



Propane Autogas Technology Update: Kentucky Clean Fuels Stakeholder Meeting

September 2015

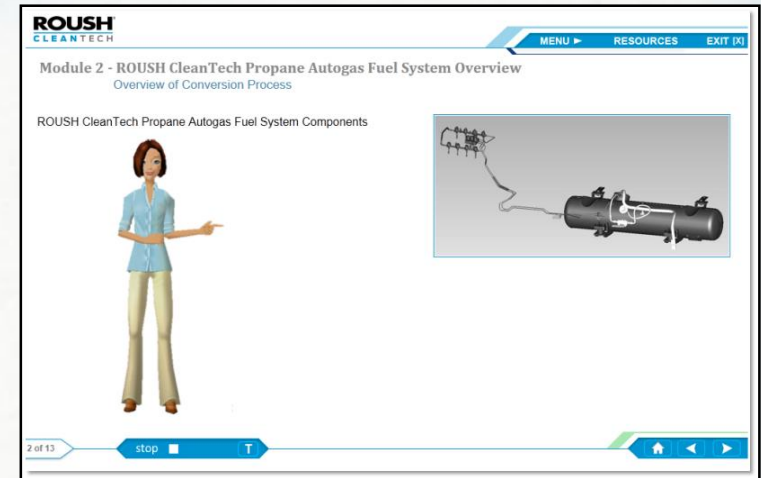


800.59.ROUSH

ROUSHcleantech.com

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



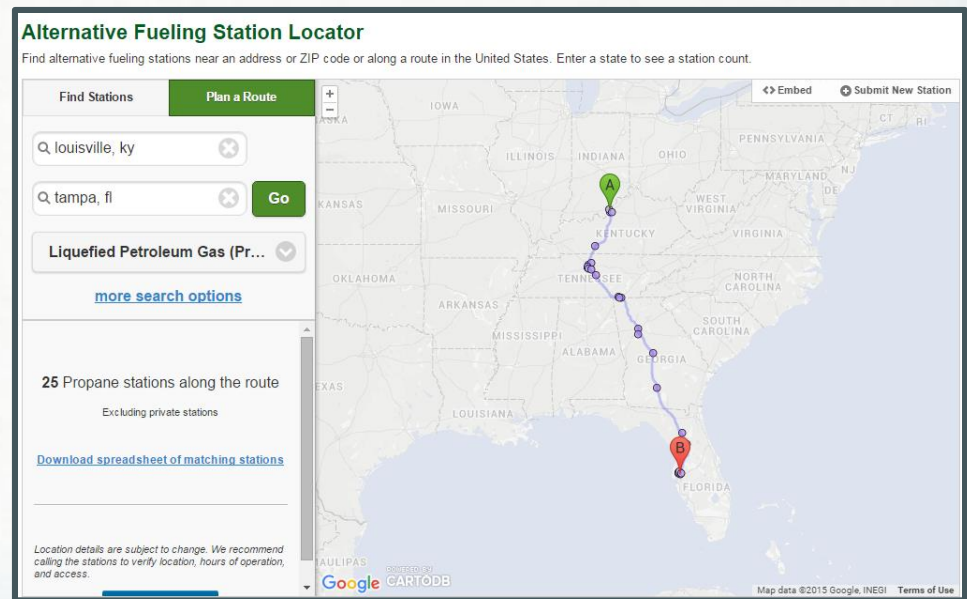
AmeriGas autogas rebate program takes up-front capital challenge out of financial equation.



Offered exclusively to Blue Bird customers beginning fall 2015.

Range Anxiety? A Different Picture in 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)

