Blue Bird Electric School Buses Pittsburgh Region Clean Cities Webinar December 2, 2021



95 Years of Building School Buses

- Founded in 1927 by Albert Luce in Fort Valley, Georgia
- Over 550,000 built
- ~180,000 still on the road today!
- Family owned until 1991
- In 2015 became publicly traded (BLBD)

























A History of Innovation



1st school bus body built utilizing steel instead of all wood (1927)

- ➤ 1st all-steel body (1937)
- > 1st school bus manufacturer to build its own chassis (1952)
- > 1st Type D Compressed Natural Gas school bus (1991)
- > 1st All-Electric powered school bus (1994)
- $> 1^{st}$ OEM propane-powered school bus (2008)
- > 1st Commercial School Bus V2G Deployment (2021)

Blue Bird The Alternative Power Experts

OVER 30,000 ALT POWER SCHOOL BUSES





OVER **3000** SCHOOL DISTRICTS





Blue Bird – First to Market with EV



Electric Recharged

>2016

Received a \$4.9MM grant from US Department of Energy (US DOE) for development and commercialization of high power V2G school buses.

> 2017

Launched current iteration of the Blue Bird electric bus at the STN Expo in Reno, NV 2018

Delivered first electric-powered school buses to customers in California

>2021

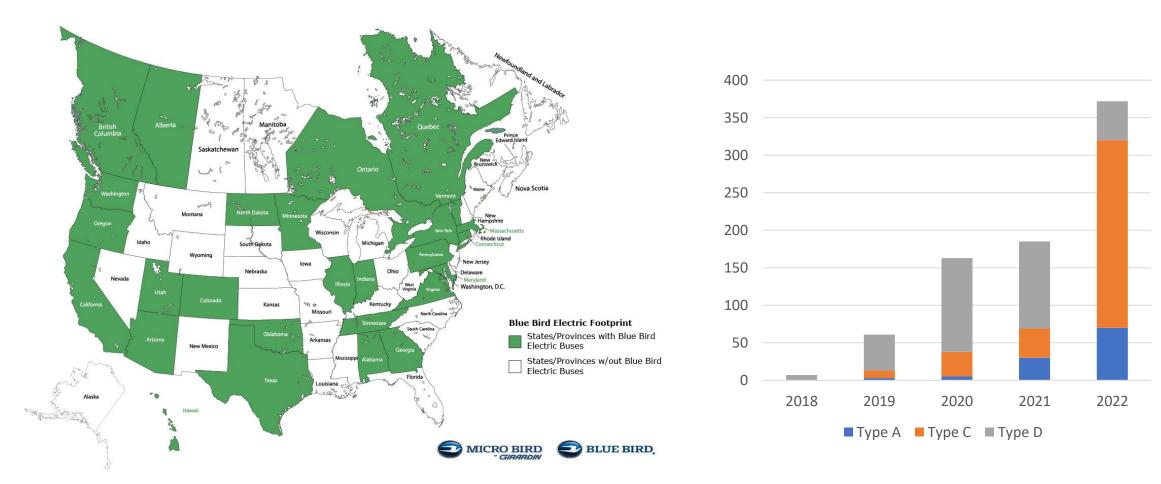
> Only manufacturer to produce and deploy electric school buses in Type A, Type C, and Type D

- Only manufacturer to offer standard CCS1 connector to allow both Level 2 and Level 3 charging
- > V2G capability standard on all of our Electric Buses

> Over 800 EV sales in 26 states and 4 Canadian Provinces!



EV Deployments and Growth





Benefits of Electric School Buses





GRANT FUNDS AVAILABLE Bus and Infrastructure



REDUCED MAINTENANCE COSTS Fewer and much simpler parts = substantially less maintenance



OUTSTANDING PERFORMANCE

Drive motor max torque and power at very low RPM's

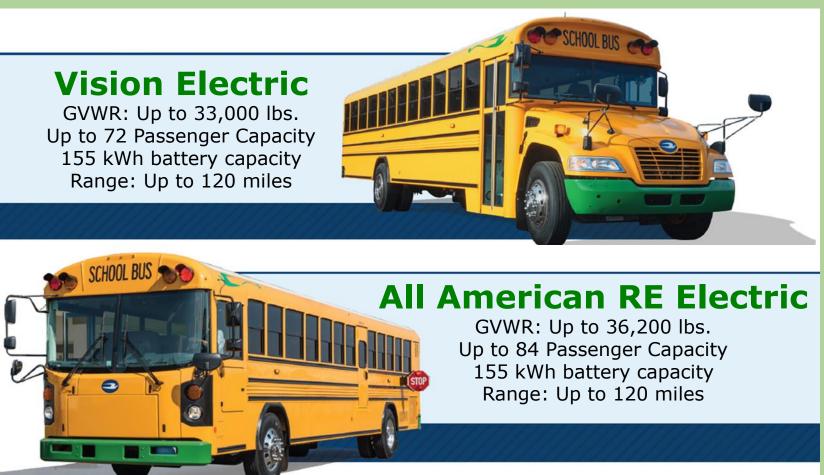
QUIET OPERATION Less sound pollution in neighborhoods, and safer driving







Type C & D



Range is dependent on terrain, driver habits and the use of heating and A/C.



Diesel vs Electric

	Diesel	Electric	
Power	300 HP	315 HP	
Torque	2,046 ft-lb (1 st gear @ max rpm)	2,400 ft-lb (instantaneous)	
Acceleration (0-60 mph)	45 s	20 s	
Fuel Cost / mile	\$0.44	\$0.17*	
Fuel Cost / year	\$5,280	\$2,040	
GHG Emissions / year	23 tons	Zero	
Maintenance	Engine Oil Change Transmission Fluid Change Fuel Filter Change DEF Fluid & Filter Air Filter Change	Coolant Flush	

EV Options

Most options available on any Blue Bird Vision are available on our EV Vision including:

- Front and rear air ride suspension (273" wb)
- Roof or skirt mounted a/c
- Wheelchair lifts
- Luggage/tool compartments
- Heaters (front/rear locations, stepwell)

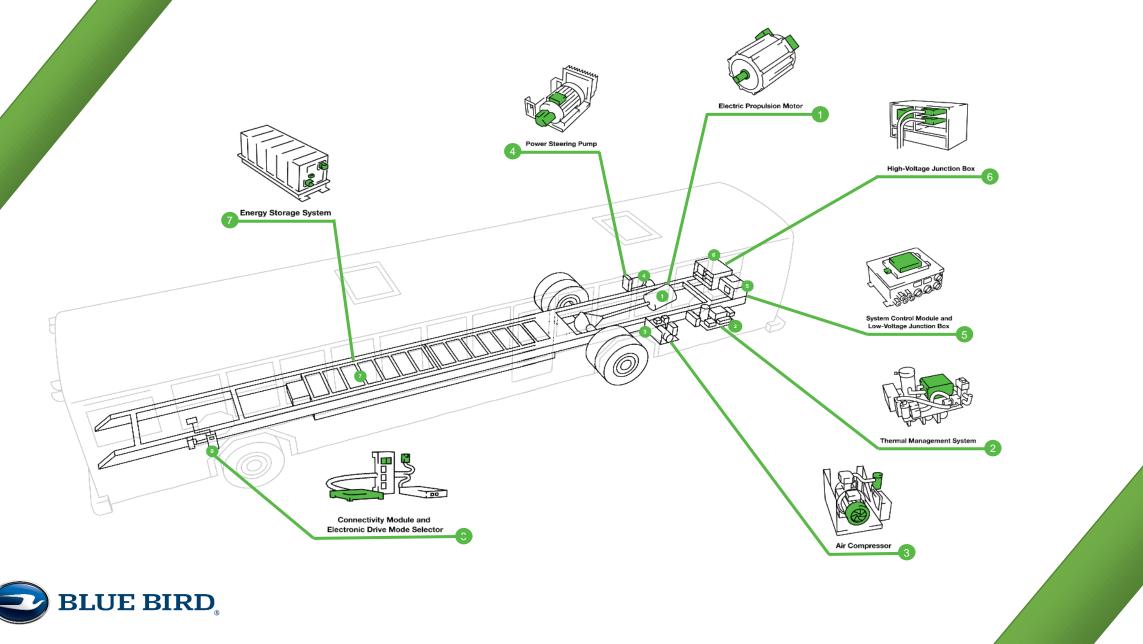
New options available this year:

- Electronic Stability Control standard
- New Thermal Management System - standard
 - Provides a 3rd electric heater to allow 1 heater to be dedicated to battery heat and 2 for cabin heat
 - Allows for pre-heating of the cabin while bus is charging

- Battery insulation optional
 - Insulation on all sides of the battery packs as well as the coolant manifolds
 - Helps to maintain optimal battery temperatures and improve efficiency
- Fuel-fired heater optional on Type C
 - Auxiliary heating for coldweather climates to improve cabin heat
 - Can be programmed for preheating of cabin



Major System Components



Electric Bus Preventative Maintenance

• Air Compressor – Oil Change

- First oil change 6,000 miles or 6 months
- After this every 18,000 miles or 12 months

• Drive Motor

- Torque hardware every 12 months
- No other maintenance required

Thermal Management System

- Check coolant level every 12 months
- Drain and refill every 5 years/150,000 miles
- Change coolant filter once indicator is on RED

• Electric Power Steering

- Check and maintain fluid level every 12 months/20,000 miles
- Battery System
 - Torque hardware every 12 months/20,000 miles





Standard Charging: Level 2 (AC) or Level 3 (DC Fast Charge)

- Connector The plug is a Combined Charging System Level 1 (CCS1). Combines a J1772 plug (used for Level 2 AC charging) with two extra pins for Level 3 DC Fast Charging
- Power Required for AC Charging For maximum 19.2kW charge rate, each EVSE must be supplied with single phase, 240v, 80 amp ac current with a 100 amp fuse. If only a 50 amp circuit breaker is available, the bus will charge at a rate up to 12 kW/hour. A bus will fully charge with AC charging from 0-100% in about 8 hours.
- Power Required for DC Charging For maximum 60kW charge rate, each station must be supplied with three phase, 480VAC, 80 amp. A bus will fully charge with DC Fast Charging from 0-100% in about 3 hours. This is required for V2G.

Charger Costs –

- Level 2 charger Cost Approximately \$2,000- \$5,000, for the hardware without installation.
- DC Fast Charging systems are more expensive: \$20,000 \$60,000 for hardware not including installation.



EVSE Compatibility – Type C & D

DC Plugin Charging

Cummins PowerDrive system is designed to be compatible with DC Plugin EVSEs complying with ISO 15118-2 & DIN 70121 communication standard, SAE J1772 interface standard and are designed to operate per IEC 61851. EVSE voltage capability shall encompass CMI's PowerDrive voltage range. Current CMI School Bus system voltage range is 550-705 V. It is not feasible to verify functionality with every EVSE manufacturer and model. Below is a list of DC EVSE's that Cummins has verified as compatible.

AC Plugin Charging

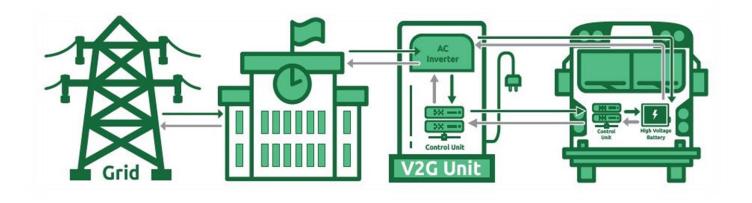
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Manufacturer	Model	Output Current Type	Input Voltage	Current
Efacec	QC150	DC	480, 3ph	0-200
ChargePoint	CPE250	DC	480, 3ph	0-78
Heliox	Fast DC 25	DC	480, 3ph	0-42
Heliox	Fast DC 40	DC	480, 3ph	0-67
ABB	HVC 150C	DC	480, 3ph	0-200
Rhombus (Nuvve)	RESDCVC6	DC/V2G	480, 3ph	-200-200

Revision Date: June 29, 2021

Cummins Confidential

Vehicle-To-Grid



V2G creates opportunities for utilities to <u>"buy back" stored energy</u> that the buses are not using.

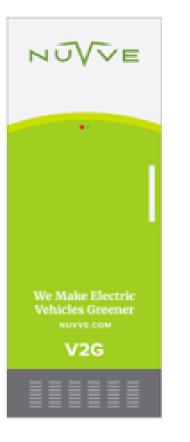
V2G also creates the ability to <u>redirect the excess power</u> to other structures like the building or fuel island.

This is valuable for peak season consumption times, as well as natural disasters when energy needs increase.

Blue Bird Standard Offering – 60kWh V2G System



V2G Charger Requirements



V2G



• Due to the lack of ISO standards in the industry for bidirectional energy flow, we have partnered with a Nuvve to develop a proprietary protocol to enable V2G capability

The Nuvve DC Heavy-Duty Charging Station (EVSE-HD60) is designed specifically for vehicle-to-grid (V2G) applications and is the ideal solution for the rapid, smart charging of heavy-duty fleet vehicles such as electric school buses. The EVSE-HD60 is fully controllable through Nuvve's fleet management app and Nuvve V2G platform (GIVe) which enables unidirectional charging of any vehicle or full, bidirectional V2G and vehicle-to-building (V2B) services when connected to a Blue Bird EV.

NUVVE – EVSE-HD60



Technical Training (Cummins or Blue Bird)

- Basic overview of the both the RE and CV
- Explain where each component is and what it does
- Explain the maintenance that the school bus shops can do to the EV components
- Compare the maintenance of an EV to that of a 6.7L diesel
- How to shut off the high voltage and waiting for the battery to discharge
- Verbally set up an accident scenario to explain the three safety features that would be triggered should the bus get hit really hard, roll over and land in the water under a bridge



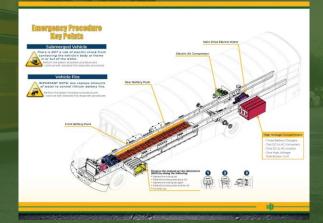
Driver Training (Blue Bird or Dealer)

- Briefly explain the major components of the EV, where each is and what each does
- List and explain the major components of the EV that are common with an ICE bus. Emphasize how the body construction is the same and how not any strength was not taken away from this safety critical component
- Discuss charging the EV in cold weather and list three methods to help the batteries recharge
- Explain and identify the function of the dash components unique to the EV and to observe their functionality while driving
- Demonstrate how to start the bus and prepare it for driving, drive the bus using techniques required to maximize the range and how to properly shut down the bus.
- Demonstrate or explain the three methods to shut down the high voltage system in the event of an emergency.
- Explain the three safety features built into the high voltage system. Verbally set up an accident scenario to explain the features that would be automatically enabled should the bus get hit really hard, roll over and land in the water under a bridge.

First Responder Training (Cummins or Blue Bird)

- System Safety Features
- Emergency Procedures
- System Shutdown Procedures
- Electric Bus Key Switch and Parking Brake
- Electric Bus Low Voltage Switch
- Electric Bus Manual Service Disconnect (MSD) Switches







Bipartisan Infrastructure Bill

> The Bipartisan Infrastructure Bill was signed into law by the President on 11/15.

- ➤ Total Clean School Bus Funding is \$5B. Allocation:
 - \$2.5B for a new electric school bus program
 - \$2.5B for a new alternative fuel school bus program
 - Includes electric, propane, CNG, and biodiesel school buses
 - 40% of funds will go to disadvantaged school districts
 - