Propane Autogas Technology Update: Kentucky Clean Fuels Stakeholder Meeting

September 2015
Key Drivers & Considerations

- Total Cost of Ownership.
- Vehicle performance.
- Reliability.
- Warranty, service and after-sale support.
- Operations and Maintenance Changes.
- Positive environmental impact.
- Refueling infrastructure.
- Operating range.
- Confidence in partners.
Available and Accessible:

- Most refueling infrastructure of any alternative fuel.
- Powers over 21 million vehicles worldwide.
- Infrastructure is scalable, inexpensive, portable and easy to install and maintain.
- Most suppliers will install refueling stations for little upfront cost with a 3-year contract.

AmeriGas autogas rebate program takes upfront capital challenge out of financial equation.

Offered exclusively to Blue Bird customers beginning fall 2015.
Example: Louisville KY to Tampa FL: 884 Miles

- 25 public propane stations along the way
- Longer stretches of route still covered
  - Louisville KY to Bowling Green KY: 118 miles
  - Tifton GA to Gainesville FL: 156 miles
- Extended range Blue Bird tank is 93 useable gallons or 450+ miles range
- Under-bed F-250 tank is 21 useable gallons or 250 miles range (in-bed is 38 useable gals)
Emissions

- **Clean:** Blue Bird Propane and CNG bus compared to EPA standard

<table>
<thead>
<tr>
<th></th>
<th>NMHC</th>
<th>NOX</th>
<th>CO</th>
<th>PM</th>
<th>HCHO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>0.14</td>
<td>0.2</td>
<td>14.4</td>
<td>0.01</td>
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<tr>
<td>LPG BB</td>
<td>0.07</td>
<td>0.08</td>
<td>2.2</td>
<td>0</td>
<td>0</td>
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</tbody>
</table>

\% Change
- **CNG/LNG**
  - NMHC: -7.14286
  - NOX: -50
  - CO: -91.6667
  - PM: -10
  - HCHO: -100

Propane autogas buses are at least 50% cleaner in every category!

- **Clean:** Blue Bird Propane Type A bus compared to gasoline bus

91,307 lbs. CO2 avoided by switching to propane autogas.

* Based on 220K miles
Cold Weather Performance

- Performs!

Customer Photo in Duluth, MN on January 6, 2013.

All propane buses started without issue.
Safety

Safe & Non-Toxic
- Low pressure (~ 200 psig)
- Narrow flammability range
- Requires a higher temperature to ignite than gas/diesel
  - Autogas ignition temperature is 920-1020°F vs 495-536 for gasoline
- Does not puddle – vaporizes and dissipates into the air
  - Nontoxic, Nonpoisonous, Insoluble in water
- Cannot be accidentally ingested

Among alternative fuels, propane has the narrowest flammability range

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Flammability Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel</td>
<td>0.6% – 5.6%</td>
</tr>
<tr>
<td>Gasoline</td>
<td>1.0% – 7.6%</td>
</tr>
<tr>
<td>Propane Autogas</td>
<td>2.2% – 9.6%</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>5.3% – 15.0%</td>
</tr>
<tr>
<td>Ethanol</td>
<td>3.3% – 19.0%</td>
</tr>
<tr>
<td>Methanol</td>
<td>6.0% – 36.5%</td>
</tr>
</tbody>
</table>
Safe & Non-Toxic

- Fuel tanks are 20 times more puncture resistant than gasoline
- Built-in safety devices and shut-off valves

Meet strict set of rules and regulations

16 Mounting Points
Located Inside Frame Rails
Maintenance Facility Requirements Similar to Gas/Diesel

- Ventilation requirements are the same as gas or diesel and gas detection devices are not required to service autogas vehicles.

- To service a vehicle inside, the same considerations for any fuel delivery system apply.

- Major repairs fall under the same code requirements as gas or diesel.

