

Fueling The Future

Presented by:

Kirk Burns – Gregory Poole Equipment

Tom Hopkins – ROUSH CleanTech



BLUE BIRD®

Product Offering



**BB Transit
EV**



**BB Vision
EV**



**BB Vision
CNG**



**BB Vision
Propane**



**BB Vision
ISB Diesel**



**BB Vision
ISV Diesel**



**BB Vision
Gasoline**



Private & Confidential

Our Partnerships



BLUE BIRD[®]

ROUSH[®]
CLEANTECH



Why Propane?



COST SAVINGS



DISTRICTS REPORT SAVINGS OF UP TO

.37¢
PER MILE

NOISE REDUCTION



UP TO
40%
QUIETER

COLD STARTS



STARTS IN TEMPERATURES AS LOW AS

-40°F

LOWEST EMISSIONS



**INCREDIBLY
REDUCED
EMISSIONS**



ROUSH
CLEANTECH

*than a typical fuel tank

Private & Confidential



Blue Bird Alternative Fuel School Buses in the US

OVER
19,000
SCHOOL
BUSES
SOLD



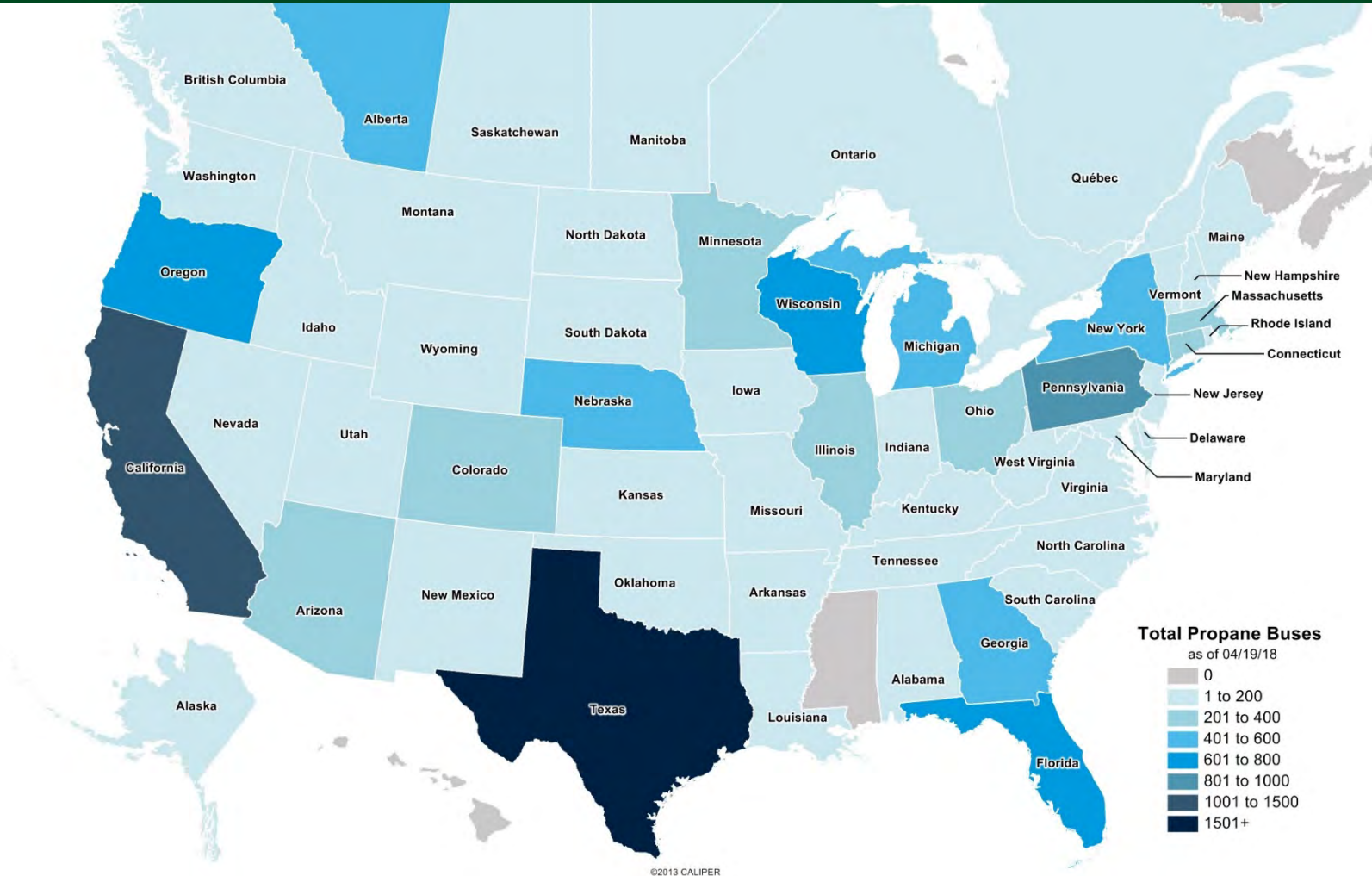
