through traditional channels (e.g. notices to OEM dealers, website postings, newspaper announcements) will likely result in a less than successful effort. At the very least, bid solicitation publication and outreach should be extended to the key alternative fuel vehicle trade press (e.g. *Fleets & Fuels, NGT News, US Gas Vehicles)* as well as the NGV and propane autogas trade associations for inclusion in their e-newsletters and website postings. NGV and propane autogas retrofit system suppliers are far more likely to be proactive, reaching out to local auto/truck dealers and facilitating the collaborative relationships needed in order to respond to the bid solicitation with technically-sound, well-developed plans.

Qualified NGV and propane autogas supply channel vendors and their networks of installers are available through Clean Cities Coalitions and the national trade organizations representing these two gaseous fuels.

Private Sector Fleets: Opportunities for Collaboration

While private fleets are not the primary target of this guide, collaboration with private sector fleets may help with a fleet deployment strategy. Discussions with other proximal fleets can justify expanding refueling infrastructure, since additional fuel use usually improves station economics. Over-the-road trucking fleets– especially dedicated contract carriage or node-based less-than-load – are the largest fuel users and generate the most favorable economics. Trash/recycling services and aggregates (e.g. concrete, stone, etc.) also generate very favorable economics and provide significant emissions reductions.

Other relatively high-volume fuel users with reasonable payback periods include local goods distribution such as supermarket/grocery; restaurant and institutional foodservice supply; appliances and furnishings; textiles/linens; taxicabs; auto parts, medical labs, package expeditors, and other couriers; and direct-store-delivery applications (e.g. snack foods, baked goods, ice cream, beverages). NGVs are available for all of these applications and propane autogas options are available for most of these applications other than the largest truck platforms.

While private fleets may not be able to directly participate in government purchasing co-operatives due to legal and/or regulatory restrictions, they should still be engaged due to the potential to promote greater infrastructure development.

Figure 19:6 Examples of Commercial Fleet Applications Well-suited for NGVs and Propane Autogas Vehicles
These are just a few of many locally and regionally based commercial private fleets that are good prospects for regional councils and their local Clean Cities to engage concerning participation in cooperative vehicle purchasing initiatives and fuel load aggregation efforts.

Additions to Procurement Language for Gaseous Fuel Vehicles

The section, *Technical Considerations for Deployment of Gaseous Fuel Vehicles*, outlined a number of considerations that fleet managers should understand in order to successfully integrate gaseous fuel vehicles into their fleets. These considerations are also important to the development of an aggregated purchasing co-operative, since the organizer of such a co-operative will need to:

- Assure that all vehicles meet applicable emissions standards.
- Assure that all vehicles meet regulations and standards governing safe design and assembly.
- Consider the relative benefits and drawbacks of bi-fuel versus dedicated capability within the context of local needs and fueling infrastructure resources.
- Evaluate the optimal specifications that will balance potential buyers' needs against the benefits of a common specification for increased purchasing volume.
- Identify the potential stakeholders involved in the vehicle supply channel and clearly defined roles and obligations of each, including warranty and service considerations.

The following table summarizes the key takeaways for procurement of gaseous fuel vehicles, and the implications for procurement documents.

Table 2. Adapting Procurement Documents for Gaseous Fuel Vehicles

Area	Recommendation
Legality of Vehicle Upfits	In aggregated order solicitations, it's imperative that there is a requirement that all vehicles comply with federal emissions regulations either through EPA Certificates of Compliance or CARB Executive Orders. While this may seem obvious, it is worth emphasizing here because of the relatively arcane regulatory process governing emissions, especially for vehicles modified with aftermarket retrofit systems.
Safety	Organizers of cooperative purchases must specify adherence to NFPA safety guidelines (NFPA 52 and 58) and verify that the vehicles received from suppliers comply with them.
Warranty	Because of the complexity of some gaseous fuel vehicle builds and the multiple parties involved in their delivery to the customer, warranty coverage, service procedures, and protocols should be clearly spelled out in bidding and award documents.
Maintenance Staff Training	Bid submittals and procurement documents should include specific provisions for customer in-house maintenance staff training, highlighting where and when training is to be provided and whether there is any additional cost. This documentation should also address the type and cost of any special tools, diagnostics instruments, and software.

In addition to the above provisions that should be included in bid documents, procuring entities should discuss the potential implications of their bid solicitations for the additional topics discussed in the technical section above, including possible modifications to maintenance facilities, possible additional refueling infrastructure needs, changes to staff, and driver training and operational policies.

Summary

Fleets continue to deploy NGVs and propane autogas vehicles in greater numbers every year due to these gaseous-fuel vehicles' advantageous attributes. As low-carbon, clean burning fuels, they reduce emissions. Ample domestic supplies of natural gas, propane autogas, and well-developed delivery infrastructures instill confidence in long-term low and stable pricing and energy security. A growing selection of vehicles and engine platforms are available from major OEMs and an expanding network of experienced, vetted aftermarket suppliers. The vehicle sales and service supply channel is maturing with OEMs, aftermarket system manufacturers, second-stage upfitters, and others coordinating more closely to reduce cost and delivery times while enhancing service capability and convenience. NGVs and propane autogas vehicles have logged hundreds of millions of miles of reliable performance in fleets of all sizes and duty-cycles, many of whom have worked collaboratively with OEMs and other gaseous-fuel technology stakeholders to apply their real-world experience to advance the next generation of vehicles. Increases in the number of natural gas (CNG and LNG) and propane autogas locations continue to make these AFV options more convenient and viable for fleets, while also building greater confidence in the consumer market. Many states are implementing policies and programs favorable to AFV use, further accelerating market adoption and facilitating economies of scale.

Working collaboratively to organize a vehicle purchasing co-operative can be an effective way to achieve critical mass for gaseous-fuel vehicle deployment, garnering lower pricing, faster delivery times, and expanded fueling and service infrastructure. Assessing the needs and concerns of all potential participants through surveys and interviews is essential to identifying applications and vehicles that have the greatest potential for aggregated purchase. This includes understanding vehicle duty-cycles and fuel capacity needs and how existing or potential new fueling infrastructure might impact those needs. Those who organize aggregated vehicle purchase co-operatives may find it useful to contact others who have gone through the process to glean lessons learned and best practices. To assure a successful initiative, lead organizations' bid solicitations should specify that vehicles meet federal emissions requirements and are designed and assembled in accordance with nationally recognized safety standards. If soliciting vehicle bids that involve multiple participants, it may be useful to request bundled bids and to clearly indicate warranty and service roles as well as responsibilities of each company involved in supplying vehicles. Because bundled bids require collaboration between supplier partners, it is helpful to communicate with all potential participants early in the process. Publicizing bid solicitations beyond the usual local channels to include national alternative fuel newsletters and association lists will likely result in more robust response and greater competition. Ultimately, coordination and information sharing with regional fleets, both public and private, can achieve critical mass for gaseous fuel vehicle deployment and support additional development of support services, including better local maintenance, service options, and fueling infrastructure.

Appendix A

Natural Gas and Propane Autogas

EPA- and CARB-Certified Aftermarket Retrofit Systems (for Light- and Medium-duty Vehicles/Chasses)

EPA-Approved Aftermarket Engine Repower Systems (for Heavy-duty Platforms)

Notes:

1. In the charts that follow, for each vehicle/engine platform and model year, reference is made to the name of the company that was issued an EPA Certificate of Compliance or CARB Executive Order. Some of these companies no longer exist and/or have been acquired by other companies since awarding of those certificates. For example, "BAF" and "IMPCO" both were subsequently acquired by Westport Fuel Systems ("Westport"). For purposes of facilitating location of the appropriate CoCs or EOs on the EPA and CARB websites, we have listed available vehicles/engine families by the name of the company shown on the CoC or EO.

2. The charts that follow include vehicles/platforms for which EPA CoCs or CARB EOs were issued for model years 2015 and 2016 only. Model year 2017 CoCs and EOs were not yet available at the time of this guides' assembly. Manufacturers of aftermarket retrofit systems are constantly updating their product offering, thus this chart should be supplemented by referencing the EPA and CARB websites for the latest additions. Furthermore, certified systems may have been available for other models/platforms in previous years and since discontinued. Fleets interested in exploring additional models not listed here may want to contact the system manufacturers to determine if additional certificates might be forthcoming.

Contact Cooridnates of Aftermarket Retrofit System Manufacturers

AGA Systems, LLC	350 North 650 West, Kaysville UT 84037	801-290-8010	www.agasystemsinc.com
Altech-Eco Corporation	101 Fair Oaks Road, Arden NC 28704	828-654-8300	www.altecheco.com
BAF Technologies	(see "Westport")		
Blossman Services Inc	2091 US Hwy 70, Swanannoa, NC 28778	800-40-AUTOGAS	www.blossmangas.com/autogas
Clean Fuel USA	508 Leander Rd., Georgetown, TX 78626	800-626-8181	www.cleanfuelusa.com
CNG Interstate of Oklahoma LLC	714 Enterprise Dr., Edmond, OK 73013	405-751-4200	www.cnginterstate.com
Crazy Diamond Performance	51285-51301 Fischer Park Drive	844-458-7727	www.crazydiamondperformance.com
GreenKraft, Inc.	2530 S. Birch Street, Santa Ana, CA 92707	714-545-7777	www.greenkraftinc.com
Green Bridge Technologies	54790 Grand River Ave., New Hudson, MI 48165	248-573-4936	www.gbtfleet.com
ICOM North America	54790 Grand River Ave., New Hudson, MI 48165	248-573-4934	www.icomnorthamerica.com
IMPCO Technologies	(see "Westport")		
Landi Renzo USA Corp	23535 Telo Avenue. Torrance, CA 90505	310-257-9481	www.landiusa.com
M-Tech Solutions, Inc.	464 Governors View Road, Asheville NC 28805	828-243-8697	www.mtechsolutionsinc.com
PowerFuel CNG Systems	650 NW 27th Ave., Fort Lauderdale, FL 33311	800-963-4375	www.powerfuelcng.com
Power Solutions International	101 Mittel Street, Wood Dale, IL 60191	630-350-9400	www.psiengines.com
Roush Industries	12170 Globe St, Livonia, MI 48150	734-779-7777	www.roushcleantech.com
STAG USA	102 Main Street, Elwood, IN 46036	317-623-8499 ext.1	www.acstag.com
Westport Fuel Systems	2180 French Settlement Rd, Dallas, TX 75212	214-231-1450	www.westport.com

Light-duty NGV Aftermarket Retrofit Systems

OEM	Original Model Year	Eng Disp	Conversion Models Covered	Converted to Operate On	Original Fuel	Conversion MFR	Conversion Certificate Number	Conversion Evap Family	Conversion Test Group	Com-pliance Status
Ford	2016	2.5	Altech-Eco Corporation: Transit Connect Van, Transit Connect Van 2WD, Transit Connect Wagon, Transit Connect Wagon FWD, Transit Connect Wagon LWB, Transit Connect Wagon LWB FWD	CNG or gasoline	Gasoline	Altech-Eco Corporation	GAECT02.52K8-024-R01	GAECR0125NBV	GAECT02.52K8	EPA
Ford	2016	3.5, 3.7	Ford: EXPLORER AWD, EXPLORER FFV 2WD, EXPLORER FFV AWD, EXPLORER FWD, Police Interceptor Utility AWD, Police Interceptor UtilityFFVAWD	CNG or gasoline	Gasoline	STAG USA	GACST03.76B5-001-R02	GACSR0145GBV	GACST03.76B5	EPA
Ford	2016	3.5, 3.7	Ford: EXPLORER AWD, FLEX AWD, Interceptor Sedan FFV AWD, Interceptor Sedan FFV FWD, Police Interceptor Sedan AWD, Police Interceptor Utility AWD, TAURUS AWD, TAURUS AWD FFV, TAURUS FWD FFV GMC: MKS AWD, MKT AWD	CNG or gasoline	Gasoline	STAG USA	GACSV03.76B5-002-R01	GACSR0145GBV	GACSV03.76B5	EPA
Ford	2016	3.5, 3.7	Ford MKZ AWD, MKZ FWD	CNG or gasoline	Gasoline	STAG USA	GACSV03.76B5-003	GACSR0125NBV	GACSV03.76B5	EPA
Ford	2016	3.7	Altech-Eco Corporation: TRANSIT T150 VAN, TRANSIT T250 VAN, TRANSIT T350 VAN, Transit T250 Van 2WD, Transit T250 Wagon 2WD, Transit T350 VAN 2WD, Transit T350 Wagon, Transit T350 Wagon 2WD	CNG	Gasoline	Altech-Eco Corporation	GAECD03.76BA-018-R01	GAECR0000NBD	GAECD03.76BA	EPA
Ford	2016	3.7	Altech-Eco Corporation: Transit T250 CUTAWAY, Transit T250 CUTAWAY 2WD, Transit T250 Chassis Cab, Transit T250 Chassis Cab 2WD, Transit T350 CUTAWAY, Transit T350 CUTAWAY 2WD, Transit T350 Chassis Cab, Transit T350 Chassis Cab 2WD	CNG	Gasoline	Altech-Eco Corporation	GAECD03.76BA-019-R01	GAECF0000NB1	GAECD03.76BA	EPA
Ford	2016	3.7	Altech-Eco Corporation: TRANSIT T150 VAN, Transit T250 Van 2WD, Transit T250 Wagon 2WD, Transit T350 VAN 2WD, Transit T350 Wagon 2WD	CNG or gasoline	Gasoline	Altech-Eco Corporation	GAECD03.76BG-016	GAECR0190NBD	GAECD03.76BG	EPA
Ford	2016	3.7	Altech-Eco Corporation: Transit T250 CUTAWAY 2WD, Transit T250 Chassis Cab 2WD, Transit T350 CUTAWAY 2WD, Transit T350 Chassis Cab 2WD	CNG or gasoline	Gasoline	Altech-Eco Corporation	GAECD03.76BG-022	GAECF0190NBS	GAECD03.76BG	EPA

Ford	2016	3.7	Altech-Eco Corporation: TRANSIT T150 VAN, TRANSIT T250 VAN, TRANSIT T350 VAN, Transit T350 Wagon	CNG or gasoline	Gasoline	Altech-Eco Corporation	GAECD03.76BX-014	GAECR0190NBD	GAECD03.76BX	EPA
Ford	2016	3.7	Altech-Eco Corporation: Transit T250 CUTAWAY, Transit T250 Chassis Cab, Transit T350 CUTAWAY, Transit T350 Chassis Cab	CNG or gasoline	Gasoline	Altech-Eco Corporation	GAECD03.76BX-023	GAECF0190NBS	GAECD03.76BX	EPA
Ford	2016	3.7	Altech-Eco Corporation: Transit T350 CUTAWAY, Transit T350 Chassis Cab	CNG	Gasoline	Altech-Eco Corporation	GAECD03.77BA-021	GAECF0000NB1	GAECD03.77BA	EPA
Ford	2016	3.7	Altech-Eco Corporation: Transit T350 CUTAWAY, Transit T350 Chassis Cab	CNG or gasoline	Gasoline	Altech-Eco Corporation	GAECD03.77BX-017	GAECF0190NBS	GAECD03.77BX	EPA
Ford	2016	3.7	Altech-Eco Corporation: Transit T150 Wagon	CNG	Gasoline	Altech-Eco Corporation	GAECT03.75HA-020	GAECR0000NBD	GAECT03.75HA	EPA
Ford	2016	3.7	Altech-Eco Corporation: Transit T150 Wagon	CNG or gasoline	Gasoline	Altech-Eco Corporation	GAECT03.75HG-015	GAECR0190NBD	GAECT03.75HG	EPA
Ford	2016	3.7	BAF Technologies: Transit Van and Wagon	CNG	Gasoline	Westport	GBAFD03.76BX-011 EO A-426-0004	GBAFR0000001	GBAFD03.76BX	EPA, CARB
Ford	2016	5.0	Altech-Eco Corporation: F150 2WD HD Payload GVWR 760, F150 4WD HD Payload GVWR 760, F150 PICKUP 2WD, F150 PICKUP 4WD	CNG	Gasoline	Altech-Eco Corporation	GAECT05.03DA-012	GAECR0000ABC	GAECT05.03DA	EPA
Ford	2016	5.0	Altech-Eco Corporation: F150 2WD HD Payload GVWR 760, F150 4WD HD Payload GVWR 760, F150 PICKUP 2WD, F150 PICKUP 4WD	CNG	Gasoline	Altech-Eco Corporation	GAECT05.03DA-013	GAECR0000NBC	GAECT05.03DA	EPA
Ford	2016	5.0	Altech-Eco Corporation: F150 2WD HD Payload GVWR 760, F150 4WD HD Payload GVWR 760, F150 PICKUP 2WD, F150 PICKUP 4WD	CNG or gasoline	Gasoline	Altech-Eco Corporation	GAECT05.03DK-010	GAECR0160ABC	GAECT05.03DK	EPA
Ford	2016	5.0	Altech-Eco Corporation: F150 2WD HD Payload GVWR 760, F150 4WD HD Payload GVWR 760, F150 PICKUP 2WD, F150 PICKUP 4WD	CNG or gasoline	Gasoline	Altech-Eco Corporation	GAECT05.03DK-011	GAECR0235NBC	GAECT05.03DK	EPA
Ford	2016	5.0	IMPCO Automotive - Ford: Ford F150 2WD, Ford F150 2WD HD, Ford F150 4WD, Ford F150 4WD HD	CNG or gasoline	Gasoline	IMPCO Technologies, Inc.	GZ9XT05.0BCE-019	GZ9XR0160BCA	GZ9XT05.0BCE	EPA
Ford	2016	5.0	IMPCO Automotive - Ford: Ford F150 2WD, Ford F150 2WD HD, Ford F150 4WD, Ford F150 4WD HD	CNG or gasoline	Gasoline	IMPCO Technologies, Inc.	GZ9XT05.0BCE-020	GZ9XR0235BCB	GZ9XT05.0BCE	EPA
Ford	2016	5.0	M-Tech Solutions: F150 2WD HD Payload GVWR 760, F150 4WD HD Payload GVWR 760, F150 PICKUP 2WD, F150 PICKUP 4WD	CNG or gasoline	Gasoline	M-tech Solutions Inc	GMTET05.03DK-001	GMTER0160ABC	GMTET05.03DK	EPA
Ford	2016	5.0	M-Tech Solutions: F150 2WD HD Payload GVWR 760, F150 4WD HD Payload GVWR 760, F150 PICKUP 2WD, F150 PICKUP 4WD	CNG or gasoline	Gasoline	M-tech Solutions Inc	GMTET05.03DK-002	GMTER0235NBC	GMTET05.03DK	EPA

Ford	2016	5.0	BAF Technologies: F150	CNG or gasoline	Gasoline	Westport	GBAFT05.03DK-008	GBAFR0000001	GBAFT05.03DK	EPA
Ford	2016	5.0	BAF Technologies: F150	CNG	Gasoline	Westport	EO A-426-0003	GBAFR0000001		CARB
Ford	2016	5.0	BAF_Bifuel: F150	CNG or gasoline	Gasoline	Westport	GBAFT05.0CNG-009	GBAFR0160ABC	GBAFT05.0CNG	EPA
Ford	2016	5.0	BAF_Bifuel: F150	CNG or gasoline	Gasoline	Westport	GBAFT05.0CNG-010	GBAFR0235NBC	GBAFT05.0CNG	EPA
Ford	2016	6.2	Altech-Eco Corporation: F250 Pickup 2WD, F250 Pickup 4WD, F350 Pickup 2WD, F350 Pickup 4WD	CNG	Gasoline	Altech-Eco Corporation	GAECD06.26LA-007-R01	GAECR0000NBS	GAECD06.26LA	EPA
Ford	2016	6.2	Altech-Eco Corporation: F350 Incomplete 2WD, F350 Incomplete 4WD	CNG	Gasoline	Altech-Eco Corporation	GAECD06.26LA-008-R01	GAECF0000NAS	GAECD06.26LA	EPA
Ford	2016	6.2	Altech-Eco Corporation: F250 2WD Bed Delete, F250 4WD Bed Delete, F350 4WD Bed Delete, F350 2WD Bed Delete	CNG	Gasoline	Altech-Eco Corporation	GAECD06.26LA-009-R01	GAECF0000NBS	GAECD06.26LA	EPA
Ford	2016	6.2	Altech-Eco Corporation: F250 Pickup 2WD, F250 Pickup 4WD, F350 Pickup 2WD, F350 Pickup 4WD	CNG or gasoline	Gasoline	Altech-Eco Corporation	GAECD06.26LT-001	GAECR0250NBS	GAECD06.26LT	EPA
Ford	2016	6.2	Altech-Eco Corporation: F250 2WD Bed Delete, F250 4WD Bed Delete, F350 4WD Bed Delete, F350 2WD Bed Delete	CNG or gasoline	Gasoline	Altech-Eco Corporation	GAECD06.26LT-002	GAECF0250NBS	GAECD06.26LT	EPA
Ford	2016	6.2	Altech-Eco Corporation: F350 Incomplete 2WD, F350 Incomplete 4WD	CNG or gasoline	Gasoline	Altech-Eco Corporation	GAECD06.26LT-003	GAECF0265NAS	GAECD06.26LT	EPA
Ford	2016	6.2	Altech-Eco Corporation: F350 Pickup 2WD, F350 Pickup 4WD	CNG or gasoline	Gasoline	Altech-Eco Corporation	GAECD06.27HV-004	GAECR0250NBS	GAECD06.27HV	EPA
Ford	2016	6.2	Altech-Eco Corporation: F350 4WD Bed Delete, F350 2WD Bed Delete	CNG or gasoline	Gasoline	Altech-Eco Corporation	GAECD06.27HV-005	GAECF0250NBS	GAECD06.27HV	EPA
Ford	2016	6.2	Altech-Eco Corporation: F350 Incomplete 2WD, F350 Incomplete 4WD	CNG or gasoline	Gasoline	Altech-Eco Corporation	GAECD06.27HV-006	GAECF0265NAS	GAECD06.27HV	EPA
Ford	2016	6.2	IMPCO Automotive - Ford: Ford F250 2WD Bed Delete, Ford F250 4WD Bed Delete, Ford F350 2WD Bed Delete, Ford F350 4WD Bed Delete	CNG or gasoline	Gasoline	IMPCO Technologies, Inc.	GZ9XD06.2BC1-008	GZ9XF0250BCA	GZ9XD06.2BC1	EPA
Ford	2016	6.2	IMPCO Automotive - Ford: Ford F350 INCOMPLETE 2WD, Ford F350 INCOMPLETE 4WD	CNG or gasoline	Gasoline	IMPCO Technologies, Inc.	GZ9XD06.2BC1-009	GZ9XF0265BCB	GZ9XD06.2BC1	EPA
Ford	2016	6.2	IMPCO Automotive - Ford: Ford F250 PICKUP 2WD, Ford F250 PICKUP 4WD, Ford F350 2WD, Ford F350 4WD	CNG or gasoline	Gasoline	IMPCO Technologies, Inc.	GZ9XD06.2BC1-010	GZ9XR0250BCC	GZ9XD06.2BC1	EPA
Ford	2016	6.2	IMPCO Automotive - Ford: Ford F350 2WD Bed Delete, Ford F350 4WD Bed Delete	CNG or gasoline	Gasoline	IMPCO Technologies, Inc.	GZ9XD06.2BC2-001	GZ9XF0250BCA	GZ9XD06.2BC2	EPA