- Indoor autogas station and storage codes included in this guide available at http://www.propanemarc.com/.
Propane price stays low as gas and diesel start to climb

eia.gov

Propane is 56% less expensive than Diesel Diesel
- Broward 2015 Average: $0.98/gal
  - Wet fuel (bobtail fill)
- Mobile 2015 Average: $0.91/gal
- 2 tank installations
## Diesel v. Propane Maintenance

### Diesel Maintenance Items
- Common Fluids/Filters (Engine Oil, Transmission, Coolant, Etc...)
- Air Filter
- Primary Fuel Filter
- Secondary Fuel Filter
- Crankcase Breather Filter
- DEF Fluid
- DEF Filter
- Turbo

### Propane Maintenance Items
- Common Fluids/Filters (Engine Oil, Transmission, Coolant, Etc...)
- Air Filter
- Spark Plugs
- Propane In-Line Filter (Pre-Tank every 50K miles)
<table>
<thead>
<tr>
<th></th>
<th>Broward County Schools, FL</th>
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</thead>
<tbody>
<tr>
<td>$1.55</td>
<td>per gallon fuel costs savings</td>
</tr>
<tr>
<td>$0.41</td>
<td>per mile savings</td>
</tr>
<tr>
<td>$6,723</td>
<td>per bus per year in fuel and maintenance savings</td>
</tr>
<tr>
<td>$10,891,396</td>
<td>over 12 years total in fuel and maintenance savings</td>
</tr>
<tr>
<td>&lt; 3 months</td>
<td>return on investment</td>
</tr>
</tbody>
</table>

**Fleet Statistics:**
- 135 buses total
- 12 years in service est.
- 16,470 miles per year

**Notes:**
- In FL, HB 579 provides a 50% rebate off propane upcharge through June 2018.
- Savings do not reflect the $.50/gallon federal rebate that has been available since 2005. If included, per mile savings would increase to $.52/mile in fuel and maintenance costs savings or $8,596/bus/year.
Mobile County Schools, AL

$1.09 per gallon fuel costs savings

$0.43 per mile savings

$4,603 per bus per year in fuel and maintenance savings

$1,933,292 over 12 years total in fuel and maintenance savings

3 years return on investment

Fleet Statistics:
- 30 buses total
- 14 years in service est.
- 12,600 miles per year

Notes:
- Savings do not reflect the $.50/gallon federal rebate that has been available since 2005.
Leaders in Industry

Over 6,000 Blue Bird Propane Buses

With over 6,000 Blue Bird Propane Buses built over the past 8 years, Blue Bird is the number one producer of propane buses in the industry. In fact, Blue Bird has produced 6 times the alternative fuel buses than all of our competitors combined!

Over 57 Million Miles Driven

Blue Bird’s propane-powered buses have travelled over 57,000,000 miles - enough miles to go around the world over 2,300 times! Our buses can go the distance, and are built to last through the rigorous years of student transport they endure.

Proven Propane Powertrain

The performance of the engine relies on the transmission it works with. This is why Blue Bird has chosen to pair the Ford 6.8L engine with the proven 6R140 Ford transmission. This transmission was designed for the Ford 6.8L engine in order to deliver the best ratio of power and fuel economy.

Fuel System Calibration Options

The Roush CleanTech fuel system in our Vision Propane buses can be calibrated to fit your needs. Our EconoShift option allows for improved fuel economy, while our PowerShift option is best suited for operating conditions that require more power.

800.59.ROUSH
Propane is Mainstream

[Map showing the distribution of propane usage across the United States with color-coded states indicating the number of units using propane.]
PRODUCT OVERVIEW

Pickups | Vans & Wagons | Cutaway Vans
Chassis Cab | School Bus
Corporate Overview

Corporate Wheel of Capability
Markets We Serve

Transportation
- Ford
- Chrysler
- GM
- Toyota
- Honda
- Hyundai
- Isuzu
- Volkswagen
- EcoMotors
- VPG
- Navistar
- Blue Bird

Defense
- Navistar Defense
- BAE Systems
- AM General
- General Dynamics
- SAIC
- Textron
- FAAC
- US Army/TARDEC
- Oskosh Defense
- Hardwire
- Astradyne

Entertainment
- Disney
- Universal Studios
- Disneyland Paris
- Universal Studios Orlando
- Hong Kong Disneyland
- Disney California Adventure
- Universal Studios Singapore
- The Henry Ford

Life Sciences
- GE Healthcare
- VWR
- UPG
- DeGroot
- Terumo
- Stryker
- Covidien
- Somanetics
- Genetix
- Merck
- Invacare

Motorsports
- Ford
- 3M
- Aflac
- Crown Royal
- UPS
- Scotts
- Kellogg
- Valvoline
- Coca-cola
- Fastenal
Game Changer: Liquid Injection

