



Initiative for Resiliency in  
Energy through Vehicles

# Propane Vehicles and Emergency Response



Propane fire and rescue vehicle in Sandy Springs, Georgia.

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This report was authored by Sandy Fazeli, NASEO Senior Program Director, in June 2016.



**West Hartford AAA has five Ford F-250s with Icom Propane Autogas systems. The 28-vehicle fleet will be switched over to propane-gasoline bi-fuel operation by the end of 2017.**

stations owned by fleets. These stations can be used to refuel vehicles during emergencies or provide propane for mobile refueling.

Propane also offers economic, environmental, and safety benefits, and is relatively low-risk: spills and contamination do not pose major problems because fuel that escapes during filling dissipates quickly and harmlessly into the air.<sup>2</sup> These characteristics potentially reduce the risk of driver injury or vehicle damage in extreme temperatures and situations. Unlike gasoline, which degrades in storage, propane can also be stored indefinitely and accessed quickly.

While propane vehicles can be a valuable asset during emergency situations, they, like most fuels, are

### Propane vehicles can boost community resilience and accelerate recovery in the wake of natural and man-made disasters.

During emergencies, propane’s mobile fueling capability can be an asset to a response and recovery fleet, particularly when stations experience fuel shortages, outages, or nearby roadblocks.<sup>1</sup> Propane also already has an established refueling network, with more than 1,500 publicly-available propane stations nationwide and additional private

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vulnerable to roadway and infrastructure conditions. Mobile fueling relies on the transport of the fuel via tank truck, and may be impractical when roadways are blocked. Stationary refueling sites may also be inoperable during power outages, unless an on-site generator is available.

The following pages include examples of cities and states that have incorporated propane vehicles into their emergency fleet, and provide additional information that fleet and emergency managers should consider when considering the use of propane vehicles.

## Propane Vehicles in Disasters

### PROS:

- ✓ Mobile fueling capability allows fuel to be delivered to remote or inaccessible areas
- ✓ Widely available infrastructure network
- ✓ Less susceptible to spills and contamination
- ✓ Easily stored and accessed

### CONS:

- ✗ Mobile refueling dependent on local codes and roadway conditions
- ✗ Stationary sites must have access to power or a generator
- ✗ Subject to supply shortages and price volatility

# Propane Autogas in Sandy Springs, GA



**A propane-fueled Ford Crown Victoria police cruiser gets refilled in Sandy Springs, Georgia.<sup>3</sup>**

**Propane (also known as propane autogas, or liquefied petroleum gas - LPG) offers important benefits both before and during crises, and has been widely adopted by emergency fleets - including the police department in Sandy Springs, Georgia.**

Between 2012 and 2014, the Sandy Springs Police Department converted 65 vehicles in its fleet to run on propane autogas. The first wave of conversions commenced in 2012, when the project was given the green light by the city council, homeland security unit, and officers in the police force.

The reasons behind the proposed investment were multifold. City and police leadership were initially attracted to alternative fuel vehicles for financial, energy security, and environmental reasons as well as for their ability to help the police department be a leader in sustainability within the Sandy Springs community. Propane's affordability, American production, reliable supply, and safe use in extreme situations caught the attention of Captain Bart Humble. "Propane autogas is clean and American-made, and was more affordable to implement than other alternative

fuels. We wouldn't have to sacrifice anything we were looking for out of an alt fuel," noted Captain Humble in an interview with the Propane Education and Research Council.<sup>4</sup>

In 2012, the department converted 25 Ford Crown Victoria cruisers from gasoline to propane autogas with EPA-certified Prins bi-fuel systems. Officers using the vehicles daily expressed a high level of satisfaction with their capabilities, performance, and ease of operation.<sup>5</sup> The success of this initial conversion spurred the force to seek a grant to convert additional vehicles. The second wave of conversions took place under a U.S. DOE Clean Cities project led by the Virginia Department of Mines, Minerals, and Energy, which houses the State Energy Office and Virginia Clean Cities. The project, titled the Southeast Propane Autogas Development Program (SPADP), is a large-scale initiative to increase the number of autogas vehicles and refueling stations in the Southeast, covering more than 30 fleets across 10 states.<sup>6</sup>

