A Report on the Fuel Cost Considerations of Propane

Alternative Fuel Vehicle Considerations for Fleet Managers

Propane

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PROJECT TEAM:
Much of this work would not be possible without the tireless efforts of the Stennis Institute and staff. In no particular order, they are:

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Commonly Used Acronyms

AFDC – Alternative Fuels Data Center, Department of Energy

DoE – Department of Energy

H.B. - House Bill

LPG – Liquified Petroleum Gas (Propane)

MDA – Mississippi Development Authority

MPG – Miles per gallon

OEM – Original Equipment Manufacturer

MSU – Mississippi State University

VMT – Vehicle Miles Traveled

Introduction

Propane, also known as liquefied petroleum gas (LPG), is an odorless, non-toxic hydrocarbon gas at normal pressures and temperature; that when pressurized, is a liquid with an energy density 270 times greater than its gaseous form. Propane is used by millions of Americans each day. People use propane in and around their homes for furnaces, water heaters, air conditioners, outdoor grills, fireplaces, and appliances. On farms, propane-fueled equipment and technologies control pests, dry crops, and power irrigation pumps. Industrial uses include propane-driven forklifts and fleet vehicles.

Up to 56,000 miles of pipeline and more than 6,000 retail dealer locations make propane readily available throughout the United States. Because propane is stored in portable tanks, it can be used in areas beyond gas mains. Refueling a propane vehicle takes about the same time as refueling a gasoline vehicle. In addition, propane is the only alternative fuel with fueling stations located in every state.

During the 2013 Mississippi legislative session, a portion of the Governor's "Energy Works: Mississippi's Energy Roadmap", was passed. H.B. 1685: Alternative Fuels Vehicle Revolving Loan Fund, creates a $2.75 million zero-interest revolving loan fund, to be administered by MDA Energy & Natural Resources Division, which will allow municipalities and school districts to borrow funds at no interest for the cost of purchasing or converting vehicles to natural gas or propane and for the cost of infrastructure required in the fueling process. As a part of a comprehensive package of bills to advance energy development in the state, this particular bill will empower municipalities and school districts to development fleet management strategies that could lead to potential cost savings and ultimately save taxpayer dollars.

Fleet managers are increasingly aware of the potential hazards greenhouse gas emissions present to the environment, and when combined with social and political pressure to respond, are investigating the requirements necessary to convert from traditional gasoline and diesel vehicles to alternative fuel vehicles (AFVs). Propane,

which is widely available and has been "used as a vehicle fuel on a widespread basis for many years", is one of several viable options, depending on the fleet's needs and future requirements (Blake, Buttner, & Rivkin, 2010). Over the last decade, the number of propane vehicles in use has incrementally declined, creating the impetus for inquiry into the reasons propane has declined in use, potentially, and whether propane should be considered as an alternative fuel for fleet vehicles, which this report shows as a definite factor in the AFV considerations.

Propane Basics

Propane is a hydrocarbon (C3H8) and is commonly referred to as liquefied petroleum gas, LP-gas, or LPG. Propane is produced from both natural gas processing and crude oil refining, in roughly equal amounts from each source. Nearly 97 percent of propane consumed in the United States is produced in North America (Department of Energy, 2013). It is nontoxic, colorless, and virtually odorless. To provide additional safety in leakage recognition, an identifying odor is added so the gas can be readily detected.

Propane is an approved, clean fuel listed in the 1990 Clean Air Act and the Energy Policy Act of 1992 and is one of the cleanest burning of all fossil fuels. Tests conducted by the U.S. Environmental Protection Agency (EPA) show that propane-fueled vehicles produce 30 percent to 90 percent less carbon monoxide and about 50 percent fewer toxins and other smog-producing emissions than gasoline engines. Propane also is nontoxic, so it's not harmful to soil or water (Department of Energy, 2013).

Propane, also known as liquefied petroleum gas (LPG), is an odorless, non-toxic hydrocarbon gas at normal pressures and temperature; that when pressurized, is a liquid with an energy density 270 times greater than its gaseous form. Propane actually provides more energy per unit than other alternatives and since it is measured in gallons (or liters) can be compared quite easily. In gaseous form, propane provides

about 2,500 BTUs per cubic foot. As compared to other alternative gases, less propane is needed to supply the same amount of energy, up to two and a half times.

Vehicles that run on propane require special tanks to hold the fuel; many cars are actually bi-fuel, which means they have additional tanks to hold gasoline. Since propane has a narrow flammability range, and its tanks are 20 times more puncture-resistant than gasoline tanks it is often safer to convert.

Propane, LPG, or propane autogas as it will be referred to from this point forward, is one of many alternative fuels that should be considered when planning a conversion of a vehicle, or vehicle fleet, to alternative fuel vehicles. Propane, while not necessarily intended for large refuse trucks or heavy-duty applications as the primary source of fuel, is perfectly suited for light-and medium-duty vehicle fleet applications.

How Does It Work?

Propane vehicles operate in a similar fashion to gasoline vehicles with spark-ignited engines. According to the Department of Energy, there are two types of fuel-injection systems available: vapor and liquid injection. In both instances, propane is stored as a liquid in a low-pressure tank (about 300 psi). In a vapor-injected system, liquid propane is controlled by a regulator or vaporizer, which converts the liquid to a vapor. The vapor is fed to a mixer located near the intake manifold where it is metered and combined with filtered air before being drawn into the combustion chamber and burned to produce power, just like a gasoline engine. In a liquid-injected system, fuel is delivered into the combustion chamber, or intake port, in a liquid form (instead of a vapor). This way, the fuel combusts more fully and provides optimal power and throttle response.

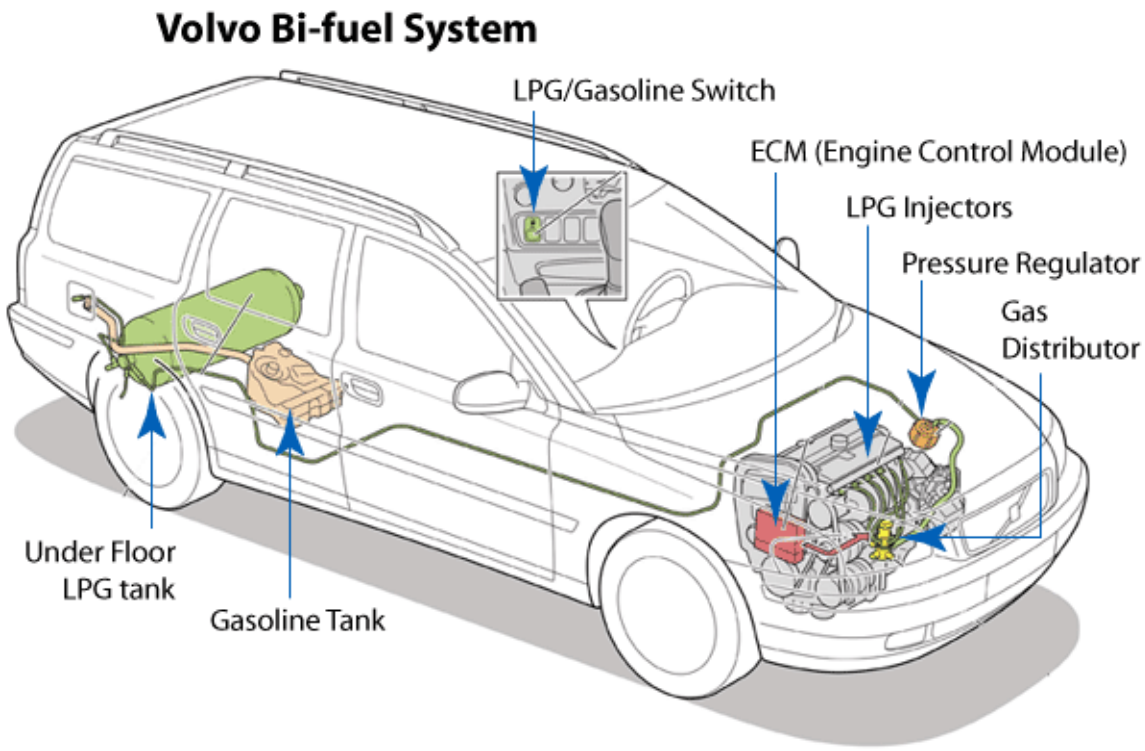
Propane as an auto fuel has a high octane value and has key properties required for spark-ignited internal combustion engines. In order for a vehicle to operate on propane as either a dedicated fuel or bi-fuel (i.e., switching between gasoline and propane) vehicle, there are only a few modifications necessary. Werpy (2010) states that

“recently propane vehicles have commonly used a vapor pressure system that was somewhat similar to a carburetion system, wherein the propane would be vaporized and mixed with combustion air in the intake plenum of the engine.” This leads to lower efficiency as more air, rather than fuel, is inducted into the cylinder for combustion (Werpy 2010). A newer liquid injection system has become available that injects propane directly into the cylinder, resulting in no mixing penalty because air is not diluted with the gaseous fuel in the intake manifold. Use of a direct propane injection system will improve engine efficiency (Werpy 2010). Other systems include the sequential multi-port fuel injection system and a bi-fuel “hybrid” sequential propane injection system (Werpy 2010).

Werpy (2010) continues, “In the United States a closed-loop system is used in after-market conversions. This system incorporates an electronic sensor that provides constant feedback to the fuel controller to allow it to measure precisely the proper air/fuel ratio. A complete conversion system includes a fuel controller, pressure regulator valves, fuel injectors, electronics, fuel tank, and software. A slight power loss is expected in conversion to a vapor pressure system, but power can still be optimized with vehicle modifications of such items as the air/fuel mixture and compression ratios. Cold start issues are eliminated for vapor pressure systems since the air/fuel mixture is gaseous. “

In light-duty propane vehicles, the fuel tank is typically mounted in the trunk; for medium- and heavy-duty vans and trucks, the tank is located under the body of the vehicle. Propane tanks add weight to a vehicle and can slightly increase the consumption of fuel. According to the Department of Energy, the energy content of propane is 73% that of gasoline, thereby requiring more propane fuel to travel an equivalent distance, however real-world applications show that there is not a consistent figure for MPG loss.

Figure 1. A typical bi-fuel propane system. (Source, AFDC, 2013)



Benefits and Considerations

Benefits

Propane autogas provides a substantial alternative to traditional gasoline and diesel fuels in fleets, but it is just one of several alternative fuels available today. Propane autogas provides numerous benefits for those fleet managers and operators who chose to incorporate alternative fuel vehicles into their fleets, but it also has some other features that require investigation and insight into the ramifications of incorporating propane. To best serve those considering the transition to propane autogas, the following section will detail the benefits and considerations for those wishing to learn more about propane autogas.

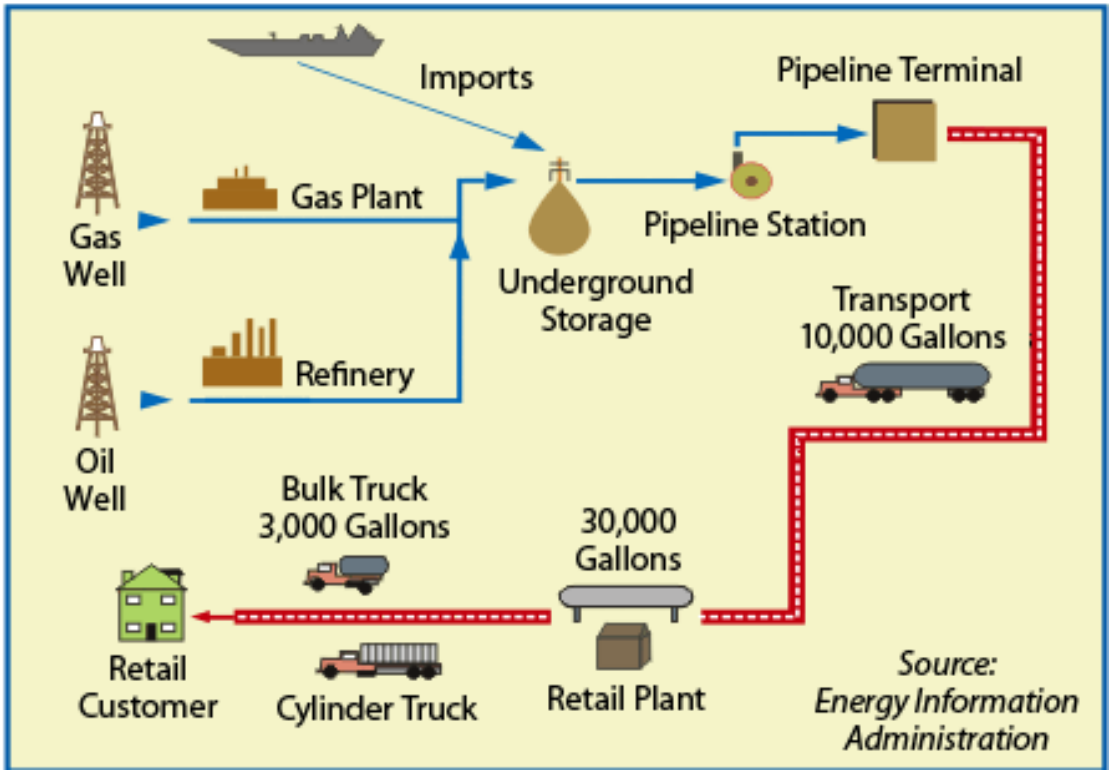
Fuel Cost Savings

Of the most widely discussed topics in considerations for converting to alternative fuels is the savings on fuel costs compared to gasoline and diesel. One of the unique aspects of propane compared to gasoline in many instances is the ability for entities to arrange for long-term fixed price contracts with propane suppliers, thereby locking in prices which can be beneficial to entities, as long as gasoline prices remain higher than propane prices. The actual savings on fuel costs vary from state to state, region to region, so applying an "across-the-board" savings calculator on propane is not a practical measure at this point. If an entity uses the Alternative Fuels Data Center conversion process to determine the price of propane, the entity is not only discounting the available savings through the current $.50 tax credit available to alternative fuel suppliers, but is also considering the average cost of propane nationwide. There are multiple reports that show that the price of fuel at a private filling station, or a station onsite, is approximately $1.50 cheaper than an average public filling station. In addition, the AFDC uses a conversion rate of 1.38 gallon ratio, which is significantly higher than what this study, and many others, have found. The conversion rate should more likely rest somewhere in the 1.18-1.22 range, which would put the gasoline gallon equivalent price of propane $.25-$.45 cheaper than gasoline, per gallon, given the currently reported prices by the AFDC in October 2013. This is a consideration for those interested in the conversion, as using the standard rates is a bit misleading.