Ford	2016	6.2	IMPCO Automotive - Ford: Ford F350 INCOMPLETE 2WD, Ford F350 INCOMPLETE 4WD	CNG or gasoline	Gasoline	IMPCO Technologies, Inc.	GZ9XD06.2BC2-002	GZ9XF0265BCB	GZ9XD06.2BC2	EPA
Ford	2016	6.2	IMPCO Automotive - Ford: Ford F350 2WD, Ford F350 4WD	CNG or gasoline	Gasoline	IMPCO Technologies, Inc.	GZ9XD06.2BC2-003	GZ9XR0250BCC	GZ9XD06.2BC2	EPA
Ford	2016	6.2	IMPCO Automotive - Ford: Ford F250 2WD Bed Delete, Ford F250 4WD Bed Delete, Ford F250 PICKUP 2WD, Ford F250 PICKUP 4WD, Ford F350 2WD, Ford F350 2WD Bed Delete, Ford F350 4WD, Ford F350 4WD Bed Delete, Ford F350 INCOMPLETE 2WD, Ford F350 INCOMPLETE 4WD	CNG	Gasoline	IMPCO Technologies, Inc.	GZ9XD06.2DC1-018 EO A-328-0080	GZ9XR0000DCF	GZ9XD06.2DC1	EPA Cert./CARB
Ford	2016	6.2	Landi Renzo USA: F250 2WD BED DELETE, F250 4WD BED DELETE, F350 2WD BED DELETE, F350 4WD BED DELETE, F350 PICKUP 2WD, F350 PICKUP 4WD; F350 Incomplete 2WD, F250 pick-up 2WD, F250 pick-up 4WD	CNG	Gasoline	Landi Renzo USA Corporation	GLDRT06.2C10-007, EO#A-400-0023	GLDRR0000C10	GLDRT06.2C10	EPA, CARB
Ford	2016	6.2	Landi Renzo USA: F250 2WD BED DELETE, F250 4WD BED DELETE, F350 2WD BED DELETE, F350 4WD BED DELETE, F350 PICKUP 2WD, F350 PICKUP 4WD	CNG or gasoline	Gasoline	Landi Renzo USA Corporation	GLDRT06.2C20-001	GLDRF0250NBS	GLDRT06.2C20	EPA
Ford	2016	6.2	Landi Renzo USA: F350 INCOMPLETE 2WD, F350 INCOMPLETE 4WD	CNG or gasoline	Gasoline	Landi Renzo USA Corporation	GLDRT06.2C20-002	GLDRF0265NAS	GLDRT06.2C20	EPA
Ford	2016	6.2	Landi Renzo USA: F250 PICKUP 2WD, F250 PICKUP 4WD, F350 PICKUP 2WD, F350 PICKUP 4WD	CNG or gasoline	Gasoline	Landi Renzo USA Corporation	GLDRT06.2C20-003	GLDRR0250NBS	GLDRT06.2C20	EPA
Ford	2016	6.2	Landi Renzo USA: F350 2WD BED DELETE, F350 4WD BED DELETE	CNG or gasoline	Gasoline	Landi Renzo USA Corporation	GLDRT06.2C30-004	GLDRF0250NBS	GLDRT06.2C30	EPA
Ford	2016	6.2	Landi Renzo USA: F350 INCOMPLETE 2WD, F350 INCOMPLETE 4WD	CNG or gasoline	Gasoline	Landi Renzo USA Corporation	GLDRT06.2C30-005	GLDRF0265NAS	GLDRT06.2C30	EPA
Ford	2016	6.2	Landi Renzo USA: F350 PICKUP 2WD, F350 PICKUP 4WD	CNG or gasoline	Gasoline	Landi Renzo USA Corporation	GLDRT06.2C30-006	GLDRR0250NBS	GLDRT06.2C30	EPA
Ford	2016	6.2	Ford: F250 Pickup 2WD FFV, F250 Pickup 4WD FFV, F350 Pickup 2WD FFV, F350 Pickup 4WD FFV	CNG	Gasoline	PowerFuel CNG Conversions, LLC	GPRFD06.2HLG-001	GPRFR0250NBS	GPRFD06.2HLG	EPA
Ford	2016	6.2	Ford: F250 2WD Bed Delete FFV, F250 4WD Bed Delete FFV, F350 2WD Bed Delete FFV, F350 4WD Bed Delete FFV	CNG	Gasoline	PowerFuel CNG Conversions, LLC	GPRFD06.2HLG-002	GPRFF0250NBS	GPRFD06.2HLG	EPA

Ford	2016	6.2	Ford: F350 Incomplete 2WD FFV, F350 Incomplete 4WD FFV	CNG	Gasoline	PowerFuel CNG Conversions, LLC	GPRFD06.2HLG-003	GPRFF0265NAS	GPRFD06.2HLG	EPA
Ford	2016	6.2	BAF Ford: F250 2WD BED DELETE, F250 4WD BED DELETE, F350 2WD BED DELETE, F350 4WD BED DELETE, F350 PICKUP 2WD, F350 PICKUP 4WD; F350 Incomplete 2WD, F250 pick-up 2WD, F250 pick-up 4WD	CNG	Gasoline	Westport	GBAFD06.26LT-001 EO A-426-0001-1	GBAFR0000001	GBAFD06.26LT	EPA, CARB
Ford	2016	6.2	BAF_Bifuel: Ford F250/350	CNG or gasoline	Gasoline	Westport	GBAFD06.26NG-002	GBAFR0250NBS	GBAFD06.26NG	EPA
Ford	2016	6.2	BAF_Bifuel: Ford F250/350	CNG or gasoline	Gasoline	Westport	GBAFD06.26NG-003	GBAFF0250NBS	GBAFD06.26NG	EPA
Ford	2016	6.2	BAF_Bifuel: Ford F250/350	CNG or gasoline	Gasoline	Westport	GBAFD06.26NG-004	GBAFF0265NAS	GBAFD06.26NG	EPA
Ford	2016	6.2	BAF_Bifuel: Ford F250/350	CNG or gasoline	Gasoline	Westport	GBAFD06.27NG-005	GBAFR0250NBS	GBAFD06.27NG	EPA
Ford	2016	6.2	BAF_Bifuel: Ford F250/350	CNG or gasoline	Gasoline	Westport	GBAFD06.27NG-006	GBAFF0250NBS	GBAFD06.27NG	EPA
Ford	2016	6.2	BAF_Bifuel: Ford F250/350	CNG or gasoline	Gasoline	Westport	GBAFD06.27NG-007	GBAFF0265NAS	GBAFD06.27NG	EPA
General Motors	2016	1.8	Crazy Diamond Performance: Cruze Limited	CNG	Gasoline	Crazy Diamond Performance Inc.	GCRZV01.8011-001	GCRZR0000818	GCRZV01.8011	EPA
General Motors	2016	2.4	Auto Gas America: BUICK VERANO	CNG or gasoline	Gasoline	AGA Systems, LLC	GAGTT02.4151-001	GAGTR0120818	GAGTT02.4151	EPA
General Motors	2016	2.4	Auto Gas America: BUICK REGAL	CNG or gasoline	Gasoline	AGA Systems, LLC	GAGTT02.4151-002	GAGTR0133810	GAGTT02.4151	EPA
General Motors	2016	2.4	Auto Gas America: CHEVROLET EQUINOX, GMC TERRAIN	CNG or gasoline	Gasoline	AGA Systems, LLC	GAGTT02.4151-003	GAGTR0138813	GAGTT02.4151	EPA
General Motors	2016	5.3	Auto Gas America: Chevrolet C1500 TAHOE 2WD, Tahoe PPV, Chevrolet K15 SILVERADO 4WD, Chevrolet K1500 TAHOE 4WD, Chevy C15 Silverado 2WD, GMC C15 SIERRA 2WD, GMC C1500 YUKON 2WD, GMC K15 SIERRA 4WD, GMC K1500 YUKON 4WD	CNG or gasoline	Gasoline	AGA Systems, LLC	GAGTT05.3382-006	GAGTR0176820	GAGTT05.3382	EPA
General Motors	2016	5.3	Auto Gas America: Chevrolet C1500 SUBURBAN 2WD, Chevrolet K15 SILVERADO 4WD, Chevrolet K1500 SUBURBAN 4WD, Chevy C15 Silverado 2WD, GMC C15 SIERRA 2WD, GMC C1500 YUKON XL 2WD, GMC K15 SIERRA 4WD, GMC K1500 YUKON XL 4WD	CNG or gasoline	Gasoline	AGA Systems, LLC	GAGTT05.3382-007	GAGTR0223840	GAGTT05.3382	EPA

General Motors	2016	5.3	Auto Gas America: Chevrolet C1500 TAHOE 2WD, Chevrolet K15 SILVERADO 4WD, Chevrolet K1500 TAHOE 4WD, Chevy C15 Silverado 2WD, GMC C15 SIERRA 2WD, GMC C1500 YUKON 2WD, GMC K15 SIERRA 4WD, GMC K1500 YUKON 4WD	CNG or gasoline	Gasoline	AGA Systems, LLC	GAGTT05.3384-008	GAGTR0176820	GAGTT05.3384	EPA
General Motors	2016	5.3	Auto Gas America: C15 SILVERADO 2WD CAB CHASSIS, Chevrolet C1500 SUBURBAN 2WD, Chevrolet K15 SILVERADO 4WD, Chevrolet K1500 SUBURBAN 4WD, Chevy C15 Silverado 2WD, GMC C15 SIERRA 2WD, GMC C15 SIERRA 2WD CAB CHASSIS, GMC C1500 YUKON XL 2WD, GMC K15 SIERRA 4WD, GMC K15 SIERRA 4WD CAB CHASSIS, GMC K1500 YUKON XL 4WD, K15 SILVERADO 4WD CAB CHASSIS	CNG or gasoline	Gasoline	AGA Systems, LLC	GAGTT05.3384-009	GAGTR0223840	GAGTT05.3384	EPA
General Motors	2016	5.3	IMPCO Automotive - Chevrolet: CHEV C15 Silverado 2WD, CHEV C1500 Tahoe 2WD, CHEV K15 Silverado 4WD, CHEV K1500 Tahoe 4WD IMPCO Automotive - General Motors: GMC C15 Sierra 2WD, GMC C1500 Yukon 2WD, GMC K15 Sierra 4WD, GMC K1500 Yukon 4WD	CNG or gasoline	Gasoline	IMPCO Technologies, Inc.	GZ9XT05.3BCE-004	GZ9XR0176BCE	GZ9XT05.3BCE	EPA
General Motors	2016	5.3	IMPCO Automotive - Chevrolet: CHEV C15 Silverado 2WD, CHEV C1500 Suburban 2WD, CHEV K15 Silverado 4WD, CHEV K1500 Suburban 4WD IMPCO Automotive - General Motors: GMC C15 Sierra 2WD, GMC C1500 Yukon XL 2WD, GMC K15 Sierra 4WD, GMC K1500 Yukon XL 4WD	CNG or gasoline	Gasoline	IMPCO Technologies, Inc.	GZ9XT05.3BCE-005	GZ9XR0223BCE	GZ9XT05.3BCE	EPA
General Motors	2016	6.0	IMPCO Automotive - Chevrolet: Chev C25 Silverado 2WD, Chev C35 Silverado 2WD, Chev G2500 Express 2WD Cargo, Chev G2500 Express 2WD Pass, Chev G3500 Express 2WD Cargo, Chev G3500 Express 2WD Pass, Chev K25 Silverado 4WD, Chev K35 Silverado 4WD IMPCO Automotive - General Motors: GMC C25 Sierra 2WD, GMC C35 Sierra 2WD, GMC G2500 Savana 2WD Cargo, GMC G2500 Savana 2WD Pass, GMC G3500 Savana 2WD Cargo, GMC G3500 Savana 2WD Pass, GMC K25 Sierra 4WD, GMC K35 Sierra 4WD	CNG or gasoline	Gasoline	AGA Systems, LLC				EPA*

General Motors	2016	6.0	IMPCO Automotive - Chevrolet: Chev C25 Silverado 2WD, Chev C35 Silverado 2WD, Chev G2500 Express 2WD Cargo, Chev G2500 Express 2WD Pass, Chev G3500 Express 2WD Cargo, Chev G3500 Express 2WD Pass, Chev K25 Silverado 4WD, Chev K35 Silverado 4WD IMPCO Automotive - General Motors: GMC C25 Sierra 2WD, GMC C35 Sierra 2WD, GMC G2500 Savana 2WD Cargo, GMC G2500 Savana 2WD Pass, GMC G3500 Savana 2WD Cargo, GMC G3500 Savana 2WD Pass, GMC K25 Sierra 4WD, GMC K35 Sierra 4WD	CNG or gasoline	Gasoline	IMPCO Technologies, Inc.	GZ9XD06.0BC1-017-R01 EO A-328-0079	GZ9XR0223841	GZ9XD06.0BC1	EPA, CARB
General Motors	2016	6.0	IMPCO Automotive - Chevrolet: Chev C25 Silverado 2WD, Chev C35 Silverado 2WD, Chev K25 Silverado 4WD, Chev K35 Silverado 4WD IMPCO Automotive - General Motors: GMC C25 Sierra 2WD, GMC C35 Sierra 2WD, GMC K25 Sierra 4WD, GMC K35 Sierra 4WD	CNG or gasoline	Gasoline	IMPCO Technologies, Inc.	GZ9XD06.0BC1-025 EO A-328-0079	GZ9XF0223850	GZ9XD06.0BC1	EPA, CARB
General Motors	2016	6.0	IMPCO Automotive - Chevrolet: Chev C35 Silverado 2WD, Chev K35 Silverado 4WD IMPCO Automotive - General Motors: GMC C35 Sierra 2WD, GMC K35 Sierra 4WD	CNG or gasoline	Gasoline	IMPCO Technologies, Inc.	GZ9XD06.0BC2-007	GZ9XR0223842	GZ9XD06.0BC2	EPA, CARB
General Motors	2016	6.0	Chevrolet G2500 Express Cargo 2WD, G2500 Express Cargo 2WD, G2500 and G3500 Express Pass, GMC G2500 Savana Cargo 2WD, GMC G2500 Savanna Pass, GMC Savanna Cargo 2WD, GMC G3500 Savana Pass	CNG	Gasoline	IMPCO Technologies, Inc.	A-328-0077 r001		GZ9XD06.0DCA	CARB
General Motors	2016	6.0	IMPCO Automotive - Chevrolet: Chev C25 Silverado 2WD, Chev C35 Silverado 2WD, Chev G2500 Express 2WD Cargo, Chev G2500 Express Conv 2WD Carg, Chev G3500 Express 2WD Cargo, Chev G3500 Express Conv 2WD Carg, Chev K25 Silverado 4WD, Chev K35 Silverado 4WD IMPCO Automotive - General Motors: GMC C25 Sierra 2WD, GMC C35 Sierra 2WD, GMC G2500 Savana 2WD Cargo, GMC G2500 Savana Cnv 2WD Car MDP, GMC G3500 Savana 2WD Cargo, GMC G3500 Savana Conv 2WD Cargo, GMC K25 Sierra 4WD, GMC K35 Sierra 4WD	CNG	Gasoline	IMPCO Technologies, Inc.	GZ9XD06.0DCA-006-R02	GZ9XR0000DCA	GZ9XD06.0DCA	EPA

General Motors	2016	6.2	Auto Gas America: Cadillac ESCALADE 2WD, Cadillac ESCALADE 4WD, Chevrolet K15 SILVERADO 4WD, Chevy C15 Silverado 2WD, GMC C15 SIERRA 2WD, GMC C1500 YUKON 2WD, GMC K15 SIERRA 4WD, GMC K1500 YUKON 4WD	CNG or gasoline	Gasoline	AGA Systems, LLC	GAGTT06.2374-004	GAGTR0176820	GAGTT06.2374	EPA
General Motors	2016	6.2	Auto Gas America: Cadillac ESCALADE ESV 2WD, Cadillac ESCALADE ESV 4WD, GMC C1500 YUKON XL 2WD, GMC K1500 YUKON XL 4WD	CNG or gasoline	Gasoline	AGA Systems, LLC	GAGTT06.2374-005	GAGTR0223840	GAGTT06.2374	EPA
Ford	2015	2.5	Altech-Eco Corporation: Transit Connect Van 2WD, Transit Connect Wagon FWD, Transit Connect Wagon LWB FWD	CNG	Gasoline	Altech-Eco Corporation	FAECT02.52DA-008	FAECR0000NBV	FAECT02.52DA	EPA
Ford	2015	2.5	Altech-Eco Corporation: Transit Connect Van 2WD, Transit Connect Wagon FWD, Transit Connect Wagon LWB FWD	CNG or gasoline	Gasoline	Altech-Eco Corporation	FAECT02.52D8-007-R01	FAECR0125NBV	FAECT02.52D8	EPA
Ford	2015	2.5	BAF_Bifuel: Transit Connect	CNG or gasoline	Gasoline	BAF Technologies	FBAFT02.5NGD-003	FBAFR0125NBV	FBAFT02.5NGD	EPA
Ford	2015	3.5, 3.7	AC Stag: Ford EXPLORER AWD, Ford EXPLORER FFV 2WD, Ford EXPLORER FFV AWD, Ford EXPLORER FWD, Ford EXPLORER Police FFV AWD, Ford EXPLORER Police FFV FWD, Ford EXPLORER Police Utility AWD, Ford EXPLORER Police Utility FWD	CNG or gasoline	Gasoline	STAG USA/AC Spolka Akcyjna	FACST03.73DM-001-R01	FACSR0145GBV	FACST03.73DM	EPA
Ford	2015	3.5, 3.7	AC Stag: Ford EXPLORER AWD, Ford EXPLORER FFV 2WD, Ford EXPLORER FFV AWD, Ford EXPLORER FWD, Ford EXPLORER Police FFV AWD, Ford EXPLORER Police FFV FWD, Ford EXPLORER Police Utility AWD, Ford EXPLORER Police Utility FWD	CNG or gasoline	Gasoline	STAG USA/AC Spolka Akcyjna	FACST03.73E8-002-R01	FACSR0145GBV	FACST03.73E8	EPA
Ford	2015	3.5, 3.7	AC Stag: Ford FLEX AWD, Ford FLEX FWD, Ford TAURUS AWD, Ford TAURUS FFV AWD, Ford TAURUS FFV FWD, Ford TAURUS FWD, Ford TAURUS Police Sedan AWD, Ford TAURUS Police Sedan FFV AWD, Ford TAURUS Police Sedan FFV FWD, Ford TAURUS Police Sedan FWD, Lincoln MKS AWD, Lincoln MKS FWD, Lincoln MKT FWD, Lincoln MKT LIVERY AWD	CNG or gasoline	Gasoline	STAG USA/AC Spolka Akcyjna	FACSV03.7VE8-003-R01	FACSR0145GBV	FACSV03.7VE8	EPA
Ford	2015	3.5, 3.7	AC Stag: Lincoln MKZ AWD, Lincoln MKZ FWD	CNG or gasoline	Gasoline	STAG USA/AC Spolka Akcyjna	FACSV03.7VE8-004-R01	FACSR0125NBV	FACSV03.7VE8	EPA
Ford	2015	3.5, 3.7	AC Stag: Ford TAURUS AWD, Ford TAURUS FFV AWD, Ford TAURUS FFV FWD, Ford TAURUS FWD, Ford TAURUS Police Sedan AWD, Ford TAURUS Police Sedan FFV AWD, Ford TAURUS Police Sedan FFV FWD, Ford TAURUS Police Sedan FWD	CNG or gasoline	Gasoline	STAG USA/AC Spolka Akcyjna	FACSV03.7VEA-005-R01	FACSR0145GBV	FACSV03.7VEA	EPA

Ford	2015	3.7	Altech-Eco Corporation: Transit T150 Van, Transit T150 Wagon, Transit T250 Van 2WD, Transit T250 Wagon 2WD, Transit T350 Van 2WD, Transit T350 Wagon 2WD	CNG	Gasoline	Altech-Eco Corporation	FAECT03.76BA-011	FAECR0000NBD	FAECT03.76BA	EPA
Ford	2015	3.7	Altech-Eco Corporation: Transit T250 Chassis Cab 2WD, Transit T250 Cutaway 2WD, Transit T350 Chassis Cab 2WD, Transit T350 Cutaway 2WD	CNG	Gasoline	Altech-Eco Corporation	FAECT03.76BA-012	FAECF0000NBS	FAECT03.76BA	EPA
Ford	2015	3.7	Altech-Eco Corporation: Transit T150 Van, Transit T150 Wagon, Transit T250 Van 2WD, Transit T250 Wagon 2WD, Transit T350 Van 2WD, Transit T350 Wagon 2WD	CNG or gasoline	Gasoline	Altech-Eco Corporation	FAECT03.76BF-009-R02	FAECR0190NBD	FAECT03.76BF	EPA
Ford	2015	3.7	Altech-Eco Corporation: Transit T250 Chassis Cab 2WD, Transit T250 Cutaway 2WD, Transit T350 Chassis Cab 2WD, Transit T350 Cutaway 2WD	CNG or gasoline	Gasoline	Altech-Eco Corporation	FAECT03.76BF-010	FAECF0190NBS	FAECT03.76BF	EPA
Ford	2015	3.7	BAF Technologies: Transit	CNG	Gasoline	BAF Technologies	FBAFT03.76BF-002	FBAFR0000001	FBAFT03.76BF	EPA
Ford	2015	5.0	M-Tech Solutions: F150 PICKUP 2WD, F150 PICKUP 4WD	CNG or gasoline	Gasoline	M-tech Solutions Inc	FMTET05.03DK-001	FMTER0160ABC	FMTET05.03DK	EPA
Ford	2015	5.0	M-Tech Solutions: F150 PICKUP 2WD, F150 PICKUP 4WD	CNG or gasoline	Gasoline	M-tech Solutions Inc	FMTET05.03DK-002	FMTER0235NBC	FMTET05.03DK	EPA
Ford	2015	6.2	Altech-Eco Corporation: F250 Pickup 2WD, F250 Pickup 4WD, F350 Pickup 2WD, F350 Pickup 4WD	CNG	Gasoline	Altech-Eco Corporation	FAECT06.27HA-004	FAECR0250NB1	FAECT06.27HA	EPA
Ford	2015	6.2	Altech-Eco Corporation: F250 2WD Bed Delete, F250 4WD Bed Delete, F350 4WD Bed Delete, F350 2WD Bed Delete, F350 Pickup 2WD, F350 Pickup 4WD	CNG	Gasoline	Altech-Eco Corporation	FAECT06.27HA-005	FAECF0250NB1	FAECT06.27HA	EPA
Ford	2015	6.2	Altech-Eco Corporation: F350 Incomplete 2WD, F350 Incomplete 4WD	CNG	Gasoline	Altech-Eco Corporation	FAECT06.27HA-006	FAECF0265NA1	FAECT06.27HA	EPA
Ford	2015	6.2	Altech-Eco Corporation: F250 Pickup 2WD, F250 Pickup 4WD, F350 Pickup 2WD, F350 Pickup 4WD	CNG or gasoline	Gasoline	Altech-Eco Corporation	FAECT06.27HL-001	FAECR0250NBS	FAECT06.27HL	EPA
Ford	2015	6.2	Altech-Eco Corporation: F250 2WD Bed Delete, F250 4WD Bed Delete, F350 4WD Bed Delete, F350 2WD Bed Delete, F350 Pickup 2WD, F350 Pickup 4WD	CNG or gasoline	Gasoline	Altech-Eco Corporation	FAECT06.27HL-002	FAECF0250NBS	FAECT06.27HL	EPA
Ford	2015	6.2	Altech-Eco Corporation: F350 Incomplete 2WD, F350 Incomplete 4WD	CNG or gasoline	Gasoline	Altech-Eco Corporation	FAECT06.27HL-003	FAECF0265NAS	FAECT06.27HL	EPA

