Propane Autogas Answers Virtual Event

Aug. 6, 2020 | 1 p.m. CDT
Quick Poll!
Autogas Answers
Achieving Environmental and Economic Goals Cost-Effectively

Stephen Whaley
Director of Autogas Business Development
Stephen.Whaley@propane.com
864-606-2290
Successful Alternative Energy Adoption
What Makes an Alternative Energy Adoption Successful?

- There is a reduction in emissions over the lifecycle of the energy used in the vehicle without increasing cost or losing efficiency.
- Total cost-of-ownership reduction or a return on investment long before the end of the vehicle lifecycle.
- The vehicle performs as well or better than the original fuel without compromising range.
- There must be a high volume supply of energy domestically sourced.
How Does Autogas Fit Into The Conversation?

• Propane autogas is the most cost-effective energy source to reduce NOx emissions.

• Propane autogas provides the lowest total cost-of-ownership of any fueled vehicle.

• Propane autogas offers comparable or improved performance without compromising range.

• Propane production in the U.S. was 28 billion gallons in 2019, nine billion used domestically and 19 billion gallons were exported.
WHAT IS PROPANE?

- Affordable, Clean, American-Made Fuel
  - C3H8
  - Byproduct of natural gas processing.
  - 100% Domestic
  - Commonly used for space and water heating, cooking, and as engine fuel.

- Using Propane
  - 48 million Households
  - 900,000 Farms
  - 600,000 Forklifts
  - 25,000 Commercial Mowers
Propane comes from organic as well as renewable sources. It’s nontoxic, meaning it does not contaminate air, soil, or water resources.
WHY FLEETS CHOOSE PROPANE AUTOGAS

Total Cost-of-Ownership
Lower Emissions
Reduce Noise
Less Maintenance/Increased Uptime
Improve Corporate Image
Employee Morale/Driver Retention
Path to Zero Emissions
• Particulate Matter
  • Virtually zero
  • Zero with renewable propane

• NOX
  • 96% reduction from best in class diesel
  • Certifying to .02, operating at 0.01, full duty cycle

• GHG
  • New technologies 25% reduction from next best technology
Fuel & Maintenance Cost Reductions
US ENERGY PRICE COMPARISON 2006 – 2018

Source: EIA.gov
Today’s Propane Autogas

Average Price Per Gallon for the week of July 9, 2020

These prices are based on National averages. Please contact your local autogas provider to get exact pricing for your state.

$1.35  West Coast
$1.37  Rocky Mountain
$1.35  Gulf Coast
$1.43  Midwest
$1.39  Lower Atlantic
$1.48  Central Atlantic
$1.41  New England
Increased Inventory

• Propane eliminates the need for DEF and the possibility of putting the wrong fluid in a tank
The Diesel We Know Today
## Engine Components: Diesel

### Cummins ISB 6.7L

<table>
<thead>
<tr>
<th>Part</th>
<th>Quantity</th>
<th>Price</th>
<th>Total</th>
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<tr>
<td>NOx Sensor</td>
<td>1</td>
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<td>Pressure Sensor</td>
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<td>Doser Injector</td>
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<tr>
<td>Catalyst Assembly w/ DPF</td>
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<td>$10,554.11</td>
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<tr>
<td>Temperature Sensor</td>
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<tr>
<td>Temperature Sensor</td>
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<tr>
<td>Turbo</td>
<td>1</td>
<td>$2,731.20</td>
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<tr>
<td>Injector</td>
<td>6</td>
<td>$755.56</td>
<td>$4,533.36</td>
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<tr>
<td>EGR Valve</td>
<td>1</td>
<td>$590.15</td>
<td>$590.15</td>
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<tr>
<td>EGR Cooler</td>
<td>1</td>
<td>$923.72</td>
<td>$923.72</td>
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**Total: $21,051.24**
Preventative Maintenance

Ford V10
Gas and Propane
7 Quarts

Various Engines
Diesel
17 – 30 Quarts
# Preventative Maintenance

## Ford 6.8L V10

<table>
<thead>
<tr>
<th>Part</th>
<th>Quantity</th>
<th>Price</th>
<th>Total</th>
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<tbody>
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<td>Element Air Cleaner</td>
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<tr>
<td>Oil Spin On Filter</td>
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<td>$4.11</td>
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<tr>
<td>Element, PSR, 510 Filter</td>
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<tr>
<td>Mobil Special 5W-20</td>
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<td>$3.74</td>
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<td><strong>Total</strong></td>
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<td></td>
<td><strong>$70.94</strong></td>
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## Cummins ISB 6.7L

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<th>Part</th>
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<td>Fuel Spin-On Filter</td>
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<td>Power Steering Spin Filter</td>
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<td>Fuel Filter</td>
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<td>Allison Control Filter</td>
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<td>Mobil Fleet 15W-40</td>
<td>18</td>
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<td>Cleaner, Air Element</td>
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<td><strong>Total</strong></td>
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<td></td>
<td><strong>$277.15</strong></td>
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</table>
Current Autogas Vehicle Offerings
SNAPSHOT OF PROPANE AUTOGAS SCHOOL BUS MARKET

1,200,000+ students transported daily

981 districts & contractors operate propane autogas buses

13 states with 500+ buses

19,700+ propane autogas buses on the road
Propane School Bus Deployments
Similarly Equipped Blue Bird Type C Bus

- Diesel, Cummins, ISB, 6.7L $98,500.00
- LPG, Ford/Roush, 6.8L $107,000.00
- CNG, Ford/Roush, 6.8L $134,000.00
- Electric, Adomani, $385,000.00
VW: School Bus Funding & No. of Buses Through July 20, 2020

Source: Propane Education & Research Council
Emerging Vehicle Markets
Top Targets For Alternative Fuel Adoptions

- Medium duty trucks.
  - Class 3-7.
- High volume fuel consumption.
  - 300 to 900+ gallons per month.
- Regional routes.
  - 75 to 300+ miles per day.
EMERGING MARKETS

Food/Beverage

- Major companies have already validated propane autogas in this market.
  - ReadyRefresh by Nestlé Waters.
  - Schwan’s Home Delivery.
Paratransit

- 25,000 paratransit vehicles nationwide.
- 600 gallons per month average fuel consumption.
- ADA requires every county in the U.S. to provide service.
EMERGING MARKETS

Parcel/Package

- USPS has 92,000 routes for moving mail.
  - Over 70,000 routes are performed by independent contractors.
- There are approximately 10,000 class 6-7 straight box trucks operated by USPS contractors.
- Contractors bidding on USPS routes score higher with alternative fuel vehicles.
- 1,000 gallons per month average fuel consumption.
## Total Cost of Ownership Calculator

<table>
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<tr>
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<th>Class 6/7 Diesel</th>
<th>Class 6/7 Propane</th>
<th>Class 6/7 Gasoline</th>
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<td><strong>FUEL</strong></td>
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<tr>
<td>Annual Miles</td>
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<td>60,000</td>
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<tr>
<td>Years Operated</td>
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<tr>
<td>Total Miles Lifetime Miles</td>
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<tr>
<td>Fuel Economy (mpg)</td>
<td>7</td>
<td>5</td>
<td>6</td>
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<tr>
<td>Gallons Used Annually</td>
<td>8,571</td>
<td>12,244</td>
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<tr>
<td>Gallons Used Total</td>
<td>42,857</td>
<td>61,224</td>
<td>54,545</td>
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<tr>
<td>Fuel Price / Gallon</td>
<td>$2.42</td>
<td>$1.39</td>
<td>$2.19</td>
</tr>
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</table>

| **PREVENTATIVE MAINTENANCE** |                  |                   |                    |
| Oil Interval           | 7,000            | 5,000             | 5,000              |
| Oil Capacity (Quarts)  | 21               | 7                 | 7                  |
| Oil Filter Cost        | $9.36            | $4.00             | $4.00              |
| Oil Cost Per Quart     | $2.55            | $2.55             | $2.55              |
| Cost Per Oil Change    | $62.91           | $21.85            | $21.85             |
| Lifetime Oil Change Total Cost | $2,696.14 | $1,311.00         | $1,311.00          |
| Lifetime DEF Gallons   | 1,500            | 0                 | 0                  |
| DEF Cost per Gallon    | $1.89            |                   |                    |
| DEF Total Cost Over Lifetime | $2,834.99 |                   |                    |
| Fuel Filter Change Interval | 15,000        | 50,000            | 15,000             |
| Fuel Filter Cost       | $12.99           | $264.00           | $15.00             |
| Total Filter Changes   | 20               | 6                 | 20                 |
| Fuel Filter Cost Lifetime | $259.80      | $1,584.00         | $300.00            |

| **ACQUISITION COST**   |                  |                   |                    |
| Acquisition Cost without body | $65,000.00   | $50,000.00        | $50,000.00         |
| Incremental Cost (Fuel System) | $0.00      | $17,900.00        | $0.00              |
| Vehicle Rebate per Unit | $0.00           |                   |                    |

| **TOTAL COST OF OWNERSHIP** |                  |                   |                    |
| Lifetime Operational Cost | $174,504.87      | $155,896.36       | $171,064.55        |
| Lifetime Savings          | 0                | $18,608.51        | $3,440.32          |
| Cost per Mile to Operate (CPM) | $0.37       | $0.29             | $0.40              |

### Customer Information

- **Propane Fuel Price**: $1.39
- **Diesel Fuel Price**: $2.42
- **Gasoline Fuel Price**: $2.19
- **GGE Fuel Price CNG**: $0.00
- **Propane MPG**: 4.90 (70%)
- **Diesel MPG**: 7.00
- **Gasoline MPG**: 5.50 (79%)
- **CNG MP GGE**: 0.00 (0%)
- **Years Operated**: 5
- **Annual Miles per Year Truck**: 60,000
- **Incremental Cost (Propane)**: $17,900.00
- **Rebate Per Unit (Propane)**: $-
- **Rebate Per Unit (CNG)**: $-

**TCO Box Truck example**
OEM Propane Options

- Light & medium duty Ford trucks & vans, school bus.
- Factory Ford warranty maintained.
- No loss of HP / torque / towing capacity.
- Serviceable with existing diagnostic equipment.
- EPA & CARB Certified.
Small Profile System Compared to Electric
OEM Propane Options

- Updated and improved to increase reliability.
- The entire powertrain is sold, warranted, and supported by Freightliner Custom Chassis.
Long Awaited
Alternative Fuel Trucks
Are Now Available!