Energy Security

One of the most heavily researched and discussed topics surrounding the use and application of alternative fuel vehicles is the reduction in dependency on foreign sources of oil. According to the Department of Energy (2013), "the United States imported about 49% of the petroleum it consumed, two thirds of which was used to fuel vehicles in the form of gasoline and diesel." Based on the nature of the extraction process of propane from natural gas processing and crude oil refining, the reliance on petroleum from foreign sources is reduced significantly. The vast infrastructure of US based propane is a domestic production line, as seen in figure 1.

Figure 2. Schematic of a typical propane distribution route (Source: EIA)



While the use of propane does not eliminate the importing of petroleum from foreign sources, the reliance is significantly reduced, thereby reducing the country's vulnerability to supply disruptions, and ultimately increasing the country's energy security.

Infrastructure

This topic will be revisited in a later section, however it is important to note that one of the biggest positives for propane autogas in the alternative vehicle fuels market is the wide availability of propane filing stations compared with other alternative fuels. The Department of Energy reports 124 public propane filling stations, and 2 private stations, across the state of Mississippi. The Mississippi Propane Gas Association (MPGA), along with several others, report that number as 241 stations. The discrepancy in station numbers can be due, in large part, to the self-reporting system the DoE has set up for the alternative fuels stations. If a station fails to notify the DoE of its presence, often times it will be left off the map of available stations.

In line with infrastructure availability is the cost of the infrastructure for a propane filling station. Many stations, while currently available to the public, may not meet the needs of some entities that require dedicated pumps for multiple vehicles, return to base filling capabilities, and other issues that are specific to fleet requirements. Propane provides the flexibility of erecting filling stations with a minimal cost, when compared to other fuels. This is based primarily on the limited equipment needed to install these stations. The Department of Energy released a report in 2010, stating that the cost of a typical propane filling station was between $37,000 and $60,000, with a cap of $175,000 for the larger filling stations available to the public (Department of Energy, 2013).

Much of this infrastructure cost can be amortized within the fuel price itself through lease agreements with propane suppliers. This possibility places the infrastructure considerations for propane in a class of its own, at least in the majority of the alternative vehicle fuels market.

Propane has been used for many decades, with studies on the use and implications of converting to propane dating back into the 1980s. Based on this history, and the wealth of available information regarding propane in fleet vehicles, it has become almost commonplace to see a repeated set of talking points for both the benefits and drawbacks of propane. That stated the primary benefit, in terms of costs compared to other alternative vehicle fuel options, is the limited costs or financial outlay needed in developing a fueling system to fit vehicle fleet needs.

Per capita, Mississippi ranks as one of the top states in filling station availability. Comparing Mississippi to availability-leading Texas, Mississippi has more public filling stations available per capita than Texas. Using 2010 US Census data, and analyzing the number of public filling stations available in both states, Mississippi has 1 propane filling station for every 23,930 people, compared to Texas, which has 1 propane filling station for every 45,288 people.

In terms of public filling stations available for every square mile of land in each of these states, Mississippi currently has 1 public filling station for every 371 square miles of land, whereas Texas has 1 public station for every 617 square miles.

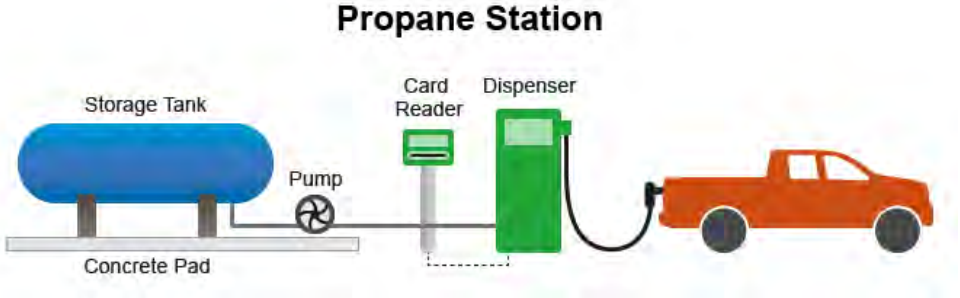
One last comparison is the number of road miles for every 1 filling station. While this calculation is the simple calculation of station per total road miles, it is indicative of the number of stations in relation to state size and expanse. In Mississippi, there is currently 1 public filling station for every 1,260 miles of road in the State. By comparison, the State of Texas currently has 1 filling station for every 1,506 miles of road, or a difference of 16% in road miles per station. These are simply illustrative in nature, but it is to show that Mississippi is positioned with a fairly established propane infrastructure, when compared to other leading states.

Propane Stations and Costs

Based on Werpy's (2010) study, the report developed three scenarios for developing infrastructure. These scenarios are based on CleanFUEL USA's estimations of costs for each, and these have been reported by DoE as standard average costs as recently as 2012.

The following page details the possible scenarios and provides a guideline for those interested in converting to propane as an alternative vehicle fuel. The scenarios are not absolute or necessarily reflective of pricing across the US, but do provide a benchmark for comparison.

Figure 3. A Typical Propane Filling Station (Source: AFDC, US Dept of Energy)



1. **Base Model Propane Fueling Dispenser**
   Non-electronic meter, 0.5-hp pump, low-profile basic cabinet that is very similar to the forklift or gas station dispensers typically used for filling RVs and BBQ bottles (not recommended for motor fuel applications but will work in most cases).

   Estimated Costs Installed—Based on Storage Tank Size:
   a. 500-gallon tank with a turnkey dispenser skid system: *$25,000*
   b. 1,000-gallon tank with a turnkey dispenser skid system: *$33,000*
   c. 2,000-gallon tank with a turnkey dispenser skid system: *$48,000*

2. **Propane-Autogas Fueling Station—Designed for Fleet Motor Fuel Applications**
   Fully integrated electronic dispenser with two wire interface capabilities for most of the major proprietary fuel management network cards, such as Fuel Man, Petro-Vend, and Gas Boy; records Word- or Excel-based fueling transaction data.

   Estimated Costs Installed:
   a. 500-gallon tank with a turnkey dispenser skid system: *$37,000*
   b. 1,000-gallon tank with a turnkey dispenser skid system: *$45,000*
   c. 2,000-gallon tank with a turnkey dispenser skid system: *$60,000*
   d. 15,000-gallon tank with two dispensers on the fueling island: *$130,000*
   e. 15,000-gallon tank with four dispensers on the fueling island: *$155,000*

3. **Propane-Autogas Retail Fueling Station—Also Designed for Large Fleet Applications**
   Fully functional electronic autogas dispenser with electronic point of sale (EPOS) credit card transactions—designed for retail and large fleet applications; seamless retail fueling dispenser system available in both Gilbarco and Dresser-Wayne models.

   Estimated Costs Installed:
   a. 1,000-gallon tank with a turnkey EPOS dispenser skid system: *$92,000*
   b. 2,000-gallon tank with a turnkey EPOS dispenser skid system: *$102,000*
   c. 15,000-gallon tank with two EPOS dispensers on the fueling island: *$150,000*
   d. 15,000-gallon tank with four EPOS dispensers on the fueling island: *$175,000*

Alliance Autogas has designed and manufactured its own turnkey solution for fleets, with a dispensing system offering a standard 1,000-gallon tank and dispenser with card reader capability for $21,000, or the same size tank capacity with a card reader for $30,000. Figures cited do not include permitting fees. Alliance provides the conversion equipment, a certified conversion center with trained technicians and follow-up diagnostics, infrastructure installation, and reliable year-round fuel supply (Werpy, Burnham, & Bertram, 2010).

Emissions

The final benefit, although the levels are questioned, is the reduction in greenhouse gas (GHG) emissions in the use of LPG over gasoline or diesel. Propane is a clean-burning, nontoxic gas which does not harm soil, water, or other natural elements. However, propane does produce reduced levels of carbon monoxide (up to 40%), a 90-95% reduction in evaporative Volatile Organic Compounds (VOCs), and up to an 80% reduction in exhaust coarse particulate matter (Werpy, Burnham, & Bertram, 2010). What this scientific jargon states is that while the exact reduction in harmful contaminants released from Tier 2 gasoline vehicles is uncertain, there is a definite reduction in *some* amounts of these contaminants.

Maintenance and Extended Vehicle Life

One of the most documented benefits of the use of propane in vehicles is the clean burning nature of the fuel, and the extended life reported in engines (Leiby & Rubin, 2001) (Haller, Welch, Lin, & Fulla, 2007) (Werpy, Burnham, & Bertram, 2010) (Weidie, 2011) (Golob, Torous, Bradley, Brownstone, Cracnce, & Bunch, 1997) (Department of Energy, 2013). The Department of Energy reports that engine life has been documented as doubling its overall lifespan when propane is used as a fuel in the vehicle (Department of Energy, 2013). In the study discussed later, each entity reported a clean burning fuel and extended maintenance schedules, due to the lack of particles and corrosion found in normal oil changes.

Considerations of Propane in Vehicles

Relatively recent studies have demonstrated that "fleet operators [are willing] to trade off greater vehicle range for better access to fueling infrastructure" (Haller, Welch, Lin, & Fulla, 2007; Golob, Torous, Bradley, Brownstone, Cracnce, & Bunch, 1997). While this has been found to be the case in studies of other alternative fuels, one article suggests that the decisions to convert fleets or to change the fleet operations are not made by one individual, but rather a team of individuals, based on importance and urgency

(Nesbitt & Sperling, 2001). The types of fleet-decision structure is highly correlated, in this study, with the ability to make changes and convert to alternative fuels (Nesbitt & Sperling, 2001).

Perhaps the most telling consideration would be the impact of a finding from the 2001 presentation by Oak Ridge National Laboratory and the Transportation Research Board (TRB), in which the scientific study found that use of AFVs would not provide enough of an impact to make a difference based on their availability and fueling infrastructure limitations, except in the case that "the United States [were] to ratify the Kyoto protocol and require reductions in greenhouse gases from the transportation sector on the order of 20% by 2010, then the whole price regime for transportation would be fundamentally altered, potentially allowing AFVs to better compete" (Leiby & Rubin, 2001). Per Executive Order 13514, President Obama has called for a 30% reduction in petroleum usage for federal fleets, driving local jobs and energy policies (White House, 2009). These considerations for propane, and other alternative fuels, are based on the federal-level push for cleaner, more efficient fuels used in fleet vehicles, which should provide a significant investment in research by those willing and able to convert to cleaner burning fuels

Conversion Costs

One consideration that is necessary when analyzing LPG as an alternative fuel to gasoline is the cost of converting existing vehicles, or purchasing OEM vehicles directly from the dealership. Because the cost of converting vehicles varies significantly based on the age, type of conversion, and model of vehicle, this study used the data found by surveying multiple entities across the state and region and found that the average conversion cost for a vehicle was $5,600, rounded off for ease of reporting. Considering the costs of the conversion, it is important that decision-makers incorporate the cost of conversion into their models for converting to LPG to fuel their fleet vehicles.

Conversion costs can also be subsidized in several ways. House bill 1685 provides the ability to apply for a 0% loan through the state of Mississippi (Appendix A). Also,

several gas companies provide loan and grant programs, and provide various funding opportunities, should an entity wish to convert its fleet to LPG vehicles. The best way to find out what is available is to contact your local provider and inquire as to the presence of funding subsidies and opportunities.

Infrastructure Availability

Propane is the most widely available alternative fuel in the state of Mississippi, and is the 3rd most commonly used transportation fuel (Department of Energy, 2013). That said, there is still a significant amount of lacking infrastructure compared to traditional gasoline. As previously mentioned, there are significantly cost-effective strategies to develop filling infrastructure depending on the needs of individuals, however this still remains a necessary point of information in considering the conversion to LPG. Infrastructure costs are typically the largest costs in the conversion process, leading to reluctance by many to convert. There are other considerations, particularly time needed to recoup the costs and begin savings, many of which are discussed in greater detail in the following sections.

Vehicle Availability

Vehicle availability, or lack thereof, is a concern for those interested in converting fleets to LPG. Many of the previously existing propane vehicles from the 1990s have been retired, reducing the number of available vehicles running propane (Werpy, Burnham, & Bertram, 2010). That noted, there have been advances and companies such as Roush are now offering conversion kits for F-250 and F-350s, along with other vehicles. For a full listing of available vehicles, both OEM and conversion kits, please visit the DoE's alternative fuels website at http://www.afdc.energy.gov/vehicles/propane_availability.html.

Price Volatility

Propane prices are closely tied to the price of crude oil, and therefore are subject to price spikes. Prices of propane, when listed in comparable price per GGE or gasoline gallon equivalent, are often reported as comparable or essentially equal to that of a

gallon of gasoline (Alternative Fuels Data Center, 2013). This should be taken with some extent of caution, as the Clean Cities Alternative Fuel Report notes that some of this pricing is based on RV and household tank refilling. Werpy (2010) notes an average discount of $1.51 between public and private filling stations, over the span from 2008-2010. Much of the savings in propane fuel costs can be achieved through longer-term fixed price contracts with propane suppliers through private stations (Werpy, Burnham, & Bertram, 2010). However, this fuel cost savings is primarily based on future price speculation and the ability to provide flexible savings incentives in the form of tax credits and other incentives.