- Fixes cold start concerns from previous vapor / fumigation systems.
- Same horsepower, torque and towing capacity as equivalent gas engine.
- More easily integrated into existing vehicle / engine architecture.
- Light & medium duty Ford trucks & vans, school bus.
- Factory Ford warranty maintained.
- Serviceable with existing diagnostic equipment.
- EPA & CARB Certified.
### Product Line to Meet Diverse Fleet Needs

<table>
<thead>
<tr>
<th>Model</th>
<th>Food &amp; Bev.</th>
<th>Government</th>
<th>Propane</th>
<th>Schools</th>
<th>Logistics</th>
<th>Telecom</th>
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<td>Ford F-450 / F-550</td>
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<td>6.8L V10</td>
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<td>Ford Transit</td>
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<td>6.8L V10</td>
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<tr>
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<td>Stripped Chassis</td>
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<td>6.8L V10</td>
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[800.59.ROUSH](http://800.59.ROUSH)  
[ROUSHcleantech.com](http://ROUSHcleantech.com)
## Engine Size
- 6.8L V10 (3V)

## Applications
- All cab configurations
- All wheelbase configurations
- 6-speed automatic transmission

## Fuel Tank Capacity
- Tank Mounted Between Frame Rails
- 41 gallons
- 67 gallons standard
- **98 gallons optional (new feature)**

## Technical Specifications
- EPA and CARB approved.
- GVWR: 33,000 lbs.
- Up to 77 passengers

## Order Availability
- Blue Bird dealers

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### Blue Bird Vision (Type C)

*Most tank options of any manufacturer, including only extended range option.*
Blue Bird Vision

**Fuel Rail**
ROUSH CleanTech’s signature blue anodized aluminum fuel rail is designed to operate under varying temperatures of liquid propane.

**Fuel Tank**
The liquid propane autogas fuel tank meets all ASME certification standards, is made of steel, and is built and assembled in the USA.

**Fuel Fill**
Industry-standard valve designed to allow for safe passage of liquid propane into the vehicle. Includes a check valve to prevent fuel leaks.

**Fuel Lines**
Made of high-durability stainless steel to handle varying temperatures and pressures. They are designed to route through the factory line locations.

**Fuel Injectors**
Special fuel injectors are used to inject liquid propane into the cylinders for ignition.

**FRPCM**
The Fuel Rail Pressure Control Module ensures consistent vehicle performance and power on-demand.

800.59.ROUSH

ROUSHcleantech.com
Ford 6.8L V10

- Production engine produced in Windsor Ontario
- Introduced in 1997
  - Upgraded in 2005 with 3 valves per cylinder to improve performance
- Currently used in Ford Super Duty trucks (F-450 / F-550 / F-650 / F-750), strip chassis, motor homes and commercial step vans
- Over 1.3 million 6.8L engines have been produced
- The engine was upgraded with premium valves, valve seats and a larger oil pump to meet Blue Bird’s needs
Transmission Life Test Assumptions:

Vehicle weight conditions
   ETW: 13,500 lbs (20% operating time)
   GVWR: 37,000 lbs (40% operating time)
   GCWR: 50,000 lbs (40% operating time)

2 Samples complete 350k miles equivalent
   No Issues – Test ran continuous.

Numerous Super Duty Life tests complete w/o issue
   250k mile requirement @ 900 ft-lbs
TOOLS & RESOURCES

Available to Partners After-the-Sale
Training Program

- Product Training
- Installation Support
- Technical Hotline
- Field Support
- Warranty Support
- Field Data Analysis
Training Program

Interactive Web-Based Training

On-Site Instruction

Repair Procedure Videos

Driver Videos
SERVICE

This is your resource for the most current and up-to-date versions of the ROUSH CleanTech service manuals, installation instructions, and owner's manuals. For specific questions, please contact ROUSH CleanTech at 800.59.ROUSH.

Click here to download a copy of our Service & Warranty Support Program Overview.

TRAINING

Special Service Tools
Updated: 1.9.2013

Service Training Overview
Updated: 6.7.2012

VIDEO: Driver Training
Updated: 9.5.2013

VIDEO: How to Fuel a Propane Autogas Vehicle
Updated: 3.1.2012

VIDEO: Blue Bird Propane Powered Vision Engine Start Procedure
Updated: 3.1.2012

VIDEO: Gen. 2 Tank Purge and Multivalve Removal
Updated: 8.6.2012