Greenkraft offers trucks in Classes 4 to 7
14,500, 16,500, 17,950, 19,500, 26,000 & 33,000 GVW

BIG SAVINGS ON FUEL
NO DIESEL NO DPF NO DOC NO SCR NO UREA

FEATURES
• Panoramic view
• Heavy duty chassis
• Increased turning radius
• Air brakes
• Available in CNG, LPG & gasoline
• More hauling
• Less servicing
• Warranty 100,000 miles
• GM 8.0 liter engine with Allison 2300 RDS transmission
• Roomy interior
• High tech dashboard
• Near zero emissions certified
• Qualifies for government incentives

Please contact us for more details: sales@greenkraftinc.com | 714-545-7777

Greenkraft Inc a publicly traded company: GRGT | Now accepting dealership applications

Propane Education & Research Council
Made in USA
GM 8.0L Propane Engine Powered by Agility

Innovation

The only dedicated propane genuine GM 8.0L engine available in the market

Improved fuel efficiency with patented Agility Liquid Propane Injection (LPI)® fuel system

Improved durability and reduced friction with roller rockers

Improved positive crankcase ventilation baffle reduces oil consumption

NEW reverse torque calibration ensures power is available even when backing up a slope

Redesigned lower intake manifold for improved gasket seal

Rugged tall deck cast iron long-block engine for improved durability

Full-length water jackets (non-siamesed cylinders) for improved cooling

Twelve unique front-end accessory drives able to accommodate your needs: three air conditioning options, air/hydraulic brakes, optional block heater

Industry standard J1939 engine controller compatible with existing diagnostic tools
<table>
<thead>
<tr>
<th>Model</th>
<th>Year</th>
<th>Engine Type</th>
<th>Model</th>
<th>Year</th>
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<td>3.3 PFDI</td>
<td>SILVERADO 1500</td>
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<td>5.3 DI</td>
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<td>5.0 PFDI</td>
<td>SILVERADO 2500/3500</td>
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<td>6.6 DI</td>
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<td>2.7/3.5 PFDI</td>
<td>EXPRESS/SAVANA</td>
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<td>6.0 PFI</td>
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<td>E450</td>
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<td>7.3 PFI (2021 MY)</td>
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<td>TRANSIT</td>
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<td>RAM</td>
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<td>(SUMMER 20)</td>
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</table>
Icom’s certified Medium Duty Platforms

The Icom JTG II system is EPA Certified & CARB approved for over 1,200 2009-2019 vehicle platforms including many Ford and GM models.

The Total Solution for any Type of Fleet!

E450 - CARB approved 2016-2017

F53 F59 (BAKERY, LINEN, FEDEX TYPE BOX TRUCKS)

F350 F450 F550
*FORD NEW 7.3L engine available Spring 2020!
Taking orders now!

6.UL HD
Please confirm with Icom engine family

F750

Chevy Cutaway
Coming soon!
CAMPBELL PARNELL AND ISUZU NPR

- Bi-Fuel conversions Pre or Post delivery
- 5 year warranty and maintenance packages available
- Plug and Play for ease of installation and service
- CP works directly with the OEM for product development
- EPA and Carb Certification
Off Road Applications
Propane Mowers

- Professional or Commercial-grade mowers
  - Zero-turn rider (ztr)
  - Walk behind
  - Stand-on
- 800 to 1,000 gallons per mower annually.
- Average of 30% fuel savings compared to gasoline.
  - 50% compared to diesel.
The Brands Farmers Know and Trust

OEM’s

Aftermarket Conversions

PROpane EDUCATION & RESEARCH COUNCIL
Reduced Emissions

17% FEWER GHG
16% FEWER NOx
19% FEWER SOx

COMPARED WITH GASOLINE
Propane Mower Calculator

- Input variables specific to your fleet to determine the amount of savings propane equipment can provide your business.
- Available in tablet, smartphone and desktop applications.

www.propane.com/mower-calculator
More Than Mowers

Propane is highly versatile and works hard in the field in a variety of applications:

- Utility Vehicles.
- Ride-on Blowers.
- Material Buggies.
- In-field Portable Power.
Technological Innovations
CUMMINS 6.7L PROPANE DEMONSTRATION ENGINE
B6.7 PROPANE DEMONSTRATION ENGINE ARCHITECTURE

**Base Engine**
- 6.7L Displacement
- 107 mm Bore x 124 mm Stroke
- 12:1 CR
- Late Intake Valve Closing cam
- 4 Head Bolt Gray Iron Block
- Dual Overhead Camshaft Valve Train
- 4 Valve Aluminum Cylinder Head
- 174 bar PCP Limit
- High Efficiency Pent Roof Combustion Chamber
- High Tumble Charge Motion Intake Ports
- Leverages B6.7 Diesel Components Where Applicable for Increased Reliability and Durability

**Fuel and Ignition System**
- Direct Propane Injection
- 200 bar Rail Pressure Capability
- High Pressure pump w/ recirculation
- M14 Spark Plug w/ single coil on plug inductive ignition system

**Air Handling System**
- Twin Entry, Dual Scroll, Wastegate Turbocharger with Command WG

**Electronics/Controls**
- SI Specific ECM

**Cummins Aftertreatment System**
- On-Engine Close Coupled Three Way Catalyst

**Vehicle Integration**
- System Weight Improved Over B6.7 Diesel
- Customer Interfaces Similar to B6.7 Diesel
• 11.4% lower CO₂ emissions than diesel engine with similar displacement and torque curve. Similar BTE, favorable H/C ratio results in lower CO₂.
Renewable Propane

The Future of Propane Autogas
Comprehensive Carbon Goals

- >50% U.S. population.
- >50% U.S. GDP.
- >40% of on-road fuel.
- >90% of heating oil.
Renewable Propane

- Low carbon intensity.
- Inexpensive feedstock.
- Abundant feedstock.
- Low energy conversion.
- Final product competitively priced.
CARBON INTENSITY SCORES

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<tr>
<th>Fuel Type</th>
<th>Carbon Intensity [g CO2/MJ]</th>
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<tr>
<td>GASOLINE</td>
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<tr>
<td>DIESEL</td>
<td>100</td>
</tr>
<tr>
<td>EV</td>
<td>94</td>
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<tr>
<td>PROPANE</td>
<td>83</td>
</tr>
<tr>
<td>CNG</td>
<td>79</td>
</tr>
<tr>
<td>RENEWABLE LPG</td>
<td>45</td>
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</table>
Renewable Propane – Drive The Future Now
www.propane.com/for-my-business/fleet-vehicles/
STEVE WHALEY

DIRECTOR OF AUTOGAS BUSINESS DEVELOPMENT
PROPANE EDUCATION & RESEARCH COUNCIL
STEPHEN.WHALEY@PROPANE.COM
864-606-2290
Quick Poll!
WELCOME
Markets We Serve

**Mobility**
- Ford
- FCA
- GM
- GAC
- Google
- Toyota
- Honda
- Hyundai
- Isuzu
- Volkswagen
- EcoMotors
- Nissan
- Blue Bird

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

**Entertainment**
- Disney
- Universal Studios
- The Henry Ford

**Aerospace**
- Bell Helicopter
- Boeing
- Pratt & Whitney
- Sikorsky
- United Launch Alliance

**Gas & Oil**
- Aramco
- Oceaneering
- Conoco Phillips
- Afton
- ProSource
- Weatherford

**Motorsports**
- Ford
- 3M
- Aflac
- Crown Royal
- UPS
- Scotts
- Kellogg
- Vavoline
- Coca-Cola
- Fastenal
Pioneer in Advanced Clean Technology

- Gaseous Fuels
- Electric
- Charging
- Hydrogen
- Autonomy
Transportation Solutions

School Buses
- Blue Bird Vision: Propane, CNG
- Micro Bird G5: Propane

Chassis Cabs
- F-650 / F-750: Propane, Electric
- F-450 / F-550: Propane

Stripped Chassis/Cutaways
- F-59 / F-53: Propane
- E-350 / E-450: Propane

800.59.ROUSH
ROUSHcleantech.com
Our Progress

Over 33,000 vehicles on the road
Accumulated over 500 million miles
Over 2,500 fleets
Disruptive Growth in Alt Fuels

FY 2012: 91% 9%
FY 2014: 83% 17%
FY 2016: 74% 26%
FY 2018: 62% 38%
FY 2019: 51% 49%
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<th></th>
<th>D</th>
<th>GAS</th>
<th>PROPANE</th>
<th>CNG</th>
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<td>Cost of Ownership</td>
<td></td>
<td></td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Maintenance</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Scalable</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cold Weather Operation</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
COST & COMPLEXITY
Preventative Maintenance

Ford V10
Gas and Propane
7 Quarts

Various Engines
Diesel
17 – 30 Quarts
## Preventative Maintenance

### Ford 6.8L V10

<table>
<thead>
<tr>
<th>Part</th>
<th>Quantity</th>
<th>Price</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Element Air Cleaner</td>
<td>1</td>
<td>$15.75</td>
<td>$15.75</td>
</tr>
<tr>
<td>Oil Spin On Filter</td>
<td>1</td>
<td>$4.11</td>
<td>$4.11</td>
</tr>
<tr>
<td>Element, PSR, 510 Filter</td>
<td>1</td>
<td>$24.90</td>
<td>$24.90</td>
</tr>
<tr>
<td>Mobil Special 5W-20</td>
<td>7</td>
<td>$3.74</td>
<td>$26.18</td>
</tr>
</tbody>
</table>

**Total** $70.94

### Cummins ISB 6.7L

<table>
<thead>
<tr>
<th>Part</th>
<th>Quantity</th>
<th>Price</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Filter</td>
<td>1</td>
<td>$13.75</td>
<td>$13.75</td>
</tr>
<tr>
<td>Fuel Spin-On Filter</td>
<td>1</td>
<td>$37.90</td>
<td>$37.90</td>
</tr>
<tr>
<td>Power Steering Spin Filter</td>
<td>1</td>
<td>$9.86</td>
<td>$9.86</td>
</tr>
<tr>
<td>Fuel Filter</td>
<td>1</td>
<td>$20.53</td>
<td>$20.53</td>
</tr>
<tr>
<td>Allison Control Filter</td>
<td>1</td>
<td>$8.49</td>
<td>$8.49</td>
</tr>
<tr>
<td>Mobil Fleet 15W-40</td>
<td>18</td>
<td>$2.59</td>
<td>$46.62</td>
</tr>
<tr>
<td>Cleaner, Air Element</td>
<td>1</td>
<td>$140.00</td>
<td>$140.00</td>
</tr>
</tbody>
</table>

**Total** $277.15

---

$200 Less than diesel PM vs. PM
The Diesel We Know Today
## Engine Components: Diesel

### Cummins ISB 6.7L

<table>
<thead>
<tr>
<th>Part</th>
<th>Quantity</th>
<th>Price</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx Sensor</td>
<td>1</td>
<td>$480.00</td>
<td>$480.00</td>
</tr>
<tr>
<td>NOx Sensor</td>
<td>1</td>
<td>$560.00</td>
<td>$560.00</td>
</tr>
<tr>
<td>Pressure Sensor</td>
<td>1</td>
<td>$140.00</td>
<td>$140.00</td>
</tr>
<tr>
<td>Doser Injector</td>
<td>1</td>
<td>$290.00</td>
<td>$290.00</td>
</tr>
<tr>
<td>Catalyst Assembly w/ DPF</td>
<td>1</td>
<td>$10,554.11</td>
<td>$10,554.11</td>
</tr>
<tr>
<td>Temperature Sensor</td>
<td>1</td>
<td>$78.90</td>
<td>$78.90</td>
</tr>
<tr>
<td>Temperature Sensor</td>
<td>2</td>
<td>$84.90</td>
<td>$169.80</td>
</tr>
<tr>
<td>Turbo</td>
<td>1</td>
<td>$2,731.20</td>
<td>$2,731.20</td>
</tr>
<tr>
<td>Injector</td>
<td>6</td>
<td>$755.56</td>
<td>$4,533.36</td>
</tr>
<tr>
<td>EGR Valve</td>
<td>1</td>
<td>$590.15</td>
<td>$590.15</td>
</tr>
<tr>
<td>EGR Cooler</td>
<td>1</td>
<td>$923.72</td>
<td>$923.72</td>
</tr>
</tbody>
</table>

**Total** $21,051.24

You will not find any of these on the Ford / Roush powered Blue Bird Vision.
Engine Components: Ford Roush

Ford 6.8L V10

<table>
<thead>
<tr>
<th>Part</th>
<th>Quantity</th>
<th>Price</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCV Hoses (2)</td>
<td>1</td>
<td>$43.68</td>
<td>$43.68</td>
</tr>
<tr>
<td>Vapor Management Valve</td>
<td>1</td>
<td>$65.00</td>
<td>$65.00</td>
</tr>
<tr>
<td>Gasket</td>
<td>1</td>
<td>$5.99</td>
<td>$5.99</td>
</tr>
<tr>
<td>Injector Assembly</td>
<td>10</td>
<td>$215.00</td>
<td>$2,150.00</td>
</tr>
<tr>
<td>Converter Assembly</td>
<td>1</td>
<td>$910.00</td>
<td>$910.00</td>
</tr>
<tr>
<td>Spark Plugs</td>
<td>10</td>
<td>$7.08</td>
<td>$70.80</td>
</tr>
<tr>
<td>O2 Sensors (all 3)</td>
<td>1</td>
<td>102.57</td>
<td>$102.57</td>
</tr>
</tbody>
</table>

Total $3,348.04

A fraction the cost of diesel emissions parts
## Full Engine Replacement

### Ford 6.8L V10

<table>
<thead>
<tr>
<th>Part</th>
<th>Price</th>
<th>Labor</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ford 6.8L Engine</td>
<td>$5,728.91</td>
<td>$3,640.00</td>
<td>$9,368.91</td>
</tr>
</tbody>
</table>

### Cummins ISB 6.7L

<table>
<thead>
<tr>
<th>Part</th>
<th>Price</th>
<th>Shipping</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cummins ISB 6.7L</td>
<td>$18,521.98</td>
<td>$400.00</td>
<td>$18,921.98</td>
</tr>
</tbody>
</table>

### PSI 8.8L

<table>
<thead>
<tr>
<th>Part</th>
<th>Price</th>
<th>Core</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSI 8.8L</td>
<td>$17,014.29</td>
<td>$3,850.00</td>
<td>$20,864.29</td>
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</tbody>
</table>

Half the cost of the competition.
# TCO - Calculator

<table>
<thead>
<tr>
<th>Fuel</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Miles per Bus</td>
<td>15,500</td>
<td>15,500</td>
<td>15,500</td>
<td>15,500</td>
</tr>
<tr>
<td>Years Operated</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Total Miles Lifetime Miles per Bus</td>
<td>279,000</td>
<td>279,000</td>
<td>279,000</td>
<td>279,000</td>
</tr>
<tr>
<td>Fuel Economy (mpg)</td>
<td>4.50</td>
<td>6.00</td>
<td>8.00</td>
<td>1.40</td>
</tr>
<tr>
<td>Gallons Used Annually per Bus</td>
<td>3,444</td>
<td>2,583</td>
<td>1,937.00</td>
<td>576</td>
</tr>
<tr>
<td>Gallons Used Total per Bus</td>
<td>62,000</td>
<td>46,500</td>
<td>34,875.00</td>
<td>10,373</td>
</tr>
<tr>
<td>Fuel Price / Gallon</td>
<td>$1.17</td>
<td>$1.85</td>
<td>$2.47</td>
<td>$4.90</td>
</tr>
</tbody>
</table>

## Preventative Maintenance

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Interval</td>
<td>5,000</td>
<td>5,000</td>
<td>7,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Oil Capacity (Quarts)</td>
<td>7</td>
<td>7</td>
<td>21</td>
<td>3</td>
</tr>
<tr>
<td>Oil Filter Cost</td>
<td>$5.00</td>
<td>$5.00</td>
<td>$15.12</td>
<td>$7.50</td>
</tr>
<tr>
<td>Cost per Oil Change</td>
<td>$22.50</td>
<td>$22.50</td>
<td>$67.62</td>
<td>$7.50</td>
</tr>
<tr>
<td>Lifetime Oil Change Total Cost</td>
<td>$1,255.50</td>
<td>$1,255.50</td>
<td>$2,695.14</td>
<td>$209</td>
</tr>
<tr>
<td>DEF Lifetime Cost</td>
<td></td>
<td></td>
<td>$2,637</td>
<td></td>
</tr>
<tr>
<td>Fuel Filters Change Interval</td>
<td>50,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel Filters Cost</td>
<td>$160</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Filters Changes</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel Filter Cost Lifetime</td>
<td>$800</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Cost</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lifetime Cost</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lifetime Savings</td>
<td>$9,111</td>
<td>$31,431</td>
<td>$7,426</td>
<td>($192,280)</td>
</tr>
<tr>
<td>Cost per Mile</td>
<td>$0.63</td>
<td>$0.55</td>
<td>$0.63</td>
<td>$0.66</td>
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</tbody>
</table>

## Fuel Costs

<table>
<thead>
<tr>
<th></th>
<th>Propane</th>
<th>Propane</th>
<th>Gasoline</th>
<th>Diesel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propane Fuel Price</td>
<td>$1.17</td>
<td>$1.85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diesel Fuel Price</td>
<td></td>
<td></td>
<td>$2.47</td>
<td></td>
</tr>
<tr>
<td>Propane MPG</td>
<td>4.50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diesel MPG</td>
<td></td>
<td></td>
<td>8.00</td>
<td></td>
</tr>
<tr>
<td>Gasoline Bus Price</td>
<td></td>
<td></td>
<td>$89,000</td>
<td></td>
</tr>
<tr>
<td>Annual Miles per Bus</td>
<td>15,500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Propane Bus Price</td>
<td>$100,000.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EV Bus Price</td>
<td></td>
<td></td>
<td>$325,000.00</td>
<td></td>
</tr>
</tbody>
</table>

## Grants

<table>
<thead>
<tr>
<th></th>
<th>Propane</th>
<th>Propane</th>
<th>Gasoline</th>
<th>Diesel</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPG Fuel Rebate</td>
<td>$0.36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EV Bus Grant</td>
<td></td>
<td></td>
<td>$0.00</td>
<td></td>
</tr>
<tr>
<td>LPG Bus Grant</td>
<td></td>
<td></td>
<td>$0.00</td>
<td></td>
</tr>
</tbody>
</table>
Alternative Fuel Tax Excise Credit

- Annual tax credit included in federal budget to promote alternative fuel adoption
  - Currently approved for 2018, 2019, and 2020 calendar years
  - Propane is funded at $.36 per gallon
  - Included in federal budget since 2008

- Credit for infrastructure also included, propane and natural gas are eligible for 30% of the cost, not to exceed $30k per property.