OVER
1,000
SCHOOL
DISTRICTS

#1 manufacturer of alternative fuel school buses



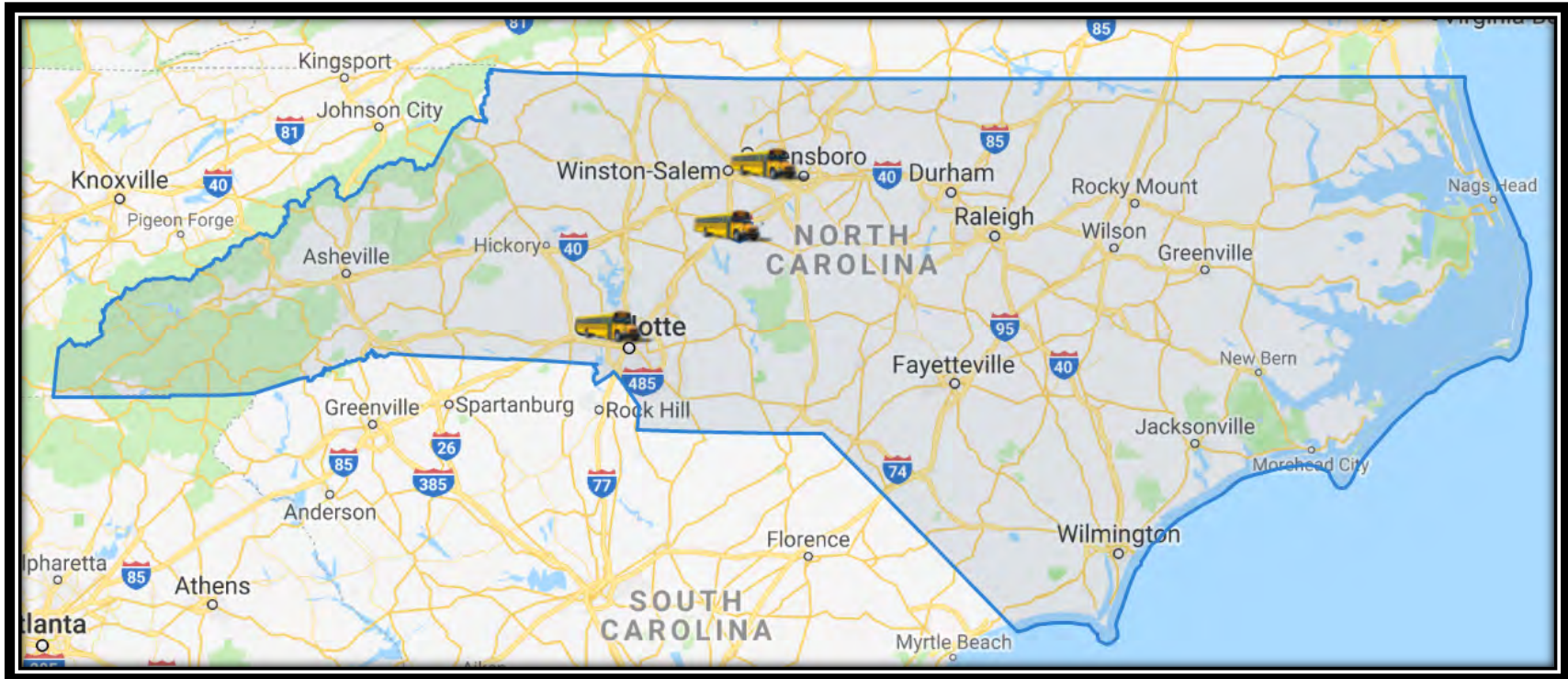
ROUSH[®]
CLEANTECH

Blue Bird Propane Deployments – North America



Over 14,000 ROUSH/FORD propane powered Blue Bird Visions sold since introduction

Gregory Poole, NC - Deployments



- CHARLOTTE-MECKLENBURG – 2
- STRAIGHTLINES (High Point) - 2
- DAVIDSON COUNTY SCHOOLS - 6

Blue Bird Vision Propane Product Information



Model Years

2020

Engine Size / Manufacturer

6.8L V10 (3V) Ford Engine with exclusive ROUSH CleanTech Propane Fuel System

Applications

189" / 217" / 238" / 252" / 273" / 280"
wheelbase configurations

6-speed automatic transmission

Fuel Tank Capacity

Short: 50 gallons (47 usable)

Standard Range: 70 gallons (67 usable)

Extended Range: 100 gallons (93 usable)