Ford	2015	6.2	IMPCO Automotive - Ford: Ford F250 2WD Bed Delete, Ford F250 4WD Bed Delete, Ford F250 PICKUP 2WD, Ford F250 PICKUP 4WD, Ford F350 2WD, Ford F350 2WD Bed Delete, Ford F350 4WD, Ford F350 4WD Bed Delete, Ford F350 INCOMPLETE 2WD, Ford F350 INCOMPLETE 4WD	CNG	Gasoline	IMPCO Technologies, Inc.	FZ9XT06.2DCA-015, EO A-328-0073	FZ9XR0000DCE	FZ9XT06.2DCA	EPA, CARB
Ford	2015	6.2	IMPCO Automotive - Ford: Ford F250 2WD Bed Delete, Ford F250 4WD Bed Delete, Ford F350 2WD, Ford F350 2WD Bed Delete, Ford F350 4WD, Ford F350 4WD Bed Delete	CNG or gasoline	Gasoline	IMPCO Technologies, Inc.	FZ9XT06.2BCE-010	FZ9XF0250BCA	FZ9XT06.2BCE	EPA
Ford	2015	6.2	IMPCO Automotive - Ford: Ford F350 INCOMPLETE 2WD, Ford F350 INCOMPLETE 4WD	CNG or gasoline	Gasoline	IMPCO Technologies, Inc.	FZ9XT06.2BCE-011	FZ9XF0265BCB	FZ9XT06.2BCE	EPA
Ford	2015	6.2	IMPCO Automotive - Ford: Ford F250 PICKUP 2WD, Ford F250 PICKUP 4WD, Ford F350 2WD, Ford F350 4WD	CNG or gasoline	Gasoline	IMPCO Technologies, Inc.	FZ9XT06.2BCE-012	FZ9XR0250BCC	FZ9XT06.2BCE	EPA
Ford	2015	6.2	Landi Renzo USA: F250 2WD BED DELETE, F250 4WD BED DELETE, F350 2WD BED DELETE, F350 4WD BED DELETE, F350 PICKUP 2WD, F350 PICKUP 4WD	CNG or gasoline	Gasoline	Landi Renzo USA Corporation	FLDRT06.2C20-001	FLDRF0250NBS	FLDRT06.2C20	EPA
Ford	2015	6.2	Landi Renzo USA: F250 PICKUP 2WD, F250 PICKUP 4WD, F350 PICKUP 2WD, F350 PICKUP 4WD	CNG or gasoline	Gasoline	Landi Renzo USA Corporation	FLDRT06.2C20-002	FLDRR0250NBS	FLDRT06.2C20	EPA
Ford	2015	6.2	Landi Renzo USA: F350 INCOMPLETE 2WD, F350 INCOMPLETE 4WD	CNG or gasoline	Gasoline	Landi Renzo USA Corporation	FLDRT06.2C20-003	FLDRF0265NAS	FLDRT06.2C20	EPA
Ford	2015	6.2	Ford: F250/350 truck 4WD	CNG or gasoline	Gasoline	PowerFuel CNG Conversions, LLC	FPRFT06.2HLF-001	FPRFR0250NBS	FPRFT06.2HLF	EPA
Ford	2015	6.2	Ford: F250/350 truck 4WD	CNG or gasoline	Gasoline	PowerFuel CNG Conversions, LLC	FPRFT06.2HLF-002	FPRFF0265NAS	FPRFT06.2HLF	EPA
Ford	2015	6.2	Ford: F250/350 truck 4WD	CNG or gasoline	Gasoline	PowerFuel CNG Conversions, LLC	FPRFT06.2HLF-003	FPRFF0250NBS	FPRFT06.2HLF	EPA
Ford	2015	6.2	Ford: F250 Pickup 2WD, F250 Pickup 4WD, F350 2WD, F350 4WD	CNG or gasoline	Gasoline	Westport	FWSPT06.2CNG-001	FWSPR0250NBS	FWSPT06.2CNG	EPA
Ford	2015	6.2	Ford: F250 2WD Bed Delete, F250 4WD Bed Delete, F350 2WD, F350 2WD Bed Delete, F350 4WD, F350 4WD Bed Delete	CNG or gasoline	Gasoline	Westport	FWSPT06.2CNG-002	FWSPF0250NBS	FWSPT06.2CNG	EPA
Ford	2015	6.2	Ford: F350 Incomplete 2WD, F350 Incomplete 4WD	CNG or gasoline	Gasoline	Westport	FWSPT06.2CNG-003	FWSPF0265NAS	FWSPT06.2CNG	EPA

Ford	2015	6.2	BAF F20 2WD Bed Delete, F250 Pickup, F350 Bed Delete, F350 Bed Delete DRW, F350 incomplete chassis cab, F350 Pickup, F350 Pickup DRW	CNG	Gasoline	Westport	FBAFT06.27HL-001, EO A-364-0050	FBAFR0000001	FBAFT06.27HL	EPA, CARB
General Motors	2015	1.2, 1.4, 1.8	Crazy Diamond Performance: Sonic, Sonic 5, Sonic 5 RS, Sonic RS, Spark	CNG	Gasoline	Crazy Diamond Performance Inc.	FCRZV01.8011-001	FCRZR0000805	FCRZV01.8011	EPA
General Motors	2015	1.2, 1.4, 1.8	Crazy Diamond Performance: Cruze, Cruze Eco	CNG	Gasoline	Crazy Diamond Performance Inc.	FCRZV01.8011-002	FCRZR0000818	FCRZV01.8011	EPA
General Motors	2015	1.4	IMPCO Automotive - Chevrolet: Chevrolet Cruze	CNG or gasoline	Gasoline	IMPCO Technologies, Inc.	FZ9XV01.4BCE-005	FZ9XR0120BCE	FZ9XV01.4BCE	EPA
General Motors	2015	2.4	Auto Gas America: BUICK VERANO	CNG or gasoline	Gasoline	AGA Systems, LLC	FAGTT02.4151-003	FAGTR0120818	FAGTT02.4151	EPA
General Motors	2015	2.4	Auto Gas America: BUICK REGAL	CNG or gasoline	Gasoline	AGA Systems, LLC	FAGTT02.4151-004	FAGTR0133810	FAGTT02.4151	EPA
General Motors	2015	2.4	Auto Gas America: CHEVROLET CAPTIVA, CHEVROLET EQUINOX, GMC TERRAIN	CNG or gasoline	Gasoline	AGA Systems, LLC	FAGTT02.4151-007	FAGTR0138813	FAGTT02.4151	EPA
General Motors	2015	3.6	GM Vehicle Division: XTS CNG-D 2wd	CNG	Gasoline	World CNG	FWRDV03.6ECA-003	FWRDR0000810	FWRDV03.6ECA	EPA
General Motors	2015	5.3	Auto Gas America: Chevrolet C1500 TAHOE 2WD, Chevrolet K15 SILVERADO 4WD, Chevrolet K1500 TAHOE 4WD, Chevy C15 Silverado 2WD, GMC C15 SIERRA 2WD, GMC C1500 YUKON 2WD, GMC K15 SIERRA 4WD, GMC K1500 YUKON 4WD	CNG or gasoline	Gasoline	AGA Systems, LLC	FAGTT05.3382-001	FAGTR0176820	FAGTT05.3382	EPA
General Motors	2015	5.3	Auto Gas America: C15 SILVERADO 2WD CAB CHASSIS, Chevrolet K1500 SUBURBAN 4WD, Chevrolet K15 SILVERADO 4WD, Chevy C15 Silverado 2WD, Chevy C1500 SUBURBAN 2WD, GMC C15 SIERRA 2WD, GMC C15 SIERRA 2WD CAB CHASSIS, GMC C1500 YUKON XL 2WD, GMC K15 SIERRA 4WD, GMC K15 SIERRA 4WD CAB CHASSIS, GMC K1500 YUKON XL AWD, K15 SILVERADO 4WD CAB CHASSIS	CNG or gasoline	Gasoline	AGA Systems, LLC	FAGTT05.3382-002	FAGTR0223840	FAGTT05.3382	EPA

General Motors	2015	5.3	CNG Interstate of Oklahoma: C15 Sierra 2WD, C15 Silverado 2WD, C1500 Tahoe 2WD, C1500 Yukon 2WD, K15 Sierra 4WD, K15 Silverado 4WD, K1500 Tahoe 4WD, K1500 Yukon 4WD	CNG or gasoline	Gasoline	CNG Interstate of Oklahoma, LLC	FCNOT05.338F-003	FCNOR0176820	FCNOT05.338F	EPA
General Motors	2015	5.3	CNG Interstate of Oklahoma: C15 Sierra 2WD, C15 Sierra 2WD Cab Chassis, C15 Silverado 2WD, C15 Silverado 2WD Cab Chassis, C1500 Suburban 2WD, C1500 Yukon XL 2WD, K15 Sierra 4WD, K15 Sierra 4WD Cab Chassis, K15 Silverado 4WD, K15 Silverado 4WD Cab Chassis, K1500 Suburban 4WD, K1500 Yukon XL 4WD	CNG or gasoline	Gasoline	CNG Interstate of Oklahoma, LLC	FCNOT05.338F-004	FCNOR0223840	FCNOT05.338F	EPA
General Motors	2015	5.3	IMPCO Automotive - Chevrolet: CHEV C15 Silverado 2WD, CHEV C1500 Tahoe 2WD, CHEV K15 Silverado 4WD, CHEV K1500 Tahoe 4WD IMPCO Automotive - General Motors: GMC C15 Sierra 2WD, GMC C1500 Yukon 2WD, GMC K15 Sierra 4WD, GMC K1500 Yukon 4WD	CNG or gasoline	Gasoline	IMPCO Technologies, Inc.	FZ9XT05.3BCE-013-R01	FZ9XR0176BCE	FZ9XT05.3BCE	EPA
General Motors	2015	5.3	IMPCO Automotive - Chevrolet: CHEV C15 Silverado 2WD, CHEV C15 Silverado 2WD Cab Chass, CHEV C1500 Suburban 2WD, CHEV K15 Silverado 4WD, CHEV K15 Silverado 4WD Cab Chass, CHEV K1500 Suburban 4WD IMPCO Automotive - General Motors: GMC C15 Sierra 2WD, GMC C15 Sierra 2WD Cab Chassis, GMC C1500 Yukon XL 2WD, GMC K15 Sierra 4WD, GMC K15 Sierra 4WD Cab Chassis, GMC K1500 Yukon XL 4WD	CNG or gasoline	Gasoline	IMPCO Technologies, Inc.	FZ9XT05.3BCE-014-R01	FZ9XR0223BCE	FZ9XT05.3BCE	EPA
General Motors	2015	5.3, 6.2	Auto Gas America: Cadillac ESCALADE 2WD, Cadillac ESCALADE 4WD, Chevrolet C1500 TAHOE 2WD, Chevrolet K15 SILVERADO 4WD, Chevrolet K1500 TAHOE 4WD, Chevy C15 Silverado 2WD, GMC C15 SIERRA 2WD, GMC C1500 YUKON 2WD, GMC K15 SIERRA 4WD, GMC K1500 YUKON 4WD	CNG or gasoline	Gasoline	AGA Systems, LLC	FAGTT06.2374-005	FAGTR0176820	FAGTT06.2374	EPA
General Motors	2015	5.3, 6.2	Auto Gas America: Cadillac ESCALADE ESV 2WD, Cadillac ESCALADE ESV 4WD, Chevrolet K1500 SUBURBAN 4WD, Chevy C1500 SUBURBAN 2WD, GMC C1500 YUKON XL 2WD, GMC K1500 YUKON XL AWD	CNG or gasoline	Gasoline	AGA Systems, LLC	FAGTT06.2374-006	FAGTR0223840	FAGTT06.2374	EPA

General Motors	2015	6.0	Auto Gas America: CHEVROLET C25 SILVERADO 2WD, CHEVROLET C35 SILVERADO 2WD, CHEVROLET K25 SILVERADO 4WD, CHEVROLET K35 SILVERADO 4WD, GMC C25 SIERRA 2WD, GMC C35 SIERRA 2WD, GMC K25 SIERRA 4WD, GMC K35 SIERRA 4WD	CNG or gasoline	Gasoline	AGA Systems, LLC	FAGTD06.0397-008	FAGTR0223841	FAGTD06.0397	EPA
General Motors	2015	6.0	IMPCO Automotive - Chevrolet: Chev G2500 Express 2WD Cargo, Chev G2500 Express 2WD Pass, Chev G2500 Express 2WD Pass MDPV, Chev G2500 Express Conv 2WD Carg, Chev G3500 Express 2WD Cargo, Chev G3500 Express 2WD Pass, Chev G3500 Express 2WD Pass MDPV, Chev G3500 Express Conv 2WD Carg IMPCO Automotive - General Motors: GMC G2500 Savana 2WD Cargo, GMC G2500 Savana 2WD Pass, GMC G2500 Savana 2WD Pass (MDPV), GMC G2500 Savana Cnv 2WD Car MDP, GMC G3500 Savana 2WD Cargo, GMC G3500 Savana 2WD Pass, GMC G3500 Savana 2WD Pass (MDPV), GMC G3500 Savana Conv 2WD Cargo	CNG	Gasoline	IMPCO Technologies, Inc.	FZ9XT06.0CDA-009, EO A-328-0071	FZ9XR0000CDA	FZ9XT06.0CDA	EPA, CARB
General Motors	2015	6.0	IMPCO Automotive - Chevrolet: Chev C25 Silverado 2WD, Chev C35 Silverado 2WD, Chev K25 Silverado 4WD, Chev K35 Silverado 4WD IMPCO Automotive - General Motors: GMC C25 Sierra 2WD, GMC C35 Sierra 2WD, GMC K25 Sierra 4WD, GMC K35 Sierra 4WD	CNG or gasoline	Gasoline	IMPCO Technologies, Inc.	FZ9XD06.0BC1-001, EO A-328-0066 EO A-328-0067 EO A-328-0068	FZ9XR0223841, FZ9XE06.0DCA	FZ9XD06.0BC1	EPA, CARB
General Motors	2015	6.0	IMPCO Automotive - Chevrolet: Chev C35 Silverado 2WD, Chev K35 Silverado 4WD IMPCO Automotive - General Motors: GMC C35 Sierra 2WD, GMC K35 Sierra 4WD	CNG or gasoline	Gasoline	IMPCO Technologies, Inc.	FZ9XD06.0BC2-002	FZ9XR0223842	FZ9XD06.0BC2	EPA
General Motors	2015	6.0	CK20: Chevrolet Silverado 2500HD, GMC Sierra 2500HD; CK30: Chevrolet Silverado 3500HD, GMC Sierra 3500HD; CK31: Chevrolet Silverado 3500 Cab Chassis, GMC Sierra 3500 Cab Chassis; G30: Chevrolet Express Commercial Cutaway 3500, GMC GMC Savana Special Cutaway 3500, Isuzu NPR ,Workhorse Custom Chassis P30, Freightlinder Chassis MT 45	CNG	Gasoline	Landi Renzo USA Corporation	EO A-400-0017	FLDRF0000000		EPA, CARB

Medium-duty NGV Aftermarket Retrofit Systems

OEM	Original Model Year	Eng Disp.	Conversion Models Covered	Converted to Operate On	Original Fuel	Conversion MFR	Conversion Certificate Number	Conversion Evap Family	Conversion Test Group	Com-pliance Status
Ford	2016	6.8	E-Series/G6.8DC2, 251 hp	CNG	Gasoline	IMPCO Technologies	Z9X-ONHWY-16-01, EO A-328-0075		GZ9XE06.8DC2	EPA, CARB
Ford	2016	6.8	E450 Incomplete/GE418N05, GE418M05, (228 for all codes)	CNG	Gasoline	Landi Renzo USA Corporation	EO A-400-0019		GLDRE06.8B10	CARB
Ford	2016	6.8	F-6501750 I GBC18A05 (253); Motor Home I GFA18Q05 (253); Motor Home I GFA18J05 (253); Step Van I GFA 18R05 (253); Step Van I GFA 18K05 (253)	CNG	Gasoline	Landi Renzo USA Corporation	EO A-400-0020		GLDRE06.8B10	CARB
Ford	2016	6.8	>14K#; V10/GBAF682V E series; 238 hp	CNG	Gasoline	Westport	EO A-426-0002		GBAFE06.8BWZ	CARB
General Motors	2016	6.0	IMPCO Automotive - Chevrolet: Chev C35 Silverado 2WD, Chev K35 Silverado 4WD IMPCO Automotive - General Motors: GMC C35 Sierra 2WD, GMC K35 Sierra 4WD	CNG	Gasoline	IMPCO Technologies	EO A-328-0078		GZ9XE06.8DCA	CARB
General Motors	2016	6.0	IMPCO Automotive - Chevrolet: Chev G4500 Express 2WD Cutaway IMPCO Automotive - General Motors: GMC G4500 Savana 2WD Cutaway	CNG	Gasoline	IMPCO Technologies, Inc.	EO A-328-0082	GZ9XR0000DCA	GZ9XD06.0DC2	EPA, CARB
General Motors	2016	6.0	NPR HD, FCCC MT45/55, GMC G4500 C/C	CNG	Gasoline	Landi Renzo USA Corporation	TBD			CARB
General Motors	2016	6.0	PSI CNG/Single Fuel CNG, 259 hp	CNG	Gasoline	Power Solutions International, Inc.	EO A-415-0005		GPSIE06.0CNG	CARB
General Motors	2016	8.8	PSI CNG 2351 Single Fuel CNG 235 (235); PSI CNG 200 I Single Fuel CNG 200 (200); PSI CNG 180 I Single Fuel CNG 180 (180)	CNG	Gasoline	Power Solutions International, Inc.	EO A-415-0007		GPSIE08.8CNG	CARB
Ford	2015	6.8	V-10/BAFA683C, 285 hp	CNG	Gasoline	BAF Technologies	EO A-364-0051		FBAFE06.83NN	CARB
Ford	2015	6.8	V-10/BAFA68C, 242 hp	CNG	Gasoline	BAF Technologies	EO A-364-0052		FBAFE06.89NN	CARB
Ford	2015	6.8	V10/DFA18N05 362 hp, V10	CNG	Gasoline	Greenkraft Inc	EO A-398-0012-1		FGKTE06.8FM1	CARB
Ford	2015	6.8	F-Series/FZ9X06.8F3, 308 hp	CNG	Gasoline	IMPCO Technologies	EO A-328-0069		FZ9XE06.8DC3	CARB

Ford	2015	6.8	E-Series/F6.8DC2 251 hp	CNG	Gasoline	IMPCO Technologies	EO A-328-0070		FZ9XE06.8DC2	CARB
Ford	2015	6.8	F450/550 Chassis Cab/FFA18N05, FFA18SOM; Step Van/DFA18R05, DFA18SO5; Motor Home/DFA18Q05; F650 Chassis Cab/DFA18A05 (362 for all codes)	CNG	Gasoline	Landi Renzo USA Corporation	EO A-400-0014		FLDRE06.8C10	CARB
General Motors	2015	6.0	V8/605851111 323, 322, 323, 323, 307 hp	CNG	Gasoline	Greenkraft Inc	EO A-398-0013-1		FGKTE06.0GM2	CARB
General Motors	2015	6.0	L96/40 (324 hp), LC8/45 (324 hp), L96/80 (293 hp), LC8/85 (293 hp)	CNG	Gasoline	Landi Renzo USA Corporation	EO A-400-0015		FLDRE06.0C10	CARB
General Motors	2015	6.0	L96/40 (324 hp), LC8/45 (324 hp), L96/80 (293 hp), LC8/85 (293 hp)	CNG	Gasoline	Landi Renzo USA Corporation	EO A-400-0017	FLDRF0000000	FLDRE06.0C11	CARB
General Motors	2015	8.0	V8 /285 hp	CNG	Gasoline	Greenkraft Inc	EO A-398-0020		GGKTE08.0GM8	CARB
General Motors	2015	8.8	PSI CNG 2351 Single Fuel CNG 235 (235); PSI CNG 200 I Single Fuel CNG 200 (200); PSI CNG 180 I Single Fuel CNG 180 (180)	CNG	Gasoline	Power Solutions International, Inc.	EO A-415-0003r1		GPSIE08.8CNG	CARB

Light-duty LPG Aftermarket retrofit Systems

OEM	Original Model Year	Eng Disp	Conversion Models Covered	Converted to Operate On	Original Fuel	Conversion MFR	Conversion Certificate Number	Conversion Evap Family	Conversion Test Group	Com-pliance Status
Ford	2016	3.5, 3.7	Blossman: EXPLORER 2WD, EXPLORER AWD, Police Interceptor Utility AWD	LPG or gasoline	Gasoline	Blossman Services, Inc.	GBLMT03.73DM-001	GBLMR0145GBV	GBLMT03.73DM	EPA
	2016	3.5, 3.7	Blossman: EXPLORER AWD, EXPLORER FWD, Interceptor Sedan AWD, Interceptor Sedan FWD, Police Interceptor Utility AWD, Taurus AWD, Taurus FWD	LPG or gasoline	Gasoline	Blossman Services, Inc.	GBLMT03.73E8-002	GBLMR0145GBV	GBLMT03.73E8	EPA
Ford	2016	3.5, 3.7	Ford: EXPLORER AWD, EXPLORER FFV 2WD, EXPLORER FFV AWD, EXPLORER FWD, Police Interceptor Utility AWD, Police Interceptor UtilityFFVAWD	LPG or gasoline	Gasoline	Icom North America LLC	GICMT03.76B5-002-R01	GICMR0145GBV	GICMT03.76B5	EPA
Ford	2016	3.5, 3.7	Ford: EXPLORER AWD, FLEX AWD, Police Interceptor Sedan AWD, Police Interceptor Sedan FFV AWD, Police Interceptor Sedan FFV FWD, Police Interceptor Utility AWD, TAURUS AWD, TAURUS AWD FFV, TAURUS FWD FFV Lincoln Truck: MKS AWD, MKT AWD	LPG or gasoline	Gasoline	Icom North America LLC	GICMV03.76B5-001-R01	GICMR0145GBV	GICMV03.76B5	EPA
Ford	2016	3.5, 3.7	Lincoln Truck: MKZ AWD, MKZ FWD	LPG or gasoline	Gasoline	Icom North America LLC	GICMV03.76B5-003	GICMR0125NBV	GICMV03.76B5	EPA
Ford	2016	3.7	Blossman: Transit T250 CUTAWAY 2WD, Transit T250 Chassis Cab 2WD, Transit T350 CUTAWAY 2WD, Transit T350 Chassis Cab 2WD	LPG or gasoline	Gasoline	Blossman Services, Inc.	GBLMD03.76BG-004	GBLMF0190NBS	GBLMD03.76BG	EPA
Ford	2016	3.7	Blossman: TRANSIT T150 VAN, Transit T250 Van 2WD, Transit T250 Wagon 2WD, Transit T350 VAN 2WD, Transit T350 Wagon 2WD	LPG or gasoline	Gasoline	Blossman Services, Inc.	GBLMD03.76BG-005	GBLMR0190NBD	GBLMD03.76BG	EPA
Ford	2016	3.7	Blossman: TRANSIT T150 VAN, TRANSIT T250 VAN, TRANSIT T350 VAN, Transit T350 Wagon	LPG or gasoline	Gasoline	Blossman Services, Inc.	GBLMD03.76BX-006	GBLMR0190NBD	GBLMD03.76BX	EPA
Ford	2016	3.7	Blossman: Transit T250 CUTAWAY, Transit T250 Chassis Cab, Transit T350 CUTAWAY, Transit T350 Chassis Cab	LPG or gasoline	Gasoline	Blossman Services, Inc.	GBLMD03.76BX-007	GBLMF0190NBS	GBLMD03.76BX	EPA
Ford	2016	3.7	Blossman: Transit T350 CUTAWAY, Transit T350 Chassis Cab	LPG or gasoline	Gasoline	Blossman Services, Inc.	GBLMD03.77BX-003	GBLMF0190NBS	GBLMD03.77BX	EPA

Ford	2016	3.7	Blossman: Transit T150 Wagon	LPG or gasoline	Gasoline	Blossman Services, Inc.	GBLMT03.75HG-008	GBLMR0190NBD	GBLMT03.75HG	EPA
Ford	2016	3.7	Ford: Transit T150 Wagon FFV	LPG or gasoline	Gasoline	Icom North America LLC	GICMT03.76DF-008	GICMR0190NBD	GICMT03.76DF	EPA
Ford	2016	3.7	Ford: Transit T150 Wagon FFV	LPG or gasoline	Gasoline	Icom North America LLC	GICMT03.76MF-009	GICMR0190NBD	GICMT03.76MF	EPA
Ford	2016	5.0	Ford: F150 2WD FFV HD PAYLOAD GVWR 760, F150 4WD FFV HD PAYLOAD GVWR 760, F150 PICKUP 2WD FFV, F150 PICKUP 4WD FFV	LPG or gasoline	Gasoline	Icom North America LLC	GICMT05.06B4-006	GICMR0160ABC	GICMT05.06B4	EPA
Ford	2016	5.0	Ford: F150 2WD FFV HD PAYLOAD GVWR 760, F150 4WD FFV HD PAYLOAD GVWR 760, F150 PICKUP 2WD FFV, F150 PICKUP 4WD FFV	LPG or gasoline	Gasoline	Icom North America LLC	GICMT05.06B4-007	GICMR0235NBC	GICMT05.06B4	EPA
Ford	2016	5.0	IMPCO Automotive - Ford: Ford F150 2WD, Ford F150 2WD HD, Ford F150 4WD, Ford F150 4WD HD	LPG or gasoline	Gasoline	IMPCO Technologies, Inc.	GZ9XT05.0BPE-022	GZ9XR0160BPA	GZ9XT05.0BPE	EPA
Ford	2016	5.0	IMPCO Automotive - Ford: Ford F150 2WD, Ford F150 2WD HD, Ford F150 4WD, Ford F150 4WD HD	LPG or gasoline	Gasoline	IMPCO Technologies, Inc.	GZ9XT05.0BPE-023	GZ9XR0235BPB	GZ9XT05.0BPE	EPA
Ford	2016	5.0	BAF Technologies: F150	LPG	Gasoline	Westport	GBAFT05.0LPG-012	GBAFR000000L	GBAFT05.0LPG	EPA
Ford	2016	6.2	Ford: F250 PICKUP 2WD FFV, F250 PICKUP 4WD FFV, F350 PICKUP 2WD FFV, F350 PICKUP 4WD FFV	LPG or gasoline	Gasoline	Icom North America LLC	GICMD06.26LT-021	GICMR0250NBS	GICMD06.26LT	EPA
Ford	2016	6.2	Ford: F250 2WD BED DELETE FFV, F350 2WD BED DELETE FFV, F350 4WD BED DELETE FFV	LPG or gasoline	Gasoline	Icom North America LLC	GICMD06.26LT-022	GICMF0250NBS	GICMD06.26LT	EPA
Ford	2016	6.2	Ford: F350 INCOMPLETE 2WD FFV, F350 INCOMPLETE 4WD FFV	LPG or gasoline	Gasoline	Icom North America LLC	GICMD06.26LT-023	GICMF0265NAS	GICMD06.26LT	EPA
Ford	2016	6.2	Ford: F350 PICKUP 2WD FFV, F350 PICKUP 4WD FFV	LPG or gasoline	Gasoline	Icom North America LLC	GICMD06.27HV-024	GICMR0250NBS	GICMD06.27HV	EPA
Ford	2016	6.2	Ford: F350 2WD BED DELETE FFV, F350 4WD BED DELETE FFV	LPG or gasoline	Gasoline	Icom North America LLC	GICMD06.27HV-025	GICMF0250NBS	GICMD06.27HV	EPA
Ford	2016	6.2	Ford: F350 INCOMPLETE 2WD FFV, F350 INCOMPLETE 4WD FFV	LPG or gasoline	Gasoline	Icom North America LLC	GICMD06.27HV-026	GICMF0265NAS	GICMD06.27HV	EPA
Ford	2016	6.2	IMPCO Automotive - Ford: Ford F250 2WD Bed Delete, Ford F250 4WD Bed Delete, Ford F350 2WD Bed Delete, Ford F350 4WD Bed Delete	LPG or gasoline	Gasoline	IMPCO Technologies, Inc.	GZ9XD06.2BP1-011-R01	GZ9XF0250BPA	GZ9XD06.2BP1	EPA
Ford	2016	6.2	IMPCO Automotive - Ford: Ford F350 INCOMPLETE 2WD, Ford F350 INCOMPLETE 4WD	LPG or gasoline	Gasoline	IMPCO Technologies, Inc.	GZ9XD06.2BP1-012	GZ9XF0265BPB	GZ9XD06.2BP1	EPA

Ford	2016	6.2	IMPCO Automotive - Ford: Ford F250 PICKUP 2WD, Ford F250 PICKUP 4WD, Ford F350 2WD, Ford F350 4WD	LPG or gasoline	Gasoline	IMPCO Technologies, Inc.	GZ9XD06.2BP1-013	GZ9XR0250BPC	GZ9XD06.2BP1	EPA
Ford	2016	6.2	IMPCO Automotive - Ford: Ford F350 2WD Bed Delete, Ford F350 4WD Bed Delete	LPG or gasoline	Gasoline	IMPCO Technologies, Inc.	GZ9XD06.2BP2-014	GZ9XF0250BPA	GZ9XD06.2BP2	EPA
Ford	2016	6.2	IMPCO Automotive - Ford: Ford F350 INCOMPLETE 2WD, Ford F350 INCOMPLETE 4WD	LPG or gasoline	Gasoline	IMPCO Technologies, Inc.	GZ9XD06.2BP2-015	GZ9XF0265BPB	GZ9XD06.2BP2	EPA
Ford	2016	6.2	IMPCO Automotive - Ford: Ford F350 2WD, Ford F350 4WD	LPG or gasoline	Gasoline	IMPCO Technologies, Inc.	GZ9XD06.2BP2-016	GZ9XR0250BPC	GZ9XD06.2BP2	EPA
Ford	2016	6.2	Roush Industries, Inc.: F250 2WD Bed Delete LPG, F250 4WD Bed Delete LPG, F350 2WD Bed Delete LPG, F350 2WD LPG, F350 4WD Bed Delete LPG, F350 4WD LPG	LPG	Gasoline	Roush Industries, Inc.	GRIID06.26LT-002	GRIIF0250LPG	GRIID06.26LT	EPA
Ford	2016	6.2	Roush Industries, Inc.: F350 2WD Incomplete LPG, F350 4WD Incomplete LPG	LPG	Gasoline	Roush Industries, Inc.	GRIID06.26LT-003	GRIIF0265LPG	GRIID06.26LT	EPA
Ford	2016	6.2	Roush Industries, Inc.: F250 2WD PICKUP LPG, F250 4WD PICKUP LPG, F350 2WD LPG, F350 4WD LPG	LPG	Gasoline	Roush Industries, Inc.	GRIID06.26LT-004	GRIIR0250LPG	GRIID06.26LT	EPA
General Motors	2016	5.3	Auto Gas America: Chevrolet C1500 TAHOE 2WD, Chevrolet K15 SILVERADO 4WD, Chevrolet K1500 TAHOE 4WD, Chevy C15 Silverado 2WD, GMC C15 SIERRA 2WD, GMC C1500 YUKON 2WD, GMC K15 SIERRA 4WD, GMC K1500 YUKON 4WD	LPG	Gasoline	AGA Systems, LLC	GAGTT05.3001-010	GAGTR0176821	GAGTT05.3001	EPA
General Motors	2016	5.3	Auto Gas America: C15 SILVERADO 2WD CAB CHASSIS, Chevrolet C1500 SUBURBAN 2WD, Chevrolet K15 SILVERADO 4WD, Chevrolet K1500 SUBURBAN 4WD, Chevy C15 Silverado 2WD, GMC C15 SIERRA 2WD, GMC C15 SIERRA 2WD CAB CHASSIS, GMC C1500 YUKON XL 2WD, GMC K15 SIERRA 4WD, GMC K15 SIERRA 4WD CAB CHASSIS, GMC K1500 YUKON XL 4WD, K15 SILVERADO 4WD CAB CHASSIS	LPG	Gasoline	AGA Systems, LLC	GAGTT05.3001-011	GAGTR0223841	GAGTT05.3001	EPA
General Motors	2016	6.0	Chevrolet: G3500 EXPRESS 2WD CUTAWAY CH GMC: G3500 SAVANA 2WD CUTAWAY CH	LPG	Gasoline	CleanFuel USA Inc.	GCLFD06.0250-007	GCLFF0176860	GCLFD06.0250	EPA

General Motors	2016	6.0	Chevrolet: G2500 EXPRESS 2WD CARGO, G2500 EXPRESS 2WD PASS, G3500 EXPRESS 2WD CARGO, G3500 EXPRESS 2WD PASS GMC: G2500 SAVANA 2WD CARGO, G2500 SAVANA 2WD PASS, G3500 SAVANA 2WD CARGO, G3500 SAVANA 2WD PASS	LPG	Gasoline	CleanFuel USA Inc.	GCLFD06.0250-008	GCLFR0223841	GCLFD06.0250	EPA
General Motors	2016	6.0	Chevrolet: C25 SILVERADO 2WD, C35 SILVERADO 2WD, K25 SILVERADO 4WD, K35 SILVERADO 4WD GMC: C25 SIERRA 2WD, C35 SIERRA 2WD, K25 SIERRA 4WD, K35 SIERRA 4WD	LPG	Gasoline	CleanFuel USA Inc.	GCLFD06.0395-005	GCLFF0223850	GCLFD06.0395	EPA
General Motors	2016	6.0	Chevrolet: C25 SILVERADO 2WD, C35 SILVERADO 2WD, G2500 EXPRESS 2WD CARGO, G2500 EXPRESS 2WD PASS, G3500 EXPRESS 2WD CARGO, G3500 EXPRESS 2WD PASS, K25 SILVERADO 4WD, K35 SILVERADO 4WD GMC: C25 SIERRA 2WD, C35 SIERRA 2WD, G2500 SAVANA 2WD CARGO, G2500 SAVANA 2WD PASS, G3500 SAVANA 2WD CARGO, G3500 SAVANA 2WD PASS, K25 SIERRA 4WD, K35 SIERRA 4WD	LPG	Gasoline	CleanFuel USA Inc.	GCLFD06.0395-006-R01	GCLFR0223841	GCLFD06.0395	EPA
General Motors	2016	6.0	Chevrolet: G3500 EXPRESS 2WD CUTAWAY CH GMC: G3500 SAVANA 2WD CUTAWAY CH	LPG	Gasoline	CleanFuel USA Inc.	GCLFD06.0395-009	GCLFF0176860	GCLFD06.0395	EPA
General Motors	2016	6.0	Chevrolet: G3500 EXPRESS 2WD CUTAWAY CH GMC: G3500 SAVANA 2WD CUTAWAY CH	LPG	Gasoline	CleanFuel USA Inc.	GCLFD06.0400-001-R01	GCLFF0176860	GCLFD06.0400	EPA
General Motors	2016	6.0	Chevrolet: C35 CHEV CAB CHASSIS 2WD, C35 SILVERADO 2WD, K35 CHEV CAB CHASSIS 4WD, K35 SILVERADO 4WD GMC: C35 GMC CAB CHASSIS 2WD, C35 SIERRA 2WD, K35 GMC CAB CHASSIS 4WD, K35 SIERRA 4WD	LPG	Gasoline	CleanFuel USA Inc.	GCLFD06.0400-002	GCLFF0223850	GCLFD06.0400	EPA
General Motors	2016	6.0	Chevrolet: K35 SUBURBAN 4WD	LPG	Gasoline	CleanFuel USA Inc.	GCLFD06.0400-003	GCLFR0260843	GCLFD06.0400	EPA
General Motors	2016	6.0	Chevrolet: C35 SILVERADO 2WD, K35 SILVERADO 4WD GMC: C35 SIERRA 2WD, K35 SIERRA 4WD	LPG	Gasoline	CleanFuel USA Inc.	GCLFD06.0400-004	GCLFR0223842	GCLFD06.0400	EPA

General Motors	2016	6.0	Chevrolet: G2500 EXPRESS 2WD CARGO, G2500 EXPRESS 2WD PASS, G3500 EXPRESS 2WD CARGO, G3500 EXPRESS 2WD PASS GMC: G2500 SAVANA 2WD CARGO, G2500 SAVANA 2WD PASS, G3500 SAVANA 2WD CARGO, G3500 SAVANA 2WD PASS	LPG or gasoline	Gasoline	Icom North America LLC	GICMD06.0250-019	GICMR0223841	GICMD06.0250	EPA
General Motors	2016	6.0	Chevrolet: G3500 EXPRESS 2WD CUTAWAY CH GMC: G3500 SAVANA 2WD CUTAWAY CH	LPG or gasoline	Gasoline	Icom North America LLC	GICMD06.0250-020	GICMF0176860	GICMD06.0250	EPA
General Motors	2016	6.0	Chevrolet: C25 SILVERADO 2WD, C35 SILVERADO 2WD, K25 SILVERADO 4WD, K35 SILVERADO 4WD GMC: C25 SIERRA 2WD, C35 SIERRA 2WD, K25 SIERRA 4WD, K35 SIERRA 4WD	LPG or gasoline	Gasoline	Icom North America LLC	GICMD06.0395-016-R01	GICMF0223850	GICMD06.0395	EPA
General Motors	2016	6.0	Chevrolet: C25 SILVERADO 2WD, C35 SILVERADO 2WD, G2500 EXPRESS 2WD CARGO, G2500 EXPRESS 2WD PASS, G3500 EXPRESS 2WD CARGO, G3500 EXPRESS 2WD PASS, K25 SILVERADO 4WD, K35 SILVERADO 4WD GMC: C25 SIERRA 2WD, C35 SIERRA 2WD, G2500 SAVANA 2WD CARGO, G2500 SAVANA 2WD PASS, G3500 SAVANA 2WD CARGO, G3500 SAVANA 2WD PASS, K25 SIERRA 4WD, K35 SIERRA 4WD	LPG or gasoline	Gasoline	Icom North America LLC	GICMD06.0395-017-R01	GICMR0223841	GICMD06.0395	EPA
General Motors	2016	6.0	Chevrolet: G3500 EXPRESS 2WD CUTAWAY CH GMC: G3500 SAVANA 2WD CUTAWAY CH	LPG or gasoline	Gasoline	Icom North America LLC	GICMD06.0395-018-R01	GICMF0176860	GICMD06.0395	EPA
General Motors	2016	6.0	Chevrolet: C25 SIERRA 2WD, C25 SILVERADO 2WD, C35 SILVERADO 2WD, K25 SILVERADO 4WD, K35 SILVERADO 4WD GMC: C35 SIERRA 2WD, K25 SIERRA 4WD, K35 SIERRA 4WD	LPG or gasoline	Gasoline	Icom North America LLC	GICMD06.0397-015	GICMR0223841	GICMD06.0397	EPA
General Motors	2016	6.0	Chevrolet: C35 SILVERADO 2WD, K35 SILVERADO 4WD GMC: C35 SIERRA 2WD, K35 SIERRA 4WD	LPG or gasoline	Gasoline	Icom North America LLC	GICMD06.0399-014	GICMR0223842	GICMD06.0399	EPA
General Motors	2016	6.0	Chevrolet: G3500 EXPRESS 2WD CUTAWAY CH GMC: G3500 SAVANA 2WD CUTAWAY CH	LPG or gasoline	Gasoline	Icom North America LLC	GICMD06.0400-010	GICMF0176860	GICMD06.0400	EPA

General Motors	2016	6.0	Chevrolet: C35 CHEV CAB CHASSIS 2WD, C35 SILVERADO 2WD, K35 CHEV CAB CHASSIS 4WD, K35 SILVERADO 4WD GMC: C35 GMC CAB CHASSIS 2WD, C35 SIERRA 2WD, K35 GMC CAB CHASSIS 4WD, K35 SIERRA 4WD	LPG or gasoline	Gasoline	Icom North America LLC	GICMD06.0400-011	GICMF0223850	GICMD06.0400	EPA
General Motors	2016	6.0	Chevrolet: K35 SUBURBAN 4WD	LPG or gasoline	Gasoline	Icom North America LLC	GICMD06.0400-012	GICMR0260843	GICMD06.0400	EPA
General Motors	2016	6.0	Chevrolet: C35 SILVERADO 2WD, K35 SILVERADO 4WD GMC: C35 SIERRA 2WD, K35 SIERRA 4WD	LPG or gasoline	Gasoline	Icom North America LLC	GICMD06.0400-013	GICMR0223842	GICMD06.0400	EPA
General Motors	2016	6.0	IMPCO Automotive - Chevrolet: Chev C25 Silverado 2WD, Chev C35 Silverado 2WD, Chev K25 Silverado 4WD, Chev K35 Silverado 4WD IMPCO Automotive - General Motors: GMC C25 Sierra 2WD, GMC C35 Sierra 2WD, GMC K25 Sierra 4WD, GMC K35 Sierra 4WD	LPG or gasoline	Gasoline	IMPCO Technologies, Inc.	GZ9XD06.0BP1-024	GZ9XR0223BP1	GZ9XD06.0BP1	EPA
FCA US LLC	2015	3.2, 3.6	Blossman: 200, 200 AWD	LPG or gasoline	Gasoline	Blossman Services, Inc.	FBLMJ03.65P0-015-R01	FBLMR0116PK0	FBLMJ03.65P0	EPA
FCA US LLC	2015	3.2, 3.6	Blossman: Wrangler 4X4	LPG or gasoline	Gasoline	Blossman Services, Inc.	FBLMJ03.65P0-016-R01	FBLMR0150PK0	FBLMJ03.65P0	EPA
FCA US LLC	2015	3.2, 3.6	Blossman: Journey AWD	LPG or gasoline	Gasoline	Blossman Services, Inc.	FBLMJ03.65P0-017-R01	FBLMR0153PK0	FBLMJ03.65P0	EPA
FCA US LLC	2015	3.2, 3.6	Blossman: Wrangler Unlimited 4X4	LPG or gasoline	Gasoline	Blossman Services, Inc.	FBLMJ03.65P0-018-R01	FBLMR0170PK0	FBLMJ03.65P0	EPA
FCA US LLC	2015	3.2, 3.6	Blossman: Cherokee 4X4, Cherokee 4x4 Active Drive II, Cherokee FWD, Cherokee Trailhawk 4X4	LPG or gasoline	Gasoline	Blossman Services, Inc.	FBLMJ03.65P0-019-R01	FBLMR0116PK1	FBLMJ03.65P0	EPA
FCA US LLC	2015	3.2, 3.6	Blossman: C/V Tradesman, Grand Caravan, Town & Country	LPG or gasoline	Gasoline	Blossman Services, Inc.	FBLMJ03.65P0-020-R01	FBLMR0150RK0	FBLMJ03.65P0	EPA
FCA US LLC	2015	3.2, 3.6	Blossman: 300, 300 AWD, Challenger, Charger, Charger AWD	LPG or gasoline	Gasoline	Blossman Services, Inc.	FBLMJ03.65P0-021	FBLMR0145PK0	FBLMJ03.65P0	EPA
FCA US LLC	2015	3.2, 3.6	Chrysler: 200, 200 AWD	LPG or gasoline	Gasoline	Imega International USA	FIMIT03.65B4-001	FIMIR0116PK0	FIMIT03.65B4	EPA
FCA US LLC	2015	3.2, 3.6	Chrysler: 200, 200 AWD	LPG or gasoline	Gasoline	Imega International USA	FIMIT03.65B4-002	FIMIR0116PKA	FIMIT03.65B4	EPA
FCA US LLC	2015	3.2, 3.6	Dodge: Journey AWD	LPG or gasoline	Gasoline	Imega International USA	FIMIT03.65B4-003	FIMIR0153PK0	FIMIT03.65B4	EPA

FCA US LLC	2015	3.2, 3.6	Chrysler: Town & Country Dodge: Grand Caravan Ram: C/V Tradesman	LPG or gasoline	Gasoline	Imega International USA	FIMIT03.65B4-004	FIMIR0150RK0	FIMIT03.65B4	EPA
FCA US LLC	2015	3.2, 3.6	Chrysler: Town & Country Dodge: Grand Caravan Ram: C/V Tradesman	LPG or gasoline	Gasoline	Imega International USA	FIMIT03.65B4-005	FIMIR0150RKA	FIMIT03.65B4	EPA
FCA US LLC	2015	3.6	Blossman: C/V Tradesman, Grand Caravan, Town & Country	LPG or gasoline	Gasoline	Blossman Services, Inc.	FBLMJ03.65PA-011	FBLMR0150RKA	FBLMJ03.65PA	EPA
FCA US LLC	2015	3.6	Blossman: Journey	LPG or gasoline	Gasoline	Blossman Services, Inc.	FBLMJ03.65PA-012	FBLMR0153PKA	FBLMJ03.65PA	EPA
FCA US LLC	2015	3.6	Blossman: 200, 200 AWD	LPG or gasoline	Gasoline	Blossman Services, Inc.	FBLMJ03.65PA-013	FBLMR0116PKA	FBLMJ03.65PA	EPA
FCA US LLC	2015	3.6	Blossman: 300, 300 AWD, Charger, Charger AWD	LPG or gasoline	Gasoline	Blossman Services, Inc.	FBLMJ03.65PA-014-R01	FBLMR0145PKA	FBLMJ03.65PA	EPA
FCA US LLC	2015	5.7	Blossman: 300, Challenger, Charger, Charger AWD	LPG or gasoline	Gasoline	Blossman Services, Inc.	GBLMV05.75P1-009	GBLMR0145PK0	GBLMV05.75P1	EPA
Ford	2015	3.5, 3.7	Blossman: EXPLORER AWD, EXPLORER FWD, Police Interceptor Sedan AWD, Police Interceptor Sedan FWD, Police Interceptor Utility AWD, Police Interceptor Utility FWD, Taurus AWD, Taurus FWD	LPG or gasoline	Gasoline	Blossman Services, Inc.	FBLMT03.73EF-010	FBLMR0145GBV	FBLMT03.73EF	EPA
Ford	2015	3.5, 3.7	Blossman: EXPLORER 2WD, EXPLORER AWD, Police Interceptor Utility AWD, Police Interceptor Utility FWD	LPG or gasoline	Gasoline	Blossman Services, Inc.	FBLMT03.73DF-008-R01	FBLMR0145GBV	FBLMT03.73DF	EPA
Ford	2015	3.5, 3.7	Blossman: MKX AWD, MKX FWD	LPG or gasoline	Gasoline	Blossman Services, Inc.	FBLMT03.73DF-009-R01	FBLMR0145ABB	FBLMT03.73DF	EPA
Ford	2015	3.5, 3.7	Ford: EXPLORER AWD, EXPLORER FFV 2WD, EXPLORER FFV AWD, EXPLORER FWD, Police Interceptor Utility AWD, Police Interceptor Utility FWD, Police Interceptor UtilityFFVAWD, Police Interceptor UtilityFFVFWD	LPG or gasoline	Gasoline	Icom North America LLC	FICMT03.75B5-012	FICMR0145GBV	FICMT03.75B5	EPA
Ford	2015	3.5, 3.7	Lincoln Truck: MKZ AWD, MKZ FWD	LPG or gasoline	Gasoline	Icom North America LLC	FICMV03.75B5-010	FICMR0125NBV	FICMV03.75B5	EPA

Ford	2015	3.5, 3.7	Ford: EXPLORER AWD, FLEX AWD, Flex FWD, Police Interceptor Sedan AWD, Police Interceptor Sedan FFV AWD, Police Interceptor Sedan FFV FWD, Police Interceptor Sedan FWD, Police Interceptor Utility AWD, TAURUS AWD, TAURUS FWD, Taurus AWD FFV, Taurus FWD FFV Lincoln Truck: MKS AWD, MKS FWD, MKT AWD, MKT FWD, MKT LIVERY AWD	LPG or gasoline	Gasoline	Icom North America LLC	FICMV03.75B5-011	FICMR0145GBV	FICMV03.75B5	EPA
Ford	2015	3.7	Blossman: Transit T150 Van, Transit T150 Wagon, Transit T250 Van 2WD, Transit T250 Wagon 2WD, Transit T350 Van 2WD, Transit T350 Wagon 2WD	LPG or gasoline	Gasoline	Blossman Services, Inc.	FBLMT03.76BF-003-R01	FBLMR0190NBD	FBLMT03.76BF	EPA
Ford	2015	3.7	Blossman: Transit T250 Chassis Cab 2WD, Transit T250 Cutaway 2WD, Transit T350 Chassis Cab 2WD, Transit T350 Cutaway 2WD	LPG or gasoline	Gasoline	Blossman Services, Inc.	FBLMT03.76BF-004-R01	FBLMF0190NBS	FBLMT03.76BF	EPA
Ford	2015	3.7	Ford: Transit T250 CUTAWAY 2WD FFV, Transit T250 Chassis Cab 2WD FFV, Transit T350 CUTAWAY 2WD FFV, Transit T350 Chassis Cab 2WD FFV	LPG or gasoline	Gasoline	Icom North America LLC	FICMT03.75DF-019	FICMF0190NBS	FICMT03.75DF	EPA
Ford	2015	3.7	Ford: Transit T150 Van FFV, Transit T150 Wagon FFV, Transit T250 Van 2WD FFV, Transit T250 Wagon 2WD FFV, Transit T350 VAN 2WD FFV, Transit T350 Wagon 2WD FFV	LPG or gasoline	Gasoline	Icom North America LLC	FICMT03.75DF-020	FICMR0190NBD	FICMT03.75DF	EPA
Ford	2015	3.7	Ford: Transit T250 CUTAWAY 2WD FFV, Transit T250 Chassis Cab 2WD FFV, Transit T350 CUTAWAY 2WD FFV, Transit T350 Chassis Cab 2WD FFV	LPG	Gasoline	Icom North America LLC	FICMT03.75MF-017	FICMF0190NAS	FICMT03.75MF	EPA
Ford	2015	3.7	Ford: Transit T150 Van FFV, Transit T150 Wagon FFV, Transit T250 Van 2WD FFV, Transit T250 Wagon 2WD FFV, Transit T350 VAN 2WD FFV, Transit T350 Wagon 2WD FFV	LPG	Gasoline	Icom North America LLC	FICMT03.75MF-018	FICMR0190NAD	FICMT03.75MF	EPA
Ford	2015	5.0	Ford: F150 PICKUP 2WD FFV, F150 PICKUP 4WD FFV	LPG or gasoline	Gasoline	Icom North America LLC	GICMT05.05B4-004	GICMR0160ABC	GICMT05.05B4	EPA
Ford	2015	5.0	Ford: F150 PICKUP 2WD FFV, F150 PICKUP 4WD FFV	LPG or gasoline	Gasoline	Icom North America LLC	GICMT05.05B4-005	GICMR0235NBC	GICMT05.05B4	EPA