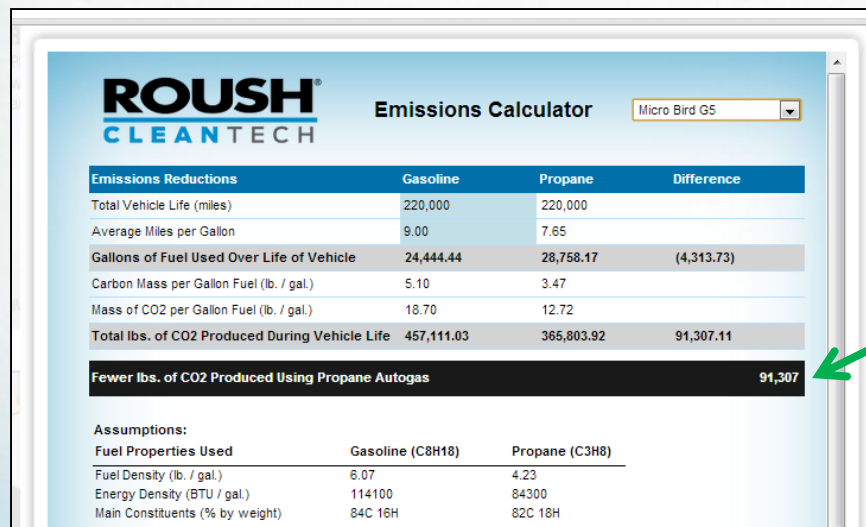


- Clean: Blue Bird Propane and CNG bus compared to EPA standard

	NMHC	NOX	CO	PM	HCHO
Standard	0.14	0.2	14.4	0.01	0.01
LPG BB	0.07	0.08	2.2	0	0
% Change	-50.00	-60.00	-84.72	-100.00	-100.00
CNG/LNG	0.13	0.1	1.2	0.009	
% Change	-7.14286	-50	-91.6667	-10	-100

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

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



ROUSH CLEANTECH Emissions Calculator			
	Micro Bird G5		
Emissions Reductions	Gasoline	Propane	Difference
Total Vehicle Life (miles)	220,000	220,000	
Average Miles per Gallon	9.00	7.65	
Gallons of Fuel Used Over Life of Vehicle	24,444.44	28,758.17	(4,313.73)
Carbon Mass per Gallon Fuel (lb. / gal.)	5.10	3.47	
Mass of CO2 per Gallon Fuel (lb. / gal.)	18.70	12.72	
Total lbs. of CO2 Produced During Vehicle Life	457,111.03	365,803.92	91,307.11
Fewer lbs. of CO2 Produced Using Propane Autogas			91,307
Assumptions:			
Fuel Properties Used	Gasoline (C8H18)	Propane (C3H8)	
Fuel Density (lb. / gal.)	6.07	4.23	
Energy Density (BTU / gal.)	114100	84300	
Main Constituents (% by weight)	84C 16H	82C 18H	

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

** Based on 220K miles*

Cold Weather Performance

- Performs!

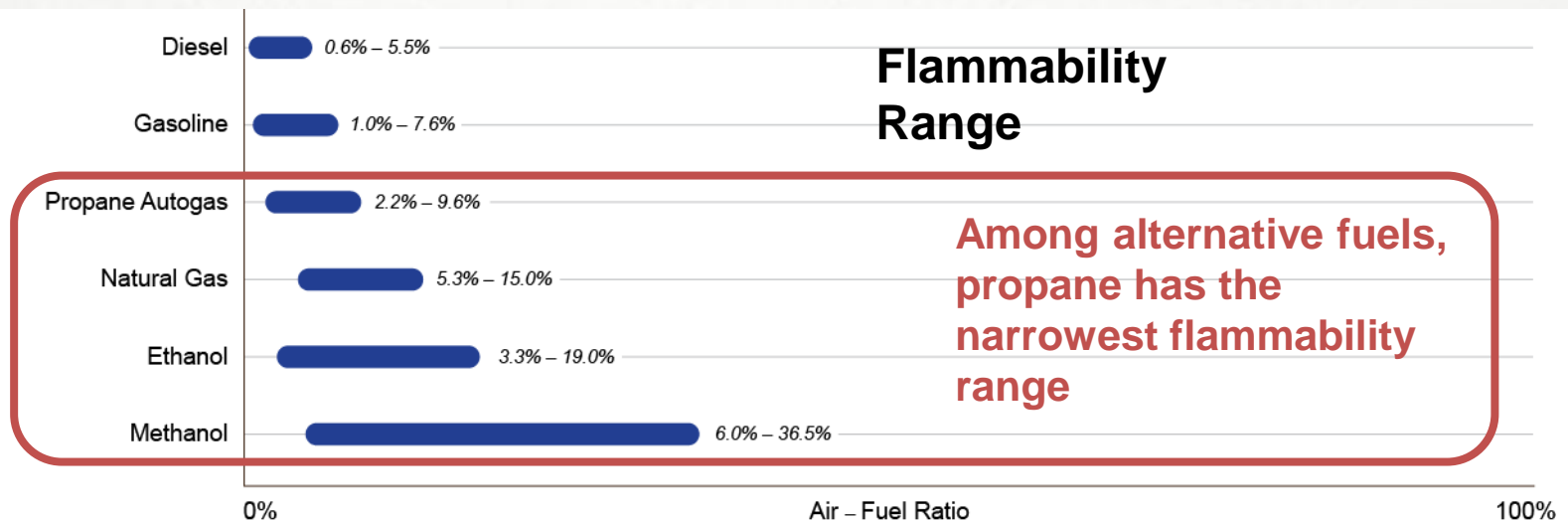


Customer Photo in
Duluth, MN on
January 6, 2013.

