

THE GROWING PRESENCE OF PROPANE IN PUPIL TRANSPORTATION

Propane autogas is the most widely used alternative fuel in world — powering more than 25 million vehicles worldwide.¹ While the U.S. lags in consumer acceptance, the school bus industry has seen significant adoption of the fuel with a 269% increase in propane autogas buses sold between 2012 to 2014.² This paper explores the many reasons for a recent surge in school bus adoption, including quieter engines, lower emissions, and an overall savings that can be pumped back into the classroom.





CREATING A SAFE DRIVING SPACE

With an average of 26 million students who ride the bus each day in the United States,³ it is critical that safety be a top priority inside and outside the bus. A Commercial Truck and Bus Safety report identified 50 safety issues in the industry, and ranked noise level on school buses in the

be more aware of what is going on inside the bus instead of trying to hear over a loud diesel engine," said Pat Mitchell, director of transportation for Mobile County Public School System.

Propane-autogas-powered buses meet U.S. Federal Motor Vehicle Safety Standards, just like every other school bus,

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Pat Mitchell

Director of Transportation, Mobile County Public School System

top 10.⁴ Case in point, recently, a Colorado bus driver veered off a road and went down an embankment, after being distracted by screaming students. The accident resulted in 10 passengers and the school bus driver being taken to a local hospital.⁵ With a noticeably quieter engine, propane autogas buses are becoming an attractive option for bus drivers from a safety standpoint, in addition to the other benefits outlined in this white paper.

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but often deliver significant safety performance above required standards:

1. Each bus is equipped with an automatic shut-off valve that prevents the flow of fuel to the engine when it's not running, even if the ignition switch is in the "on" position.
2. To ensure the propane tanks remain mounted to the bus in the event of a collision or rollover, OEMs like Blue Bird designed its propane mounting systems at twice the requirement specified by the National Fire Protection Association.⁶

3. Propane tanks are 20 times more puncture resistant than gasoline or diesel tanks and have the lowest flammability of any alternative fuel. For the fuel to ignite it must reach 940° F, which is significantly higher than gasoline's ignition temperature of 430-500° F, according to the Propane Education and Research Council [PERC].⁷

TRAINING

Safety means nothing without proper training. Many new propane autogas fleets have taken advantage of training provided by bus manufacturers and PERC, teaching driver best practices and safety tips. These fleets have seen minimal downtime during the training, which is typically only 4 to 8 hours, according to Mike Taylor, director of autogas business development for PERC.

THE CLEAN ALTERNATIVE

Unfortunately, the common diesel engine powering many school buses also brings with it a host of health issues. The International Agency for Research on Cancer [IARC] classified diesel exhaust as a carcinogen, which can cause short- and long-term health effects.⁸ A study conducted by the Natural Resources Defense Council found that a child riding inside of a diesel school bus may be exposed to as much as four times the level of toxic diesel exhaust as someone standing or riding beside it. Because children breathe at a faster rate than adults, they are even

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more susceptible to the adverse effects of regular exposure to diesel exhaust — and for children who are asthmatic, the diesel fumes can exacerbate respiratory problems even more.⁹

Diesel particulate matter is responsible for 15,000 premature deaths annually, according to the EPA.¹⁰ Despite these studies, diesel currently fuels the majority of school buses in the U.S. With the emergence of alternative fuels like propane autogas, school districts can ensure their students are no longer exposed to black clouds of diesel exhaust.

REDUCING YOUR CARBON FOOTPRINT

EPA standards are increasing, bringing to the forefront the harmful effects of pollution from diesel engines on the environment. Diesel exhaust contains pollutants that contribute to ozone formation, acid rain, and global climate change. The emphasis to cut back on carbon emissions and stricter EPA standards is pushing school districts to re-evaluate their options. Within the last several years, propane autogas' presence in the school bus industry has continued to grow, as well as outpace other alternative fuels in the market. In 2012, 493 propane school buses were sold in the U.S. and Canada. Two years later, 1,820 propane school buses were sold, which is nearly three times as many compared to 2012.¹¹ Propane buses that year accounted for 84% of all alternative-fuel buses sold.

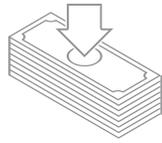
A 2014 case study highlighting five school districts that switched to propane-fueled buses found the total petroleum displacement was 212,000 DGE per year for the 110 buses.¹² Propane autogas is also a non-contaminant of soil, air and water, unlike diesel. By using propane autogas, fleets can reach sustainability goals without additional, costly emissions technology.