Ford	2015	6.2	Blossman: F250 Pickup 2WD, F250 Pickup 4WD, F350 Pickup 2WD, F350 Pickup 4WD	LPG or gasoline	Gasoline	Blossman Services, Inc.	FBLMT06.27HL-024	FBLMR0250NBS	FBLMT06.27HL	EPA
Ford	2015	6.2	Blossman: F250 2WD Bed Delete, F250 4WD Bed Delete, F350 4WD Bed Delete, F350 2WD Bed Delete, F350 Pickup 2WD, F350 Pickup 4WD	LPG or gasoline	Gasoline	Blossman Services, Inc.	FBLMT06.27HL-025	FBLMF0250NBS	FBLMT06.27HL	EPA
Ford	2015	6.2	Blossman: F350 Incomplete 2WD, F350 Incomplete 4WD	LPG or gasoline	Gasoline	Blossman Services, Inc.	FBLMT06.27HL-026	FBLMF0265NAS	FBLMT06.27HL	EPA
Ford	2015	6.2	Ford: F250 PICKUP 2WD, F250 PICKUP 4WD, F350 Pickup 2WD, F350 Pickup 4WD	LPG or gasoline	Gasoline	Icom North America LLC	FICMT06.25DF-001	FICMR0250NBS	FICMT06.25DF	EPA
Ford	2015	6.2	Ford: F350 INCOMPLETE 2WD, F350 INCOMPLETE 4WD	LPG or gasoline	Gasoline	Icom North America LLC	FICMT06.25DF-002	FICMF0265NAS	FICMT06.25DF	EPA
Ford	2015	6.2	Ford: F250 2WD BED DELETE, F250 4WD BED DELETE, F350 2WD BED DELETE, F350 4WD BED DELETE, F350 Pickup 2WD, F350 Pickup 4WD	LPG or gasoline	Gasoline	Icom North America LLC	FICMT06.25DF-003	FICMF0250NBS	FICMT06.25DF	EPA
Ford	2015	6.2	Ford: F250 PICKUP 2WD, F250 PICKUP 4WD, F350 Pickup 2WD, F350 Pickup 4WD	LPG	Gasoline	Icom North America LLC	FICMT06.25MF-004	FICMR0250NBS	FICMT06.25MF	EPA
Ford	2015	6.2	Ford: F350 INCOMPLETE 2WD, F350 INCOMPLETE 4WD	LPG	Gasoline	Icom North America LLC	FICMT06.25MF-005	FICMF0265NAS	FICMT06.25MF	EPA
Ford	2015	6.2	Ford: F250 2WD BED DELETE, F250 4WD BED DELETE, F350 2WD BED DELETE, F350 4WD BED DELETE, F350 Pickup 2WD, F350 Pickup 4WD	LPG	Gasoline	Icom North America LLC	FICMT06.25MF-006	FICMF0250NBS	FICMT06.25MF	EPA
Ford	2015	6.2	IMPCO Automotive - Ford: Ford F250 2WD Bed Delete, Ford F250 4WD Bed Delete, Ford F350 2WD, Ford F350 2WD Bed Delete, Ford F350 4WD, Ford F350 4WD Bed Delete	LPG or gasoline	Gasoline	IMPCO Technologies, Inc.	FZ9XT06.2BPE-006	FZ9XF0250BPA	FZ9XT06.2BPE	EPA
Ford	2015	6.2	IMPCO Automotive - Ford: Ford F350 INCOMPLETE 2WD, Ford F350 INCOMPLETE 4WD	LPG or gasoline	Gasoline	IMPCO Technologies, Inc.	FZ9XT06.2BPE-007	FZ9XF0265BPB	FZ9XT06.2BPE	EPA
Ford	2015	6.2	IMPCO Automotive - Ford: Ford F250 PICKUP 2WD, Ford F250 PICKUP 4WD, Ford F350 2WD, Ford F350 4WD	LPG or gasoline	Gasoline	IMPCO Technologies, Inc.	FZ9XT06.2BPE-008	FZ9XR0250BPC	FZ9XT06.2BPE	EPA
Ford	2015	6.2	Roush Industries, Inc.: F250 2WD PICKUP LPG, F250 4WD PICKUP LPG, F350 2WD LPG, F350 4WD LPG	LPG	Gasoline	Roush Industries, Inc.	FRIIT06.27HL-001	FRIIR0250LPG	FRIIT06.27HL	EPA

Ford	2015	6.2	Roush Industries, Inc.: F250 2WD Bed Delete LPG, F250 4WD Bed Delete LPG, F350 2WD Bed Delete LPG, F350 2WD LPG, F350 4WD Bed Delete LPG, F350 4WD LPG	LPG	Gasoline	Roush Industries, Inc.	FRIIT06.27HL-002	FRIIF0250LPG	FRIIT06.27HL	EPA
Ford	2015	6.2	Roush Industries, Inc.: F350 2WD Incomplete LPG, F350 4WD Incomplete LPG	LPG	Gasoline	Roush Industries, Inc.	FRIIT06.27HL-003	FRIIF0265LPG	FRIIT06.27HL	EPA
General Motors	2015	6.0	Chevrolet: C25 SIERRA 2WD, C25 SILVERADO 2WD, C35 SILVERADO 2WD, K25 SILVERADO 4WD, K35 SILVERADO 4WD GMC: C35 SIERRA 2WD, K25 SIERRA 4WD, K35 SIERRA 4WD	LPG	Gasoline	CleanFuel USA Inc.	FCLFD06.0397-004	FCLFR0223841	FCLFD06.0397	EPA
General Motors	2015	6.0	Chevrolet: C35 SILVERADO 2WD, K35 SILVERADO 4WD GMC: C35 SIERRA 2WD, K35 SIERRA 4WD	LPG	Gasoline	CleanFuel USA Inc.	FCLFD06.0399-003	FCLFR0223842	FCLFD06.0399	EPA
General Motors	2015	6.0	IMPCO Automotive - Chevrolet: Chev C25 Silverado 2WD, Chev C35 Silverado 2WD, Chev K25 Silverado 4WD, Chev K35 Silverado 4WD IMPCO Automotive - General Motors: GMC C25 Sierra 2WD, GMC C35 Sierra 2WD, GMC K25 Sierra 4WD, GMC K35 Sierra 4WD	LPG or gasoline	Gasoline	IMPCO Technologies, Inc.	FZ9XD06.0BP1-003	FZ9XR0223BP1	FZ9XD06.0BP1	EPA
General Motors	2015	6.0	IMPCO Automotive - Chevrolet: Chev C35 Silverado 2WD, Chev K35 Silverado 4WD IMPCO Automotive - General Motors: GMC C35 Sierra 2WD, GMC K35 Sierra 4WD	LPG or gasoline	Gasoline	IMPCO Technologies, Inc.	FZ9XD06.0BP2-004	FZ9XR0223BP2	FZ9XD06.0BP2	EPA
General Motors	2015	6.0, 4.8	Chevrolet: G2500 EXPRESS 2WD CARGO, G2500 EXPRESS 2WD PASS, G2500 EXPRESS 2WD PASS MDPV, G2500 EXPRESS CONV 2WD CARGOMDPV, G3500 EXPRESS 2WD CARGO, G3500 EXPRESS 2WD PASS, G3500 EXPRESS 2WD PASS MDPV GMC: G2500 SAVANA 2WD CARGO, G2500 SAVANA 2WD PASS, G2500 SAVANA 2WD PASS MDPV, G2500 SAVANA CONV 2WD CARGO MDPV, G3500 SAVANA 2WD CARGO, G3500 SAVANA 2WD PASS, G3500 SAVANA 2WD PASS MDPV	LPG	Gasoline	CleanFuel USA Inc.	FCLFT06.05B8-001	FCLFR0223841	FCLFT06.05B8	EPA

Medium-duty LPG Aftermarket Retrofit Systems

OEM	Eng Disp (L)	Converted to Operate On	Original Fuel	Conversion MFR	Original Model Year	Conversion Models Covered	Conversion Certificate Number	Conversion Evap Family	Conversion Engine Family	Com-pliance status
Ford	6.8	LPG	Gasoline	Icom North America	2009 to 2015		ICMONHWY-15-02	FICMF0265LPG	FICME06.8FM1	CARB
Ford	6.8	LPG	Gasoline	Icom North America	2009 to 2015		ICMONHWY-15-01	FICMF0265LPG	FICME06.8FM2	CARB
Ford	6.8	LPG	Gasoline	Roush Industries	2016/2017	>14K#; 320 hp, Blue Bird Vision School Bus, F650/750, F53 stepvan	EO A-344-0064 EO A-344-0065-1 EO A-344-0066-1 EO A-344-0068	GRIIF0265LPG	GRIIE06.8BWL GRIIE06.8BW6	CARB
Ford	6.8	LPG	Gasoline	Roush Industries	2016	>14K#; 305 hp, F450/550, Blue Bird Vision Bus	EO A-344-0058-1	GRIIF0265LPG	FRIIE06.8BW5	CARB
Ford	6.8	LPG	Gasoline	Roush Industries	2016/2017	>14K#; 362 hp, E450 incomplete	EO A-344-0059-1 EO A-344-0060 EO A-344-0067	GRIIF0265LPG	GRIIE06.8BWZ	CARB

General Motors	6.0	LPG	Gasoline	GreenKraft	2016	V8 /605851111 (323), 20 (322), 30 (323), 40 (323), so (307), 50 (307)	EO A-398-0018 EO A-398-0021 EO A-398-0022		GGKTE06.0PRO GGKTE06.0PR8	CARB
General Motors	6.0	LPG	Gasoline	Power Solutions Inc	2016	> 14K#; 324 hp	EO A-415-0004		GPSIE06.0LPG	CARB
General Motors	8.0	LPG	Gasoline	Clean Fuels USA	2016	339 hp	EO A-367-0036 EO A-367-0037 EO A-367-0038	GCLFFOOOOFCC	GCLFE08.0LPG	CARB
Power Solutions Inc	8.8	LPG	Gasoline	Power Solutions Inc	2016	>14K#; PSI LPG I (270}, 220 (220), (200); PSI-N LPG I (270), (220), (200)	EO A-415-0006-1		GPSIE08.8LPG	CARB
Power Solutions Inc.	8.8	LPG	Gasoline	Power Solutions Inc	2016	>14K#; PSI-N LPG I (270), (220), (200)	EO A-415-0008-1	GPSIFOOOOLPG	GPSIE08.8LPG	CARB
Power Solutions Inc	8.8	LPG	Gasoline	Power Solutions Inc	2015	>14K#; PSI-N LPG I (270), (220), (200)	EO A-415-0002-2	GPSIFOOOOLPG	GPSIE08.8LPG	CARB
Ford	6.8	LPG	Gasoline	Roush Industries	2015	>14K#; 362 hp, F450/550, Blue Bird Vision Bus, Step van, F650/750	EO A-344-0052-5	GRIIF0265LPG	FRIIE06.8BW5	CARB
Ford	6.8	LPG	Gasoline	Roush Industries	2015	>14K#; 305 hp, E450 incomplete	EO A-344-0056	GRIIF0265LPG	GRIIE06.8BWZ	CARB
Ford	6.8	LPG	Gasoline	Roush Industries	2015	>14K#; 320 hp, Blue Bird Vision School Bus, F650/750, F53 stepvan	EO A-344-0063	GRIIF0265LPG	GRIIE06.8BWL GRIIE06.8BW6	CARB

Heavy-duty Natural Gas Engine Retrofit/Repower Systems

OEM	Eng Disp (L)	Original Model Year	Conversion Models Covered	Conversion Manufacturer	Converted to Operate On	Original Fuel	OEM Engine Families(s)/OEM Test Groups	Conversion Engine Family/ Conversion Test Group	Compliance Status
Caterpillar	10.3	1998 to 2002	C-10	Clean Air Power, Inc.	Diesel/CNG	Diesel	WCPXH0629ERK, XCPXH0629ERK, YCPXH0629ERK, 1CPXH0629ERK, 2CPXH0629ERK	DCLAH0629E6J	OUL
Caterpillar	10.3, 11.9	1996 to 2003	C-10, C-12	American Power Group, Inc.	Diesel or Diesel/CNG Diesel/LNG	Diesel	WCPXH0629ERK, WCPXH0729ERK, XCPXH0629ERK, XCPXH0729ERK, YCPXH0629ERK, YCPXH0729ERK, 1CPXH0629ERK, 1CPXH0729ERK, 2CPXH0629ERK, 2CPXH0729ERK, 3CPXH0629EBV, 3CPXH0629EBX, 3CPXH0729EBV, 3CPXH0729EBX, TCP629EZDARK, TCP629EZDARM, TCP729EZDARL, VCP629EZDARK, VCP629EZDARX, VCP729EZDARX	CAPGH11.9CP4	OUL
Caterpillar	11.1, 12.5	2004 - 2006	C11, C13	American Power Group, Inc.	Diesel or Diesel/CNG	Diesel	4CPXH0680EBK, 4CPXH0763EBK, 5CPXH0680EBK, 5CPXH0763EBK, 6CPXH0680EBK, 6CPXH0763EBK	CAPGH12.5CP4	OUL
Caterpillar	11.9	1998 to 2002	C-12	Clean Air Power, Inc.	Diesel/CNG	Diesel	WCPXH0729ERK, XCPXH0729ERK, YCPXH0729ERK, 1CPXH0729ERK, 2CPXH0729ERK	BCLAH0729E6J	OUL
Caterpillar	14.6	1998 to 2002	C-15	Clean Air Power, Inc.	Diesel/CNG	Diesel	WCPXH0893ERK, XCPXH0893ERK, YCPXH0893ERK, 1CPXH0893ERK, 2CPXH0893ERK	CCLAH0893E6J	OUL
Caterpillar	14.6, 15.8	1993 to 2003	C-15, C-16	American Power Group, Inc.	Diesel or Diesel/CNG or Diesel/LNG	Diesel	WCPXH0893ERK, WCPXH0967ERK, XCPXH0893ERK, XCPXH0967ERK, YCPXH0893ERK, YCPXH0967ERK, 1CPXH0893ERK, 1CPXH0967ERK, 2CPXH0893ERK, 2CPXH0967ERK, 3CPXH0893EBV, TCP893EZDARW , TCP893EZDARK , VCP893EZDARA , VCP893EZDARX , VCP967EZDARK , PCT0893FPB7, PCT0893FZE3, RCP893EZDARA, SCP893EZDARK	CAPGH15.8CP4	OUL
Caterpillar	15.2	2004 - 2006	C15	American Power Group, Inc.	Diesel or Diesel/CNG	Diesel	4CPXH0928EBK, 5CPXH0928EBK, 6CPXH0928EBK	BAPGH15.2CP4	OUL
Cummins	8.3, 8.9	2006 - 2009	ISC, ISL	American Power Group, Inc.	Diesel, or Diesel/CNG, or Diesel/LNG	Diesel	6CEXH0505CAZ, 6CEXH0540LAL, 7CEXH0505CAA, 7CEXH0505CAZ, 7CEXH0540LAL, 7CEXH0540LAM, 7CEXH0540LAO, 8CEXH0505CAA, 8CEXH0505CAZ, 8CEXH0540LAL, 8CEXH0540LAM, 8CEXH0540LAO, 9CEXH0505CAA, 9CEXH0505CAB, 9CEXH0505CAC, 9CEXH0505CAZ, 9CEXH0540LAL, 9CEXH0540LAM, 9CEXH0540LAO	DAPGH08.9CM7	OUL

OEM	Eng Disp (L)	Original Model Year	Conversion Models Covered	Conversion Manufacturer	Converted to Operate On	Original Fuel	OEM Engine Families(s)/OEM Test Groups	Conversion Engine Family/ Conversion Test Group	Compliance Status
Cummins	8.3, 8.9	1991 - 2002	C8.3, ISC, ISL	American Power Group, Inc	Diesel, or Diesel/CNG, or Diesel/LNG	Diesel	MCE0505FAA2, NCE0505FAA1, NCE0505FAB2, PCE0505FAAX, PCE0505FAB0, RCE505D6DARW, SCE505D6DARW, TCE505D6DAAA, TCE505D6DAAW, TCE505D6DABW, TCE505D6DARW, TCE505F6DAAW, TCE505F6DABW, VCE505D6DAAA, VCE505D6DAAW, VCE505D6DABW, VCE505D6DARW, VCE505F6DAAW, VCE505F6DABW, WCEXH0505CAA, WCEXH0505CAC, WCEXH0505CAD, WCEXH0505CAE, WCEXH0505CAF, XCEXH0505CAC, XCEXH0505CAD, XCEXH0505CAE, XCEXH0505CAF, YCEXH0505CAF, YCEXH0505CAG, YCEXH0505CAH, YCEXH0505CAI, YCEXH0540LAA, 1CEXH0505CAM, 1CEXH0505CAN, 1CEXH0505CAO, 1CEXH0505CAP, 1CEXH0540LAA, 1CEXH0540LAB, 1CEXH0540LAC, 2CEXH0505CAM, 2CEXH0505CAN, 2CEXH0505CAQ, 2CEXH0540LAB, 2CEXH0540LAC, 3CEXH0505CAM, 3CEXH0505CAN, 3CEXH0505CAQ, 3CEXH0540LAB, 3CEXH0540LAC, 4CEXH0505CAR, 4CEXH0505CAS, 4CEXH0505CAU, 4CEXH0540LAE, 5CEXH0540LAG, 5CEXH0505CAV, 5CEXH0505CAW, 5CEXH0505CAX, 5CEXH0505CAR, 5CEXH0540LAE, 5CEXH0505CAY, 5CEXH0540LAH, 5CEXH0540LAI, 6CEXH0540LAJ, 6CEXH0540LAG, 6CEXH0505CAV, 6CEXH0505CAW, 6CEXH0505CAX, 6CEXH0505CAY, 6CEXH0540LAI	DAPGH08.9CM1	OUL
Cummins	10, 10.8	1991 - 2002	L10, M11, ISM	American Power Group, Inc	Diesel, or Diesel/CNG, or Diesel/LNG	Diesel	MCE0611FZA2, MCE0611FZB3, NCE0611FZA2, NCE0611FZB2, NCE0611FZD4, PCE0611FZAX, PCE0611FZB0, PCE0611FZE3, PCE0661FZA2, PCE0661FZB3, RCE661EJDARA, RCE661EJDARC, RCE661EJDARW, SCE611EGDARW, SCE661EJDARA, SCE661EJDARC, SCE661EJDARW, SCE661EJDASW, SCE661EJDATW, TCE611EGDARW, TCE661EJDARA, TCE661EJDARB, TCE661EJDARC, TCE661EJDASW, TCE661EJDATW, VCE611EGDARW, VCE661EJDARB, VCE661EJDARC, VCE661EJDASA, VCE661EJDATW, WCEXH0611LAA, WCEXH0661MAA, WCEXH0661MAB, WCEXH0661MAD, WCEXH0661MAE, WCEXH0661MAF, XCEXH0661MAH, XCEXH0661MAI, YCEXH0661MAH, YCEXH0661MAI, 1CEXH0661MAQ, 1CEXH0661MAR, 2CEXH0661MAS	DAPGH10.8CM1	OUL
Cummins	10.8	2007 - 2009	ISM	American Power Group, Inc.	Diesel or Diesel/CNG or Diesel/LNG	Diesel	7CEXH0661MAA, 7CEXH0661MAB, 7CEXH0661MAY, 7CEXH0661MAZ, 8CEXH0661MAA, 8CEXH0661MAY, 8CEXH0661MAZ, 9CEXH0661MAD, 9CEXH0661MAE, 9CEXH0661MAF, 9CEXH0661MAY, 9CEXH0661MAZ	DAPGH10.8CM7	OUL

OEM	Eng Disp (L)	Original Model Year	Conversion Models Covered	Conversion Manufacturer	Converted to Operate On	Original Fuel	OEM Engine Families(s)/OEM Test Groups	Conversion Engine Family/ Conversion Test Group	Compliance Status
Cummins	10.8	2002 - 2006	ISM	American Power Group, Inc.	Diesel/LNG + Diesel	Diesel	2CEXH0661MAT, 3CEXH0661MAT, 3CEXH0661MAU, 4CEXH0661MAT, 4CEXH0661MAU, 5CEXH0661MAX, 5CEXH0661MAT, 5CEXH0661MAU, 6CEXH0661MAT, 6CEXH0661MAU, 6CEXH0661MAX, 6CEXH0661MAY, 6CEXH0661MAZ, 6CEXH0661MAA	CAPGH10.8CM2	OUL
Cummins	10.8, 14.9	2004 - 2009	ISX, ISM	EcoDual Group LP	Diesel or Diesel/CNG/ LNG	Diesel	9CEXH0912XAK, 9CEXH0912XAL, 9CEXH0912XAM, 8CEXH0912XAK, 8CEXH0912XAL, 8CEXH0912XAM, 7CEXH0912XAK, 7CEXH0912XAL, 7CEXH0912XAM, 6CEXH0912XAK, 6CEXH0912XAL, 6CEXH0912XAM, 6CEXH0912XAH, 6CEXH0912XAJ, 5CEXH0912XAH, 5CEXH0912XAJ, 4CEXH0912XAH, 4CEXH0912XAJ, 9CEXH0661MAC, 9CEXH0661MAD, 9CEXH0661MAE, 9CEXH0661MAF, 9CEXH0661MAY, 9CEXH0661MAZ, 8CEXH0661MAA, 8CEXH0661MAB, 8CEXH0661MAC, 8CEXH0661MAY, 8CEXH0661MAZ, 7CEXH0661MAA, 7CEXH0661MAB, 7CEXH0661MAC, 7CEXH0661MAY, 7CEXH0661MAZ, 6CEXH0661MAA, 6CEXH0661MAT, 6CEXH0661MAU, 6CEXH0661MAX, 6CEXH0661MAY, 6CEXH0661MAZ, 5CEXH0661MAT, 5CEXH0661MAU, 5CEXH0661MAV, 5CEXH0661MAX, 4CEXH0661MAT, 4CEXH0661MAU, 4CEXH0661MAV	BEDGE14.9ISX	OUL
Cummins	14, 14.9	1991 - 2002	N14, ISX	American Power Group, Inc	Diesel, or Diesel/CNG, or Diesel/LNG	Diesel	MCE0855FZA6, MCE0855FZB7, MCE0855FZC8, MCE0855FZD9, NCE0855FZA5, NCE0855FZB6, NC0855FZC7, NCE0855FZD8, NCE0855FZFX, NCE0855FZG0, PCE085FZA3, PCE0855FZB4, PCE0855FC5, PCE0855FZD6, PCE0855FZF8, RCE855EJDARW, RCE855EJDASW, SCE855EJDARA, SCE855EJDARB, SCE855EJDARW, SCE855EJDASW, SCE855EJDATW, TCE855EJDARA, TCE855EJDARB, TCE855EJDARW, TCE855EJDASW, TCE855EJDATW, VCE855EJDARA, VCE855EJDARB, VCE855EJDARC, VCE855EJDATW, WCEXH0855NAA, WCEXH0855NAB, WCEXH0855NAC, WCEXH0912XAA, XCEXH0855NAD, XCEXH0855NAE, XCEXH0855NAF, XCEXH0912XAB, XCEXH0912XAD, YCEXH0855NAD, YCEXH0855NAE, YCEXH0855NAF, YCEXH0912XAC, YCEXH0912XAD, YCEXH0912XAE, 1CEXH0855NAD, 1CEXH0855NAE, 1CEXH0855NAF, 1CEXH0912XAC, 1CEXH0912XAD, 1CEXH0912XAE, 2CEXH0855NAA, 2CEXH0912XAF	DAPGH14.9CM1	OUL
Cummins	14.9	2010 - 2012	ISX	ECG	Diesel/CNG	Diesel	ACEXH0912XAP, ACEXH0912XAQ, ACEXH0912XAR, BCEXH0912XAP, BCEXH0912XAQ, BCEXH0912XAR, CCEXH0912XAP, CCEXH0912XAQ, CCEXH0912XAR	ESKGH0912ISX	EPA cert

OEM	Eng Disp (L)	Original Model Year	Conversion Models Covered	Conversion Manufacturer	Converted to Operate On	Original Fuel	OEM Engine Families(s)/OEM Test Groups	Conversion Engine Family/ Conversion Test Group	Compliance Status
Cummins	14.9	2007 - 2009	ISX	American Power Group Inc	Diesel or Diesel/CNG or Diesel/LNG	Diesel	7CEXH0912XAK, 8CEXH0912XAK, 9CEXH0912XAK, 9CEXH0912XAP, 9CEXH0912XAQ, 7CEXH0912XAL, 7CEXH0912XAM, 8CEXH0912XAL, 8CEXH0912XAM, 9CEXH0912XAL, 9CEXH0912XAM, 9CEXHO912XAN	DAPGH14.9CM7	OUL
Cummins	14.9	2005 to 2013	ISX	American Power Group, Inc.	Diesel or Diesel/CNG, or Diesel/LNG	Diesel	DCEXH0912XAT, DCEXH0912XAU, CCEXH0912XAR, CCEXH0912XAP, CCEXH0912XAQ, CCEXH0912XAS, BCEXH0912XAP, BCEXH0912XAQ, BCEXH0912XAR, BCEXH0912XAS, ACEXH0912XAP, ACEXH0912XAQ, ACEXH0912XAR, 9CEXH0912XAK, 9CEXH0912XAL, 9CEXH0912XAM, 9CEXH0912XAN, 9CEXH0912XAP, 9CEXH0912XAQ, 8CEXH0912XAK, 8CEXH0912XAL, 8CEXH0912XAM, 7CEXH0912XAK, 7CEXH0912XAL, 7CEXH0912XAM, 6CEXH0912XAH, 6CEXH0912XAJ, 6CEXH0912XAM, 6CEXH0912XAK, 6CEXH0912XAL, 5CEXH0912XAH, 5CEXH0912XAJ	FAPGH14.9CMC	Inter Appr

OEM	Eng Disp (L)	Original Model Year	Conversion Models Covered	Conversion Manufacturer	Converted to Operate On	Original Fuel	OEM Engine Families(s)/OEM Test Groups	Conversion Engine Family/ Conversion Test Group	Compliance Status
Cummins	14.9	2004 - 2009	ISX 325V, ISX 400, ISX 400ST2, ISX 450, ISX 450ST2, ISX 465V, ISX 475, IXS 475ST, ISX 500, ISX 500ST, ISX 500ST2, ISX 525, ISX 530, ISX565, ISX 385ST, ISX 400ST, ISX 435, ISX 435ST, ISX 435V, ISX 450, ISX 450ST, ISX 465V, ISX 565, ISX 600, ISX 400ST, ISX 425, ISX 425ST, ISX 435ST, ISX 485, ISX 485ST, ISX 500V, ISX 550, ISX 600, ISX 455ST, ISX 485, ISX 485ST, ISX 500, ISX 500ST, ISX 500V, ISX 485ST, ISX 15 400, ISX 15 400ST,ISX 15 425, ISX 15 425ST, ISX 15 435V, ISX 15 450, ISX 15 450ST	Clean Fuel Technologies II LLC	Diesel/LNG	Diesel	4CEXH0912XAH, 4CEXH0912XAJ, 5CEXH0912XAH, 5CEXH0912XAJ, 6CEXH0912XAH, 6CEXH0912XAJ, 6CEXH0912XAK, 6CEXH0912XAL, 6CEXH0912XAM, 7CEXH0912XAK, 7CEXH0912XAL, 7CEXH0912XAM, 8CEXH0912XAK, 8CEXH0912XAL, 8CEXH0912XAM, 9CEXH0912XAK, 9CEXH0912XAL, 9CEXH0912XAM, 9CEXH0912XAN, 9CEXH0912XAP	ECFTH14.9LNG	OUL
Cummins	14.9	2002 - 2006	ISX	American Power Group, Inc.	Diesel or Diesel/CNG	Diesel	2CEXH0912XAG, 3CEXH0912XAH, 3CEXH0912XAJ, 4CEXH0912XAH, 4CEXH0912XAJ, 5CEXH0912XAH, 5CEXH0912XAJ, 6CEXH0912XAH, 6CEXH0912XAJ, 6CEXH0912XAM, 6CEXH0912XAK, 6CEXH0912XAL	CAPGH14.9CM2	OUL

OEM	Eng Disp (L)	Original Model Year	Conversion Models Covered	Conversion Manufacturer	Converted to Operate On	Original Fuel	OEM Engine Families(s)/OEM Test Groups	Conversion Engine Family/ Conversion Test Group	Compliance Status
Cummins	15	2007 - 2009	ISX 435ST, ISX 435, ISX 425ST, ISX 425, ISX 400ST, ISX 400, ISX 385ST, ISX 435V, ISX 450ST	SkyGo, LLC	Diesel/CNG	Diesel	7CEXH0912XAK, 8CEXH0912XAK, 9CEXH0912XAK	ESKGH0912ISX	OUL
Daimler Chrysler	6.37	2006	OM 906	NGV Motori	CNG	Diesel	6MBXH6.37DJA	BNGCH6.37DJD	Int Appr
Daimler Chrysler	6.37	2005	OM 906	NGV Motori	CNG	Diesel	5MBXH6.37DJA	BNGCH6.37DJC	Int Appr
Daimler Chrysler	6.37	2004	OM 906	NGV Motori	CNG	Diesel	4MBXH6.37DJA	BNGCH6.37DJB	Int Appr
Daimler Chrysler	6.37	2003	OM 906	NGV Motori	CNG	Diesel	3MBXH6.37DJA	BNGCH6.37DJA	Int Appr
Daimler Chrysler	12, 12.8	2000 - 2003	OM457LA, OM460LA	American Power Group, Inc	Diesel or Diesel/CNG or Diesel/LNG	Diesel	YMBXH12.0DJA, 1MBXH12.0DJA, 1MBXH12.8DJA, 2MBXH12.0DJA, 2MBXH12.8DJA, 3MBXH12.0DJA, 3MBXH12.8DJA	DAPGH12.8DC1	OUL
Daimler Chrysler	12.8	2004 - 2006	OM 460 LA	FYDA Energy Solutions and The Hardstaff Group	Diesel/CNG	Diesel	4MBXH12.8DJA, 5MBXH12.8DJA, 6MBXH12.8DJA	DFYDT12.8MBX	OUL
Detroit Diesel	11. 11.1	1990 - 1999	SERIES 60	American Power Group, Inc	Diesel or Diesel/CNG or Diesel/LNG	Diesel	LDD11.1FZA3, MDD11.1FZA2, NDD11.1FZA1, PDD11.1FZD2, PDD11.1FZAX, RDD11.EJDARA, SDD11.EJDARA, TDD11.EJDARA, VDD11.EJDARA, WDDXH11.1EHD, XDDXH11.1EHL	DAPGH11.1DD1	OUL
Detroit Diesel	11.1, 12.7	1998 to 2009	Series 60	OMNITEK	CNG	Diesel	JDD12.7FZA2, KDD12.7FZA1, LDD11.1FZA3, LDD12.7FZA0, MDD11.1FZA2, MDD12.7FZAX, NDD11.1FZA1, NDD12.7FZA9, PDD11.1FZAX, PDD11.1FZD2, PDD12.7FZA7, PDD12.7FZDX, RDD11.EJDARA, RDD12.EJDARA, RDD12. EJDASW, SDD11.EJDARA, SDD12.EJDARA, SDD12.EJDASW, TDD11.EJDARA, TDD12.EJDARA, TDD12.EJDASW, VDD11. EJDARA, VDD12.EJDARA, WDDXH11.1EHD, WDDXH12.7EGD, XDDXH11.1EHL, XDDXH12.7EGL, XDDXH14.0ELL, YDDXH12.7EGL, YDDXH14.0ELL, 1DDXH12.7EGL, 1DDXH14.0ELL, 2DDXH12.7EGL, 2DDXH12.7FGF, 2DDXH12.7FGN, 2DDXH12.7ELL, 3DDXH12.7EGY, 3DDXH12.7ELY, 4DDXH12.7EGY, 4DDXH12.7ELY, 5DDXH12.7EGY, 5DDXH12.7ELY, 6DDXH12.7EGY, 6DDXH12.7ELY, 7DDXH12.7ELY, 8DDXH12.7ELY, 9DDXH12.7ELD, 9DDXH12.7ELY	EOMNH12.7S60	EPA Cert

OEM	Eng Disp (L)	Original Model Year	Conversion Models Covered	Conversion Manufacturer	Converted to Operate On	Original Fuel	OEM Engine Families(s)/OEM Test Groups	Conversion Engine Family/ Conversion Test Group	Compliance Status
Detroit Diesel	11.1, 12.7	1998 - 2002	Series 60	Landi Renzo USA Corporation	Diesel/CNG	Diesel	WDDXH11.1EHD, WDDXH12.7EGD, XDDXH11.1EHL, XDDXH12.7EGL, YDDXH12.7EGL, 1DDXH12.7EGL, 2DDXH12.7EGL	DLDRH12.7DD1	OUL
Detroit Diesel	12.7	2003 to 2006	DD60-12.7	NGV Motori LLC	Diesel/CNG	Diesel	6DDXH12.7EGY, 5DDXH12.7EGY, 4DDXH12.7EGY, 3DDXH12.7EGY	ENGCH12.7DDF	OUL
Detroit Diesel	12.7, 12, 14	1987 - 2002	SERIES 60	American Power Group, Inc	Diesel or Diesel/CNG or Diesel/LNG	Diesel	HGM12.7FZA0, JDD12.7FZA2, KDD12.7FZA1, LDD12.7FZA0, MDD12.7FZAX, NDD12.7FZA9, PDD12.7FZA7, PDD12.7FZDX, RDD12.EJDARA, RDD12.EJDASW, SDD12.EJDARA, SDD12.EJDASW, TDD12.EJDASW, TDD12.EJDARA, TDD12.EJDATW, VDD12.EJDARA, VDD12.EJDATA, WDDXH12.7EGD, XDDXH12.7EGL, XDDXH14.0ELL, YDDXH12.7EGL, YDDXH14.0ELL, 1DDXH12.7EGL, 1DDXH14.0ELL, 2DDXH12.7EGL, 2DDXH14.0ELL	DAPGH14.0DD1	OUL
Detroit Diesel	12.7, 12.8, 14, 14.8	2005 to 2012	DD15, DD13, SERIES 60, MBE 4000, OM460LA	American Power Group, Inc.	Diesel or Diesel/CNG or Diesel/LNG	Diesel	ADDXH14.8EED, ADDXH14.8EEY, ADDXH12.8FED, ADDXH12.8FEY, ADDXH12.8TER, BDDXH14.8EED, BDDXH14.8EEY, BDDXH12.8FED, BDDXH12.8FEY, BDDXH12.8TER, CDDXH14.8EED, CDDXH14.8EEY, CDDXH12.8FED, CDDXH12.8FEY, 9DDXH14.0ELD, 9DDXH14.0ELY, 9DDXH14.8EED, 9DDXH14.8EEY, 9DDXH12.8DJA, 9DDXH12.8DJD, 9DDXH12.8FED, 9DDXH12.8FEY, 9DDXH12.8TER, 8DDXH14.0ECL, 8DDXH14.0ELY, 8DDXH14.8EEC, 8DDXH14.8EEY, 8DDXH12.8DJA, 8DDXH12.8DJC, 8DDXH12.8TER, 7DDXH14.0ELY, 7DDXH12.8DJA, 6DDXH14.0ELY, 6DDXH12.7EGY, 5DDXH14.0ELY, 5DDXH12.7EGY	FAPGH14.8DDB	Inter Appr
Detroit Diesel	12.7, 12.8, 14.0, 14.8	2002 to 2009	SERIES 60 , MBE 4000, OM460LA, NA, DD15, DD13, DD14, DD16, DD17, DD18, DD19, DD20, DD21, DD22, DD23, DD24, DD25, DD26, DD27, DD28, DD29, DD30, DD31, DD32, DD33, DD34, DD35, DD36, DD37, DD38, DD39, DD40	dHybrid Inc.	Diesel/CNG	Diesel	2DDXH12.7EGL, 2DDXH14.0ELL, 3DDXH12.7EGY, 3DDXH14.0ELY, 4DDXH12.7EGY, 4DDXH14.0ELY, 5DDXH12.7EGY, 5DDXH14.0ELY, 6DDXH12.7EGY, 6DDXH14.0ELY, 7DDXH12.8DJA, 7DDXH14.0ELY, 8DDXH12.8DJA, 8DDXH12.8DJC, 8DDXH14.0ELY, 8DDXH14.0ELC, 8DDXH12.8TER, 8DDXH14.8EEY, 8DDXH14.8EEC, 9DDXH12.8DJA, 9DDXH12.8FED, 9DDXH12.8TER, 9DDXH14.0ELY, 9DDXH14.8EEY, 9DDXH12.8DJD, 9DDXH12.8FEY, 9DDXH14.0ELD, 9DDXH14.8EED	FDHYH14.0DD1	OUL

OEM	Eng Disp (L)	Original Model Year	Conversion Models Covered	Conversion Manufacturer	Converted to Operate On	Original Fuel	OEM Engine Families(s)/OEM Test Groups	Conversion Engine Family/ Conversion Test Group	Compliance Status
Detroit Diesel	12.7, 12.8, 14.0, 14.8	2002 - 2009	SERIES 60 12.7L, SERIES 60 14L, OM460LA, MBE 4000, DD15, DD13	American Power Group, Inc.	Diesel/CNG + Diesel	Diesel	2DDXH12.7EGL, 2DDXH14.0ELL, 3DDXH12.7EGY, 3DDXH14.0ELY, 4DDXH12.7EGY, 4MBXH12.8DJA, 4DDXH14.0ELY, 5DDXH12.7EGY, 5MBXH12.8DJA, 5DDXH14.0ELY, 6DDXH12.7EGY, 6MBXH12.8DJA, 6DDXH14.0ELY, 7DDXH12.8DJA, 7DDXH14.0ELY, 8DDXH12.8DJA, 8DDXH14.0ELY, 8DDXH12.8TER, 8DDXH14.8EEY, 9DDXH12.8DJA, 9DDXH12.8FED, 9DDXH12.8TER, 9DDXH14.0ELY, 9DDXH14.8EEY, 9DDXH12.8DJD, 9DDXH12.8FEY, 9DDXH14.0ELD, 9DDXH14.8EED	CAPGH14.8DD8	OUL
Detroit Diesel	12.7, 14	2004 - 2006	DDC Series 60	Diesel 2 Gas Inc.	Diesel/CNG	Diesel	4DDXH12.7EGY, 4DDXH14.0ELY, 5DDXH12.7EGY, 5DDXH14.0ELY, 6DDXH12.7EGY, 6DDXH14.0ELY	DDSLH14.0DD2	OUL
ESI Phoenix	7.6	2010, 2011, 2012	DT 466 MHDD	NGV Motori	CNG	CNG	AEMSH07.6NGE, BEMHS07.6NGE, CEMSH07.6NGE	ENGCH07.6NGE	EPA
International Truck and Engine Corp.	466	2006	6NVHX0466AEA	NGV Motori	CNG	Diesel	6NVHX0466AEA	CNGCH0466AEA	Inter Appr
International Truck and Engine Corp.	466	2005	5NVHX0466AEA	NGV Motori	CNG	Diesel	5NVHX0466AEA	CNGCH0466AEB	Inter Appr
International Truck and Engine Corp.	466	2004	4NVXH0466AEA	NGV Motori	CNG	Diesel	4NVXH0466AEA	CNGCH0466AEC	Inter Appr
Mack	11.9	2004 - 2006	AC-460P, AC-460E, AC-427, AC-400, AC-355/380, AC-350, AC-330/350, AC-380/410, AC-310/330	FYDA Energy Solutions and The Hardstaff Group	Diesel/CNG	Diesel	4MKXH11.9H70, 5MKXH11.9H70, 6MKXH11.9H70, 4MKXH11.9H64	DFYDT11.9MAC	OUL
Mack	11.9	2003 to 2006	E7	NGV MOTORI	Diesel/CNG	Diesel	6MKXH11.9H70, 5MKXH11.9H70, 4MKXH11.9H70, 3MKXH11.9H70	FNGCH11.9MDF	OUL

OEM	Eng Disp (L)	Original Model Year	Conversion Models Covered	Conversion Manufacturer	Converted to Operate On	Original Fuel	OEM Engine Families(s)/OEM Test Groups	Conversion Engine Family/ Conversion Test Group	Compliance Status
Mack	11.9, 12, 12.15	1996 - 2002	E7, EM7, VE D12	American Power Group, Inc	Diesel, or Diesel/CNG, or Diesel/LNG	Diesel	TMK12.EJDARW, TMK12.EJDASW, TMK12.EJDATW, TMK728EGDARA, TMK728EGDARW, TMK728EGDASW, TMK728EGDATW, TMK728EJDARA, TMK728EJDARW, TMK728EJDASW, TMK728EJDATW, TVT12.EJDBRA, VMK12.EJDARW, VMK12.EJDASW, VMK12.EJDATW, VMK728EGDARA, VMK728EGDARW, VMK728EGDASW, VMK728EGDATW, VMK728EJDARA, VMK728EJDARW, VMK728EJDASW, VMK728EJDATW, VMK728EJDAYW, VMK728EJDAZW, VVT12.EJDBRA, WMKXH0728V40, WMKXH0728V41, WMKXH0728V43, WMKXH11.9E51, WMKXH11.9E52, WMKXH11.9E53, WMKXH0728M44, WVTXH12.150S, XMKXH11.9E54, XVTXH12.150S, YMKXH11.9H56, YMKXH11.9V57, YVTXH12.150S, 1MKXH11.9H56, 1MKXH11.9V57, 1MKXH11.9H59, 1MKXH11.9V60, 1MKXH11.9V61, 1VTXH12.150S, 2MKXH11.9H59, 2MKXH11.9H63, 2MKXH11.9V60, 2MKXH11.9V61, 2VTXH12.150S	DAPGH12.1VP1	OUL

OEM	Eng Disp (L)	Original Model Year	Conversion Models Covered	Conversion Manufacturer	Converted to Operate On	Original Fuel	OEM Engine Families(s)/OEM Test Groups	Conversion Engine Family/ Conversion Test Group	Compliance Status
Mack	12	1996 - 2007	E7 Engine	Omnitek Engineering Corp.	CNG or LNG	Diesel	1MKXH11.9H56, 1MKXH11.9H59, 1MKXH11.9V57, 1MKXH11.9V60, 1MKXH11.9V61, 2MKXH11.9H59, 2MKXH11.9H63, 2MKXH11.9H64, 2MKXH11.9V60, 2MKXH11.9V61, RMK728EJDARW, RMK728EJDASW, RMK728EJDATW, SMK12.EJDARW, SMK12.EJDASW, SMK12.EJDATW, SMK728EGDARA, SMK728EGDASW,6MKXH11.9V75, RMK12.EJDARW, RMK12.EJDASW, RMK12.EJDATW, RMK728EGDARA, RMK728EGDASW, RMK728EGDATW, RMK728EJDARA,5MKXH11.9V67, 5MKXH11.9V71, 5MKXH11.9V74, 6MKXH11.9H70, 6MKXH11.9H73, 6MKXH11.9V65, 6MKXH11.9V67, 6MKXH11.9V71, 6MKXH11.9V74,4MKXH11.9H64, 4MKXH11.9H70, 4MKXH11.9H73, 4MKXH11.9V65, 4MKXH11.9V67, 4MKXH11.9V71, 5MKXH11.9H70, 5MKXH11.9H73, 5MKXH11.9V65,2MKXH11.9V65, 2MKXH11.9V66, 2MKXH11.9V67, 3MKXH11.9H64, 3MKXH11.9H70, 3MKXH11.9V65, 3MKXH11.9V67, 3MKXH11.9V68, SMK728EGDATW, SMK728EJDARA, SMK728EJDARW, SMK728EJDASW, SMK728EJDATW, TMK12.EJDARW, TMK12.EJDASW, TMK12.EJDATW, TMK728EGDARA, TMK728EGDARW, TMK728EGDASW, TMK728EGDATW, TMK728EJDARA, TMK728EJDARW, TMK728EJDASW, TMK728EJDATW, VMK728EGDARA, VMK728EGDARW, VMK728EGDASW, VMK728EGDATW, VMK728EJDARA, VMK728EJDARW, VMK728EJDASW, VMK728EJDATW, VMK728EJDAYW, VMK728EJDAZW, WMKXH0728M44, WMKXH0728V40, WMKXH0728V41, WMKXH0728V43, WMKXH11.9E51, WMKXH11.9E52, WMKXH11.9E53, XMKXH11.9E54, YMKXH11.9E56, YMKXH11.9V57		EPA Cert
Navistar	7.6	2010 to 2012	DT466	NGV Motori	CNG	Diesel	AEMSH07.6NGE, BEMSH07.6NGE, CEMSH07.6NGE	ENGCH07.6NGE	EPA Cert
Navistar	7.6	2004	ALL	North American Repower	CNG	Diesel	4NVXH0466ANA, 4NVXH0466ANB, 3NVXH0466ANA, 3NVXH0466ANB, 2NVXH0466ANA, 2NVXH0466ANB, 1NVXH0466ANA, 1NVXH0466ANB, YNVXH0466ANA, YNVXH0466ANB, XNVXH0466ANA, XNVXH0466ANB, WNVXH0466CCB, WNVXH0466CCD, VNV466D6DARA, VNV466D8DASA, TNV466D8DARB, TNV466D8DATB	ENARH0466CNG	OUL

OEM	Eng Disp (L)	Original Model Year	Conversion Models Covered	Conversion Manufacturer	Converted to Operate On	Original Fuel	OEM Engine Families(s)/OEM Test Groups	Conversion Engine Family/ Conversion Test Group	Compliance Status
Navistar	7.6	2000 - 2003	C175, C195, CH195, CH215, CL215, C215, C230, CH230, C250, CH250	Omnitek Engineering Corp.	CNG	Diesel	1NVXH0466ANA, 2NVXH0466ANA, 3NVXH0466ANA, YNVXH0466ANA, 1NVXH0466ANB, 2NVXH0466ANB, 3NVXH0466ANB, YNVXH0466ANB	DOMNH07.6466	OUL
Navistar	7.6	1996 - 1999	A175, A175C, A175F, A190, A190C, A190F, A195, A195C, A195F, A210, A 210F, A210C, A210F, BH210, A230, A230C, A230F, A250, AB250F, A250C, A250F, B250	Omnitek Engineering Corp.	CNG	Diesel	VNV466D8DARW, WNVXH0466CCB, WNVXH0466FNA, XNVXH0466ANA, TNV466D8DARB, VNV466D8DASA, WNVXH0466CCD, WNVXH0466FNC, TNV466D8DATB, VNV466F8DAAA, XNVXH0466ANB	DOMNH07.6465	OUL
Navistar	8.7	1996 - 2003	BT250, A250C, A250F, AL275C, AL275F, C275, CG275, AB275F, AF275C, AF275F, BT275, CH275, A275, A275C, A275F, BH275, CT280, C280, CV280, C300, AL300C, AL300F, CL300, AF300C, AF300F, A300, A300C, A300F, CH300, CV300, AF320C, AF320F,	Omnitek Engineering Corp.	CNG	Diesel	XNVXH0530ACT, WNVXH0530CCB, WNVXH0530FNA, 1NVXH0530ANA, 1NVXH0530ATA, 2NVXH0530ANA, 2NVXH0530ATA, 3NVXH0530ANA, 3NVXH0530ATA, VNV530F8DAAA, TNV530D8DARA, VNV530D8DARA, XNVXH0530ANA, 1NVXH0530ACT, 2NVXH0530ACT, 3NVXH0530ACT, YNVXH0530ANA, YNVXH0530ACT, 2NVXH0530ANC, 3NVXH0530ANC, 2NVXH0530ANB, WNVXH0530CCD, WNVXH0530FNC, 1NVXH0530ANB, 3NVXH0530ANB, TNV530E8DASA, VNV530E6DASA, VNV530E8DASA, XNVXH0530ANB, YNVXH0530ANB	DOMNH08.7530	OUL
Volvo	10.8	2006 - 2009	MP7, D11	American Power Group, Inc	Diesel or Diesel/CNG or Diesel/LNG	Diesel	6MKXH10.8C02, 6VPTH10.8H01, 6VPTH10.8H02, 7VPTH10.8H03, 7VPTH10.8H04, 8VPTH10.8H03, 8VPTH10.8H04, 9VPTH10.8H03, 9VPTH10.8H04	DAPGH10.8VP7	OUL