All propane buses
started without issue.

Safe & Non-Toxic

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



Safe & Non-Toxic

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



16 Mounting Points
Located Inside Frame

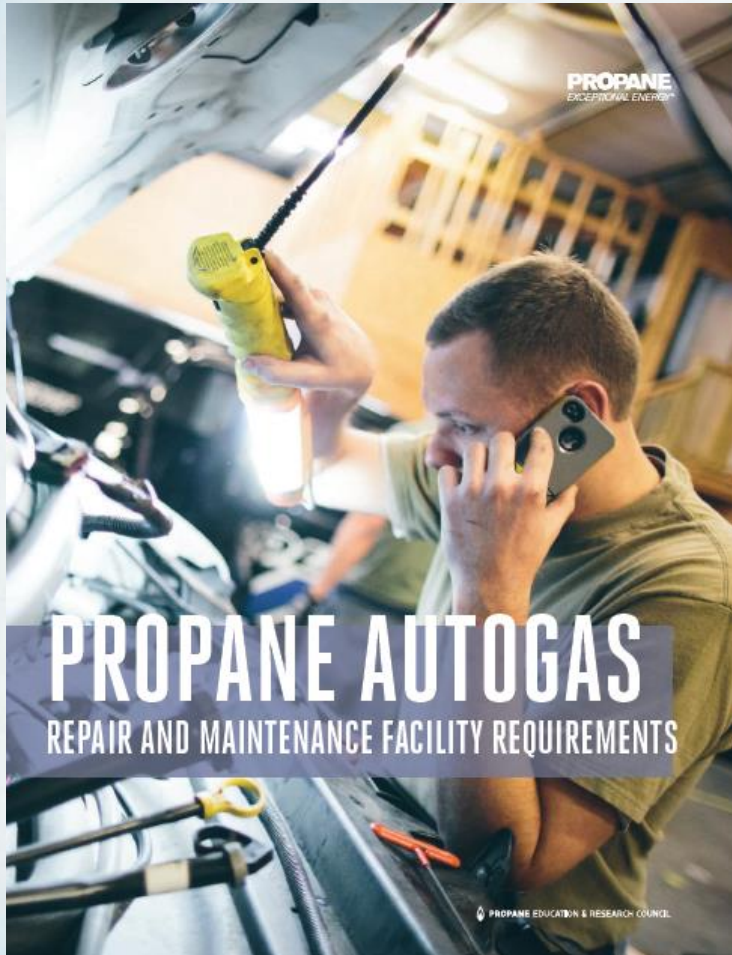
Rails



- Meet strict set of rules and regulations

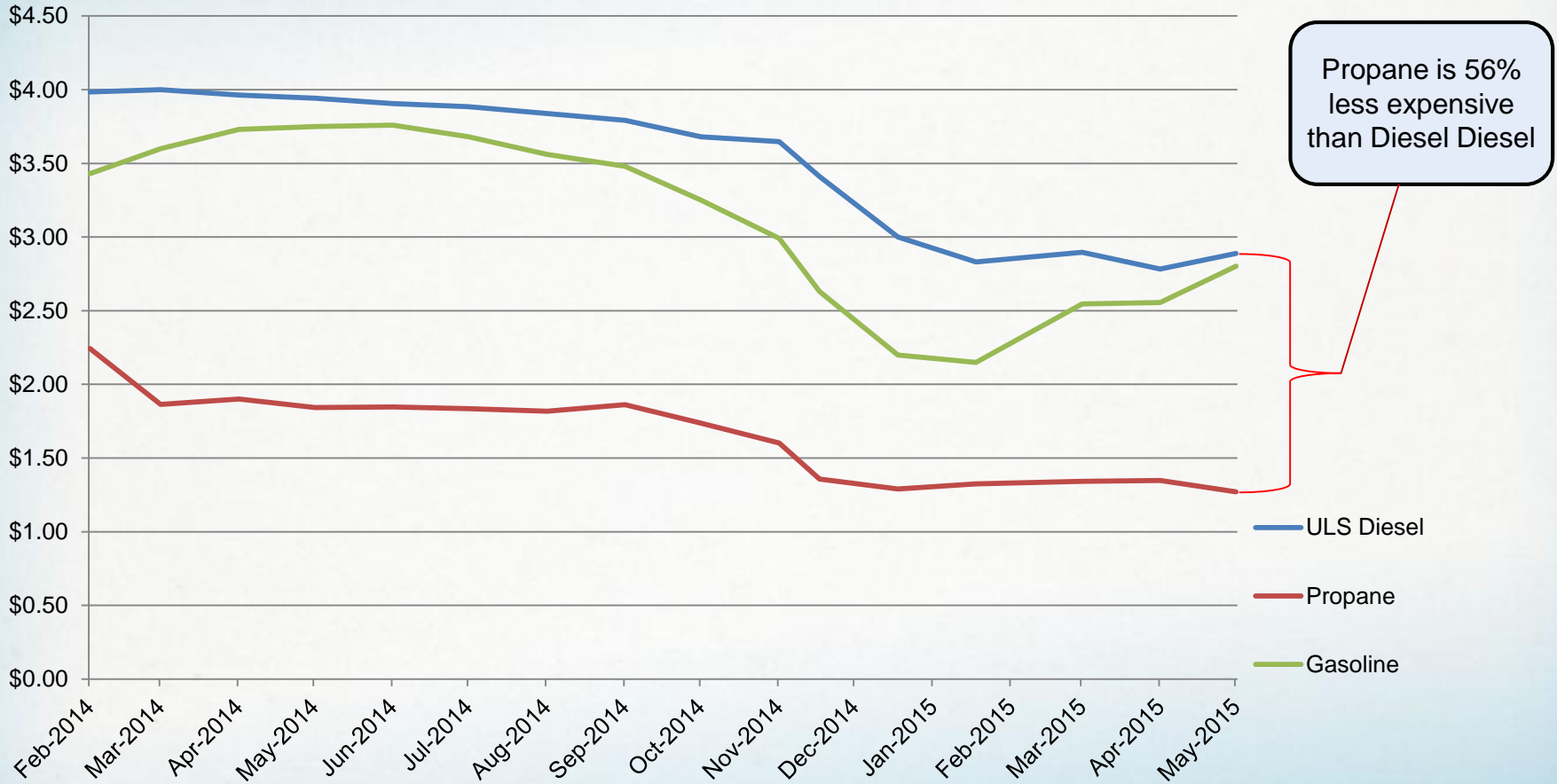


Maintenance Facility Requirements Similar to Gas/Diesel



- 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/>.

Comparisons



Propane price stays low as gas and diesel start to climb
eia.gov

- **Broward 2015 Average: \$0.98/gal**
 - **Wet fuel (bobtail fill)**
- **Mobile 2015 Average: \$0.91/gal**
 - **2 tank installations**

Subscriptions:

<https://www.bpnews.com/index.php/industry-events?catid=0&id=36>

BPN's

Weekly Propane Newsletter

Volume 45, Number 38

September 21, 2015

In This Issue

Page 2...

- Propane Council of Texas Hosts Safety Training Program
- Pembina Places \$650 Million Of New Assets Into Service

Page 3...

- Mexico Crude Swaps Likely To Provide Economic Benefits
- Enterprise Completes Second Segment of Aegis Ethane Pipeline

Page 6...

- Fossil Fuel Reduction Cut From California Climate Bill

Principal Averages

Mont Belvieu	56.500
Kearney	50.840
Conway	47.678
Los Angeles	50.500
Selkirk	58.114
Apex	55.436
Hattiesburg	50.311

All postings reflect rack price only and do not include other fees, assessments, or taxes.

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Mont Belvieu, Conway Spots Post Gains

Even as crude oil futures seasawed from monthly lows to highs over the week, spot propane at the nation's major trading hubs managed to strengthen, with Midwest prices drawing to within about 2 cents under Mont Belvieu. Early-week deals saw the two markets gain fractionally compared to the previous reporting period, and by Thursday another 1.75 to 1.875 cents had been added at Belvieu and nearly 2 cents at Conway, Kan. for increases of 2.375 cents for Texas and 2.625 cents for the Midwest in a week's time, despite U.S. propane demand falling 0.2 MMBbl compared to the previous week.