SPADP reimbursed the police department for half of the total cost to convert 40 more vehicles, including Crown Victorias, Caprices, and Expeditions. The Police Department has since added two dedicated propane vehicles to its fleet, now operating a total of 67 propane-powered vehicles. Through the second quarter of 2014, the police department charted over 90% propane usage in its fleet, with an average fuel costs savings of \$1.49 per gallon when compared to gasoline. The high adoption and level of performance in Sandy Springs is an excellent example of ways that propane vehicles and other alternative fuels can be incorporated into policy and other emergency response fleets.

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## CASE STUDY

# Propane Autogas in Boston Public Schools



**Peter Crossan of Boston Public Schools discusses its propane autogas school bus fleet. “The fuel savings will offset the small premium in price in less than two years,” he notes.<sup>7</sup>**

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**Boston Public Schools operates a large school bus fleet that is used to transport students even during snow and other extreme weather emergencies, and opted to convert a portion of its fleet to propane vehicles for economic, environmental, and resiliency reasons.**

In fall 2015, Boston Public Schools (BPS) began to operate 11 percent of its total bus fleet on propane with the purchase of 86 Blue Bird propane autogas buses, which are the city’s first buses powered on alternative fuels. Propane offered BPS the opportunity to switch from a totally diesel fleet without needing to change their workshops, routes, or fueling locations to accommodate for the change in fuel.

In addition to operations and maintenance cost savings and convenience, security and resiliency were

major factors in BPS’s assessment of alternative fuels and in its decision to invest in propane. BPS’s Department of Transportation (BPSDOT) researched propane pipeline, storage, delivery, and alternate supplies to assure reliable and safe operation of the propane buses. Propane presents minimal hazardous materials concerns, is easier to start in Boston’s extreme winters, and shows no visible exhaust except for water vapor.<sup>8</sup> Compared to the older diesel buses in the BPS fleet, the propane vehicles produce significantly less noise and harmful pollutant emissions to which young children in particular may be vulnerable.<sup>9</sup>

BPS partnered with Blue Bird and propane vendor Frank Lamparelli Oil to ensure that the vehicles, the fueling process, and the fuel purchase process met the school system’s exacting specifications. The vehicles are designed to be handicap-accessible and to minimize noise and pollution. To maximize its available, limited space and minimize expenses, BPS has opted for mobile fueling services, eliminating the need for on-site infrastructure.<sup>10</sup> BPS also retains the option to buy fuel futures or use spot-buy prices in its arrangement with Frank Lamparelli.<sup>11</sup>

As of December 2015, BPSDOT notes that propane has averaged \$1.00 per gallon less than diesel since the propane buses began operation. Even with diesel prices at a low, this differential will allow BPS to pay off the four percent premium for the Roush propane engines in about three years.<sup>12</sup> The cost savings, environmental benefits, and mobile fueling capability has been an asset to BPS and has led to a more resilient fleet.

## BACK TO BASICS

# What You Need to Know About Propane Vehicles

Propane vehicles share similar refueling and performance characteristics with gasoline and diesel vehicles. Like gasoline-powered vehicles, propane vehicles operate using spark-ignited engines. Their fuel-injection systems may either inject vapor or liquid. The vapor-injected system uses a regulator or vaporizer to convert the liquid fuel into a vapor, which is then combined with filtered air, drawn into the combustion chamber, and burned to power the vehicle. In a liquid-injected system, fuel is introduced into the combustion chamber as a liquid, which combusts more fully and optimizes power and throttle response.<sup>13</sup>

There are two types of propane vehicles: dedicated (running only on propane) and bi-fuel (with two separate fueling systems that operate on either propane or gasoline).