- More information available: https://afdc.energy.gov/laws/319
ENVIRONMENT
## ROUSH Propane – Emissions

<table>
<thead>
<tr>
<th>Emission Constituent</th>
<th>ROUSH Propane Certification Level</th>
<th>% Lower than EPA / CARB Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx (Nitrogen Oxides)</td>
<td>0.01</td>
<td>90%(^\downarrow)</td>
</tr>
<tr>
<td>HCHO (Formaldehyde)</td>
<td>0.001</td>
<td>90% (^\downarrow)</td>
</tr>
<tr>
<td>PM (Particulate Matter)</td>
<td>0.002</td>
<td>80% (^\downarrow)</td>
</tr>
<tr>
<td>NMHC (Non-Methane Hydrocarbons)</td>
<td>0.06</td>
<td>57% (^\downarrow)</td>
</tr>
<tr>
<td>CO (Carbon Monoxide)</td>
<td>5.0</td>
<td>65% (^\downarrow)</td>
</tr>
</tbody>
</table>

**Greenhouse Gas Emissions**

| GHG Carbon Dioxide (CO₂)                   | 612                              | <1% \(^\downarrow\)               |
| GHG Methane (CH₄)                          | 0.03                             | 70% \(^\downarrow\)               |
| GHG Nitrous Oxide (N₂O)                    | 0.02                             | 80% \(^\downarrow\)               |

- Approximate Avg. Nearly 70% cleaner than current standards
Recent Studies

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Propane (LPG)</th>
<th>Ultra-Low Sulfur Diesel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle</td>
<td>Blue Bird School Bus (6.8L, 10 Cylinder)</td>
<td>Blue Bird School Bus (6.7L, 6 Cylinder)</td>
</tr>
<tr>
<td>Model Year</td>
<td>2015</td>
<td>2014</td>
</tr>
<tr>
<td>Exhaust Aftertreatment</td>
<td>Three-Way Catalyst</td>
<td>Diesel Oxidation Catalyst, Diesel Particulate Filter, Selective Catalytic Reduction System</td>
</tr>
</tbody>
</table>

**Noteworthy Results:**

- 96% NOx reduction
- >13% CO2 reduction

**Noteworthy Results:**

- New diesels produced ultra-fine particulate that isn’t regulated
- During DPF regen, particulate emissions spiked 32%-115% above legal limits

A first-of-its-kind 2019 study released by Georgia State University links low emission on school buses to improved academic performance.

The study found students who rode to school in alternative fuel buses like propane autogas had higher test scores in math and English compared to students who rode to school in diesel buses.
Environmental Benefits - Infrastructure

- Non-toxic
- Non-contaminant
- Non-carcinogenic
- Can’t contaminate ground water

- K15 0.4 cc release, \( \frac{1}{2} \) the volume of a green pea
SAFETY
Followed CMVSS 301.1 protocol

4,000 lbs @ 40 MPH

Angled side and rear impact

220 PSI tank pressure

No leakage or no pressure drop in 30 minute test
LPG Safety

- Solenoid Shut-offs
- Mechanical Back-ups
- Pressure Relief Device
Consideration Summary

- Simple and Robust Design
- No Duty Cycle Compromise
- Economical Operation
- Safe by Composition and Design
- Environmentally Responsible from Well to Wheels
Agricultural Cooperative
Started in business in 1937 as single county Farm Bureau Co-op’s
Now serving 83 counties in Indiana, Ohio, Michigan and Illinois
Four unique divisions
Energy – Agronomy – Swine - Grain
This diversification gives us stability in todays markets
Energy Division
Propane – Liquid Fuels
Propane sales of around 30 million gallons
Farm – Commercial – Home heat - Autogas
Propane Autogas Fueling Options & Installations

- Cash posted price, OPIS pricing, fixed price contract
- Onsite fueling vs. wet-hosing of buses on site
On-site Propane Autogas Fueling Infrastructure

Many options
• Tank size
• Aboveground / Underground
• Single hose vs. dual hose dispenser
• Skid mount vs. components
• Crash protection
• Electrical supply
• Lighting
Fleet Success

Avon Community School Corporation
• analyzed the cost effectiveness of Propane buses
• did not count on any rebates or incentives in calculations
• evaluated their pre-purchase analysis and continue to add Propane Autogas buses
Fleet Success

• Every fleet that we partner with that has added additional new vehicles have added Propane Autogas vehicles.

• Schools still feel the need to keep a few gasoline or diesel buses for out of town trips but most plan to be 90% Propane.