Mont Belvieu non-LST propane mid-morning Thursday was trading at 45.75-46.25 cents/gal., up 1.75 cents for buyers and 2 cents for sellers compared to the Monday email Update. Low and high deals posted as of press time were at 46.25 and 46.50 cents. Belvieu LST spots, an eighth of a cent higher at 45.875-46.50 cents/gal., were ending the week 1.875 cents stronger for buyers and up 2.25 cents for sellers. Low and high trades were at 46.00 and 46.75 cents.

The Group 140 (Conway) bid and offer were at 43.625-44.25 cents/gal. for a gain of 1.875 cents for buyers and 2 cents for sellers from Monday. Low and high deals were on the board as of mid-morning at 43.75 and 44.50 cents.

Elsewhere, NYMEX crude oil futures Thursday were showing small losses and gains following a nearly 6% jump in the market Wednesday. October West Texas Intermediate (WTI) traded at \$47.27/bbl, higher by 12 cents, or 0.3%. WTI a day earlier rallied to its highest settlement since Aug. 31 after the Energy Information Administration reported the nation's crude stockpiles fell by 2.1 MMBbl the week ended Sept. 11. The rally was greeted as a sign prices were less likely to fall to the \$20/bbl range forecast by some analysts based on storages continuing to fill.

Early in the week U.S. oil futures settled at more than a two-week low, with economic data showing weaker-than-expected industrial production for China, which raised concerns crude oil demand would slacken further. WTI settled at \$44/bbl, down 63 cents, or 1.4%. Traders note that crude oil remains vulnerable to a weakening economy in China. In addition, for now the global oil market continues to be oversupplied.

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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)

\$1.55

per gallon fuel costs savings

\$0.41

per mile savings

\$6,723

per bus per year in fuel and maintenance savings

\$10,891,396

over 12 years total in fuel and maintenance savings

< 3 months

return on investment

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.

<https://youtu.be/dTBGG241XeI>

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

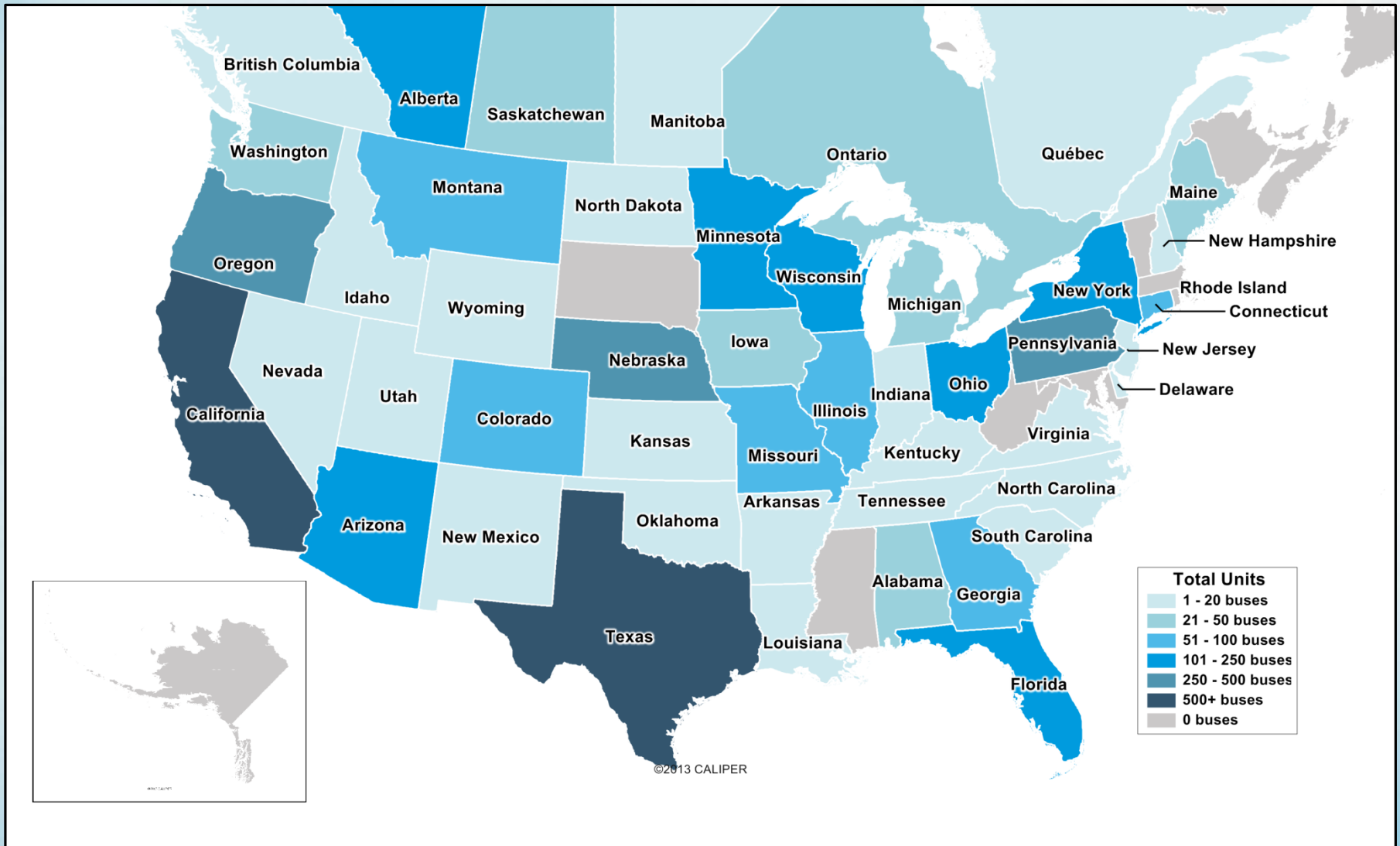
The performance of the engine relies on the transmission it works with. This is why Blue Bird has chosen to pair the Ford 6.8L engine with the proven 6R140 Ford transmission. This transmission was designed for the Ford 6.8L engine in order to deliver the best ratio of power and fuel economy.