OEM	Eng Disp (L)	Original Model Year	Conversion Models Covered	Conversion Manufacturer	Converted to Operate On	Original Fuel	OEM Engine Families(s)/OEM Test Groups	Conversion Engine Family/ Conversion Test Group	Compliance Status
Volvo	12.8	2012		Clean Air Power	Mixed-fuel(CNG/Diesel) or Diesel	Diesel	CVPTH12.8S01	FCLAH12.8E6J	EPA Cert
Volvo	16.1	2006 - 2009	D16	American Power Group, Inc	Diesel or Diesel/CNG or Diesel/LNG	Diesel	6VTXH16.1C01, 7VPTH16.1H01, 8VPTH16.1H01, 9VPTH16.1H01	DAPGH16.1VP7	OUL
Volvo	11.9, 12.1, 12.8	2002 to 2009	E7, D12, MP8, D13	American Power Group, Inc	Diesel or Diesel/CNG or Diesel/LNG	Diesel	2MKXH11.9H64, 2MKXH11.9V65, 2MKXH11.9V66, 2MKXH11.9V67, 3MKXH11.9H64, 3MKXH11.9H70, 3MKXH11.9V65, 3MKXH11.9V67, 3MKXH11.9V68, 4VTXH12.150S, 4MKXH11.9H64, 4MKXH11.9H70, 4MKXH11.9H73, 4MKXH11.9V65, 4MKXH11.9V67, 4MKXH11.9V71, 5VTXH12.150S, 5MKXH11.9V71, 5MKXH11.9V65, 5MKXH11.9V74, 5MKXH11.9V67, 5MKXH11.9H70, 5MKXH11.9H73, 6VTXH12.150S, 6MKXH11.9V71, 6MKXH11.9V74, 6MKXH11.9V67, 6MKXH11.9V65, 6MKXH11.9H70, 6MKXH11.9H73, 6MKXH11.9V75, 6VPTH12.8H01, 7VPTH12.8H02, 8VPTH12.8H02, 9VPTH12.8H02	DAPGH12.8VP7	OUL
Volvo/Mack	11.9, 12.1, 12.8	2004 to 2012	D-12, FAMILY 64, FAMILY 70, FAMILY 73, FAMILY 65, FAMILY 67, FAMILY 71, FAMILY 74, MP8	American Power Group, Inc.	Diesel or Diesel/CNG or Diesel/LNG	Diesel	4VTXH12.150S, 4MKXH11.9H64, 4MKXH11.9H70, 4MKXH11.9H73, 4MKXH11.9V65, 4MKXH11.9V67, 4MKXH11.9V71, 5VTXH12.150S, 5MKXH11.9V71, 5MKXH11.9V65, 5MKXH11.9V74, 5MKXH11.9V67, 5MKXH11.9H70, 5MKXH11.9H73, 6VTXH12.150S, 6MKXH11.9V71, 6MKXH11.9V74, 6MKXH11.9V67, 6MKXH11.9V65, 6MKXH11.9H70, 6MKXH11.9H73, 6VPTH12.8H01, 7VPTH12.8H02, 8VPTH12.8H02, 9VPTH12.8H02, AVPTH12.8S01, BVPTH12.8S01, CVPTH12.8S01	EAPGH12.8VPA	Inter Appr
Volvo/Mack	12.8	2010 to 2013	D13/MP8	American Power Group, Inc.	Diesel or Diesel/CNG or Diesel/LNG	Diesel	AVPTH12.8S01, BVPTH12.8S01, CVPTH12.8S01, DVPTH12.8S01	EAPGH12.8VPA	OUL

EPA Cert - U.S. EPA certified
CARB - California Air Resource Board
OUL - Outside Useful Life
Int Appr - Intermediate Approval

Heavy-Duty LPG Engine Retrofit/Repower Systems

OEM	Eng Disp (L)	Original Model Year	Conversion Models Covered	Conversion Manufacturer	Converted to Operate On	Original Fuel	OEM Engine Families(s)/OEM Test Groups	Conversion Engine Family/ Conversion Test Group	Compliance Status
Volvo Powertrain Corp	12.8	2010 to 2013	MP8 AND D13H	Blossman Services Inc	Diesel/LPG	Diesel	AVPTH12.8S01, BVPTH12.8S01, BVPTH12.8S02, CVPTH12.8S01, DVPTH12.8S01	FBLMH12.8BL1	IUL
Detroit Diesel Corp	14	2004 to 2009	SERIES 60	Blossman Services Inc.	Diesel/LPG	Diesel	4DDXH14.0ELY, 5DDXH14.0ELY, 6DDXH14.0ELY, 7DDXH14.0ELY, 8DDXH14.0ELY, 8DDXH14.0ELC, 9DDXH14.0ELY, 9DDXH14.0ELD	SERIES 60	OUL

Appendix B: CNG Station Considerations

This appendix complements the Gaseous Fuel Vehicles Guide's abbreviated discussions of CNG station planning and related component costs of CNG fuel.

Basic CNG Station Components

Natural Gas Service: Work with your local gas utility to assure that sufficient pressure and volume are available to meet your station's present and future needs. Depending on location and loads already on the existing distribution system in your area, your local gas utility *may* have some flexibility to adjust available pressures and volume. Another option may be to extend service from another nearby branch/leg but this can be expensive and requires commitment of usage for the utility to make the added investment or pass along the charges for the upgrade.

Electric Service: This may seem obvious but compressor motors can be significant loads on local electric service. Work with your electric utility to make sure that service to that location meets the power requirements (e.g. 3-phase power of sufficient kVa, etc.). Some larger stations may need to upgrade onsite transformer equipment; again, this is typically borne by the station developer.

Compression System: Natural gas must be taken from street pressure (varies depending on utility and location within their distribution system) up to 4000-4500psi for insertion into storage vessels (or directly to vehicles at 3600 psi). Consider use of multiple compressors for variable load matching efficiencies and redundancy in case of planned outages (e.g. scheduled maintenance) and/or unplanned downtime. Compressor sizing and staging will depend on projected loads and predictability of that load (hourly, daily), especially for fast-fill stations and to a lesser degree, time-fill stations.

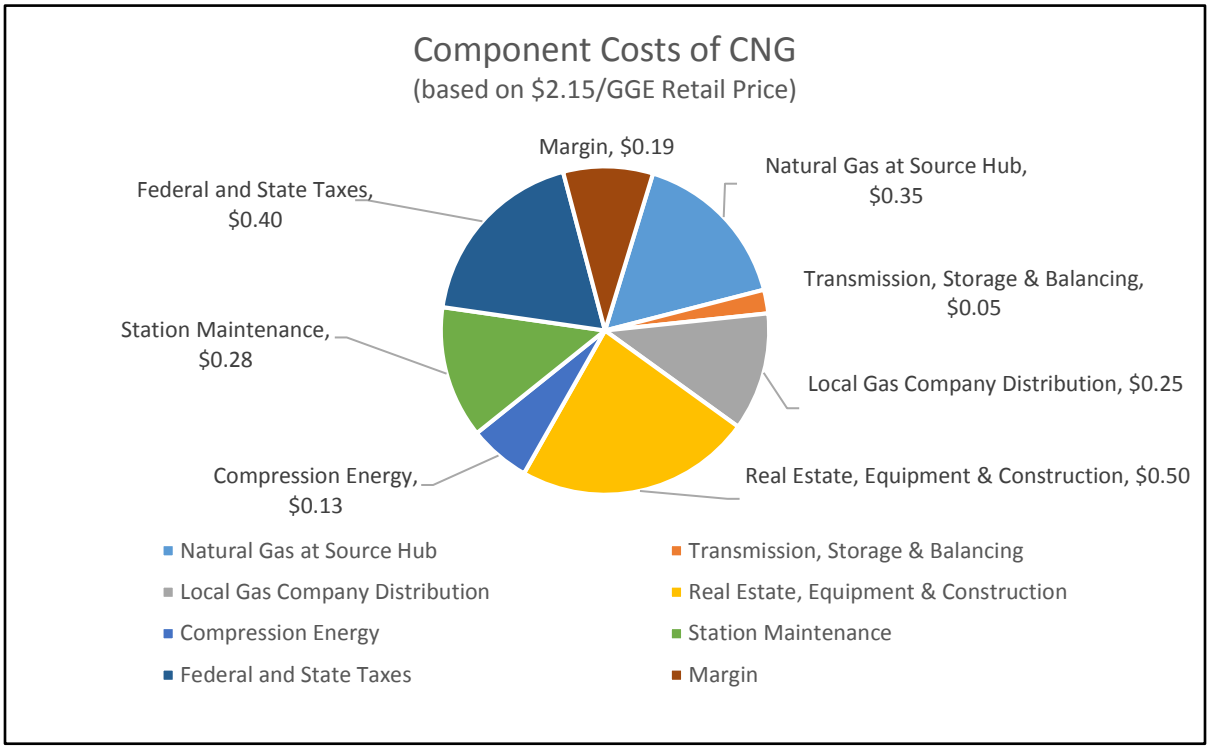
Gas Conditioning Equipment: Natural gas contains moisture, the amount of which varies depending on geographic region as well as connection point within the local distribution system. It is advisable to condition gas to remove this moisture, usually via desiccant-type dryers. Depending on projected moisture loads, gas volumes, and station utilization, there are a variety of different dryer equipment packages available, including use-and-dispose canisters and regenerating systems. In addition, most CNG stations include various filtration systems to remove contaminants that may be present in the gas supply or oil carried over from the compression system.

Storage Capacity (optional for time-fill stations): Once compressed, CNG is stored in stationary onsite steel vessels at high pressure (typically 4000+ psi) for fast-fill flow capability. There are several different types of storage systems (e.g. cascade, buffer); your storage needs will be determined by your usage patterns.

Dispensing Equipment: If planning only for time-fill capability, this may include a number of dispensing hoses and associated pressure transducers and valves. For public access fast-fill stations, a National Conference of Weights and Measures-certified dispenser is required.

Payment/Data Capture System: Most stations (even those that do not plan to sell to others) include a payment/data processing system to capture fuel volumes, vehicle data, etc. This system may be a separate card reader/scanner located adjacent to dispensing equipment or built into the dispenser.

Component Costs of CNG



The primary components of CNG pump prices are listed below.

Natural Gas Procurement - Unregulated "free market" commodity priced at key node delivery points usually indexed to the NYMEX price based on the Henry Hub in Louisiana, regardless of where the node is actually located. Although indexed to NYMEX, regional supply and demand dictate hub pricing.

Transportation/Storage/Balancing Fees: These are paid to the interstate pipeline for delivery of the procured gas from the delivery node to the local gas distribution company's "city gate." Pricing is influenced by factors such as the utility's or customer's overall yearly and seasonal volumes, distance between node and city gate, regional pipeline and storage system capacity and the impact of weather-related demand on that capacity, and amount of "buffer" included in contractual commitments to accommodate differentials between firm nominations and variable demand.

Distribution Tariff - This public service/utility commission (PSC/PUC)-regulated tariff charged by the local gas distribution company (LDC) generally covers delivery of gas from their city gate to the CNG station meter. Embedded in distribution tariffs are expenses associated with recovery of capital investment in the LDC's distribution system as well as the ongoing investment in system integrity, safety, operations, and maintenance. These tariffs change quite infrequently based on PSC/PUC public hearings and extensive review of utility documentation of system costs and operational efficiency. LDC tariffs vary fairly dramatically from one region to the next and, often, within regions.

[Note: For residential customers and most smaller commercial and industrial accounts, these first three components are often "bundled" into a single rate charged by the local utility that procures gas and makes all delivery arrangements to their customers' meters. The only adjustable portions of the rate are the unregulated costs of procuring gas up to the city gate, which are passed along at cost to the customer. In some utility areas, large customers with substantial natural gas

needs may negotiate and procure their own gas for delivery to the city gate, thus paying the local utility only to transport their gas over local lines to their meter.]

Compression Energy Expense: While engine-driven compressors are in use in some high-capacity CNG stations where demand is near-constant and thus able to take advantage of steady-state operational efficiencies, most CNG stations use electric-motor-driven compressors. Electricity is typically provided by a local regulated electric utility. A commonly accepted rule-of-thumb is ~1 fully loaded kWh per GGE (more for smaller compressor stations, less for larger compression stations); "fully loaded" includes energy (kWh), demand (kW), and other system charges divided by total kWh used. Demand charges are a very important component of station operation costs, especially in regions where peak generation capacity is priced at high premiums such as the northeast U.S.

Station Maintenance Expenses: Comprising preventative maintenance, planned major overhauls of key equipment/components at fixed intervals over the life of the equipment, emergency repairs and all associated parts and supplies; generally amortized over throughput of station for the expected depreciable life of the equipment (e.g. 7 years, 10 years, 15 years). Factors affecting this component include proximity and timeliness of technician availability and/or the related ability to distribute labor costs across multiple locations/cost centers, technician training, the costs of parts/supplies inventories, and inclusion (or not) of a "sinking fund" for equipment replacement at the end of useful life.

Station Development & Construction Costs: This component comprises the following: site acquisition and preparation; permitting, engineering, and construction; compression, gas processing, storage, and dispensing equipment; canopies, lighting, signage, and other potential site improvements such as sound attenuation via enclosures, site grading, or landscaping. Station development and construction costs can vary significantly from one location to the next based on the following factors: available electricity and natural gas services; fuel capacity (compression and storage); regionally-variable costs for construction services; on-site power generation (especially if back-up fueling locations are not available); and real estate. Concerning this last item, consider the following:

- Egress/Ingress: If expecting to fuel heavy-duty vehicles, take into account turning radii and ease of egress/ingress. This also includes assessing traffic patterns to minimize cross-traffic turning (if possible).
- Public Access: If planning to allow public access (either now or later), include space for "outside the fence" fuel dispensing including necessary utilities (gas, electric, data cabling), lighting, canopy, and/or signage.
- Future Growth: Prepare site plans, expand foundation pads, and stub out utilities to facilitate and lower the cost of future station capacity expansion.

Taxes: This component comprises federal motor fuels excise taxes (MFET) based on $.183/GGE (regardless of unit used in dispensing/sales, i.e., the equivalent DGE tax would be approximately $.205); applicable state motor fuels excise taxes; and, in some cases, other sales taxes. State taxes on CNG vary considerably across the nation and may or may not equal those applied to gasoline and/or diesel. Some states do not impose MFETs on natural gas (nor propane autogas). Others that do collect MFETs impose a lesser tax, either permanently or on a phased-in schedule as an incentive to accelerate adoption of NGV technology. Note that tax exempt entities such as municipalities, schools, airports, and universities are still responsible for collecting and remitting federal and state MFET for all sales to taxable entities.

Profit Margin: Addition of profit margin and the amount of the margin, if any, is generally discretionary. In times of low gasoline and/or diesel prices, independent fuel retailers may forego profit margin and/or even suspend capital equipment amortization allocations to remain competitive. For regulated utilities that have rate-based their CNG station investment, retail rates include the regulated ROI built into their approved tariff; as a regulated investment, discretionary tacking on of profit margin typically is not permitted. Many municipalities that offer public access to their CNG stations to promote greater adoption by other public and private fleets will price their fuel to recover costs but not include profit margin; this is discretionary.

Station capital investment and operations and maintenance (O&M) expenses are the two components most directly impacted by economies of scale, i.e., the volume of station throughput against which to amortize these expenses; the larger the station throughput and utilization factor, the lower the amortized cost per GGE.

Federal or state tax credits and/or grants can reduce net station capital investment and significantly lower this component of pump price. For municipalities that choose to partner with an independent fuel provider for CNG fueling infrastructure, providing access to government property under a no-cost or low-cost lease can reduce or eliminate the real estate portion of station cost, also resulting in lower pump price. Federal or state tax incentives/rebates for fuel are also an effective way to reduce the total cost per GGE of CNG fuel.

CNG Station Development, Ownership, and Operations & Maintenance Options

CNG fuel station procurement generally falls into one of the three models summarized below. The "right choice" for a public agency will depend on its available capital, its technician staff's capabilities and resources, and the management's risk tolerance. In all three, the station design and construction should be delegated to professionals with the appropriate engineering and construction expertise.

Agency develops, owns, operates, and maintains its CNG station.

Under this model, an agency contracts the engineering and construction of its station (either through EPC or design-build process), then uses in-house staff to operate and maintain it. The agency provides capital or secures it through a debt service instrument to pay for the station, actively monitors station performance, handles all maintenance including initial and ongoing technician training, and stocks spare parts. The agency procures its own utility services, either bundled through the local gas and electric service companies or independently procured through brokers and transported via the local utilities, and accrues financial credits/incentives for fuel and/or station investment, if available.

In this arrangement, the agency has complete ownership of their CNG fueling operation, assuming all risks. "Savings" realized by handling all facets in-house and eliminating the profit margin built into O&M or third party fuel provider contracts need to be balanced against potential increased expenses and/or allocation of limited staff resources. The agency also foregoes the integration of station design engineering and station operations and maintenance expertise that O&M and third party retailers provide. This approach also ties up the agency's available capital or credit line and requires additional expenditures on spare parts inventories, technician training, lubricants, etc. The agency also foregoes some of the purchasing economies of scale enjoyed by these contract service providers (utilities, parts, lubricants, etc.).

Agency develops and owns station, but contracts out station O&M.

Under this model, an agency typically works with a qualified CNG station developer to design and build the station, paying for the asset, but then contracting station monitoring, maintenance, and repairs to a firm with experience and expertise in these areas, typically under a multi-year O&M contract. O&M contracts are often initially awarded to the company that designed and built the station, then rebid for additional terms thereafter. O&M service contracts are structured in many ways but usually include a monthly fee and/or surcharges tied to overall throughput. Utilities may be paid by the agency or included in the per-gallon O&M fee. Financial credits/incentives are typically taken by the agency but may be delegated to the O&M provider under contract terms.

Under this strategy, the agency retains ownership of their station but ties up capital and/or available credit line. It benefits from the O&M provider's experience, trained technicians, spare parts inventories, etc. The agency reduces risk exposure in exchange for the payment of the provider's fees. For some agencies, this type of arrangement is the only one available based on their charter or local/state laws and regulations that preclude allowing third party retailers to own essential city property.

Agency delegates development/ownership/O&M to turnkey station provider.

Under this model, the agency selects an independent CNG fuel provider to design, construct, operate, and maintain a CNG station on agency property - usually under a long-term property lease agreement, in exchange for the agency's commitment to purchase a minimum amount of fuel over the life of the contract at pre-determined rates, which may be structured in a variety of ways such as cost-plus margin, guaranteed discount against diesel market price, etc. Other capital investments such as vehicle financing/leasing and/or facility modifications may also be amortized into the agreement. Contract lengths vary but are usually a minimum of five years and often 10 years or even longer when the client is a government or quasi-government entity. Because reliability is the responsibility of the fuel retailer, contracts often include emergency back-up provisions such as temporary skid-mounted station or mobile fueling services until the station is back online. The CNG fuel retailer takes full responsibility for station monitoring, preventative maintenance, and emergency repairs, assigning trained technicians who are based in the area and equipped with all necessary parts. The fuel retailer also procures all necessary utilities and benefits from available financial credits/incentives that may be available. If the contract permits public access fueling, retail sales royalties to agency may be available (all negotiable). At the end of the contract, the depreciated station is often sold to the agency at a pre-agreed value, at which time the agency may take O&M responsibility in-house or solicit bids for contracted O&M services.

Under this approach, the agency shifts nearly all risk to the fuel retailer and enjoys far greater assurance of reliability. The agency avoids tying up capital, and eliminates expenses associates with spare parts inventories, technician training, and other station O&M related concerns. The only potential "down side" to this approach is that the agency *may* not garner as much savings for their own benefit as they would if they had kept the operations in-house, but given the economies of scale that the turnkey provider is able to leverage, these "unrealized savings" may be more perception than reality.

Appendix C

FLEETS FOR THE FUTURE: ALTERNATIVE FUEL VEHICLE FLEET SURVEY

Note: For the purposes of this survey, please consider the following alternative fuels/technologies: Ethanol 85%, Biodiesel, Dedicated Electric, Plug-In Hybrid Electric, Compressed Natural Gas, Liquefied Natural Gas, and Propane.

CONTACT INFORMATION:

Name: _____
Title: _____
Organization: _____
Email: _____
Phone: _____

FLEET PROFILE

1. How many on-road vehicles does your fleet operate/maintain in each of the following classes:
   - ☐ Check here if the following numbers are estimates
   - ☐ Light duty vehicles (Up to 8,500 lbs. GVW): _____
   - ☐ Medium duty vehicles (8501 – 26,000 lbs. GVW): _____
     (E.g. ranging from F-250/GMC 2500 to F-650/GMC C6500)
   - ☐ Heavy duty vehicles (Over 26,000 lbs. GVW): _____
   - ☐ Motorized commercial mowers (excluding tractor attachments) _____

2. Roughly how many vehicles of each of the following classes will your organization need to replace within the next 2-3 years?
   - ☐ Light duty vehicles (Up to 8,500 lbs. GVW): _____
   - ☐ Medium duty vehicles (8501 – 26,000 lbs. GVW): _____
   - ☐ Heavy duty vehicles (Over 26,000 lbs. GVW): _____
   - ☐ Please note any specific vehicle models that are particularly important to your upcoming replacement needs: _____

3. Does your organization have any of the following alternative fuel vehicles in your fleet? Check all that apply and specify what types of vehicles (e.g. school buses, pickup trucks, etc.) are using the alternative fuel:
   - ☐ Ethanol 85%: _____
   - ☐ Biodiesel: _____
   - ☐ Dedicated Electric: _____
   - ☐ Plug-In Hybrid: _____
   - ☐ Compressed Natural Gas: _____
   - ☐ Liquefied Natural Gas: _____
   - ☐ Propane: _____

4. For the alternative fuel vehicle type you expect your fleet is most likely to adopt in the next 2-3 years, what changes would need to happen in order to accelerate the fleet's adoption of these vehicles? If you are considering adopting more than one alternative fuel, describe the one you expect more difficulty with.

   ☐ Circle the most likely type:

Ethanol 85%	Bio-diesel	Dedicated Electric	Plug-in Hybrid Electric	Compressed Natural Gas	Liquefied Natural Gas	Propane

   ☐ Rate the changes in conditions that would be most helpful: Very Important, Important, Somewhat Important, Indifferent, or Not Important.
   - ☐ Better availability of alternative fuel packages for specialty vehicles _____
   - ☐ Better fleet evaluation tools _____
   - ☐ Change in driver attitudes _____
   - ☐ Change in local political climate _____
   - ☐ Improvement of public charging/refueling infrastructure _____
   - ☐ More data on maintenance savings, fuel savings, and/or reliability _____
   - ☐ Reduction in cost of the vehicle

5. Does your fleet have one or more of the following mandates or requirements? Check all that apply.
   - ☐ Mandates or requirements to acquire alternative fuel vehicles? If yes, describe: _____
   - ☐ Mandates or requirements to use alternative fuel? If yes, describe: _____
   - ☐ Mandates or requirements to reduce the use of petroleum based fuels and/or reduce fleet based greenhouse gas emissions? If yes, describe: _____

FLEET INFRASTRUCTURE & MAINTENANCE SUPPORT

6. If you handle maintenance onsite at a maintenance facility, does your organization currently have capacity and expertise to maintain the following alternative fuel vehicles? Check all that apply.
   - ☐ Ethanol 85%
   - ☐ Biodiesel
   - ☐ Dedicated Electric
   - ☐ Plug-In Hybrid Electric
   - ☐ Compressed Natural Gas
   - ☐ Liquefied Natural Gas
   - ☐ Propane
   - ☐ Do not have capacity and expertise to maintain AFVs
   - ☐ No onsite maintenance

7. What types of alternative fuel infrastructure does your fleet currently own or use? (enter Y/N in each cell)

Alternative Fuel/Technologies	Own and/or Operate	Use (public infrastructure)	Would like to expand in next 2-3 years
Electric vehicle charging stations (Level 2)			
Electric vehicle charging stations (DC fast chargers)			
Propane fueling station			
CNG fueling station			
LNG fueling station			
Ethanol blends			
Biodiesel blends			

8. How readily available are each of the following alternate fuels are in your area? Select one of the following for each fuel type: I Don't Know, Not Available, Available but Inconvenient, Available, or Other. If other, please specify.
   - ☐ Ethanol 85 _____
   - ☐ Biodiesel _____
   - ☐ Public EV charging stations _____
   - ☐ Compressed Natural Gas _____
   - ☐ Liquefied Natural Gas _____
   - ☐ Propane _____

9. For alternative fuel vehicles, does your fleet have experience bundling the procurement of the vehicle with the procurement of fueling infrastructure and/or fuel?
   - ☐ Yes, for electric vehicles
   - ☐ Yes, for propane vehicles
   - ☐ Yes, for natural gas vehicles
   - ☐ Yes, for ethanol vehicles
   - ☐ Yes, for biodiesel vehicles
   - ☐ No, but we would be interested in exploring such an approach
   - ☐ No, and our policies prohibit such procurement strategies

FLEET FINANCING

10. Within your organization, what payback period of cost savings (fuel, maintenance, and life-cycle savings) would be enough to justify the up-front investment in alternative fuel vehicles?
    - ☐ 1-2 Years
    - ☐ 2-3 Years
    - ☐ 3-5 Years
    - ☐ 5-7 Years
    - ☐ 7+ Years
    - ☐ I Don't Know
    - ☐ N/A: we have no way of justifying higher capital expenses through savings in fuel and maintenance.