• Police/Sheriff have really liked the bi-fuel option. They can choose which fuel is most cost-effective at the time but more often they really appreciate the increased range with two full fuel tanks.
Thank you

Mike Hayden
Co-Alliance Propane
5250 E US Highway 36
Building 1000
Avon, IN 46123
Office 317-745-4491
Cell 317-710-5818
mike.hayden@co-alliance.com
SUE HARRISON
Director of Transportation
Michigan City Area Schools
Michigan City, Indiana
BACKGROUND OF MICHIGAN CITY AREA SCHOOLS

- Northwest Indiana
- Tourist Community
- 5500 Students
- Transport 4400 Students
• 12 Schools
  • 1 High School
  • 1 Career Center (Trade School)
  • 2 Middle Schools
  • 8 Elementary Schools
• 120 Square Miles
• LaPorte and Porter Counties
• 42 Secondary Routes and 39 Elementary Routes
• Over 2400 Miles per Day
ENVIRONMENTAL

- Thermal Densification System
- Transform Styrofoam Trays to Pavers
- Reduces Waste by 95%

Michigan City Area Schools Food Service
• Numerous State and National Recognitions
• Environmental Education
• Community Service Projects
MICHIGAN CITY AREA SCHOOLS
COMMITMENT TO SOLAR ENERGY
On March 28th, 2018 the Michigan City Area Schools initiated the largest renewable energy project by a school district. With the installation of Solar Arrays and LED lighting across 7 school facilities, the district is projected to save 23 million dollars over 30 years.
MY BACKGROUND AND FLEET EXPERIENCE
What made me research alternate fuels and why propane?
HOW DID WE GET TO WHERE WE ARE NOW?

• Attended the South Shore Clean Cities Annual Conference
• Northwestern Indiana Regional Planning Commission Meetings- Learning about the VW Grant
• Partnered with South Shore Clean Cities in April 2019
• Worked with Ryan Lisek to apply for the VW Settlement Grant
• Awarded the Grant on August 12, 2019 for the amount of $207,699.00 to replace 8 Diesel School Buses.
• Working with Shawn Seals, IDEM VW Grant Administrator
ORDERING, RECEIVING & DESTROYING

• Once the VW Grant was awarded, bids were obtained for the buses, propane and infrastructure.
• Blue Bird was awarded the bid for the buses, Co-Alliance as the propane supplier and Oscar Larsen was hired to install the infrastructure.
• 5 Propane Buses were initially ordered and then 3 additional shortly thereafter.
• Received the initial 5 buses in January of 2020 and were put into service the following month.
• The main stipulation of the grant was to destroy the diesel engines from the buses being replaced by propane. GMI Services handled the destruction of the buses.
SCHOOL DISTRICT & COMMUNITY SUPPORT

Michigan City Area Schools
Opportunity ★ Excellence ★ Pride

Welcome to Michigan City
Shops • Sand • Smiles
Blue Bird Color Coordinates Buses:
Propane-Green
Gasoline-Blue
Diesel-Black
COST SAVINGS

• COVID-19 Pandemic
• No Sufficient Data
• Cost Savings Estimate
IS PROPANE IN THE MICHIGAN CITY AREA SCHOOLS TRANSPORTATION DEPARTMENT’S FUTURE PLANS?

YES!
ADVICE?

Do Your Research!

Any additional questions, feel free to contact me.
Sue Harrison
sharrison@mcas.k12.in.us
219-873-2127 ext. 8607
About South Shore Clean Cities
SSCC manages the Northern Indiana Green Fleet Program including fleets within the MACOG and NIRPC territories.

**Goal of the program:** To improve the environmental performance of public, private and nonprofit vehicle fleets in Northern Indiana.

SSCC currently guides over 170 municipal, county, school & university member fleets to help mitigate barriers associated with sustainable transportation adoption while creating policies supporting vehicle emission & petroleum use reductions.
How does the Green Fleet program work?

- Educational opportunities including fuel & technology workshops, trainings & seminars
- Recognition & certification for fleet leaders taking steps to improve environmental performance & efficiency
- Branding & promotional tools to help fleets leverage earned certification status
- Informational resources including current technology options, market conditions, laws & incentives
- Connections with vendors offering sustainable transportation options
- Funding assistance with grant opportunities and other state and federal incentive programs
- Professional consultation including a Green Fleet audit and emissions quantification.
Step 1: South Shore Clean Cities staff will conduct a complete fleet analysis, including:

- Annual fuel usage
- Annual miles traveled & hours used
- Total number of vehicles & equipment
- Vehicle & equipment type, make & model
- Fuel type
- Average vehicle and equipment life
- Down time for fueling and maintenance
- Fuel cost
Green Fleet Audits

Step 2: South Shore Clean Cities staff then provides a complete fleet analysis in a written Green Fleet audit report, including:

- Cost comparisons for various sustainable fuel and vehicle types
- Availability and location of fueling options
- Personalized recommendations for short- and long-term fleet purchase plans
- Provide total cost of ownership and return on investment analysis
- Suggestions for implementing cost-saving programs & training such as idle reduction
- Information on potential funding opportunities to best leverage sustainable transportation investments
South Shore Clean Cities
Ryan Lisek
Project Manager
Office: 219-644-3690
rlisek@southshorecleancities.org
www.southshorecleancities.org
10115 Ravenwood Drive, Suite B
St. John, IN 46373
Type your questions in the question box!
Contact Our Speakers!

**Propane Education & Research Council**
Stephen Whaley  
Director of Autogas Business Development  
864-606-2290  
Stephen.whaley@propane.com

**ROUSH CleanTech**
Derek Whaley  
Business Development Manager  
734-780-4418  
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