LOW TOTAL COST-OF-OWNERSHIP

When school districts are looking for areas to trim their budget, oftentimes, transportation funding is first on the list of cuts. For years transportation directors have been tasked with finding ways to keep transportation services the same but with tighter purse strings.

While the upfront costs of propane autogas buses are slightly higher, the overall

LOWER - COST OF - OWNERSHIP



"We think that the fuel savings will offset the small premium in price in less than two years. We estimate that we're probably going to save over a thousand dollars per school day running these buses."

Peter Crossan
Fleet and Compliance Manager,
Boston Public Schools

cost of ownership is substantially lower than diesel due to long-term savings coming from fuel, reduced maintenance and operating costs. The following seven benefits all add to the savings, which can be put back where it matters most: the classroom.

1. LOWER FUEL COSTS



Fuel is one of the largest components in a fleet's budget. Gasoline and diesel prices have been favorable in 2015, but the stability of fuel pricing is unpredictable. When fuel costs surpass the projected cost built into the budget, schools are left with two options: reduce the number of buses used by increasing the number of students on each bus or keep older buses running longer. Both of

these options pose safety hazards or add time to the route.

Historically, the price of propane has fallen between the price of crude oil and natural gas. As a result, propane is consistently less expensive than diesel, even as fuel prices fluctuate. Propane is still 30 to 50 percent cheaper compared to conventional fuels.

2. NO ADDITIONAL FLUIDS



Today's diesel emissions technology comes with an added inconvenience of regularly maintaining the engine with diesel emissions fluid [DEF]. Diesel also consumes more oil by volume than propane.

On top of regular maintenance, diesel engines require much more attention in the

FUEL SAVINGS CALCULATOR

	A diesel school bus fleet	A propane school bus fleet
Fleet size	10	10
Average fuel economy*	7 MPG*	5 MPG**
Average U.S. price per gallon	\$2.02 [†]	\$1.25 ^{††}
Average gallons per year	1,714	2,400
Average miles annually per bus*	12,000	12,000
Total annual fuel costs	\$34,628.57	\$30,000
Annual fuel savings		\$4,628.57

*According to American School Bus Council

**According to PERC

[†]Diesel price per gallon found on EIA.org as of Feb. 2, 2016

^{††}Propane price per gallon pulled from averages provided by industry experts and reports



winter. When temperatures begin to drop, the paraffin in the fuel begins to harden and coats the engine, which prevents the fuel to flow as easily. To prevent the clogging of fuel filters and lines, diesel requires fuel conditioners, commonly known as anti-gelling agents. A benefit of propane is that it doesn't require any of these aftermarket treatments.

3. NO DIESEL FILTERS



On top of additives, new low-emissions diesel technology requires a diesel particulate filter (DPF) that must be cleaned periodically. DPFs require constant monitoring by the driver during operation and the emissions regeneration process to ensure the component is operating properly and does not become clogged. A clogged DPF will de-rate the engine's revolutions per minute and render the vehicle inoperable. Excessive idling also accelerates the required cleaning intervals, adding extra maintenance and repair expenses.

4. FEWER REPAIRS



Even in the presence of disciplined maintenance programs, diesel engines can require expensive repairs and replacement parts that propane fleets do not. These include injectors, exhaust gas recirculation valves and coolers, turbochargers, dirty after coolers, and irregular closed crankcase filters.

5. LESS DOWNTIME

As a result of the additional maintenance required with diesel engines, downtime must also be factored in. Diesel emissions technology is complex and the likelihood of the engine's fuel and emissions systems malfunctioning or needing repair is greater than with a propane-autogas-powered vehicle.

Additionally, unlike conventional and other alternative fuels that struggle in colder climates, propane autogas buses do not require engine block heaters to crank reliably. Propane autogas buses heat up quickly to keep students and drivers warm, which is critical when temperatures drop.

6. EASY REFUELING INFRASTRUCTURE

Infrastructure is a commonly voiced concern when switching over to an alternative fuel. Fleet managers express worries about the cost of installing proper infrastructure and a driver's ability to locate fuel without traveling an unreasonable distance. But with the demand steadily increasing for propane autogas in the light- and medium-duty market, public propane autogas infrastructure is continuing to grow.