11. Rate the following financing mechanisms by how commonly they are used within your fleet for AFVs and for conventional vehicles: Never, Uncommon, Common, or Very Common.

Financing mechanisms	For conventional vehicles	For AFVs
Direct upfront purchase		
Commercial leases		
3rd party financing		
US General Services Administration		
State bid list		
National cooperative procurement contracts (E.g. HGAC Buy, NJPA, National IPA, US Communities, NASPO ValuePoint, etc.)		
Other (specify): _____		

- ☐ If your organization feels strongly about not using one of the financing mechanisms listed above please comment: _____

12. If Fleets for the Future could reduce the cost of **one type of alternative fuel vehicle** for your procurement needs, which vehicle would you want it to be? (Indicate the vehicle fuel type and function. E.g. CNG transit bus, propane school bus, electric pool vehicle, etc.)

    Vehicle function: _____
    Vehicle fuel(s): _____
    Comments: _____

AFV FLEET BEST PRACTICES

13. Fleets for the Future is writing best practice guidelines to aid fleet managers and procurement specialists in procuring AFVs. What topic areas would be most useful to you and your organizations? Specify: High, Medium, or Low interest for each area below.

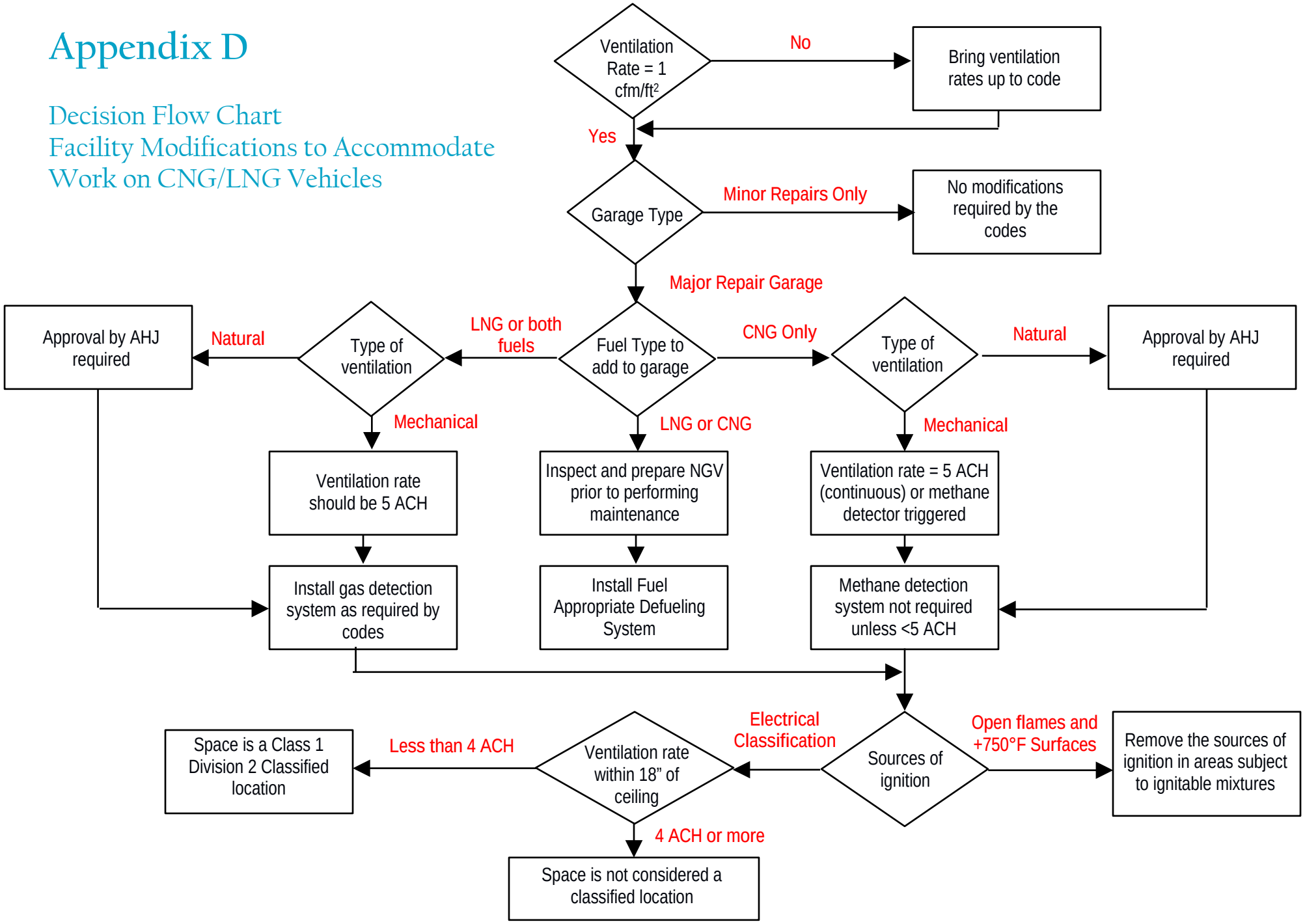
Topic Area	Electric vehicles	Propane vehicles	Natural gas vehicles	Ethanol vehicles	Biodiesel vehicles
Vehicle procurement decision support (e.g. suitability analysis, vehicle specs, etc.)					
Fueling infrastructure procurement decision support (e.g. siting and needs assessment, usage of public/private stations, setting up payment systems, etc.)					
Vehicle financing methods and incentives					
Infrastructure financing methods and incentives					
Additional requirements to consider for inclusion in procurement documents (e.g. warranty, training, maintenance, and service agreements)					
Operations best practices (e.g. driver training, vehicle dispatching, optimization for fleet needs, etc.)					
Maintenance best practices					
Other: _____					

14. Comments:

_____
_____
_____
_____

Appendix D

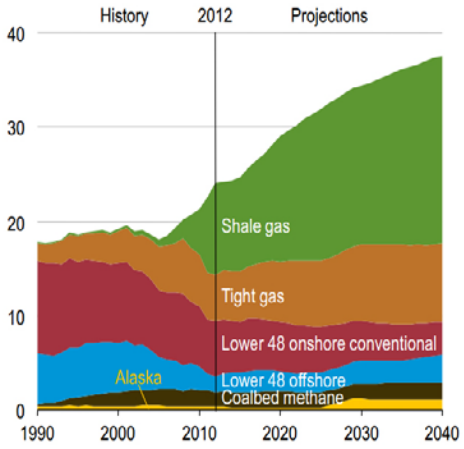
Decision Flow Chart
Facility Modifications to Accommodate Work on CNG/LNG Vehicles



Appendix E: Natural Gas Vehicle FAQs

What is natural gas?

Natural gas is a fuel typically delivered by the local gas utility company through underground pipeline distribution systems to homes, commercial/institutional facilities, factories, power plants, and vehicle fueling stations. *Note: See "mobile/virtual pipeline" reference under "Where can I fuel my NGV" below.*



Most pipeline-supplied gas is composed of 88-95% methane (CH4), with the remainder comprising small amounts of ethane, propane, and other combustible and inert gases. Natural gas is produced primarily by the decomposition of hydrocarbon-based plants and animals, and most natural gas discoveries are underground where these carbon-based materials have been trapped for thousands if not a million or more years. These underground deposits may be deep beneath the land or sea, entrained in seams of coal, and/or trapped within rock deposits. More recently, advances in exploration and production technologies have unlocked the ability to extract natural gas trapped within shale rock/sediment layers. This shale gas is released through a process called hydraulic fracturing or "fracking." Currently, shale gas accounts for about 45% of all natural gas produced in North America; the rest is derived from conventional deep wells, and limited amounts from coal seams.

Some natural gas used today comes from renewable sources, such as landfills, wastewater/sewage plants, and agricultural facilities. This natural gas, commonly referred to as 'biomethane,' is produced by decomposition of hydrocarbon materials and is not "trapped" deep in the earth. It is recoverable through gas collection systems where it is typically cleaned to remove entrained non-desirable decomposition by-products and concentrated to achieve pipeline standards for methane and other constituent gas content. Raw biomethane that has been cleaned and brought up to pipeline standards is often referred to as renewable natural gas (RNG).

What are CNG and LNG? How are these fuels different than LPG?

Compressed Natural Gas (CNG) is composed of the same natural gas that is delivered to your home or business by the local gas utility (albeit at very low pressures, 1/4psi to 2psi) but, in the case of CNG, the gas is compressed to a much higher pressure, usually 3600psi when dispensed to a vehicle. This is done by multi-stage compressors at the CNG station, which typically run on electricity or sometimes natural gas. *Liquefied Natural Gas (LNG)* is liquid version of the same natural gas used by millions of homes and businesses; this is achieved through a cryogenic refrigeration process that drops the gas to -259°F. When refrigerated to this level, the methane and other constituent gas molecules change from a gas to a liquid. If allowed to warm sufficiently, LNG will re-gasify. LNG is typically produced at a limited number of cryogenic facilities around the country, then stored in "super insulated" thermos-type vessels for transport or use at the production site.

The main difference between CNG and LNG is the state of the gas – it is important to note that during liquefaction, some non-methane constituent gases "drop out" before reaching -259°F, thus LNG tends to have an even higher methane content than CNG. Although it is possible to run a light-duty vehicle on LNG (it has been done), nearly all of today's light- and medium-duty NGVs and about two-thirds of heavy-duty NGVs (such as Class 8 over the road trucks) run on CNG. About one-third of the heavy-duty on-road

trucks (and a growing number of large off-road construction vehicle/equipment, locomotives, and marine vessels) run on LNG.

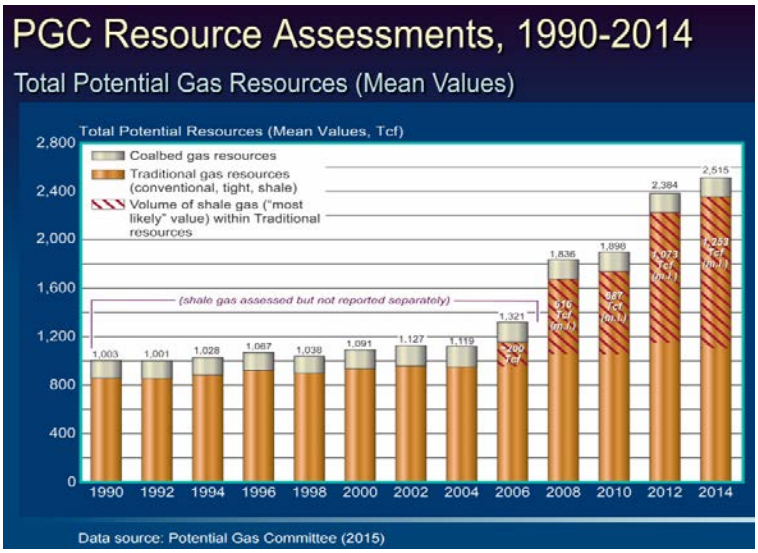
Liquefied Petroleum Gas (LPG) is a hydrocarbon fuel mix composed mostly of propane (C3H8), and other heavier hydrocarbon combustible and inert gases. Propane and LPG are sometimes used interchangeably, (as are methane and natural gas) even though they are not identical. Furthermore, LPG/propane has far different properties than natural gas/methane. Most notably, due to molecular content, propane is heavier than air while natural gas is lighter than air. And, while both are used as "alternative fuels" in vehicles, they are not interchangeable fuels.

While similar, natural gas (in either CNG or LNG state) and LPG, are both very clean, low-carbon fuels. Both produce significantly fewer emissions than gasoline or diesel fuel.

Where does America's natural gas come from?

The U.S. consumes about 27 trillion cubic feet (Tcf) of gas per year. About 90% of the natural gas consumed in the U.S. comes from the U.S, and the rest comes from Canada. While the U.S. has LNG import facilities where LNG produced elsewhere in the world may be offloaded, the present economics of domestically produced gas have all but shut down these import facilities; some are even being modified to become export facilities. Nearly all the gas used in the contiguous U.S. comes from those states and Canada. Small amounts of natural gas produced in Alaska is used there and/or liquefied and transported – again mostly to other Alaskan or arctic areas.

Two respected authorities, the U.S. Energy Information Administration (EIA) and the non-partisan Potential Gas Committee (PGC), provide reliable estimates of domestic natural gas resources. The PGC's year-end 2014 assessment exceeds all others in their 50-year history with a reported 2,515 Tcf of technically recoverable natural gas. Combined with the U.S. DOE's proven dry-gas reserves as of year-end 2013, the PGC estimates the U.S. has 2,853 Tcf of future supply. At the current rate of consumption in the U.S., which is about 26.8 Tcf per year, domestic natural gas resources will supply over 100 years of use.



How do NGVs work? How does fuel efficiency compare to gasoline- or diesel-powered vehicles?

Light-duty natural gas vehicles work much like gasoline-powered vehicles in that a fuel-air mixture is introduced into the engine cylinder, compressed by the piston, and ignited by a spark plug. Like a gasoline vehicle, the expanding combustion gases push the cylinder down, turning the crankshaft, which – via the rest of the powertrain – turns the wheels. Unlike a gasoline vehicle where liquid gasoline pressure is *increased* to suitable injection pressure by the fuel pump, in a CNG fuel system, high-pressure natural gas moves from the storage tank through a regulator where its pressure is *reduced* to the engine's required fuel injection system pressure. All fuels – gasoline, diesel, natural gas, ethanol, propane, alcohol, kerosene – have an energy potential measured in BTUs. An engine's operation depends on getting sufficient BTUs to ignite and create the combustion energy needed to push the piston down. NGV engines are calibrated so that each compression cycle receives the same amount of BTUs as gasoline, so the mileage per gallon (mpg) is the same. Because CNG is a gas, we compare with gasoline by using an equivalent energy measurement – the Gasoline Gallon Equivalent (GGE), developed using U.S. DOE-determined gasoline

Btu content. To summarize, if a gasoline-fueled sedan gets 36 mpg on the highway or 26 mpg in the city, the same model natural gas sedan will get equivalent mileage. Natural gas engines are not more efficient, they just produce power using a cleaner method.

In diesel engines, there are no spark plugs – diesel fuel is compressed and its temperature increases to the point of ignition (thus referred to as *compression ignition* engines). Typical diesel engine compression ratios are 18-20:1 whereas spark-ignited engine compression ratios are generally much less (e.g. 10-12:1). Therefore, when diesel engine platforms are modified in design to become spark-ignited-natural-gas (SING) engines as is the case with the Cummins Westport engine platforms used by the major truck and bus OEMs, their compression ratios are reduced to eliminate potential for pre-ignition. This drop in compression ratio reduces their relative fuel efficiency as compared to comparably-sized diesel-fueled engines. The reduction in fuel efficiency runs from 2-18% depending on the duty-cycle of the application. Generally speaking, applications where the engine mostly operates at the low RPM high-torque end of the Hp/Torque range (such as refuse trucks, city buses, and other stop-start low speed applications), the fuel efficiency differential is minimal or even negligible. Conversely, in applications where the engine is operating more hours at the high RPM lower torque end of the spectrum (such as an over-the-road freight truck), fuel efficiency reductions tend to be larger (12-18%).

When calculating fuel needs (e.g. to estimate vehicle range or operating hours per tank), diesel fleet operators should apply the appropriate "fuel efficiency discount" that fits their application duty-cycle.

What's the difference between "dedicated," "bi-fuel," and "dual-fuel" vehicles?

Dedicated vehicles, sometimes referred to as "mono-fuel," have only one fuel on board to run the vehicle (e.g. dedicated CNG vehicles have no gasoline tank and run entirely on CNG). *Bi-Fuel* vehicles are vehicles that are capable of running on two different fuels and – in most cases – typically only one at a time. Thus, a bi-fuel CNG-gasoline vehicle will run on CNG until it runs out, then switch over to gasoline. Many bi-fuel vehicles will start on gasoline and run a very short time – just long enough to generate heat for the engine coolant loop – before seamlessly switching to CNG. This is usually done to generate heat to circulate through the CNG regulator to counteract the Joule-Thompson effect, a pressure-drop phenomenon that produces extreme cold that can potentially freeze any moisture entrained in the fuel as it passes through the regulator. One retrofit system manufacturers' "bi-fuel" system for direct injection gasoline engines actually uses a small amount of gasoline while running in "CNG mode." The intermittent bursts of gasoline during CNG operation are primarily to cool the gasoline injectors. Technically, these vehicles are running in *dual-fuel* mode, which refers to the *simultaneous* use of two fuels in the combustion process. Dual-fuel typically refers to diesel engines that have been manufactured or retrofitted to run on both diesel fuel and natural gas at the same time, with the amount of diesel fuel displacement varying as the duty cycle varies. For example, most dual-fuel engines are diesel compression ignition engines (i.e. no spark plugs) where the vehicle starts on 100% diesel and quickly begins to displace diesel with natural gas as the call for power rises. At full throttle (e.g. when running down the highway, the proportional mix of diesel fuel/natural gas may be as high as 30%/70%). Note that most dual-fuel engines are capable of running solely on diesel if the onboard storage of natural gas runs out (not optimally, but enough to return to base or get to the next natural gas fueling location).

Where can I fuel my NGV?

Because vehicular natural gas (CNG or LNG) requires additional "handling," it is only available at stations specifically equipped to handle the fuel. Presently, there are about 1650 CNG stations across the U.S. and about 125 LNG stations, the latter of which mostly serve heavy-duty trucks. Slightly more than one-half of CNG stations are open to the public and offer standard payment mechanisms (e.g. credit card). The number of CNG stations is growing quickly, driven by fleets' adoption of the technology and fuel retailers' inclusion of CNG fueling capability at existing petroleum fuel locations such as convenience stores, highway travel plazas, truck stops, and super-stores. Some fleets even elect to provide public access to

their private CNG stations by installing retail dispensing capability "outside the fence." Examples include many municipalities, transit agencies, and a number of private businesses (e.g. Waste Management's Clean-N-Green retail CNG sites). The economics of building and operating a CNG station are typically driven by volume throughput, thus many are installed at locations convenient to an "anchor fleet" or several aggregated anchor fleets whose fuel use justifies the station investment. Many fleets whose fuel use per year does not justify a dedicated CNG station of their own identify an existing CNG station that is either close to their home base of operations or located on a regularly traveled route.

More recently, a new natural gas delivery model has emerged, most commonly referred to as "mobile-" or "virtual-pipeline" delivery. In this application, natural gas is drawn from a local utility distribution point, compressed, and loaded into large high-pressure CNG cylinders mounted on a flatbed trailer. The multi-cylinder "tube trailer" is then delivered by truck (or railcar) to an end-use location. In some cases, the trailer is dropped off and connected to the site's local connection point or CNG station equipment (exchanged for an empty trailer). In other cases, especially applicable to the transportation sector, a mobile pipeline truck may travel to a fleet location where it fuels vehicles on site before departing. This type of fueling arrangement (commonly referred to as "wet fueling" in the liquid fuels business) may be a good option for fleets far from existing CNG stations and local gas distribution pipelines, and where CNG fuel use is insufficient to justify investment in a station.

While most NGV-driving *consumers* use existing public access CNG stations, some choose to install home CNG fueling appliances. These appliances compress low pressure gas delivered via local gas pipeline to their home up to 3600psi. For safety code reasons, the compressed gas is distributed directly to the vehicle's onboard storage cylinder and never stored in a stationary vessel located at the home. At the present time, there are only one or two appliances on the market that have been tested and approved to national safety standards; several more are expected to be introduced in the near future. Generally speaking, these devices produce only a small amount of CNG per hour (0.5-1.25GGE/hour) and thus rely on the vehicle being connected at night or during "down-time" to fill the onboard cylinder. Home CNG fueling appliances tend to be very expensive to buy and install, as the demand is not yet high enough to be cost competitive. Most homeowners install these units based on environmental commitment or convenience, rather than economic reasons.

What are the environmental attributes and advantages of NGVs?

Methane, the primary component of natural gas, is composed of a single carbon molecule and, as such, is extremely clean burning, producing carbon dioxide and water as by-products of combustion. Natural gas is the cleanest-burning alternative transportation fuel commercially available today. To be precise, hydrogen-fueled vehicles (e.g. fuel cell cars) are cleaner, but are not considered commercially viable nor are there a statistically significant number of stations in use – most are demonstration projects and/or heavily subsidized fleet-demo locations for a very limited number of vehicles.

The primary benefit when it comes to "new" vehicles is a reduction in mono-nitrogen oxides (NOx) and greenhouse gas (GHG) emissions. Light-duty NGVs produce approximately 10% less NOx than the newest gasoline vehicles (model years 2014 and later) and up to 97% less than older gasoline vehicles (model years 2002-2007). As a very low carbon fuel, NGVs also produce far less particulate matter than older gasoline vehicles.

More recently, greater emphasis has been placed on GHG emissions. Natural gas contains less carbon than any other fossil fuel and thus produces fewer carbon dioxide (CO2) emissions when burned. While NGVs do emit methane, another principle GHG, the increase in methane emissions is more than offset by a substantial reduction in CO2 emissions. The California Air Resources Board (CARB) has conducted extensive analysis on this issue. CARB concludes that a CNG fueled vehicle emits 26 to 29 percent fewer GHG emissions than a comparable gasoline fueled vehicle on a well-to-wheel basis. For natural gas vehicles that run on biomethane, the GHG emissions reduction approaches 90 percent. A recent re-analysis by Argonne National Laboratories for the U.S. EPA factored in upstream methane emissions from the natural

gas production and delivery channel; it found that NGVs still produce 5-15% less GHG than petroleum-fueled vehicles.

Are NGVs Safe?

Natural gas is an inherently safe fuel and, unlike gasoline, dissipates into the atmosphere in the event of an unlikely accidental release because it is lighter than air. The high ignition temperature for natural gas (i.e. ~1000°F compared to 495°F for gasoline and 600°F for diesel) and limited flammability range make accidental ignition or combustion of natural gas unlikely.

CNG vehicle storage cylinders and other fuel system components are manufactured to strict standards and installed in accordance with applicable codes. They are subject to extreme testing including, bonfire, high-impact, and bullet-fire tests. CNG cylinders are built to withstand pressures 2.25 times their operating pressures. Furthermore, they are equipped with pressure relief devices that deliberately release the gas in a controlled way should the cylinder experience prolonged exposure to fire – this is a safety measure to protect firemen and other first responders. While CNG cylinders operate at 3600psi, few are aware that a child's paintball gun operates at 5000psi or that high-pressure gases (>5000psi) such as oxygen and acetylene are routinely transported on our roads and highways to hospitals and industrial facilities. The industry has an excellent safety record, especially when compared to other fuel types.

Is converting my vehicle to CNG legal? Will it negate my OEM warranty?

Converting a vehicle that was originally manufactured to run on gasoline is legal only if the retrofit ("conversion") system is 1) EPA- or California Air Resources Board (CARB)-certified for that particular vehicle and model year and 2) installed in compliance with NFPA standards governing the safe installation of CNG systems on that vehicle. EPA-/CARB-certified systems are available through a limited number of manufacturers who have gone through the expensive and technically challenging process of engineering, testing, and submitting their vehicles to national testing laboratories for EPA/CARB compliance. These manufacturers offer their retrofit systems through qualified installers. Despite the errant information posted on the Internet by many unscrupulous and unqualified "conversion kit" dealers, retrofitting a vehicle to run on CNG is NOT a do-it-yourself hobby. Even those with significant automotive experience MUST use an EPA-/CARB-certified system; there are federal penalties for "tampering with a federally approved emissions control device." Internet kit manufacturers that claim that EPA or CARB certification is not required are typically clueless to the law and its legal repercussions.

If a vehicle has been properly converted to CNG using an EPA-/CARB-certified system, the OEM warranty remains in place for all items originally warranted by the OEM, except that the EPA/CARB certificate holder (manufacturer of the retrofit system) now has legal (federally imposed) responsibility for the emissions related components and systems (typically, the fuel rail, injectors, catalytic converter, etc.) for the official "life of the vehicle." This "lifetime" determination varies based on the vehicle class and type but is typically in the range of 80,000 to 110,000 miles. In effect, the certificate provides protection to the manufacturer against "anti-tampering" provisions of federal law, but also transfers responsibility from the OEM to the retrofit system manufacturer. The installer (an agent of the manufacturer) also has responsibilities for the vehicle parts registration and tracking should there be a NHTSA-initiated recall of that vehicle.

In summary, for non-CNG related items, the OEM still must maintain the vehicle's warranty and for those emissions-related items (including the CNG components and exhaust after-treatment system), the retrofit system manufacturer (i.e. the EPA/CARB certificate holder) must maintain the minimum federally-required warranty on those items.

If a non-EPA-/CARB-certified system is installed, the vehicle is in violation of federal emissions anti-tampering law and will lose its OEM warranty.

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