The State of Mississippi

The State of Mississippi currently uses over 5 billion gallons of fuel each year. Gasoline makes up 85% of this total while diesel accounts for an additional 14%. Aviation and jet fuel is said to account for the other 1% (Bryant, 2012). In his energy roadmap, Governor Bryant lists out a significant amount of alternative fuel processes to reduce our dependency on foreign oil, reinforce Mississippi's strengths, and ensuring our energy supply for the State and the Nation (Bryant, 2012).

Propane, in applications ranging from taxis and police vehicles to passenger vans and school buses, provides an alternative fuel option for individuals in the State wishing to promote the reduction of reliance on foreign sources of fuel, the desire to use cleaner burning fuels, or simply to reinforce the State's energy supply capabilities through using a primarily domestic fuel source.

The key components of Governor Bryant's energy roadmap include "building capacity for future economic development by ensuring the state's transportation and energy infrastructure is developed to meet the energy demands of tomorrow" and "promoting Mississippi's competitive advantages, maximizing the use of the state's abundant

energy resources…" (Bryant, 2012). To achieve these goals, it is imperative that the decision makers in the state consider the implications of converting to alternative fuel vehicles, when appropriate, and maximize the state's abundant resources. Propane currently has a significant amount of infrastructure in place and is positioned to be considered in the alternative vehicle fuel market. Whether it is a viable alternative for various applications is up to the agencies, department heads, and other decision makers.

The Study

The State of Mississippi is in a unique position when it comes to energy production. The current Governor, Phil Bryant, has been active in his support for the reduction in our carbon footprint and the exploration of alternative fuel usage, as seen in his "Energy Works" publication in 2012. In addition, Governor Bryant has signed an alternative fuels memorandum of understanding, a House Bill supporting the conversion of traditional gasoline vehicles and infrastructure to alternative fuels (HB 1685) and has addressed these issues in his State of the State address, in 2012. With this political energy, the State of Mississippi is now working to identify its position in the alternative fuels market, and to identify the possibilities for the State to capitalize on its energy production capabilities.

Purpose of the Study

The Stennis Institute at Mississippi State University was asked to provide a report detailing the various considerations of converting traditional gasoline fleet vehicles, primarily medium-duty vehicles and police cruisers, to propane. The primary focus on these types of vehicles was based on the recommendation by the MPGA, as propane is better positioned for medium-duty vehicles with significant vehicle availability. The research team was tasked with collecting quantitative and qualitative data to provide a guide for fleet managers and decision-makers in conversion considerations.

The research team worked to contact multiple state agencies in Mississippi, organizations across the state that worked with propane vehicles, comparable areas across the southeast region, and compare this data to that found in secondary sources found from the multiple case studies available online. The report's remaining sections are dedicated to displaying the data obtained from various organizations. At the request of several of the organizations, the names of the different groups have been removed as not to identify the individuals or agencies involved. However, should an

individual wish to contact these groups or organizations independently, he or she should contact the research team and the dialog can continue from that point. The organizations that requested they remain anonymous based on the premise that they are still working to identify their next steps in conversion and do not wish to be identified as a proponent or opponent of propane, but simply to provide the research team with data pertinent to the needs of the study.

Methodology

The research team first worked to develop a literature review based on the significant amount of literature available on alternative fuels. Propane has been used in vehicle fueling situations dating back to the 1920s, with experiments dating back to the 1910s (Werpy, Burnham, & Bertram, 2010). Based on this extensive history, there have been significant strides in propane as a vehicle fuel research, much of which involves the costs, considerations, and emissions compared to traditional gasoline and diesel fuels.

The research team derived a list of current propane vehicle users, particularly fleet vehicles, and worked to contact each entity over a several month process. Much of this contact was initially conducted in phone interviews, with several later attempts utilizing emails and a web survey. A final push for data was made in October 2013, to validate the responses given from previous contact attempts.

Much of the data collected was qualitative, as many of the quantifiable data found in propane extensively researched and analyzed over the past few decades. The primary focus of this research was to uncover the benefits and drawbacks of the conversion processes each entity encountered and their feedback regarding the transition. This was found to be the most beneficial information to the study, however the quantifiable data provided the necessary numbers to support or deny the claims made from each of the organizations.

The interviews and data were collected, cleaned, and analyzed for validity, consistency, and reliability. The follow-up contacts were made to provide a check against the original responses, which when compared to the quantified data, provide a triangulation approach to the analysis. The findings are reported in the next few sections, concluded by a small recommendations section. The appendices are included to provide any additional information not contained in this report.

The data are provided by the organizations and the Institute cannot confirm nor deny the precision of the information. Should there be any questions regarding the validity of the data beyond the estimates of this report, they should be directed to the Institute for further investigation.

Results

The research team worked with multiple agencies, organizations, and entities across the State of Mississippi to identify their use of propane in their fleet vehicles. The resulting tables and discussions will be listed as entity A, entity B, etc. When possible, the fleet applications will be identified, so that the reader may understand the application of propane and can identify his or her own needs in accordance with each applicable entity. The entities will be sectioned off and then a compilation of results will follow in the conclusions section.

ENTITY A

Entity A is an organization that drives approximately 24,300 miles per year, per vehicle, using medium-duty trucks. The team averaged the entity's miles per gallon (MPG) for each vehicle using propane in fiscal year 2013, as well as comparing the average miles per gallon for each vehicle using gasoline MPG data from fiscal year 2012, and found that the average loss in MPG was about 18% from the use of gasoline. The savings were calculated by adjusting the number of gallons needed from the year prior using nothing but gasoline and comparing them to the propane vehicles, and the savings are listed

beside each vehicle. The numbers are seen below in Table 1. Gasoline was quoted at $3.10, which was the current state contract price for fy2013, while the propane costs were calculated given the private filling station price, including the $.50 tax credit. The overall savings based on ENTITY A's data is approximately $2,006 per vehicle, per year. Using a standard lifespan of 7 years, that equates to an approximate savings of $14,000 per vehicle, assuming the prices remain constant. It should be noted that with the expiration of the $.50 tax credit, set to expire on December 31, 2013, the price of propane could rise significantly, although the effects of the removal of the tax credit, if it is not renewed, are beyond the scope of this study. The propane usage and mileage are accurate according to the reporting entity.

With a conversion cost around $5,200 per vehicle, the return on investment for each vehicle can be calculated with little math needed. The return on the investment for vehicle A is approximately 5.38 years, ceteris paribus, while the average return on investment for vehicles B-H is 2.82 years, ceteris paribus. What is not calculated in this equation is the reduction in maintenance costs, which have been documented by the Department of Energy in multiple instances, where the use of propane vehicles reduces the intervals on necessary oil changes and maintenance issues, as propane is a clean burning fuel and does not require the high temperatures that gasoline and diesel require (Department of Energy, 2013).

Entity A is in a position to recoup its initial conversion investment in approximately 3 years, whereby any savings after that point are available for use in other areas of need for the entity. The initial conversion costs when subsidized can virtually be eliminated, thereby resulting in significant savings for the entity, depending on the price of propane and gasoline or diesel during the operation of these vehicles.

One last point of consideration for entity A is that the cost of conversion for the vehicles, while stated at $5,200, is recoverable, to some extent, according to the entity. The entity reports that $4,800 is recoverable and able to be outfitted on a new vehicle, thereby reducing future costs of conversion for replacement vehicles. While this

number could not be verified by the research team, it was reported by the entity and is therefore reported in the results.

Figure 4. Entity A's miles, gallons, and cost savings calculations.

Vehicle	Mileage	Propane Gallons	Propane MPG	Propane Cost @ $1.51	Gasoline Gallons	FY 12 Gasoline MPG	Gasoline Cost @ $3.10	Savings
A	9,276	836	11.1	$ 1,262.36	719	12.9	$ 2,229.12	$ 966.76
B	30,842	2,269	13.6	$ 3,426.19	1,881	16.4	$ 5,829.89	$ 2,403.70
C	28,372	2,633	10.8	$ 3,975.83	1,991	14.3	$ 6,172.15	$ 2,196.32
D	24,339	2,173	11.2	$ 3,281.23	1,844	13.2	$ 5,715.98	$ 2,434.75
E	19,931	1,474	13.5	$ 2,225.74	1,230	16.2	$ 3,813.96	$ 1,588.22
F	23,290	1,687	13.8	$ 2,547.37	1,503	15.5	$ 4,658.00	$ 2,110.63
G	24,768	1,969	12.6	$ 2,973.19	1,696	14.6	$ 5,258.96	$ 2,285.77
H	33,583	3,294	10.2	$ 4,973.94	2,269	14.8	$ 7,034.28	$ 2,060.34
TOTAL	**194,401**	**16,335**		**$ 24,665.85**	**13,133**		**$ 40,712.33**	**$ 16,046.48**

***Gasoline MPG was computed from FY12 numbers for same vehicle. Cost per gallon was actual yearly average cost for propane and current state contract price for gasoline as of 7-1-13.

ENTITY B

Entity B has 41 trucks that have been converted to propane. 29 of these vehicles were first converted as a result of a grant obtained by the entity, which enabled the offset of most of the costs associated with the conversion. The entity still utilizes over 40 gasoline-fueled vehicles, with a fleet totaling 86 vehicles to date. The entity reported driving an average of 4.400 miles per quarter per vehicle, on average. This number is offset by the miles ranging from 1,800 to 15,000 for the vehicle fleet.

Overall, the entity drives approximately 120,000 total miles per quarter on propane and approximately 15,000 on gasoline. The entity reports consuming approximately 12,000

gallons of propane per quarter and 1,000 gallons of gas. The entity approximates its breakeven point to be 75,000 VMTs, based on fuel cost savings and maintenance schedule reductions.

The vehicles referenced by this entity are Ford E-350 vans, ranging from 2010 to 2012. The organization reports spending approximately $20,000 per quarter on propane and $3,000 per quarter on gasoline. This number breaks down to roughly $1.67/gal of propane, and $3.00/gal of gasoline, which is fairly close to prior entity's estimates and publicly available case studies.

The costs associated with the vehicles at the time of purchase were the initial van cost, $23,500, and the conversion costs which ranged from $5,000 to $6,000, depending on the age of the van. Many of the costs, savings, and maintenance topics were on average with the other studied entities.

In a follow up interview with the entity, the research team asked the individual to identify any experiences with the conversion process, the maintenance, and any perceived benefits or drawbacks not reported initially. This dialogue resulted in the following data collection:

- *Have you experienced any negatives on the conversion?*
  - "There were a few maintenance issues in the beginning, but now many of the maintenance problems are easy to fix and repair due to a software system that provides the detection of problems such as a filter change or fuel contamination."
- *How do your employees view the alternative fuel?*
  - "Employees were apprehensive at first due to the fear of the flammability and the smell associated with the fuel [propane]. However, the [entity] has an in house training program that has alleviated these fears by educating employees on the facts and methods for using the fuel. "
- *What are your maintenance schedules?*
  - "The propane burns cleaner so they are changing oil every 5,000 miles instead of every 3,000. They also change the filters at 20,000 mile intervals. "
  - The organization has an in-house diagnostic system that allows maintenance to be performed in-house, and lowers maintenance costs of having to outsource the repairs.
- *Are you planning on converting your entire fleet?*
  - "We are not certain, but the organization did convert an additional 12 vehicles after the grant expired. The costs were offset because of the fuel cost savings and the cleaner burning fuel's impact on the organization."

While entity's A data provided the quantifiable look at the benefits and drawbacks of propane, entity B's feedback provides a un-biased approach to gathering information on the conversion of traditional gasoline vehicles, in this instance Ford e-350 vans, to propane vehicles. Much of this information was obtained in the follow-up confirmation

of the consumption data provided prior to the follow-up conversation. The research team is extremely grateful for the information provided by the individual.

ENTITY C

Entity C is a law enforcement department within the State of Mississippi, which has currently converted 16 law enforcement vehicles to propane. This entity did not provide individualized data per vehicle, but did provide overall averages and numbers, including overall savings reported by the department. After a follow-up conversation regarding the figures obtained originally, the research team concluded that the data provided was accurate and valid

The entity reported using 1,072 gallons of gasoline, on average, per vehicle. The vehicles are 3-4 years old. Each vehicle required a conversion cost of $5,500, which was subsidized by a grant from a local gas company. The vehicles were approximately $20,000 at the time of their purchase, and each vehicle has been utilizing propane for approximately 3.5 years.

The entity reported an overall savings of $60,000 over the first year of using propane vehicles. This equates to approximately $3,750 per vehicle during the first year of operation. Without the subsidized grant from the gas company, the entity could anticipate a return on investment of just under 2 years. However, with the grant from the gas company, the entity was able to realize the savings from the onset of the conversion.

In the follow-up conversation with the entity, the conversion process was extremely positive. However, one point of note was that the entity was hesitant to convert the entire fleet due to cost concerns without the aid of the grant monies. This, when followed up, was based on the concern that gas prices dropping and propane prices uncertain and the uncertainty that comes with future speculation. The entity did notice roughly a 10% loss in fuel economy, but did not seem concerned as the fuel cost savings realized provided the monetary comfort for the entity.

One other note is that this entity had a filling station installed on the premises. The entity was able to obtain a filling station and lock in a price for propane based on their agreement with the propane supplier, thereby providing the enhanced savings.

ENTITY D

Entity D is a transportation fleet that converted 18 vehicles over the last year. The vehicles ranged from 2 to 8 years old, and the costs ranged from $10,000-$30,000, with very little feedback on the actual miles traveled. This entity was included for their qualitative feedback, as the research team could not verify the numbers provided to the team regarding conversion costs, fuel costs, and usage. However, this entity is valuable to this research in that it represents a non-law enforcement, non-government agency fleet comprised of specific transportation use vans. In addition, the entity has not been using propane for longer than a year on most vehicles, so their experiences with the conversion process is more valuable for reference than their cost savings, at least for this reasearch.