Technical Specifications

EPA and CARB approved

GVWR: 33,000 lbs

Up to 77 passengers

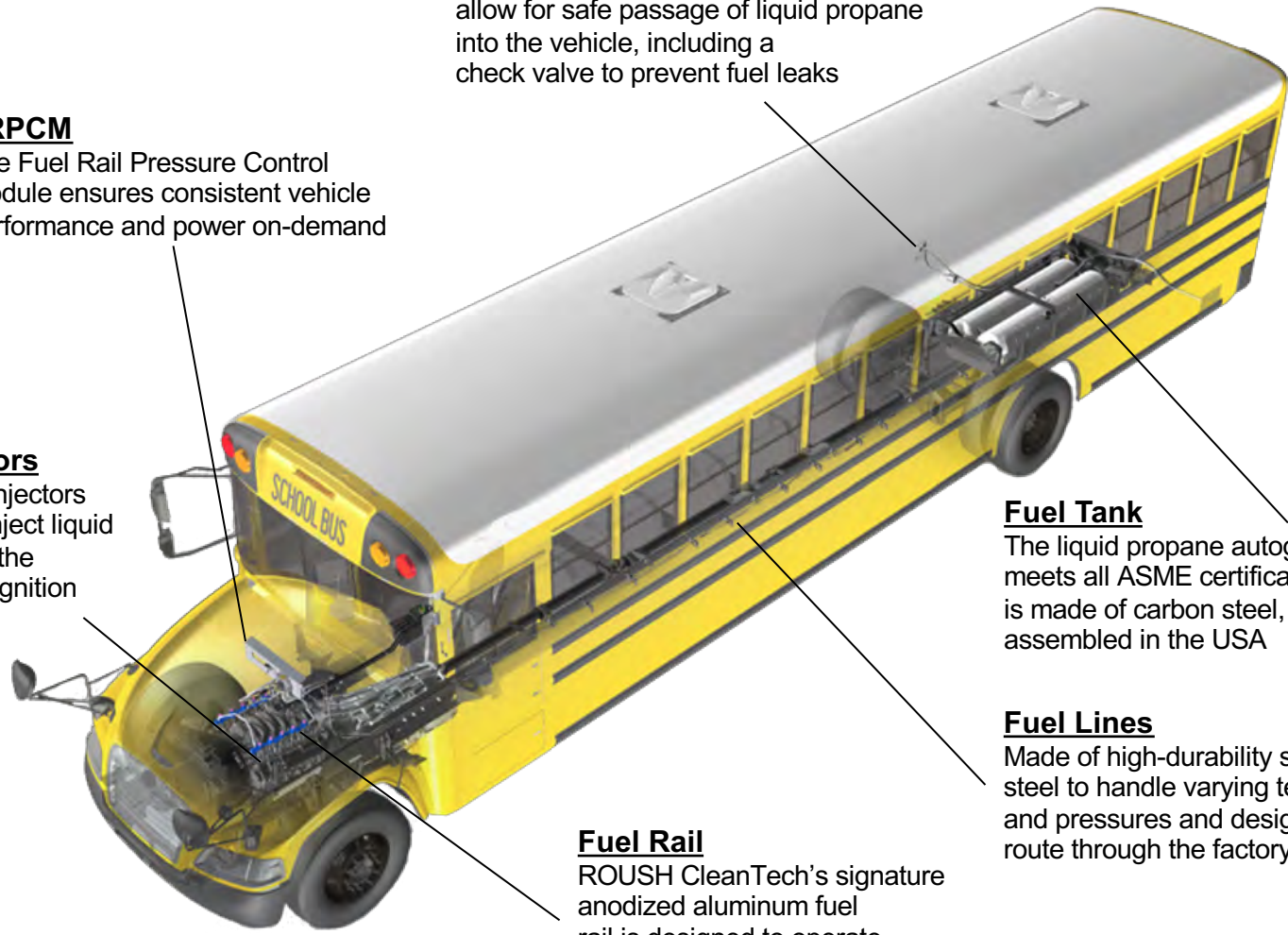
Blue Bird Vision (Type C)



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Blue Bird Vision Propane Highlights



Fuel Fill

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

FRPCM

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

Fuel Injectors

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

Fuel Rail

ROUSH CleanTech's signature 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 carbon steel, and is built and assembled in the USA

Fuel Lines

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



Operational Impact

Controlling Cost / Complexity



BLUE BIRD®

Preventative Maintenance



Ford V10
Gas and Propane
7 Quarts



Various Engines
Diesel
17 – 30 Quarts



Increased Inventory



- ❖ Gas and Propane eliminate the need for DEF and the possibility of putting the wrong fluid in a tank.



Average diesel needs around 70 gallons / year

Modern Diesel Technology = Complexity & Cost





Ford 6.8L V10

Part	Quantity	Price	Total	Total \$70.94
Element Air Cleaner	1	\$15.75	\$15.75	
Oil Spin On Filter	1	\$4.11	\$4.11	
Element, PSR, 510 Filter	1	\$24.90	\$24.90	
Mobil Special 5W-20	7	\$3.74	\$26.18	

Cummins ISB 6.7L

Part	Quantity	Price	Total	Total \$277.15
Oil Filter	1	\$13.75	\$13.75	
Fuel Spin-On Filter	1	\$37.90	\$37.90	
Power Steering Spin Filter	1	\$9.86	\$9.86	
Fuel Filter	1	\$20.53	\$20.53	
Allison Control Filter	1	\$8.49	\$8.49	
Mobil Fleet 15W-40	18	\$2.59	\$46.62	
Cleaner, Air Element	1	\$140.00	\$140.00	

Engine Components (Ford ROUSH)



Ford 6.8L V10

Part	Quantity	Price	Total
PCV Hoses (2)	1	\$43.68	\$43.68
Vapor Management Valve	1	\$65.00	\$65.00
Gasket	1	\$5.99	\$5.99
Injector Assembly	10	\$215.00	\$2,150.00
Converter Assembly	1	\$910.00	\$910.00
Spark Plugs	10	\$7.08	\$70.80
O2 Sensors (all 3)	1	102.57	\$102.57

**Total
\$3,348.04**



Cummins ISB 6.7L

Part	Quantity	Price	Total
NOx Sensor	1	\$480.00	\$480.00
NOx Sensor	1	\$560.00	\$560.00
Pressure Sensor	1	\$140.00	\$140.00
Doser Injector	1	\$290.00	\$290.00
Catalyst Assembly w/ DPF	1	\$10,554.11	\$10,554.11
Temperature Sensor	1	\$78.90	\$78.90
Temperature Sensor	2	\$84.90	\$169.80
Turbo	1	\$2,731.20	\$2,731.20
Injector	6	\$755.56	\$4,533.36
EGR Valve	1	\$590.15	\$590.15
EGR Cooler	1	\$923.72	\$923.72
			Total \$21,051.24



Ford 6.8L V10

Part	Price	Core	Total
Ford 6.8L Engine	\$7,194.85	\$900.00	\$8,094.85

Cummins ISB 6.7L

Part	Price	Shipping	Total
Cummins ISB 6.7L	\$18,521.98	\$400.00	\$18,921.98

Total Cost of Ownership

Experience



BLUE BIRD®

Savings Calculation (vs. Diesel)



	Diesel	Blue Bird Propane	Blue Bird Gasoline	Blue Bird C-CNG	Customer Information
FUEL					Propane Fuel Price \$1.25
Annual Miles per Bus	15,000	15,000	15,000	15,000	Diesel Fuel Price \$2.95
Years Operated	15	15	15	15	Gasoline Fuel Price \$2.75
Total Miles Lifetime Miles per Bus	225,000	225,000	225,000	225,000	GGE Fuel Price CNG \$2.05
Fuel Economy (mpg)	7.00	4.50	5.75	5.75	Propane MPG 4.50 64%
Gallons Used Annually per Bus	2,142.00	3,333	2,608	2,608	Diesel MPG 7.00
Gallons Used Total per Bus	32,142.00	50,000	39,130	39,130	Gasoline MPG 5.75 82%
Fuel Price / Gallon	\$2.95	\$1.25	\$2.75	\$2.05	CNG MP GGE 5.75 82%
PREVENTATIVE MAINTENANCE					Years Operated 15
Oil Interval	7,000	5,000	5,000	5,000	Annual Miles per Year per Bus 15,000
Oil Capacity (Quarts)	21	7	7	7	
Oil Filter Cost	\$9.36	\$4.00	\$4.00	\$4.00	
Oil Cost Per Quart	\$2.55	\$2.55	\$2.55	\$2.55	
Cost Per Oil Change	\$62.91	\$22	\$22	\$22	
Lifetime Oil Change Total Cost	\$2,022.11	\$983.25	\$983.25	\$983.25	
Lifetime DEF Gallons	1,124.97	0	0	0	
DEF Cost per Gallon	\$1.89				
DEF Total Cost Over Lifetime	\$2,126.19				
Fuel Filter Change Interval	15,000	50,000	15,000	5,000	
Fuel Filter Cost	\$12.99	\$43	\$15	\$150	
Total Filter Changes	15	4	15	45	
Fuel Filter Cost Lifetime	\$194.85	\$172	\$225	\$6,750	
ACQUISITION COST					
Incremental Acquisition Cost	\$0.00	\$7,000	\$2,500	\$25,000	
Vehicle Rebate per Unit			\$0.00	\$0.00	
TOTAL COST OF OWNERSHIP					
Lifetime Operational Cost/Bus	\$99,162.05	\$70,655.25	\$111,315.75	\$112,949.75	
Lifetime Savings/Bus		\$28,506.80	-\$12,153.70	-\$13,787.70	
Cost per Mile to Operate	\$0.44	\$0.28	\$0.48	\$0.39	

Savings Calculation (vs. Diesel)



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TCO Calculator

	Diesel	Blue Bird Propane	Blue Bird Gasoline	Blue Bird C-CNG	Customer Information
FUEL					
Annual Miles per Bus	15,000	15,000	15,000	15,000	Propane Fuel Price \$1.25

TOTAL COST OF OWNERSHIP	Diesel	Blue Bird Propane	Blue Bird Gasoline	Blue Bird C-CNG
Lifetime Operational Cost/Bus	\$99,162.05	\$70,655.25	\$111,315.75	\$112,949.75
Lifetime Savings/Bus		\$28,506.80	-\$12,153.70	-\$13,787.70
Cost per Mile to Operate	\$0.44	\$0.28	\$0.48	\$0.39

Fuel Filter Cost Lifetime	\$569.10	\$225	\$11,700	
ACQUISITION COST				
Incremental Acquisition Cost	\$0.00	-\$4,000	\$25,000	
Vehicle Rebate per Unit		\$0.00	\$0.00	
TOTAL COST OF OWNERSHIP	Diesel	Blue Bird Propane	Blue Bird Gasoline	Blue Bird C-CNG
Lifetime Operational Cost/Bus	\$109,176.60	\$70,655.25	\$102,479.65	\$117,911.45
Lifetime Savings/Bus		\$38,521.35	\$6,696.95	-\$8,734.85
Cost per Mile to Operate	\$0.49	\$0.29	\$0.47	\$0.41

5.75 92%

Years Operated
15

Annual Miles per Year per Bus
15,000



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Real World Savings



“15 Cents per Mile Savings on Average”



“34 Cents per Mile Savings on Average”



“Over \$7,000 per Bus Savings in First Year”



“80% Lower Fuel Costs”



Environment



BLUE BIRD®



- CARB (California Air Resources Board)
 - Established a mechanism for engine MFR's to pursue lower NOx certification than Federal requirement of 0.20 g/bhp-hr
 - 50% lower or 0.10
 - 75% lower or 0.05
 - 90% lower or 0.02
 - CA, CT, ME, NY, DC



Ultra Low NOx Emissions Certified



Achievement of Ultra Low NOx starts with a high quality production engine

- ARB is encouraging all Manufacturers of Record (MORs) to overachieve on the NOx standard to support smog reduction.

ROUSH CLEANTECH **BLUE BIRD**

Blue Bird Vision Propane

The Most Cost-Effective Solution to Reduce NOx Emissions from School Buses

Approved buses throughout 25 states nationwide across the U.S. to help lower school bus NOx emissions. School buses emit increased air pollutant emissions. Blue Bird's Propane Vision Propane helps reduce NOx emissions, which benefits our nation's children.

PROPANE	DIESEL	ELECTRIC
Propane price: \$195,000 NOx emissions: 294 g/bhp-hr	Purchase price: \$250,000 NOx emissions: 427 g/bhp-hr	Purchase price: \$300,000 NOx emissions: 1,119 g/bhp-hr
Cost per pound of NOx reduced: \$106	Cost per pound of NOx reduced: \$1,330	Cost per pound of NOx reduced: \$268

92% more cost-effective than diesel school buses

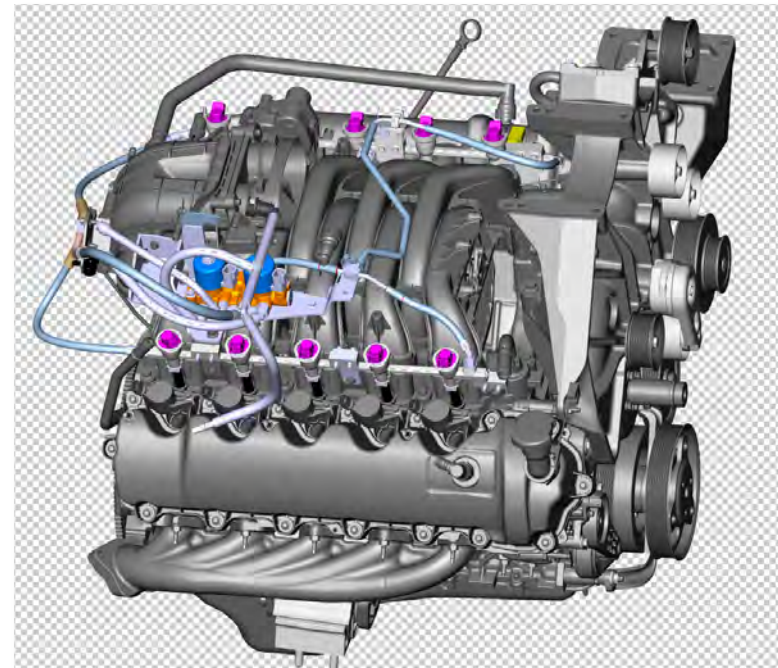
60% more cost-effective than electric school buses

750+ School transportation fleets in operation

12,000+ School buses in service across North America

.05 g/bhp-hr Standard

.02 g/bhp-hr Available





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

96%

NOx REDUCTION VERSUS CLEAN DIESEL BUS

Duty cycle: Low speed, stop-and-go route



Source: 2018 West Virginia University study, comparing 2015 LPG Blue Bird school bus [6.8L, 10 Cylinder] with 2014 ultra-low sulfur diesel Blue Bird school bus [6.7L, 6 cylinder].