» 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.

BLUE BIRD
EconoShift™
BLUE BIRD
PowerShift™

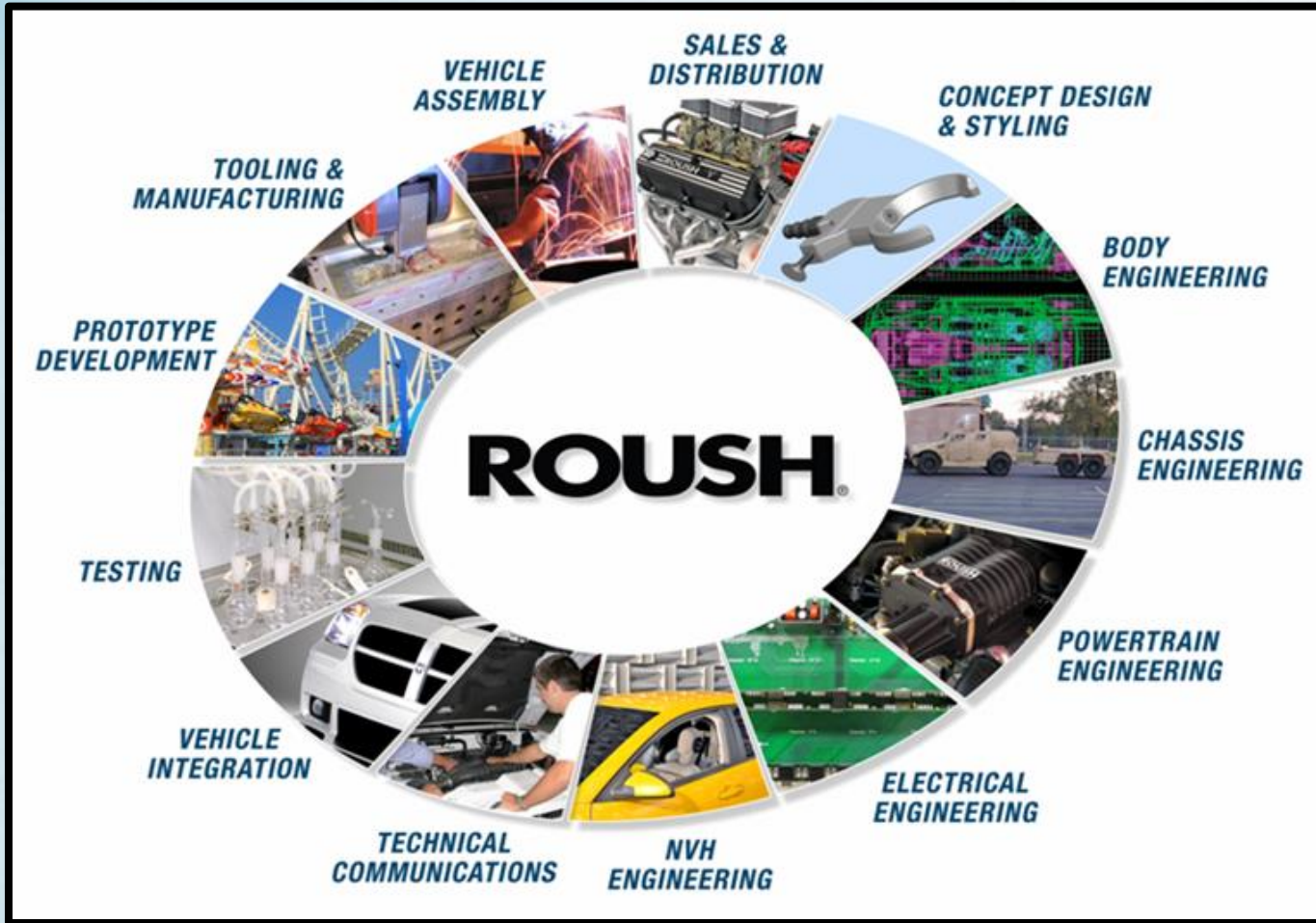
Propane is Mainstream





PRODUCT OVERVIEW

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



Corporate Wheel of Capability



Markets We Serve

Transportation

- Ford
- Chrysler
- GM
- Toyota
- Honda
- Hyundai
- Isuzu
- Volkswagon
- 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

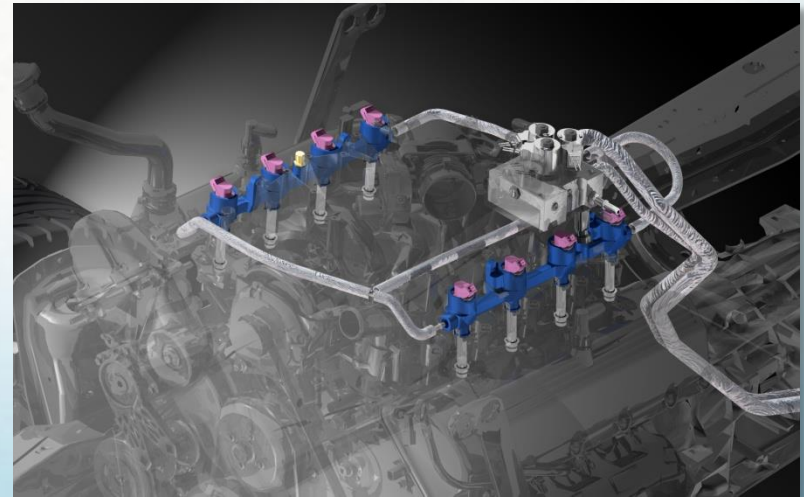
- GE Healthcare
- VWR
- UPG
- DeGroot
- Terumo
- Stryker
- Covidien
- Somanetics
- Genetix
- Merck
- Invacare

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



Food & Bev.



Government



Propane



Schools



Logistics



Telecom

Ford F-250 / F-350

6.2L V8



Ford F-450 / F-550

6.8L V10



Ford F-650

6.8L V10



Ford E-150/250/350

5.4L V8



Ford E-450

6.8L V10



Ford Transit

3.7L V6



Blue Bird Vision

6.8L V10



E-450 / F-53 / F-59

Stripped Chassis

6.8L V10



	Food & Bev.	Government	Propane	Schools	Logistics	Telecom
Ford F-250 / F-350 6.2L V8	●	●	●	●		●
Ford F-450 / F-550 6.8L V10	●	●	●	●		●
Ford F-650 6.8L V10	●	●	●			●
Ford E-150/250/350 5.4L V8	●	●	●	●	●	●
Ford E-450 6.8L V10	●	●		●	●	●
Ford Transit 3.7L V6	●	●	●	●	●	●
Blue Bird Vision 6.8L V10				●		
E-450 / F-53 / F-59 Stripped Chassis 6.8L V10	●	●			●	●



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

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.

FRPCM

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

Fuel Fill

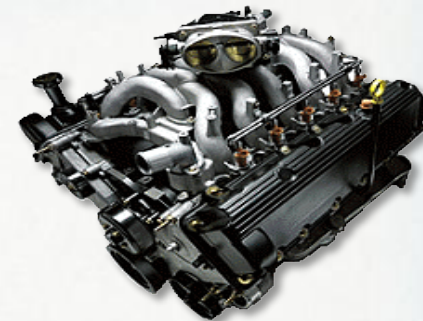
Industry-standard valve designed to allow for safe passage of liquid propane into the vehicle. Includes a check valve to prevent fuel leaks.

Fuel Injectors

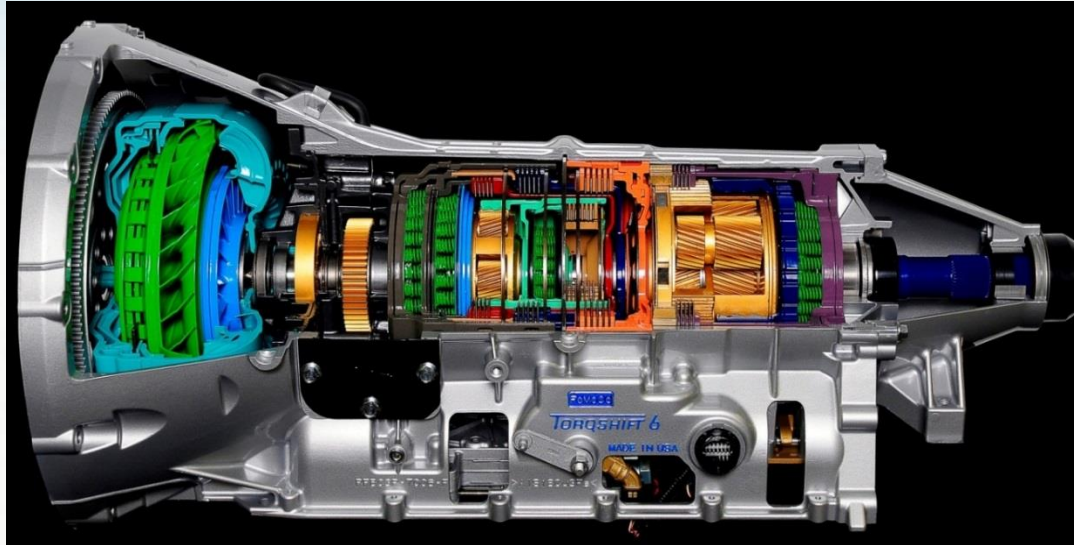
Special fuel injectors are used to inject liquid propane into the cylinders for ignition.

Fuel Lines

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



- ❖ 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



Product Training



Installation Support



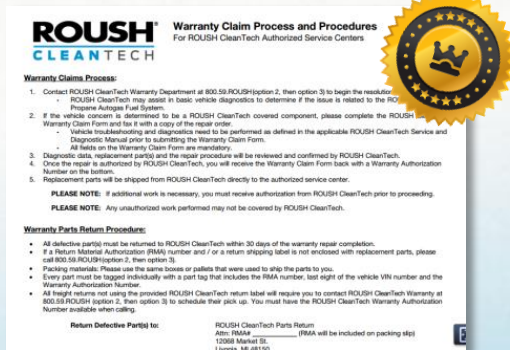
Technical Hotline



Field Support



Warranty Support

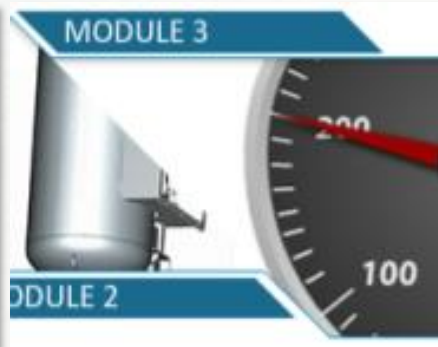
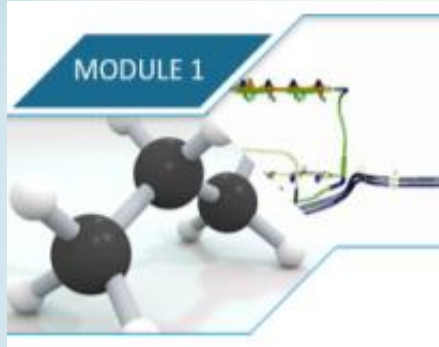


Field Data Analysis





Interactive Web-Based Training



On-Site Instruction



Repair Procedure Videos



Driver Videos



Service | ROUSH CleanTec x

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PARTNERS

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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




CUSTOMER SPOTLIGHT




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SIGN UP FOR CLEANTALK

CALCULATORS: SAVINGS EMISSIONS



Calculate how much you can lower your emissions and operating costs by switching to propane autogas



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“be the
CHANGE
you wish
to see in
THE WORLD”