The initial conversion process created problems with two vehicles, however these problems were “fixed quickly”. The entity expressed concerns on safety, but in a follow up conversation, stated that the concerns were simply that of the overall safety of propane and fuel in general.

The entity expressed overall satisfaction with the propane conversion. They expressed that the staff did not have feelings one way or another towards the use of propane, but the executives felt that the move was a good one. The entity expressed that there was a steep learning curve in using propane, but this learning curve was focused around the internal workings of the system and the necessary electronics. The entity has no plans to convert the entire fleet, however this is due to the light-duty nature of some of the

fleet. The vehicles not slated for conversion are Toyota Prius vehicles, and would not benefit, economically, from the conversion.
The entity expressed great satisfaction with the price of propane compared to gasoline. The maintenance schedules were still reltatively new, as the conversion process was still new to the organization, but the entity expects extended periods between oil changes, and extended vehicle life.

Overall, the entity was satisfied with the outcome of the transition, and plans to continue using propane as an alternative vehicle fuel, when appropriate. The entity expressed overall satisfaction with the conversion process and recommended propane as a consideration for other fleets with "heavy amounts of road time".

HYPOTHETICAL MODEL

As described in the above models, propane could potentially be a source for fuel costs savings. While no individual fleet will share the exact similar savings, it is relatively straightforward to make assumptions based on previous years' actual driving history should a fleet wish to consider a transition to propane. While these assumptions are not scientifically absolute, they do provide a basis for consideration for fleet managers and decision-makers in the development of a strategy for converting fleets in the future to alternative fuel. Table 2 below shows the possible results of a fleet converting to propane, using moderate assumptions throughout. Many other studies have used a similar, rudimentary approach found in the earlier citations, so it only follows that this report contains the same. Below, table 2 shows that potential fuel cost savings for a 12-month period for a vehicle that traveled 23, 290 miles could result in a savings of approximately $2,108.83. These savings could then be used to pay off the conversion costs, maintenance for gasoline vehicles, or other uses for that money. While the exhibits A-D show that multiple agencies have responded favorably to the conversion to propane for some of their fleet vehicles, one could continue the research into converting fleet vehicles should he or she continue to work towards converting vehicles to run on alternative fuels.

Table 2. Model Simulation of Vehicle Conversion

Gasoline vs. Propane: Mock-up		
12 Months of Data with Same Driver:		
July 1, 2012-June 30, 2013		
Fuel Source	Gasoline	Propane
MPG	15.5	13.8
Miles	23290	23290
Gallons	1502	1687
Avg Price/Gal	$3.10	$1.51
Concluding Model Costs		
Costs	$4,656.20	$2,547.37
Potential Savings	***$2,108.83***	

Conclusions

While the prices of both gasoline and propane fluctuate, the feedback from those involved in the conversion of their specific fleets from gasoline to propane remains positive in their decisions. Much of the feedback is repetitive, throughout the multiple entities interviewed, in a positive manner regarding the cleaner fuel, lower maintenance costs, and the significant fuel cost savings. Future questions remain as to whether the prices of propane will increase, whether the fuel tax credit will cease to exist, among many other questions in reference to using propane as a fleet vehicle fuel. Propane availability does not appear to be a concern over the foreseeable future, and there exists a market in which propane appears to have some market penetration possibilities, such as law enforcement vehicles, taxis, and school buses. This is not to infer or assume that propane is the only alternative fuel considered viable for these uses, simply that propane has made its presence in the vehicle fuel market.

Propane has a vast network of filling stations across the State, whether it's the 124-station report from the US Department of Energy or the 241 stations reported by other entities across the state, the distribution of filling stations and the potential for low-cost infrastructure development are positive considerations for certain fleet vehicle conversions. Depending on fleet size, makeup, and VMTs, propane might not be the answer for everyone, but it is an avenue of consideration for fleets interested in utilizing alternative fuel vehicles.

Recommendations

Increased Education on Propane Safety

Propane, as is the case with other combustible fuels, often falls victim to media exaggerations as a result of movies and television dramatizing the safety of propane and gasoline tanks. Often, these tanks are seen exploding from lighters, gunshots, or car accidents. However, propane is very safe, as its ignition point is much higher than gasoline as well as other alternative fuels. As a point of reference, entity C from above experienced three (3) significant vehicle accidents in the last year, none of which resulted in any additional safety hazards or impacts from propane. Educating citizens on the safety of propane, proper use of propane, and the basics of propane use will enable a more informed decision from the populous.

Public/Private Partnerships

Infrastructure and vehicle costs are a concern for many cities, counties, and agencies across the State as a result of tightening budgets. The availability of resources to convert vehicles from gasoline to alternative fuels might be beyond the scope of possibility for many of these entities without assistance from private entities. Through the collaboration with the local gas companies, entities may explore their options when considering converting to propane. Exploring public/private partnerships also relaxes some of the burden, often falling on taxpayers, by distributing the costs across

agreements between public and private entities, in which both experience mutual benefits.

Educate Local Gas Companies on Autogas as a Vehicle Fuel

One study noted the lack of education from many of the small gas companies in Texas and the shortcomings that presented for the propane autogas industry. If the individuals responsible for maintaining these stations are not aware of the potential of autogas in the vehicle market, it essentially is an overlooked concept in these areas. Educating the public is one step, but ensuring that local gas companies are aware that autogas, or propane, is also used as a vehicle fuel.

Continuing Supply Analysis between Suppliers and Analysts

Propane autogas is susceptible to shocks to the system, particularly weather events and distribution system disruptions. Because a large portion of propane is used for heating and cooking, particularly in rural areas like Mississippi, shocks to the system which impact supply can be significant (Blake, Buttner, & Rivkin, 2010). The collaboration and interaction between suppliers and analysts can help to alleviate these potential impacts from significant shocks to supply and pricing of propane in vehicle applications. Preparation and mitigation for natural and man-made disasters can alleviate the shocks to the distribution system during unforeseen events. Removing, or at the very least alleviating some of the dramatic price shocks may instill confidence among potential customer bases.

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Appendix A: House Bill 1685

House Bill 1685
(As Sent to Governor)
AN ACT TO CREATE THE "MISSISSIPPI ALTERNATIVE FUEL SCHOOL BUS AND MUNICIPAL MOTOR VEHICLE REVOLVING LOAN FUND" AS A SPECIAL FUND IN THE STATE TREASURY; TO PROVIDE THAT THE MISSISSIPPI DEVELOPMENT AUTHORITY SHALL USE MONIES IN THE SPECIAL FUND FOR THE PURPOSE OF ESTABLISHING A REVOLVING LOAN PROGRAM TO ASSIST PUBLIC SCHOOL DISTRICTS AND MUNICIPALITIES IN PAYING COSTS INCURRED FOR THE PURCHASE OF ALTERNATIVE FUEL SCHOOL BUSES AND MOTOR VEHICLES, THE CONVERSION OF SCHOOL BUSES AND MOTOR VEHICLES TO UTILIZE ALTERNATIVE FUELS AND FOR ALTERNATIVE FUEL SYSTEM EQUIPMENT AND FACILITIES; TO AUTHORIZE THE ISSUANCE OF $2,750,000.00 OF STATE GENERAL OBLIGATION BONDS TO PROVIDE FUNDS FOR THE MISSISSIPPI ALTERNATIVE FUEL SCHOOL BUS AND MUNICIPAL MOTOR VEHICLE REVOLVING LOAN FUND; AND FOR RELATED PURPOSES.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF MISSISSIPPI:

SECTION 1. (1) As used in this subsection:

(a) "Alternative fuel" means compressed natural gas and liquefied natural gas, as defined in Section 27-59-3, and propane fuel when used as a fuel in a motor vehicle or motor vehicles on the highways of the state.

(b) "Alternative fuel school bus" means a school bus propelled by alternative fuel either as a dedicated alternative fuel vehicle, as a bi-fuel vehicle using alternative fuel as one of its fuels, or as a dual-fuel vehicle using alternative fuel as one of its fuels.

(c) "Conversion kit" means the fuel system equipment necessary in order to retrofit a motor vehicle propelled by gasoline, diesel or other fuel so that the motor vehicle may be converted or modified into an alternative fuel motor vehicle.

(d) "Cost of qualified alternative fuel motor vehicle fuel property" means any of the following:

(i) The actual cost per school bus paid by the school district for the purchase and installation of qualified alternative fuel motor vehicle fuel property described in paragraph (l)(i) of this subsection.

(ii) The incremental cost per school bus paid by the school district upon the purchase of an OEM alternative fuel school bus for the qualified alternative fuel motor vehicle fuel property (including installation) described in paragraph (l)(ii) of this subsection.

(iii) The cost of the qualified alternative fuel motor vehicle fuel property described in paragraph (l)(iii) of this subsection and its installation.

(iv) The cost of the qualified alternative fuel motor vehicle fuel property described in paragraph (l)(iv) of this subsection and its construction and installation. The cost directly related to a refueling station shall not include costs associated with exploration and development activities necessary for severing natural resources from the soil or ground.

(e) "Fuel system equipment" means tanks, pumps, hoses, injectors, electronic controls and related supplies, materials, parts and components for the storage of alternative fuel as fuel for an alternative fuel school bus, the delivery of alternative fuel to the engine of an alternative fuel school bus, and the exhaust from an alternative fuel school bus of gases from combustion of alternative fuel used to propel an alternative

fuel school bus, excluding equipment necessary for operation of a school bus on gasoline, diesel or any fuel other than alternative fuel.

(f) "Incremental cost" means:

(i) The stated MSRP of the fuel system equipment and its installation for an OEM alternative fuel school bus; or

(ii) If no separate MSRP is stated, the difference between the MSRP of the OEM alternative fuel school bus and the MSRP of the same make and model of school bus manufactured without the fuel system equipment but otherwise identically equipped.

When an OEM alternative fuel school bus is sold for less (or more) than its MSRP, the amount determined in subparagraph (i) or (ii) of this paragraph (f) shall be proportionately reduced (or increased) by the same percentage as the discount (or premium) on the MSRP, as applicable.

(g) "School district" means a public school district.

(h) "OEM alternative fuel motor vehicle" means an alternative fuel school bus manufactured by the original vehicle manufacturer (or its contractor) with the fuel system equipment installed as original equipment by the manufacturer (or its contractor) at the factory or at another installation site approved by the manufacturer (or its contractor).

(i) "Motor vehicle" shall have the meaning ascribed to such term in Section 27-59-3.

(j) "MSRP" means manufacturer's suggested retail price.

(k) "Original purchase" means the purchase directly from a dealer at retail of a new OEM alternative fuel school bus which has never been titled.

(l) "Qualified alternative fuel motor vehicle fuel property" means any of the following:

(i) A conversion kit which has not previously been used to retrofit any motor vehicle and is installed and results in a reduction in emissions.

(ii) The fuel system equipment on an OEM alternative fuel school bus which results in a reduction in emissions.

(iii) A refueling system installed at a governmental entity location for the nonpublic refueling with alternative fuel of the governmental entity's alternative fuel school buses.

(iv) A refueling station located in the state and operated by a school district for refueling of alternative fuel motor vehicles owned by the school district.

(v) Upgrades to a refueling system included in subparagraphs (iii) and (iv) of this paragraph (l).

(vi) Portable or mobile refueling systems.

(m) "Reduction in emissions" means a reduction in atmospheric emissions from fuel consumption by an alternative fuel motor vehicle as demonstrated by certification of the fuel system equipment by the federal Environmental Protection Agency or the Mississippi Department of Environmental Quality or any other test or standard recognized by the Mississippi Department of Environmental Quality.

(n) "Refueling system" means compressors (whether used separately or in combination with cascade tanks), process piping, hoses, dispensing units at the point where alternative fuel is delivered as a fuel, meters and other parts and equipment and installation supplies and materials therefor that constitute a refueling system capable of

dispensing alternative fuel into fuel tanks of alternative fuel motor vehicles for use as a fuel.

(o) "Refueling station" means property constituting a facility operated for dispensing alternative fuel into fuel tanks of alternative fuel motor vehicles, which shall include:

(i) A refueling system; and

(ii) A building or other structural components constructed or installed as part of and directly related to such refueling system.

(p) "Retrofit" means the installation of a conversion kit in a school bus designed to operate on gasoline, diesel or other fuel in order to convert or modify the bus vehicle into an alternative fuel school bus.

(q) "School bus" means a vehicle owned by a school district that is primarily used by the school district to transport students.

(2) As used in this subsection:

(a) "Alternative fuel" means compressed natural gas and liquefied natural gas, as defined in Section 27-59-3, and propane fuel when used as a fuel in a motor vehicle or motor vehicles on the highways of the state.

(b) "Conversion kit" means the fuel system equipment necessary in order to retrofit a motor vehicle propelled by gasoline, diesel or other fuel so that the motor vehicle may be converted or modified into an alternative fuel motor vehicle.

(c) "Cost of qualified alternative fuel motor vehicle fuel property" means any of the following:

(i) The actual cost per vehicle paid by the municipality for the purchase and installation of qualified alternative fuel motor vehicle fuel property described in paragraph (l)(i) of this subsection.

(ii) The incremental cost per vehicle paid by the municipality upon the purchase of an OEM alternative fuel motor vehicle for the qualified alternative fuel motor vehicle fuel property (including installation) described in paragraph (l)(ii) of this subsection.

(iii) The cost of the qualified alternative fuel motor vehicle fuel property described in paragraph (l)(iii) of this subsection and its installation.

(iv) The cost of the qualified alternative fuel motor vehicle fuel property described in paragraph (l)(iv) of this subsection and its construction and installation. The cost directly related to a refueling station shall not include costs associated with exploration and development activities necessary for severing natural resources from the soil or ground.

(d) "Fuel system equipment" means tanks, pumps, hoses, injectors, electronic controls and related supplies, materials, parts and components for the storage of alternative fuel as fuel for an alternative fuel motor vehicle, the delivery of alternative fuel to the engine of an alternative fuel motor vehicle, and the exhaust from an alternative fuel motor vehicle of gases from combustion of alternative fuel used to propel an alternative fuel motor vehicle, excluding equipment necessary for operation of a motor vehicle on gasoline, diesel or any fuel other than alternative fuel.

(e) "Incremental cost" means:

(i) The stated MSRP of the fuel system equipment and its installation for an OEM alternative fuel motor vehicle; or

(ii) If no separate MSRP is stated, the difference between the MSRP of the OEM alternative fuel motor vehicle and the MSRP of the same make and model of motor vehicle manufactured without the fuel system equipment but otherwise identically equipped.

When an OEM alternative fuel motor vehicle is sold for less (or more) than its MSRP, the amount determined in subparagraph (i) or (ii) of this paragraph (e) shall be proportionately reduced (or increased) by the same percentage as the discount (or premium) on the MSRP, as applicable.

(f) "Municipality" means an incorporated city, town or village in the State of Mississippi.

(g) "OEM alternative fuel motor vehicle" means an alternative fuel motor vehicle manufactured by the original vehicle manufacturer (or its contractor) with the fuel system equipment installed as original equipment by the manufacturer (or its contractor) at the factory or at another installation site approved by the manufacturer (or its contractor).

(h) "Motor vehicle" shall have the meaning ascribed to such term in Section 27-59-3.

(i) "MSRP" means manufacturer's suggested retail price.

(j) "Alternative fuel motor vehicle" means a motor vehicle propelled by alternative fuel either as a dedicated alternative fuel vehicle, as a bi-fuel vehicle using alternative fuel as one of its fuels, or as a dual fuel vehicle using alternative fuel as one of its fuels.

(k) "Original purchase" means the purchase directly from a dealer at retail of a new OEM alternative fuel motor vehicle which has never been titled.

(l) "Qualified alternative fuel motor vehicle fuel property" means any of the following:

(i) A conversion kit which has not previously been used to retrofit any motor vehicle and is installed and results in a reduction in emissions.

(ii) The fuel system equipment on an OEM alternative fuel motor vehicle which results in a reduction in emissions.

(iii) A refueling system installed at a municipality location for the nonpublic refueling with alternative fuel of the municipality's alternative fuel motor vehicles.

(iv) A refueling station located in the state and operated by a municipality for refueling of alternative fuel motor vehicles owned by the municipality.

(v) Upgrades to a refueling system included in subparagraphs (iii) and (iv) of this paragraph (l).

(vi) Portable or mobile refueling systems.

(m) "Reduction in emissions" means a reduction in atmospheric emissions from fuel consumption by an alternative fuel motor vehicle as demonstrated by certification of the fuel system equipment by the federal Environmental Protection Agency or the Mississippi Department of Environmental Quality or any other test or standard recognized by the Mississippi Department of Environmental Quality.

(n) "Refueling system" means compressors (whether used separately or in combination with cascade tanks), process piping, hoses, dispensing units at the point where alternative fuel is delivered as a fuel, meters and other parts and equipment and installation supplies and materials therefor that constitute a refueling system capable of

dispensing alternative fuel into fuel tanks of alternative fuel motor vehicles for use as a fuel.

(o) "Refueling station" means property constituting a facility operated for dispensing alternative fuel into fuel tanks of alternative fuel motor vehicles, which shall include:

(i) A refueling system; and

(ii) A building or other structural components constructed or installed as part of and directly related to such refueling system.

(p) "Retrofit" means the installation of a conversion kit in a motor vehicle designed to operate on gasoline, diesel or other fuel in order to convert or modify such motor vehicle into an alternative fuel motor vehicle.

(3) (a) The Mississippi Development Authority shall establish a revolving loan program to provide loans to (i) school districts for the purpose of assisting school districts with paying the cost of qualified alternative fuel motor vehicle fuel property and (ii) municipalities for the purpose of assisting municipalities with paying the cost of qualified alternative fuel motor vehicle fuel property. Loans made under this section shall bear no interest.

(b) A school district or municipality desiring a loan under this section must submit an application to the Mississippi Development Authority. The application shall include:

(i) A description of the purpose for which the loan is requested;

(ii) The amount of the loan requested; and

(iii) Any other information required by the Mississippi Development Authority.

(c) Repayments of loans made under this section shall be deposited to the credit of the Mississippi Alternative Fuel School Bus and Municipal Motor Vehicle Revolving Loan Fund.

(4) (a) There is created in the State Treasury a special fund to be designated as the "Mississippi Alternative Fuel School Bus and Municipal Motor Vehicle Revolving Loan Fund," which shall consist of funds appropriated or otherwise made available by the Legislature in any manner and funds from any other source designated for deposit into such fund. Unexpended amounts remaining in the fund at the end of a fiscal year shall not lapse into the State General Fund, and any investment earnings or interest earned on amounts in the fund shall be deposited to the credit of the fund. Monies in the fund shall be used by the Mississippi Development Authority for the purposes described in this section.

(b) Monies in the fund which are derived from the proceeds of general obligation bonds may be used to reimburse reasonable actual and necessary costs incurred by the Mississippi Development Authority in providing loans under this section through the use of general obligation bonds. Monies authorized for a particular loan may not be used to reimburse administrative costs for unrelated loans. Reimbursements made under this subsection shall satisfy any applicable federal tax law requirements.

(4) The Mississippi Development Authority shall have all powers necessary to implement and administer the program established under this section, and the Mississippi Development Authority shall promulgate rules and regulations, in accordance with the Mississippi Administrative Procedures Law, necessary for the implementation of this section.

SECTION 2. (1) As used in this section, the following words shall have the meanings ascribed herein unless the context clearly requires otherwise:

(a) "Accreted value" of any bonds means, as of any date of computation, an amount equal to the sum of (i) the stated initial value of such bond, plus (ii) the interest accrued thereon from the issue date to the date of computation at the rate, compounded semiannually, that is necessary to produce the approximate yield to maturity shown for bonds of the same maturity.

(b) "State" means the State of Mississippi.

(c) "Commission" means the State Bond Commission.

(2) (a) The Mississippi Development Authority, at one time, or from time to time, may declare by resolution the necessity for issuance of general obligation bonds of the State of Mississippi to provide funds for the loan program authorized in Section 1 of this act. Upon the adoption of a resolution by the Mississippi Development Authority, declaring the necessity for the issuance of any part or all of the general obligation bonds authorized by this subsection, the Mississippi Development Authority shall deliver a certified copy of its resolution or resolutions to the commission. Upon receipt of such resolution, the commission, in its discretion, may act as the issuing agent, prescribe the form of the bonds, determine the appropriate method for sale of the bonds, advertise for and accept bids or negotiate the sale of the bonds, issue and sell the bonds so authorized to be sold, and do any and all other things necessary and advisable in connection with the issuance and sale of such bonds. The total amount of bonds issued under this section shall not exceed Two Million Seven Hundred Fifty Thousand Dollars ($2,750,000.00). No bonds authorized under this section shall be issued after July 1, 2017.

(b) The proceeds of bonds issued pursuant to this section shall be deposited into the Mississippi Alternative Fuel School Bus and Municipal Motor Vehicle Revolving Loan Fund created pursuant to Section 1 of this act. Any investment earnings on bonds issued pursuant to this section shall be used to pay debt service on bonds issued under this section, in accordance with the proceedings authorizing issuance of such bonds.

(3) The principal of and interest on the bonds authorized under this section shall be payable in the manner provided in this subsection. Such bonds shall bear such date or dates, be in such denomination or denominations, bear interest at such rate or rates (not to exceed the limits set forth in Section 75-17-101, Mississippi Code of 1972), be payable at such place or places within or without the State of Mississippi, shall mature absolutely at such time or times not to exceed twenty-five (25) years from date of issue, be redeemable before maturity at such time or times and upon such terms, with or without premium, shall bear such registration privileges, and shall be substantially in such form, all as shall be determined by resolution of the commission.

(4) The bonds authorized by this section shall be signed by the chairman of the commission, or by his facsimile signature, and the official seal of the commission shall be affixed thereto, attested by the secretary of the commission. The interest coupons, if any, to be attached to such bonds may be executed by the facsimile signatures of such officers. Whenever any such bonds shall have been signed by the officials designated to sign the bonds who were in office at the time of such signing but who may have ceased to be such officers before the sale and delivery of such bonds, or who may not have been in office on the date such bonds may bear, the signatures of such officers upon

such bonds and coupons shall nevertheless be valid and sufficient for all purposes and have the same effect as if the person so officially signing such bonds had remained in office until their delivery to the purchaser, or had been in office on the date such bonds may bear. However, notwithstanding anything herein to the contrary, such bonds may be issued as provided in the Registered Bond Act of the State of Mississippi.

(5) All bonds and interest coupons issued under the provisions of this section have all the qualities and incidents of negotiable instruments under the provisions of the Uniform Commercial Code, and in exercising the powers granted by this section, the commission shall not be required to and need not comply with the provisions of the Uniform Commercial Code.

(6) The commission shall act as issuing agent for the bonds authorized under this section, prescribe the form of the bonds, determine the appropriate method for sale of the bonds, advertise for and accept bids or negotiate the sale of the bonds, issue and sell the bonds so authorized to be sold, pay all fees and costs incurred in such issuance and sale, and do any and all other things necessary and advisable in connection with the issuance and sale of such bonds. The commission is authorized and empowered to pay the costs that are incident to the sale, issuance and delivery of the bonds authorized under this section from the proceeds derived from the sale of such bonds. The commission may sell such bonds on sealed bids at public sale or may negotiate the sale of the bonds for such price as it may determine to be for the best interest of the State of Mississippi. All interest accruing on such bonds so issued shall be payable semiannually or annually.

If such bonds are sold by sealed bids at public sale, notice of the sale shall be published at least one time, not less than ten (10) days before the date of sale, and shall be so published in one or more newspapers published or having a general circulation in the City of Jackson, Mississippi, selected by the commission.

The commission, when issuing any bonds under the authority of this section, may provide that bonds, at the option of the State of Mississippi, may be called in for payment and redemption at the call price named therein and accrued interest on such date or dates named therein.

(7) The bonds issued under the provisions of this section are general obligations of the State of Mississippi, and for the payment thereof the full faith and credit of the State of Mississippi is irrevocably pledged. If the funds appropriated by the Legislature are insufficient to pay the principal of and the interest on such bonds as they become due, then the deficiency shall be paid by the State Treasurer from any funds in the State Treasury not otherwise appropriated. All such bonds shall contain recitals on their faces substantially covering the provisions of this subsection.

(8) Upon the issuance and sale of bonds under the provisions of this section, the commission shall transfer the proceeds of any such sale or sales to the Mississippi Alternative Fuel School Bus and Municipal Motor Vehicle Revolving Loan Fund created in Section 1 of this act. The proceeds of such bonds shall be disbursed solely upon the order of the Mississippi Development Authority under such restrictions, if any, as may be contained in the resolution providing for the issuance of the bonds.

(9) The bonds authorized under this section may be issued without any other proceedings or the happening of any other conditions or things other than those proceedings, conditions and things which are specified or required by this section. Any

resolution providing for the issuance of bonds under the provisions of this section shall become effective immediately upon its adoption by the commission, and any such resolution may be adopted at any regular or special meeting of the commission by a majority of its members.

(10) The bonds authorized under the authority of this section may be validated in the Chancery Court of the First Judicial District of Hinds County, Mississippi, in the manner and with the force and effect provided by Chapter 13, Title 31, Mississippi Code of 1972, for the validation of county, municipal, school district and other bonds. The notice to taxpayers required by such statutes shall be published in a newspaper published or having a general circulation in the City of Jackson, Mississippi.

(11) Any holder of bonds issued under the provisions of this section or of any of the interest coupons pertaining thereto may, either at law or in equity, by suit, action, mandamus or other proceeding, protect and enforce any and all rights granted under this section, or under such resolution, and may enforce and compel performance of all duties required by this section to be performed, in order to provide for the payment of bonds and interest thereon.

(12) All bonds issued under the provisions of this section shall be legal investments for trustees and other fiduciaries, and for savings banks, trust companies and insurance companies organized under the laws of the State of Mississippi, and such bonds shall be legal securities which may be deposited with and shall be received by all public officers and bodies of this state and all municipalities and political subdivisions for the purpose of securing the deposit of public funds.

(13) Bonds issued under the provisions of this section and income therefrom shall be exempt from all taxation in the State of Mississippi.

(14) The proceeds of the bonds issued under this section shall be used solely for the purposes therein provided, including the costs incident to the issuance and sale of such bonds.

(15) The State Treasurer is authorized, without further process of law, to certify to the Department of Finance and Administration the necessity for warrants, and the Department of Finance and Administration is authorized and directed to issue such warrants, in such amounts as may be necessary to pay when due the principal of, premium, if any, and interest on, or the accreted value of, all bonds issued under this section; and the State Treasurer shall forward the necessary amount to the designated place or places of payment of such bonds in ample time to discharge such bonds, or the interest thereon, on the due dates thereof.

(16) This section shall be deemed to be full and complete authority for the exercise of the powers therein granted, but this section shall not be deemed to repeal or to be in derogation of any existing law of this state.

SECTION 3. This act shall take effect and be in force from and after July 1, 2013.

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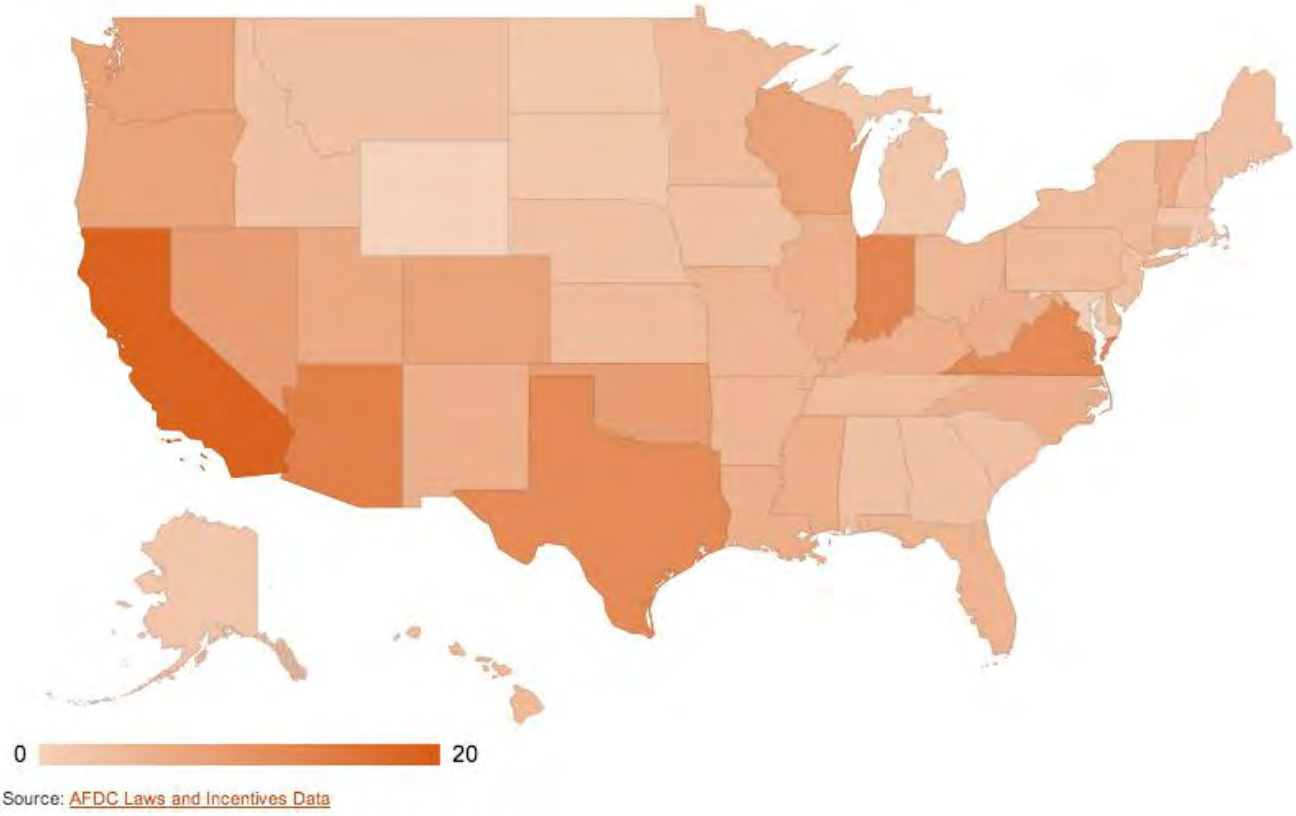
Appendix B: Federal Laws and Incentives: Propane

Propane laws and incentives, 2013 (Department of Energy, 2013)



Federal Laws and Incentives for Propane (LPG)

The list below contains summaries of all Federal laws and incentives related to Propane (LPG).

Incentives

Alternative Fuel Infrastructure Tax Credit
Fueling equipment for natural gas, liquefied petroleum gas (propane), electricity, E85, or diesel fuel blends containing a minimum of 20% biodiesel installed between January 1, 2006, and December 31, 2013, is eligible for a tax credit of 30% of the cost, not to exceed $30,000. Permitting and inspection fees are not included in covered expenses. Fueling station owners who install qualified equipment at multiple sites are allowed to use the credit towards each location. Consumers who purchased qualified residential fueling equipment prior to December 31, 2013, may receive a tax credit of up to $1,000. Unused credits that qualify as general business tax credits, as defined by the Internal Revenue Service (IRS), may be carried backward one year and carried forward 20 years. For more information about claiming the credit, see IRS Form 8911, which is

available on the IRS Forms and Publications website. (Reference Public Law 112-240, 26 U.S. Code 30C and 38, and IRS Notice 2007-43*(PDF)*)

Point of Contact

U.S. Internal Revenue Service
Phone: (800) 829-1040
http://www.irs.gov/

Alternative Fuel Excise Tax Credit

A tax incentive is available for alternative fuel that is sold for use or used as a fuel to operate a motor vehicle. A tax credit in the amount of $0.50 per gallon is available for the following alternative fuels: compressed natural gas (based on 121 cubic feet), liquefied natural gas, liquefied petroleum gas, P-Series fuel, liquid fuel derived from coal through the Fischer-Tropsch process, and compressed or liquefied gas derived from biomass. For an entity to be eligible to claim the credit they must be liable for reporting and paying the federal excise tax on the sale or use of the fuel in a motor vehicle. Tax exempt entities such as state and local governments that dispense qualified fuel from an on-site fueling station for use in vehicles qualify for the incentive. Eligible entities must be registered with the Internal Revenue Service (IRS). The incentive must first be taken as a credit against the entity's alternative fuel tax liability; any excess over this fuel tax liability may be claimed as a direct payment from the IRS. The tax credit is not allowed if an incentive for the same alternative fuel is also determined under the rules for the ethanol or biodiesel tax credits. This tax credit is applicable to fuel sold or used between January 1, 2005, and December 31, 2013. For more information about claiming the credit, see IRS Publication 510*(PDF)* and IRS Forms 637, 720, 4136, and 8849, which are available on the IRS Forms and Publications website. (Reference Public Law112-240 and 26 U.S. Code 6426)

Point of Contact

Excise Tax Branch
U.S. Internal Revenue Service Office of Chief Counsel
Phone: (202) 622-3130
http://www.irs.gov/

Alternative Fuel Mixture Excise Tax Credit

An alternative fuel blender that is registered with the Internal Revenue Service (IRS) may be eligible for a tax incentive on the sale or use of the alternative fuel blend (mixture) for use as a fuel in the blender's trade or business. The credit is in the amount of $0.50 per gallon of alternative fuel used to produce a mixture containing at least 0.1% gasoline, diesel, or kerosene. Qualified alternative fuels are: compressed natural gas (based on 121 cubic feet), liquefied natural gas, liquefied petroleum gas, P-Series fuel, liquid fuel derived from coal through the Fischer-Tropsch process, and compressed or liquefied gas derived from biomass. The incentive must first be taken as a credit against the blender's alternative fuel tax liability; any excess over this fuel tax liability may be claimed as a direct payment from the IRS. The tax credit is not allowed if an incentive for the same alternative fuel is also determined under the rules for the ethanol or biodiesel tax credits. This tax credit is applicable to fuel sold or used between January 1, 2005, and December 31, 2013. For more information about claiming the

credit, see IRS Publication 510*(PDF)* and IRS Forms 637, 720, 4136, and 8849, which are available on the IRS Forms and Publications website. (Reference Public Law 112-240 and 26U.S. Code 6426)

Point of Contact

Excise Tax Branch
U.S. Internal Revenue Service Office of Chief Counsel
Phone: (202) 622-3130
http://www.irs.gov/

Alternative Fuel Tax Exemption

Alternative fuels used in a manner that the Internal Revenue Service (IRS) deems as nontaxable are exempt from federal fuel taxes. Common nontaxable uses in a motor vehicle are: on a farm for farming purposes; in certain intercity and local buses; in a school bus; exclusive use by a nonprofit educational organization; and exclusive use by a state, political subdivision of a state, or the District of Columbia. This exemption is not available to tax exempt entities that are not liable for excise taxes on transportation fuel. For more information, see IRS Publication 510, which is available via the IRS website.

Point of Contact

Excise Tax Branch
U.S. Internal Revenue Service Office of Chief Counsel
Phone: (202) 622-3130
http://www.irs.gov/

Improved Energy Technology Loans

The U.S. Department of Energy (DOE) provides loan guarantees through the Loan Guarantee Program (Program) to eligible projects that reduce air pollution and greenhouse gases, and support early commercial use of advanced technologies, including biofuels and alternative fuel vehicles. The Program is not intended for research and development projects. DOE may issue loan guarantees for up to 100% of the amount of the loan for an eligible project. For loan guarantees of over 80%, the loan must be issued and funded by the Treasury Department's Federal Financing Bank. For more information, see the Loan Guarantee Program website. (Reference 42 U.S. Code 16513)

Point of Contact

U.S. Department of Energy
Phone: (202) 586-5000
Fax: (202) 586-4403
http://www.energy.gov

Alternative Fuel and Advanced Vehicle Technology Research and Demonstration Bonds

Qualified state, tribal, and local governments may issue Qualified Energy Conservation Bonds subsidized by the U.S. Department of Treasury at competitive rates to fund capital expenditures on qualified energy conservation projects. Eligible activities include research and demonstration projects related to cellulosic ethanol and other

non-fossil fuels, as well as advanced battery manufacturing technologies. Government entities may choose to issue tax credit bonds or direct payment bonds to subsidize the borrowing costs. For information on eligibility, processes, and limitations, see IRS Notices 2009-29*(PDF)*, 2010-35*(PDF)*, and 2012-44*(PDF)* or contact local issuing agencies. (Reference 26 U.S. Code 54D)

Laws and Regulations

Alternative Fuel Definition - Internal Revenue Code
The Internal Revenue Service (IRS) defines alternative fuels as liquefied petroleum gas (propane), compressed natural gas, liquefied natural gas, liquefied hydrogen, liquid fuel derived from coal through the Fischer-Tropsch process, liquid hydrocarbons derived from biomass, and P-Series fuels. Biodiesel, ethanol, and renewable diesel are not considered alternative fuels by the IRS. While the term "hydrocarbons" includes liquids that contain oxygen, hydrogen, and carbon and as such "liquid hydrocarbons derived from biomass" includes ethanol, biodiesel, and renewable diesel, the IRS specifically excluded these fuels from the definition. (Reference 26 U.S. Code 6426)
Point of Contact
U.S. Internal Revenue Service
Phone: (800) 829-1040
http://www.irs.gov/

Vehicle Acquisition and Fuel Use Requirements for Federal Fleets
Under the Energy Policy Act (EPAct) of 1992, 75% of new light-duty vehicles acquired by covered federal fleets must be alternative fuel vehicles (AFVs). As amended in January 2008, Section 301 of EPAct 1992 defines AFVs to include hybrid electric vehicles, fuel cell vehicles, and advanced lean burn vehicles. Federal fleets are also required to use alternative fuels in dual-fuel vehicles unless the U.S. Department of Energy (DOE) determines an agency qualifies for a waiver; grounds for a waiver include the lack of alternative fuel availability and cost restrictions. Fleets that use fuel blends containing at least 20% biodiesel (B20) may earn credits toward their annual requirements. Additionally, Executive Order 13423, issued in January 2007, requires federal agencies with 20 vehicles or more in their U.S. fleet to decrease petroleum consumption by 2% per year, relative to their Fiscal Year (FY) 2005 baseline, through FY 2015. Agencies must also continue to increase their alternative fuel use by 10% per year, relative to the previous year, based on a FY 2005 baseline.

Executive Order 13514, issued in October 2009, requires each federal agency to develop, implement, and annually update a Strategic Sustainability Performance Plan. Federal agencies must measure, reduce, and report their greenhouse gas (GHG) emissions, with an overall federal government direct GHG emissions reduction goal of 28% by 2020, relative to a FY 2008 baseline. Federal fleets of 20 vehicles or more must reduce petroleum consumption by a minimum of 2% per year through the end of FY 2020 as compared to 2005 baseline usage. Each agency must establish a comprehensive inventory of GHG emissions for FY 2010, to be updated on an annual basis thereafter.

Reductions may be achieved through a variety of measures including the use of AFVs, and fleet optimization efforts.
Additional requirements for federal fleets were included in the Energy Independence and Security Act of 2007, including fleet management plan requirements (Section 142), low GHG emitting vehicle acquisition requirements (Section 141), and renewable fuel infrastructure installation requirements (Section 246). DOE is currently developing a rulemaking on the alternative fuel increase requirements (verified December 2012; Section 142).
For more information, visit the Sustainable Federal Fleets website.
(Reference 42 U.S. Code 13212, Executive Order 13423*(PDF)*, and Executive Order 13514*(PDF)*)

Point of Contact

Federal Energy Management Program
U.S. Department of Energy
https://federalfleets.energy.gov/fleet_management_contacts

Vehicle Acquisition and Fuel Use Requirements for State and Alternative Fuel Provider Fleets

Under the Energy Policy Act (EPAct) of 1992, certain state government and alternative fuel provider fleets are required to acquire alternative fuel vehicles (AFVs). Compliance is required by fleets that operate, lease, or control 50 or more light-duty vehicles within the U.S. Of those 50 vehicles, at least 20 must be used primarily within a single Metropolitan Statistical Area/Consolidated Metropolitan Statistical Area. Those same 20 vehicles must also be capable of being centrally fueled. Covered fleets earn credits for each vehicle purchased, and credits earned in excess of their requirements can be banked or traded with other fleets. Additionally, fleets that use fuel blends containing at least 20% biodiesel (B20) in medium- and heavy-duty vehicles may earn credits toward their annual AFV acquisition requirements.

On March 20, 2007, the U.S. Department of Energy (DOE) issued a final rule on Alternative Compliance*(PDF)*, which allows fleets the option to choose a petroleum reduction path in lieu of acquiring AFVs. Interested fleets must obtain a waiver from DOE by proving that they will achieve petroleum reductions equivalent to that achieved by having AFVs running on alternative fuels 100% of the time. For more information, visit the EPAct State and Alternative Fuel Provider Fleets website. (Reference 42 U.S. Code 13251 and 13263a, and 10CFR 490)

Point of Contact

EPAct Transportation Regulatory Activities
U.S. Department of Energy
regulatory_info@afdc.nrel.gov
http://www.eere.energy.gov/vehiclesandfuels/epact/contacts.html

Vehicle Acquisition and Fuel Use Requirements for Private and Local Government Fleets

Under the Energy Policy Act (EPAct) of 1992, the U.S. Department of Energy (DOE) was directed to determine whether private and local government fleets should be mandated to acquire alternative fuel vehicles (AFVs). In January 2004, DOE published a final rule announcing its decision not to implement an AFV acquisition mandate for private and local government fleets. In response to a March 2006 ruling by a U.S. District Court, DOE issued a subsequent final rulemaking on the new Replacement Fuel Goal in March 2007, which extended the EPAct 1992 goal to 2030. The goal is to achieve a domestic production capacity for replacement fuels sufficient to replace 30% of the U.S. motor fuel consumption. In March 2008, DOE issued its determination not to implement a fleet compliance mandate for private and local government fleets, concluding that such a mandate is not necessary to achieve the Replacement Fuel Goal. For more information on the Private and Local Government Fleet Rule compliance, visit the EPAct Private and Local Government Fleet Determination website. (Reference 42 U.S. Code 13257)

Alternative Fuel Definition

The following fuels are defined as alternative fuels by the Energy Policy Act (EPAct) of 1992: pure methanol, ethanol, and other alcohols; blends of 85% or more of alcohol with gasoline; natural gas and liquid fuels domestically produced from natural gas; liquefied petroleum gas (propane); coal-derived liquid fuels; hydrogen; electricity; pure biodiesel (B100); fuels, other than alcohol, derived from biological materials; and P-Series fuels. In addition, the U.S. Department of Energy may designate other fuels as alternative fuels, provided that the fuel is substantially nonpetroleum, yields substantial energy security benefits, and offers substantial environmental benefits. For more information, see the EPAct website. (Reference 42 U.S. Code 13211)

Point of Contact

U.S. Department of Energy
Phone: (202) 586-5000
Fax: (202) 586-4403
http://www.energy.gov

Aftermarket Alternative Fuel Vehicle (AFV) Conversions

Conventional original equipment manufacturer vehicles altered to operate on propane, natural gas, methane gas, ethanol, or electricity are classified as aftermarket AFV conversions. All vehicle conversions, except those that are completed for a vehicle to run on electricity, must meet current applicable U.S. Environmental Protection Agency (EPA) standards. For more information about vehicle conversion certification requirements, see the Alternative Fuels Data Center's Vehicle Conversions website and EPA's Alternative Fuel Conversion website. (Reference 40 CFR 85)

Point of Contact

Regulatory Compliance
U.S. Environmental Protection Agency
Phone: (734) 214-4343
complianceinfo@epa.gov
http://www.epa.gov

Alternative Fuel and Vehicle Labeling Requirements

Alternative fuel vehicles (AFVs) and fuel dispensers must be labeled with information to help consumers make informed decisions about buying or fueling a vehicle. All new and used AFVs, including vehicles with an aftermarket conversion system installed, must be clearly labeled with the vehicle's cruising range as estimated by the manufacturer, as well as other descriptive information. The labeling requirements do not apply to hybrid electric vehicles. Alternative fuel dispensers must also be clearly labeled with the name of the fuel and fuel rating. This rule applies to, but is not limited to, the following fuel types: methanol, denatured ethanol, and/or other alcohols; mixtures containing 85% or more by volume of methanol, denatured ethanol, and/or other alcohols; natural gas; liquefied petroleum gas; hydrogen; coal derived liquid biofuels; biodiesel blends containing more than 5% biodiesel by volume; and electricity. (Reference 16 CFR 306 and 309)

Point of Contact

Federal Trade Commission
Phone: (202) 326-2222
http://www.ftc.gov/

High Occupancy Vehicle (HOV) Lane Exemption

States are allowed to exempt certified low emission and energy-efficient vehicles from HOV lane requirements within the state. Eligible vehicles must be certified by the U.S. Environmental Protection Agency (EPA) and appropriately labeled for use in HOV lanes. The U.S. Department of Transportation is responsible for planning and implementing HOV programs, including the exemption criteria established by EPA. States that choose to adopt these requirements will be responsible for enforcement and vehicle labeling. The HOV exemption for low emission and energy-efficient vehicle expires September 30, 2017. (Reference Public Law 112-141 and 23 U.S. Code 166)

Vehicle Incremental Cost Allocation

The U.S. General Services Administration (GSA) must allocate the incremental cost of purchasing alternative fuel vehicles (AFVs) across the entire fleet of vehicles distributed by GSA. This mandate also applies to other federal agencies that procure vehicles for federal fleets. For more information, see the GSA's AFV website. (Reference 42 U.S. Code 13212 (c))

Point of Contact

U.S. General Services Administration
Phone: (703) 605-5630
AFVteam@gsa.gov

Programs

Clean Cities

The mission of Clean Cities is to advance the energy, economic, and environmental security of the United States by supporting local initiatives to adopt practices that reduce the use of petroleum in the transportation sector. Clean Cities carries out this

mission through a network of nearly 100 volunteer coalitions, which develop public/private partnerships to promote alternative fuels and advanced vehicles, fuel blends, fuel economy, hybrid vehicles, and idle reduction. Clean Cities provides information about financial opportunities, coordinates technical assistance projects; updates and maintains databases and websites, and publishes fact sheets, newsletters, and related technical and informational materials. For more information, see the Clean Cities website.

Point of Contact

U.S. Department of Energy
Phone: (202) 586-5000
Fax: (202) 586-4403
http://www.energy.gov

State Energy Program (SEP) Funding

SEP provides grants to states to assist in designing, developing, and implementing renewable energy and energy efficiency programs. Each state's energy office receives SEP funding and manages all SEP-funded projects. States may also receive project funding from technology programs in the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) for SEP Special Projects. EERE distributes the funding through an annual competitive solicitation to state energy offices. For more information, see the SEPwebsite.

Point of Contact

U.S. Department of Energy
Phone: (202) 586-5000
Fax: (202) 586-4403
http://www.energy.gov

National Clean Diesel Campaign (NCDC)

The NCDC was established by the U.S. Environmental Protection Agency to reduce pollution emitted from diesel engines through the implementation of varied control strategies and the involvement of national, state, and local partners. The NCDC includes programs for existing diesel fleets, regulations for clean diesel engines and fuels, and regional collaborations and partnerships. For information on available grants and funding opportunities, see the NCDCGrants & Funding website.

Point of Contact

Jennifer Keller
National Clean Diesel Campaign
U.S. Environmental Protection Agency
Phone: (202) 343-9541
keller.jennifer@epa.gov
http://www.epa.gov/cleandiesel/

SmartWay Transport Partnership

The SmartWay Transport Partnership is a voluntary partnership between the U.S. Environmental Protection Agency (EPA) and the domestic freight industry. This public-private partnership was designed to reduce greenhouse gases and air pollution through

increased fuel efficiency. EPA provides partners with benefits and services that include fleet management tools, technical support, information, public recognition, and use of the SmartWay Transport Partner logo as a mark of excellence. The SmartWay Transport Partnership is working with partners to develop advanced technologies and operational practices that save fuel and reduce emissions. Grants are available to states, nonprofits, and academic institutions to demonstrate innovative idle reduction technologies for the trucking industry. For more information, see the SmartWay Transport Partnership website.

Point of Contact

SmartWay Transport Partnership
U.S. Environmental Protection Agency
Phone: (734) 214-4767
Fax: (734) 214-4052
smartway_transport@epa.gov
http://www.epa.gov/smartway

Clean School Bus USA

Clean School Bus USA is a public-private partnership that focuses on reducing children's exposure to harmful diesel exhaust by limiting school bus idling, implementing pollution reduction technologies, improving route logistics, and switching to clean fuels. Clean School Bus USA is part of the U.S. Environmental Protection Agency's National Clean Diesel Campaign and provides funding for projects designed to retrofit and/or replace older diesel school buses. Eligible applicants are school districts, state and local government programs, federally recognized Indian tribes, and non-profit organizations. For more information, see theClean School Bus USA website.

Point of Contact

Jennifer Keller
National Clean Diesel Campaign
U.S. Environmental Protection Agency
Phone: (202) 343-9541
keller.jennifer@epa.gov
http://www.epa.gov/cleandiesel/

Clean Ports USA

Clean Ports USA is an incentive-based program designed to reduce emissions by encouraging port authorities and terminal operators to retrofit and replace older diesel engines with new technologies and use cleaner fuels. The U.S. Environmental Protection Agency'sNational Clean Diesel Campaign offers funding to port authorities and public entities to help them overcome barriers that impede the adoption of cleaner diesel technologies and strategies. For more information, see the Clean Ports USA website.

Point of Contact

Julie Henning
National Clean Diesel Campaign
U.S. Environmental Protection Agency
Phone: (734) 214-4442
Fax: (734) 214-4052

henning.julie@epa.gov
http://www.epa.gov/cleandiesel/

Clean Construction USA
Clean Construction USA is a voluntary program that promotes the reduction of diesel exhaust emissions from construction equipment and vehicles by encouraging proper operations and maintenance, use of emissions-reducing technologies, and use of cleaner fuels. Clean Construction USA is part of the U.S. Environmental Protection Agency's National Clean Diesel Campaign, which offers funding for clean diesel construction equipment projects. For more information, see the Clean Construction USA website.
Point of Contact
Julie Henning
National Clean Diesel Campaign
U.S. Environmental Protection Agency
Phone: (734) 214-4442
Fax: (734) 214-4052
henning.julie@epa.gov
http://www.epa.gov/cleandiesel/

Clean Agriculture USA
Clean Agriculture USA is a voluntary program that promotes the reduction of diesel exhaust emissions from agricultural equipment and vehicles by encouraging proper operations and maintenance by farmers, ranchers, and agribusinesses, use of emissions-reducing technologies, and use of cleaner fuels. Clean Agriculture USA is part of the U.S. Environmental Protection Agency's National Clean Diesel Campaign, which offers funding for clean diesel agricultural equipment projects. For more information, see the Clean Agriculture USA website.
Point of Contact
Julie Henning
National Clean Diesel Campaign
U.S. Environmental Protection Agency
Phone: (734) 214-4442
Fax: (734) 214-4052
henning.julie@epa.gov
http://www.epa.gov/cleandiesel/

Air Pollution Control Program
The Air Pollution Control Program assists state, local, and tribal agencies in planning, developing, establishing, improving, and maintaining adequate programs for prevention and control of air pollution or implementation of national air quality standards. Plans may emphasize alternative fuels, vehicle maintenance, and transportation choices to reduce vehicle miles traveled. Eligible applicants may receive federal funding for up to 60% of project costs to implement their plans. (Reference 42 U.S. Code 7405)

Point of Contact
U.S. Environmental Protection Agency
Phone: (202) 272-0167
http://www.epa.gov

Congestion Mitigation and Air Quality (CMAQ) Improvement Program
The CMAQ Improvement Program provides funding to state departments of transportation (DOTs), municipal planning organizations (MPOs), and transit agencies for projects and programs in air quality nonattainment and maintenance areas that reduce transportation-related emissions. Eligible activities include transit improvements, travel demand management strategies, traffic flow improvements, purchasing idle reduction technology, development of alternative fueling infrastructure, conversion of public fleet vehicles to operate on cleaner fuels, and outreach activities that provide assistance to diesel equipment and vehicle owners and operators regarding the purchase and installation of diesel retrofits. State DOTs and MPOs must give priority to projects and programs to include diesel retrofits and other cost-effective emissions reduction activities, and cost-effective congestion mitigation activities that provide air quality benefits. For more information, see the CMAQ Improvement Program website. (Reference Public Law 112-141, and 23 U.S. Code 149)
Point of Contact
Federal Highway Administration
U.S. Department of Transportation
http://www.fhwa.dot.gov/index.html

Voluntary Airport Low Emission (VALE) Program
The goal of the VALE Program is to reduce ground level emissions at commercial service airports located in designated ozone and carbon monoxide air quality nonattainment and maintenance areas. The VALE Program provides funding through the Airport Improvement Program and the Passenger Facility Charges program for the purchase of low-emission vehicles, development of fueling and recharging stations, implementing gate electrification, and other airport air quality improvements. For more information, see the VALE Programwebsite. (Reference 49 U.S. Code 40101)
Appendix C: Mississippi Laws and Incentives: Propane

Appendix C: State Incentives and Laws

State Incentives

Alternative Fuel Vehicle Revolving Loan Program

Effective July 1, 2013, the Mississippi Development Authority must establish a revolving loan program to provide zero-interest loans for public school districts and municipalities to purchase alternative fuel school buses and other motor vehicles, convert school buses and other motor vehicles to use alternative fuels, purchase alternative fuel equipment, and install fueling stations. The program will use funds from the Mississippi Alternative Fuel School Bus and Municipal Motor Vehicle Revolving Loan Fund. (Reference House Bill 1685, 2013)

Propane Education and Research Program

The State Liquefied Compressed Gas Board (Board), operated through the Mississippi Insurance Department, enforces laws and regulations regarding the distribution of liquefied compressed gases within the state. The Board may issue grants to Mississippi-based entities for the purpose of promoting and researching the development of more cost-effective uses of propane. Educational, safety, and market development programs may also qualify for grant funding. The Board must review all proposals. For more information, see the Mississippi Insurance Department's Liquefied Compressed Gas website. (Reference Mississippi Code 75-57-119)

Point of Contact

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Laws and Regulations

Fuel-Efficient and Alternative Fuel Vehicle Use

The State Bureau of Fleet Management (Bureau), operated through the Mississippi Department of Finance and Administration, coordinates and promotes fuel efficiency when state agencies purchase, lease, rent, acquire, use, maintain, and dispose of vehicles. The Bureau encourages state agencies to use fuel-efficient or hybrid electric vehicles as appropriate and, when feasible, use alternative fuels, including ethanol, biodiesel, natural gas, or electricity to operate the vehicles. By July 1, 2014, at least 75% of all vehicles titled under the Bureau must have a U.S. Environmental Protection Agency estimated fuel economy rating of at least 40 miles per gallon for highway driving.
(Reference Mississippi Code 25-1-77)

Installation of Alternative Fuel Components in Vehicles

A propane or compressed natural gas (CNG) carburetion system installer who collects an installation service fee must hold an installer's license from the State Liquefied Compressed Gas Board (Board)

and must notify the Board of any applicable installation. The Board or the Mississippi Insurance Department must inspect propane or CNG carburation systems not installed by a qualified installer or manufacturer. Regardless of installer, a field inspector must inspect all propane and CNG carburetion systems installed on public transportation vehicles, including school buses. The Board may require the inspection of any propane or CNG carburetion systems installed on other vehicle types as necessary, and all installations must comply with its rules and regulations. (Reference Mississippi Code 75-57-47)

Compressed Natural Gas (CNG) and Propane Deregulation

The transmission, sale, or distribution of CNG and distribution or sale of propane is deregulated when used as a motor vehicle fuel and for related purposes. (ReferenceMississippi Code 77-3-3 and 77-3-11)

State Employee Travel Policy

All state agencies and institutions must develop and adopt travel policies that include strategies to reduce petroleum consumption, such as carpooling to meetings and purchasing alternative fuels where available. (Reference Executive Order 82, 2009)

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Appendix D: Propane Codes

Source: (Blake, Buttner, & Rivkin, 2010)

Propane has been used as a vehicle fuel on a widespread basis for many years, with significant interest growing shortly after World War II [6]. As a result of this long history, the codes and standards for Propane are well established, but by no means comprehensive. The utilization of Propane as a vehicular fuel has been growing in the past decade. Figure 3 shows that the number of Propane vehicles has increased steadily from 1995 through 2002 [7]. In Figure 3, it should be noted that the 2001 value given is preliminary and the 2002 value is a projected estimate.

NFPA 58, the Liquefied Petroleum Gas Code, was created in 1932 [9]. After World War II, interest in Propane vehicles grew, particularly for fleet vehicles and industrial fork trucks. Consequently, NFPA 58 was modified to encompass Propane vehicle requirements. Since then, some minor revisions to NFPA 58 have occurred. As a result of the comparatively long history of Propane use as a vehicle fuel, the Propane codes and standards are more established and the user market is more familiar with the pertinent codes and standards relative to other alternative fuel types. NFPA 58 is used throughout the United States and has been directly adopted as a regulation (e.g., a code) by most states. This document sets specifications for storage, dispensing, onboard vehicle requirements, and infrastructure requirements for Propane. Table 4 presents code citations from NFPA 58 as well as the documents referenced in NFPA 58. The existing infrastructure is also well established. Therefore, AHJs are sufficiently familiar with the permitting of associated fueling facilities.

Codes and Standards Citations for Propane Fuel

GENERAL REQUIREMENTS
NFPA 58, Liquefied Petroleum Gas Code, 4
Acceptance of Equipment and Systems
NFPA 58, Liquefied Petroleum Gas Code, 4.1
Odorization
NFPA 58, Liquefied Petroleum Gas Code, 4.2
Notification of Installations
NFPA 58, Liquefied Petroleum Gas Code, 4.3
Qualification of Personnel
NFPA 58, Liquefied Petroleum Gas Code, 4.4
Ammonia Contamination
NFPA 58, Liquefied Petroleum Gas Code, 4.5
Minimum Requirements
NFPA 58, Liquefied Petroleum Gas Code, 4.6

GAS EQUIPMENT AND APPLIANCES
NFPA 58, Liquefied Petroleum Gas Code, 5
Containers
NFPA 58, Liquefied Petroleum Gas Code, 5.2

American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section VIII, "Rules for the Construction of Unfired Pressure Vessels"
American Petroleum Institute (API)-ASME Code for Unfired Pressure Vessels for Petroleum Liquids and Gases,
National Board Inspection Code
Compressed Gas Association (CGA) C-6, Standard for Visual Inspection of Steel Compressed Gas Cylinders
American Society of Civil Engineers (ASCE) 7, Minimum Design Loads for Buildings and Other Structures
Container Appurtenances
- NFPA 58, Liquefied Petroleum Gas Code, 5.7
- Underwriters' Laboratories, Inc. (UL) 132, Standard on Safety Relief Valves for Anhydrous Ammonia and Liquefied Petroleum Gas
- UL 144, Standard for Liquefied Petroleum Gas Regulators
- NFPA 54, National Fuel Gas Code (ANSI Z223.1), 5.9.2
- UL 651, Schedule 40 or 80 Rigid PVC Conduit 602
- CGA V-1, Standard Compressed Gas Cylinder Valve Outlet and Inlet Connections
- API 607, Fire Test for Soft-Seated Quarter Turn Ball Valves

Piping (including Hose), Fittings and Valves
- NFPA 58, Liquefied Petroleum Gas Code, 5.8
- NFPA 54, National Fuel Gas Code
- Referenced American Society for Testing and Materials (ASTM) Piping and Tubing Standards

Valves Other Than Container Valves
- NFPA 58, Liquefied Petroleum Gas Code, 5.10
- Referenced ASTM Standards

Hydrostatic Relief Valves
- NFPA 58, Liquefied Petroleum Gas Code, 5.11
- Referenced ASTM Standards

Equipment
- NFPA 58, Liquefied Petroleum Gas Code, 5.15
- Referenced ASTM Standards

INSTALLATION OF LP GAS SYSTEMS
- NFPA 58, Liquefied Petroleum Gas Code, 6

Scope
- NFPA 58, Liquefied Petroleum Gas Code, 6.1

Location of Containers
- NFPA 58, Liquefied Petroleum Gas Code, 6.2

Container Separation Distances
- NFPA 58, Liquefied Petroleum Gas Code, 6.3

Other Container Location Requirements

NFPA 58, Liquefied Petroleum Gas Code, 6.4
NFPA 30, Flammable and Combustible Liquids Code
NFPA 55, Compressed Gases and Cryogenic Fluids Code
ANSI/CGA C-7, Guide to the Preparation of Precautionary Labeling and Marking of Compressed Gas Containers

Location of Transfer Operations
NFPA 58, Liquefied Petroleum Gas Code, 6.5

Installation of Containers
NFPA 58, Liquefied Petroleum Gas Code, 6.6
NFPA 220, Standard on Types of Building Construction

Installation of Containers Appurtenances
NFPA 58, Liquefied Petroleum Gas Code, 6.7
ANSI Z21.80/Codes and Standards of America (CSA) 6.22, Standard for Line Pressure Regulators.
NFPA 54, National Fuel Gas Code

Piping Systems
NFPA 58, Liquefied Petroleum Gas Code, 6.8 613
ASME B 31.3, Process Piping
ASME Boiler and Pressure Vessel Code, Section IX
References ASTM Piping Standards

Internal Valves
NFPA 58, Liquefied Petroleum Gas Code, 6.9

Emergency Shutoff Valves
NFPA 58, Liquefied Petroleum Gas Code, 6.10

Hydrostatic Relief Valve Installation
NFPA 58, Liquefied Petroleum Gas Code, 6.11

Testing Piping Systems
NFPA 58, Liquefied Petroleum Gas Code, 6.12
ASME Boiler and Pressure Vessel Code, Section IX

Installation in Areas with Heavy Snowfall
NFPA 58, Liquefied Petroleum Gas Code, 6.13

Corrosion Protection
NFPA 58, Liquefied Petroleum Gas Code, 6.14

Equipment Installation
NFPA 58, Liquefied Petroleum Gas Code, 6.15

Bulk Plant and Industrial Liquefied Petroleum Gas Systems
NFPA 58, Liquefied Petroleum Gas Code, 6.16

Liquefied Petroleum Gas Systems in Buildings or on Roofs
NFPA 58, Liquefied Petroleum Gas Code, 6.17
UL 147A, Standard for No refillable (Disposable) Type Fuel Gas Cylinder Assemblies
UL 147B, Standard for No Refillable (Disposal) Type Metal Container Assemblies for Butane

Ignition Source Control
NFPA 58, Liquefied Petroleum Gas Code, 6.20
NFPA 70, National Electrical Code

Vehicle Fuel Dispenser and Dispensing Stations
NFPA 58, Liquefied Petroleum Gas Code, 6.22
UL 567, Standard Pipe Connectors for Flammable and Combustible Liquids and Liquefied Petroleum Gas
Fire Protection
NFPA 58, Liquefied Petroleum Gas Code, 6.23
NFPA 15, Standard for Water Spray Fixed Systems for Fire Protection
Alternate Provisions for Installation of ASME Containers
NFPA 58, Liquefied Petroleum Gas Code, 6.24

LIQUEFIED PETROLEUM GAS LIQUID TRANSFER
NFPA 58, Liquefied Petroleum Gas Code, 7
Scope
NFPA 58, Liquefied Petroleum Gas Code, 7.1 624
Operational Safety
NFPA 58, Liquefied Petroleum Gas Code, 7.2
Venting Liquefied Petroleum Gas to the Atmosphere
NFPA 58, Liquefied Petroleum Gas Code, 7.3
Quantity of Liquefied Petroleum Gas in Containers
NFPA 58, Liquefied Petroleum Gas Code, 7.4

BUILDINGS OR STRUCTURES HOUSING LIQUEFIED PETROLEUM GAS FOR DISTRIBUTION
NFPA 58, Liquefied Petroleum Gas Code, 10
Scope
NFPA 58, Liquefied Petroleum Gas Code, 10.1
Separate Structures or Buildings
NFPA 58, Liquefied Petroleum Gas Code, 10.2
NFPA 70, National Electrical Code
Attached Structures or Rooms Within Structures
NFPA 58, Liquefied Petroleum Gas Code, 10.3

ENGINE FUEL SYSTEMS
NFPA 58, Liquefied Petroleum Gas Code, 11
Scope
NFPA 58, Liquefied Petroleum Gas Code, 11.1
Training
NFPA 58, Liquefied Petroleum Gas Code, 11.2
Containers
NFPA 58, Liquefied Petroleum Gas Code, 11.3
U.S. Department of Transportation (DOT)

Rules for Construction of Unfired Pressure Vessels," Section VIII, Division I of the ASME Boiler and Pressure Vessel Code

Container Appurtenances

NFPA 58, Liquefied Petroleum Gas Code, 11.4

UL 132, Standard on Safety Relief Valves for Anhydrous Ammonia and Liquefied Petroleum Gas

Carburetion Equipment

NFPA 58, Liquefied Petroleum Gas Code, 11.5

Piping, Hose, and Fittings

NFPA 58, Liquefied Petroleum Gas Code, 11.6

Referenced ASTM Piping and Tubing Standards

Installation of Containers and Container Appurtenances

NFPA 58, Liquefied Petroleum Gas Code, 11.7

Installation in the Interior of Vehicles

NFPA 58, Liquefied Petroleum Gas Code, 11.8

Pipe and Hose Installation

NFPA 58, Liquefied Petroleum Gas Code, 11.9 635

Equipment Installation

NFPA 58, Liquefied Petroleum Gas Code, 11.10

Marking

NFPA 58, Liquefied Petroleum Gas Code, 11.11

Industrial (and Forklift) Trucks Powered by LP-Gas

NFPA 58, Liquefied Petroleum Gas Code, 11.12

General Provisions for Vehicles Having Engines Mounted on Them

NFPA 58, Liquefied Petroleum Gas Code, 11.13

Engine Installation Other Than on Vehicle

NFPA 58, Liquefied Petroleum Gas Code, 11.14

Garaging of Vehicles

NFPA 58, Liquefied Petroleum Gas Code, 11.15

OPERATIONS AND MAINTENANCE

NFPA 58, Liquefied Petroleum Gas Code, 14

Scope

NFPA 58, Liquefied Petroleum Gas Code, 14.1

Operating Requirements

NFPA 58, Liquefied Petroleum Gas Code, 14.2

Maintenance

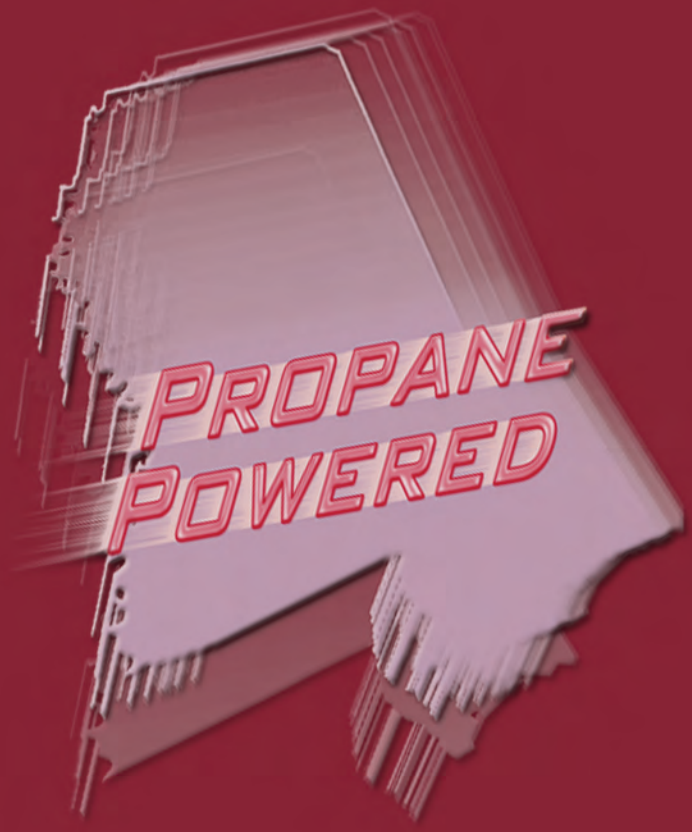
NFPA 58, Liquefied Petroleum Gas Code, 14.3

NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems

NFPA 10, Standard for Portable Fire Extinguishers

PIPING AND TUBING SIZING TABLES

NFPA 58, Liquefied Petroleum Gas Code, 15



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