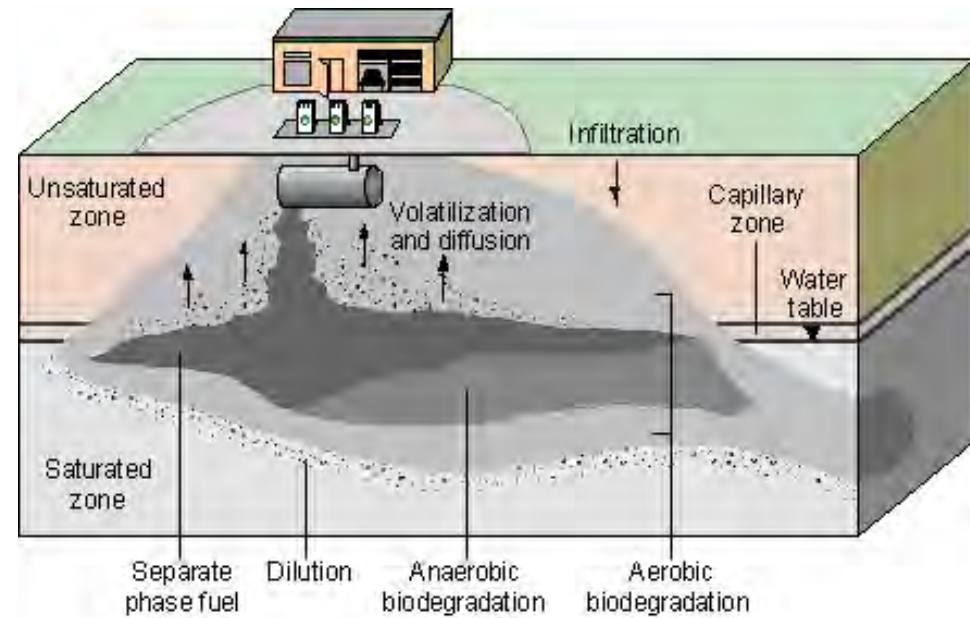
PROPANE.COM

Noteworthy Results:

- 96% NOx reduction
- >95% NOx reduction
- >93% NOx reduction
- >13% CO2 reduction



- The EPA has strict requirements surrounding AST and UST systems that hold diesel and gasoline
 - Above Ground Storage Tanks and Below Ground Storage Tanks
 - The EPA estimates that the average remediation is \$130,000
 - If groundwater is affected, the correction can exceed \$1,000,000



Safety



BLUE BIRD®



- When Propane Autogas is released from the tank it is a vapor, therefore cannot be ingested like gasoline, diesel, or alcohol fuels
- Propane is an odorless gas
 - Ethyl mercaptan is added so any presence of propane may be easily detected
- Propane Autogas tanks are 20 times more puncture-resistant than standard fuel tanks, so they are more durable in an accident
- The ROUSH CleanTech fuel system is fitted with safety devices and shut-off valves that function automatically if the fuel line ruptures



Crash Testing

- ✓ Blue Bird is certified to **CMVSS 301.1** testing protocol
- ✓ 4,000 lbs. @ 30 MPH
- ✓ Angled side and rear impact

Other Features

- ✓ In the quest to design and manufacture the safest school bus in the industry, Blue Bird school buses are always in compliance with both **the Colorado Rack Test and the Kentucky Pole Test**—Blue Bird is the only school bus manufacturer that has both tests as a requirement
 - *Colorado Rack Test: Ensures that the structural integrity of the bus remains intact in the event of a rollover accident*
 - *Kentucky Pole Test: Ensures the strength of the school bus roof in case of a pole, or another sharp object impacts the bus during a rollover*



Refueling Infrastructure

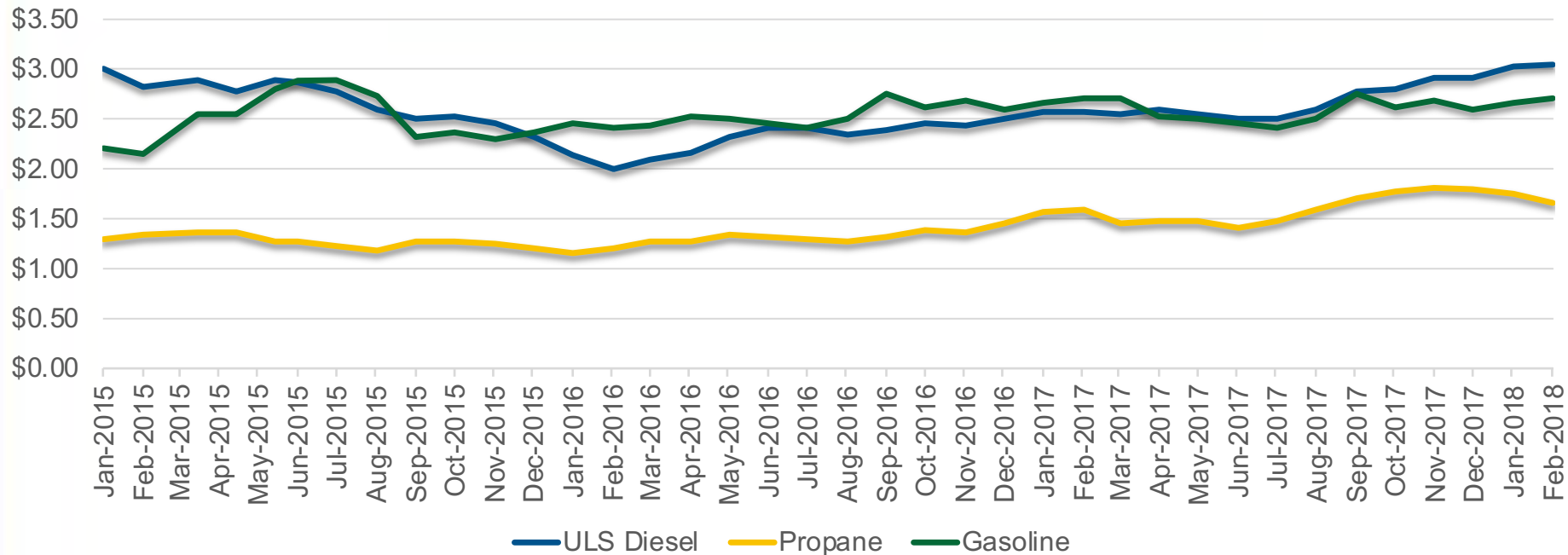


BLUE BIRD®

Fuel Budget: PROPANE



Fuel Price History



- ❖ Propane has a stable price history
 - Recent surge in gasoline and diesel
- ❖ Price lock contracting for multiple years
- ❖ Eligible for rebates, bringing District dollars back



Budget Friendly Fuel

Low Cost Fueling Infrastructure



Ford Michigan Assembly Plant
(MI)



AmeriGas Propane Tank



Kyrene Elementary School
(AZ)



Bend LaPine School District
(OR)



ROUSH CleanTech
(MI)

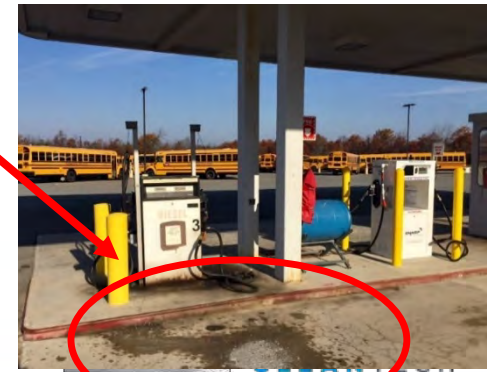


Fueling Infrastructure



- ❖ Propane fuel transfers as fast as gasoline or diesel but with these added benefits:
 - Secured connection, no spillage
 - No diesel residual on pump handle
 - No residual on the ground
 - Non-carcinogenic

- ❖ Propane is non-toxic and dissipates into the atmosphere





- ✓ Simple and Robust Design
- ✓ No Duty Cycle Compromise
- ✓ Economical Operation
- ✓ Safe by Composition and Design
- ✓ Environmentally Responsible from Well to Wheels



Blue Bird Electric School Bus

Presented by:

Kuba Szczypiorski

Director - Alternative Fuels

Blue Bird Corporation



BLUE BIRD®

Electric Type C & D



BLUE BIRD®





ZERO EMISSIONS

Cleaner air for our children



GO FURTHER

Go approximately 100 miles on a single charge



REDUCED MAINTENANCE COSTS

Less parts means less maintenance



VEHICLE TO GRID TECHNOLOGY

(V2G) technology will allow you to "sell" energy back into the grid



TEMPERATURE CONTROL

Excellent performance in many weather conditions



BATTERY CAPACITY

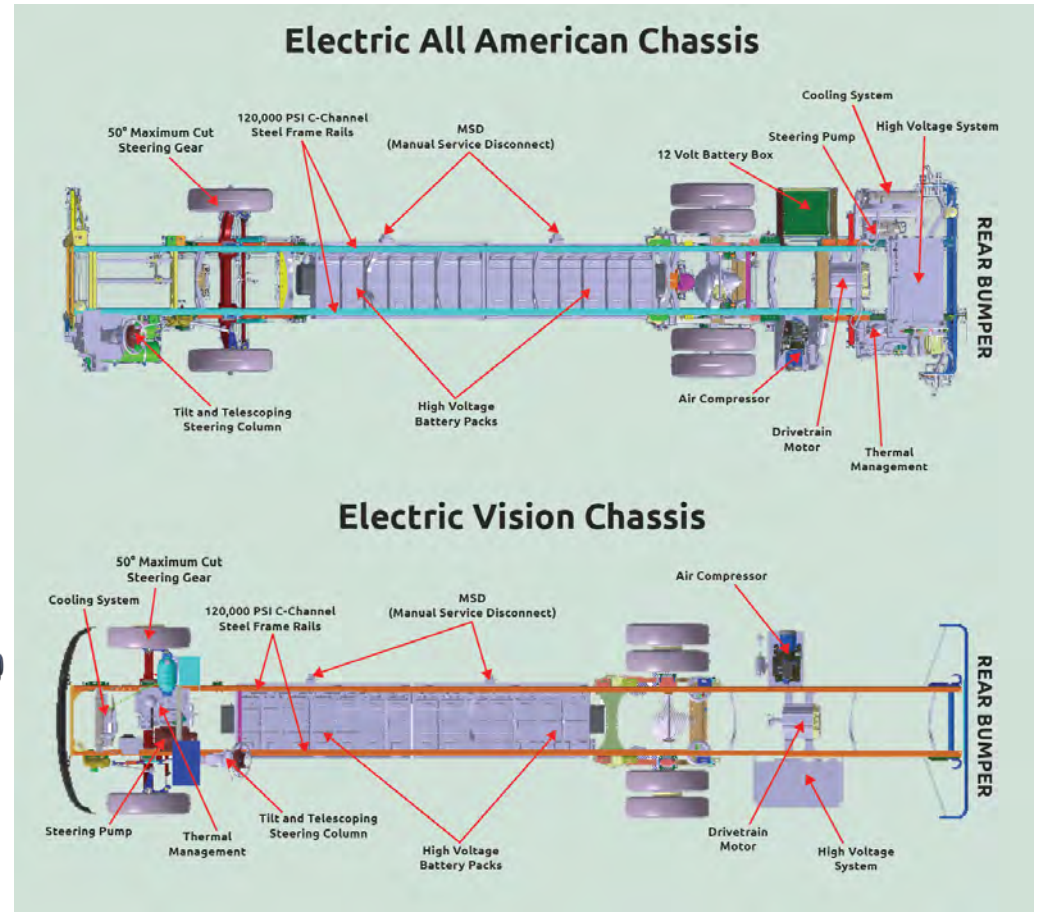
Multiple battery capacities: 100-150kWh options