Propane-powered vehicles typically match gasoline or diesel vehicles in terms of their power, acceleration, and cruising speed, and bi-fuel vehicles offer a comparable driving range. Propane vehicles have a slightly lower fuel economy because of the fuel's lower energy content.<sup>14</sup>

Fleet managers commonly choose to use propane in three major vehicle platforms: light-duty, medium-duty, and transportation and transit vehicles. Light- and medium-duty, dedicated propane vehicles are typically available as trucks and vans from leading original equipment manufacturers (OEM) such as Roush CleanTech, CleanFuel USA, Isuzu, and Freightliner Custom Chassis Corporation. Propane vehicles

from these OEMs are certified by the Environmental Protection Agency (EPA) and the California Air Resources Board (CARB).<sup>15</sup>

There are also EPA-certified bi-fuel conversion options available for a wide range of light-duty vehicles, including police cruisers, SUVs, and taxis. For heavy duty vehicles, propane autogas is a

common fuel for school buses, which are offered by many of the OEMs that manufacture conventionally fueled school buses.<sup>16</sup> Propane also has offroad applications, including for lawn equipment and forklifts. The Propane Education and Research Council (PERC) maintains a vehicles list, updated quarterly, of EPA- and CARB-certified propane autogas vehicles and "aftermarket" (a.k.a. conversion) systems.<sup>17</sup>



**Propane truck on display at "Fueling the Future" in Dover, Delaware.**

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# Refueling

The process and amount of time it takes to fuel a propane vehicle are similar to filling a gasoline vehicle. Where local codes allow, propane vehicles and fleets can benefit from the option of mobile onsite fueling, also known as “wet hosing.” Fleet operators may opt for mobile fueling instead of building infrastructure for cost or convenience benefits, for vehicles in remote areas, or as an interim option when onsite fueling is down.<sup>18</sup>

The fuel pump is powered by the tank truck’s engine power takeoff, enabling fueling even during onsite power outages. Mobile fueling relies on the transport of the fuel via tank truck—so, while it offers a more portable fueling option than a filling station, it may present vulnerabilities when roadways are down.

## How Does it Work?

### Look to Local Codes for Guidance on Mobile Onsite Fueling

Mobile fueling is the practice of filling fuel tanks of vehicles from tank vehicles. Mobile fueling is typically governed by codes and requirements at the state and local level. These regulations may dictate, for instance, fueling practices that protect against water and soil pollution or promote fire safety. State Departments of Transportation, Energy Offices, Fire Marshals, and/or State environmental agencies may have state-specific information on mobile fueling.

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# Costs

For many fleets, fuel price stability and fuel cost make a compelling business case for propane vehicle conversions and investments. While the retail price of propane tends to move with oil and gas and may react to seasonal spikes in demand for heating, fleets have access to contracts that buffer budgets from such fluctuations. The rates secured through such arrangements, including “pre-buy” (fixed rate) and “price cap” contracts.

Due to contract agreements, the price a fleet pays for propane autogas is often significantly lower than the going rates for conventional fuels. For instance, a 2013 case study by the Texas Department of Transportation estimated the fuel cost-per-mile for their 102 propane school buses to be \$0.37, absent of the \$0.50 per gallon federal tax credit for propane and

natural gas. This is nearly half the \$0.72 cost-per-mile of their 80 diesel school buses.<sup>19</sup> A 2012 National Propane Gas Association review of private pricing data found propane prices to be \$0.68 per gallon lower than gasoline in 2010, and \$0.92 per gallon lower in 2011.<sup>20</sup>

Such price differentials are sometimes obscured by national propane price reporting. Fuel costs vary widely by volume and by region, skewing the national averages disclosed in such reports as DOE’s Alternative Fuel Price Report. A typical fleet consumer with private refueling may pay much less in some instances than an individual customer at a public propane refill station.<sup>21</sup> For this reason, fleets interested in the “true” cost of propane may benefit from contacting other propane users in their region.

## Cost Comparison - Propane, Diesel and Gasoline Vehicles

	Gasoline	Diesel	Propane
<b>VEHICLE</b>			
Base Price	\$32,035	\$40,035	\$32,350
Conversion	–	–	\$15,995
Total	\$32,035	\$40,035	\$48,345
<b>OPERATION*</b>			
Lifecycle (5 yrs, 40,000 miles/yr)	200,000	200,000	200,000
Average MPG	6.9	8	5.5
Total Gallons	28,986	25,000	36,364
Fuel (per gallon)**	\$2.67	\$3.13	\$2.00
Fuel Costs	\$77,391	\$78,250	\$72,727
Maintenance Rate (per mile)	\$0.14	\$0.16	\$0.08
Maintenance Costs	\$28,000	\$32,000	\$16,000
<b>Total Vehicle Lifecycle Cost</b>	<b>\$137,998</b>	<b>\$150,285</b>	<b>\$136,310</b>

\*Does not include body configuration, license, registration, or insurance costs. \*\*Based on average North Carolina prices for January 2015. Includes federal alternative fuel tax credit but does not take into account the option of negotiating lower prices in exchange for a fuel contract.

**Lifecycle cost comparison of Ford E-450 6.8L V10 paratransit van on gasoline, diesel, and propane. Cost savings may be greater for light-duty propane vehicle conversions.<sup>22</sup>**

The lifecycle cost savings associated with propane vehicles also form a strong case for fleet investments. While propane vehicles and propane vehicle conversions may cost more than their conventional fuel counterparts, high mileage fleets will likely recover the incremental cost over the lifetime of the vehicle through fuel savings. Propane vehicles typically have a longer engine life, due to the fuel's high octane rating and reduced likelihood for oil contamination. These characteristics result in lower maintenance costs over the lifespan of the fleet.<sup>23</sup>

The costs of installing and operating propane fueling infrastructure varies, and includes such expenses as permitting, construction, storage, and dispensing, pump and motor equipment. Cost estimates range from \$45,000 for a small, skid-mounted station up to \$300,000 for a large station. However, innovative leasing options can help make such purchases more affordable, for instance in return for a multi-year contract.<sup>24</sup>

Federal and state incentives for propane may further sweeten propane investments. For instance, the federal Alternative Fuel Mixture Excise Tax Credit provides a \$0.36 per gallon credit for alternative fuel sold through December 31, 2016. Additionally, several states offer tax reductions, exemptions, and credits for alternative fuel vehicles or infrastructure. AFDC maintains a searchable database of federal and state laws and incentives at [www.afdc.energy.gov/laws](http://www.afdc.energy.gov/laws).

Beyond specific project and fleet cost savings, propane autogas offers benefits to the domestic economy. The vast majority (97%) of the propane consumed in the United States is produced in North America, and propane production, transportation, retail, and storage form a multi-billion dollar per year industry. As a result, propane investments offer significant macro-economic and job retention benefits to the U.S. and state economies.<sup>25</sup>

# Other Benefits of Propane Vehicles



**Delaware Governor Jack Markell's July 2015 announcement of the Clean Transportation Incentive Program, which provides rebates and grants for alternative fuels.<sup>26</sup>**

Fleets, including fleets involved with emergency preparedness are adopting propane technology because of other environmental and energy security benefits. Propane has a low carbon content and a short lifetime when released into the atmosphere, offering climate and air quality benefits. Propane is chemically reactive, and is quickly removed from the atmosphere by sunlight or precipitation, minimizing the global warming effect of propane emissions. Propane investments may reduce lifecycle greenhouse gas (GHG), hydrocarbon, carbon monoxide, and nitrogen oxide emissions. Estimates from Argonne National Laboratory's Greenhouse Gases, Regulated

Emissions, and Energy Use in Transportation (GREET) Model show that propane use reduces GHG emissions by approximately 10% compared to conventional fuels.<sup>27</sup>

Propane's primarily domestic production also offers important energy and homeland security benefits. In 2014, more than one quarter of the petroleum consumed by the United States was imported from foreign countries. While the top source country is Canada, a stable partner whose petroleum represented 37% of gross imports in 2014, a significant share of U.S. petroleum comes from less secure regions and countries. For instance, 35% of 2014 gross petroleum imports hailed from Saudi Arabia, Mexico, Venezuela, and Iraq.<sup>28</sup>

Propane production occurs for the large part domestically and, once produced, propane autogas is distributed through a well-established infrastructure and fueling network. Not only does propane drastically reduce vulnerability to supply disruptions as compared to conventional fuels; by displacing an increasing volume of petroleum fuels year after year, propane investments also diversify the U.S. transportation fuel market and reduce dependence on gasoline and diesel.



**Propane autogas refueling site in Mesa, Arizona.**

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# Other Considerations

Fleet and emergency managers should also consider propane's safety benefits. Propane is a safe and stable fuel when properly stored, dispensed, and used. Although the fuel itself is nontoxic and odorless, mercaptan (an odorant) is added to make leaks easy to detect.<sup>29</sup> LPG vehicles and systems on the market today are tested and designed to meet the same safety and crash testing standards as conventionally fueled vehicles. While propane tanks have a relatively low working pressure, they are tested to four times this amount and are 20 times more puncture-resistant than gasoline or diesel tanks.<sup>30</sup>

Two voluntary national codes address requirements for building or modifying propane vehicle facilities:

the National Fire Protection Agency (NFPA) 58 Liquefied Petroleum Gas Code, and NFPA 30A Code for Motor Fuel Dispensing Facilities and Repair Garages. Some jurisdictions may have additional or different requirements.<sup>31</sup> The National Alternative Fuels Training Consortium (NAFTC) also has been conducting an important effort across the country to provide first responder safety training for propane and other alternative fuel vehicles. This training leverages NAFTC's suite of First Responder Safety Training products to highlight the unique safety considerations of alternative fuels for firefighters, emergency medical service personnel, law enforcement professionals, and other first responders.<sup>32</sup>

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# Conclusion

Propane vehicles offer unique benefits that can enhance system resilience. Propane's mobile-fueling capability can deliver needed fuel to remote areas when supplies are needed. There is also an established, nationwide stationary propane infrastructure

network that can be used by emergency fleets and others. Propane's unique ability to be stored indefinitely and accessed quickly can also be a major asset to first responders and other emergency fleets.



LPG autogas buses.

# Ready to Get Under the Hood?

*Resources to Help Fleets Get Started and Connected with Existing Propane Users*

## The Initiative for Resiliency in Energy through Vehicles (iREV)

iREV supports state and local emergency management decision makers by providing tools and information on alternative fuel vehicles and their use in emergency management and response. iREV is led by the National Association of State Energy Officials and supported by the U.S. Department of Energy Clean Cities Program. Visit [www.naseo.org/irev](http://www.naseo.org/irev) for more information.

## U.S. Department of Energy Clean Cities Program

The Clean Cities program advances the nation's economic, environmental, and energy security by supporting local actions to cut petroleum use in transportation. Nearly 100 local coalitions serve as the foundation of the Clean Cities program by working to cut petroleum use in communities across the country. Visit [cleancities.energy.gov](http://cleancities.energy.gov) for more information and to find contact information for your local coordinator.

## Propane Education and Research Council (PERC)

PERC is a check-off program established, operated, and funded by the propane industry. It is an incubator of new propane-fueled technology and a leader in propane safety and training programs and products. More information about PERC is available at [www.propanecouncil.org](http://www.propanecouncil.org)

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# Images

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