Plus, with propane, many fleets choose to install private, onsite infrastructure due to its low costs and quick setup. Once site permitting has been approved and

LONG-TERM FUEL STRATEGY

With low prices of conventional fuels, some fleets are questioning whether there's still a business case for alternative fuels. However, fleets must consider the price stability of transportation fuels like gasoline or diesel. Opting out of plans to roll out alternative-fuel vehicles may seem like a good idea in the immediate future, but smart fleets have to think about their long-term fuel strategy. Even with lower fuel prices for conventional fuels, propane autogas still has the lowest total cost of ownership from reduced fuel and maintenance expenses. Although the majority of school buses are still powered by diesel engines, the interest in alternative-fuel vehicles is still increasing. Sales of more than 10,000 vehicles have been logged in 45 states, from private contractors and school districts, mainly in the last two to three years, according to PERC.

prepped, installation can take as little as two weeks. The infrastructure for propane is easily scalable and can range from basic pump-and-go configurations to computer integrated systems. More sophisticated systems can provide school districts with a complete report on how many gallons of propane were used during a refueling, which bus was refueled, its mileage and the time the fueling occurred. If a fleet is looking to install its own advanced private station, it is responsible for the cost of a canopy, propane tank, pump, motor, and dispenser with card lock and vehicle tracking capability. The cost for this type of station can range from \$50,000 to \$200,000.¹³

Propane's fueling infrastructure is very similar to gasoline and diesel. The main difference between the fuels is that propane autogas is delivered to the vehicle under pressure so it remains a liquid.

7. NO SPECIAL MAINTENANCE FACILITY REQUIRED

Requirements for a propane autogas vehicle repair facility are generally the same

as those for conventionally fueled vehicles. Other alternative fuels, however, may require different facility requirements than conventional fuels, such as additional gas detection and ventilation equipment — adding upfront costs for fleets making the switch. With propane autogas, vehicles do not require segregation of major and minor repair garages if all areas of the garage are fully code compliant. Segregation of repairs can equate to costly upfront expenses for large shops and increases in the cost of electricity, air handling, cooling, and heating over time.

Fleets planning on repairing propane autogas vehicles at an existing facility should still contact a local authority having jurisdiction for codes regarding building or modifying a facility for propane-autogas-powered vehicle repair or maintenance.

“When propane was first introduced, it was seen as a trend. We are no longer a trend, but a choice.”

Mike Taylor
Director of Autogas Business Development, PERC

THE OEM EFFECT

OEMs have also contributed to the adoption of propane autogas in pupil transportation. With all four major bus manufacturers offering a propane-autogas-powered vehicle, school districts and private contractors are not only seeing propane autogas as a viable option, but can stick with the specific brands they have been using and trust.

THE FUTURE OF PROPANE

Under the Clean Air Act of 1990, propane autogas is an approved and clean alternative fuel. This designation, and the accompany-

ing benefits, provide a clear rationale for the increase in propane autogas school bus sales. Coupled with cost savings over the life of the vehicle, propane autogas has clear advantages compared to diesel bus options.

The school bus fleet industry has the opportunity in the U.S. to accomplish the propane autogas adoption successes achieved in Asia by taxi industries or in Europe within the consumer market. This adoption will equate to quieter vehicles, removal of black clouds of diesel emissions, and a reduction in costs.

RESOURCES

¹<http://auto-gas.net/about-autogas/the-autogas-market/>

²<http://www.schoolbusfleet.com/article/612368/room-for-more-growth-in-alt-fuels>

³<http://asumag.com/maintenancetransportation/hop-bus>

⁴<http://www.durangoherald.com/article/20151119/NEWS01/151119537/Durango-school-bus-driver-had-been-driving-solo-for-only-a-week-before-crash-school-district-says>

⁵http://onlinepubs.trb.org/onlinepubs/ctbssp/ctbssp_syn_17.pdf

⁶[http://www.roushcleantech.com/sites/all/themes/roushcleantech/pdf/2014BlueBirdVision\[RCT\].pdf](http://www.roushcleantech.com/sites/all/themes/roushcleantech/pdf/2014BlueBirdVision[RCT].pdf)

⁷<https://www.blue-bird.com/blue-bird/Propane-is-safe.aspx>

⁸<http://scienceblog.cancerresearchuk.org/2012/06/14/diesel-fumes-definitely-cause-cancer-should-we-be-worried/>

⁹<http://www.nrdc.org/air/transportation/schoolbus/intro.asp>

¹⁰http://www3.epa.gov/region1/eco/diesel/health_effects.html

¹¹<http://www.afdc.energy.gov/uploads/publication/case-study-propane-school-bus-fleets.pdf>

¹²<http://www3.epa.gov/otaq/climate/420r06003.pdf>

¹³<http://propane.com/on-road-fleets/refueling/>