- No Engine Oil Changes, No Transmission, No Engine
- Up to 120 miles on a single charge. 80% of school bus routes are 80 miles or less.
 - 315 HP - 2,176 ft/lb TORQUE - Up top 65 MPH
 - Lithium Nickel-Manganese-Cobalt Battery
 - Level 2 Charger – Approx 8 Hour Charge Time

Exclusive Purpose Built Chassis



Blue Bird's purpose-built chassis combines over 90 years of innovation with our exclusive drivetrain partners ADOMANI and Efficient Drivetrains (EDI), which was recently acquired by Cummins Inc., allowing us to offer efficient and affordable electric bus solutions.



EV Charging Options



- ✓ **AC Level 1:** Uses a 120-volt (V) alternate current (AC) power connection to a standard residential / commercial outlet capable of supplying 12-16 amps of current, for a power draw of about 1.4 to 1.9 kW when charging
- ✓ **AC Level 2:** Uses a 208 / 240V AC power connection to an electrical outlet capable of supplying 30-80 amps of current with 19.2 kW max—EV school buses can use AC Level 2 EVSE but require higher amperage and can charge a 160 kWh electric school bus between eight and nine hours and cost \$3,000-\$10,000, including purchase price and installation
- ✓ **DC Fast Charging:** Delivers high power directly into an electric vehicle battery system by converting AC into DC, using an inverter built into the EVSE and uses 208-600V AC for charging rates of up to 90 kW, enabling an EV school bus to be charged in between 20-30 minutes—DC Fast Charging systems are more expensive: \$15,000 for hardware not including installation, plus another \$10,000-\$20,000 for software costs
- ✓ **Bidirectional Charging (VTG):** Allows EVs to both receive energy from the grid and send energy stored in the vehicle back to the grid or a building enabling the vehicle battery to function as an energy storage resource either through an on-board system located on the bus or an off-board system which is stationary inverter located in a DC fast charger equipped for bidirectional power flow

Blue Bird Electric Buses Deployed



First Blue Bird Electric School Buses Delivered in North America

Blue Bird electric school buses are on the way to customers in California and Ontario

Fort Valley, GA (September 27, 2018) – Blue Bird just delivered the first electric-powered school buses to customers in California and Ontario, just in time for the new school year. Seven Type-D All American Rear Engine Electric school buses and one Type A Micro Bird G5 Electric school bus will be in operation this year.

All of the customers who obtained electric school buses were able to do so through the help of financial grants offered by various entities and government programs. These grants helped to pay for all or part of the cost of the buses, as well as some necessary infrastructure costs.

Jack Matrosov of Wheelchair Accessible Transit, based in Toronto, Ontario, was able to add a Micro Bird G5 Electric school bus to his fleet through the use of the [Electric and Hydrogen Vehicle Incentive Program \(EHVIP\)](#), which is offered by Ontario's government.

"When the EHVIP Grant became available, we were thrilled to find out that Micro Bird had an electric bus solution in the works. Over 90% of our fleet are Micro Bird buses and we feel these buses offer great quality, and good local service when needed," said Matrosov. He added that the grant also allowed him to cover nearly all of the costs of the infrastructure needed for this bus.

The larger, 72-passenger buses ordered by customers in California have a similar design to the many Blue Bird Type D CNG buses that districts operate in the state today. These districts utilized many California-based grants, including [South Coast AQMD](#) and [HVIP](#), which helped to pay towards the cost of the buses and infrastructure.

"We were excited to find out, in the midst of the search process, that Blue Bird had created an electric bus solution," said Hector Morales, supervisor of M.O.T. of Mountain View School District in El Monte, CA. "Our mechanic is familiar with Blue Bird Type D buses, so it was an easy choice for our fleet."

"We decided to go with Blue Bird's electric school buses, because we know the level of service we require will be available to us," said Mark Toti, transportation manager at Bellflower Unified School District in Bellflower, CA. "We currently operate 26 Blue Bird CNG buses, and feel comfortable relying on local support from Blue Bird in order to introduce this new technology to our existing fleet."

While grants were widely responsible for the purchase of these buses, manufacturers like Blue Bird see a future in this technology that will make these buses more affordable and wide-spread as a viable alternative fuel solution.































"We are thrilled to see our all-new Blue Bird electric school buses going into the hands of customers for the first time," said Phil Horlock, president and CEO of Blue Bird Corporation. "With zero-emissions, our electric school buses provide the cleanest possible environment for our customers and the children they transport. Also, with battery technology constantly advancing and becoming more efficient, we foresee a great future for growth."

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Your Fuel Options



					
Ease of Adoption					
Energy Independence					
NOx Emissions					
Fuel Infrastructure					
Cost of Ownership					
Range					
Maintenance					
Scalable					
Cold Weather Operation					

Propane Checks Every Box

Thank You!



Questions?



BLUE BIRD®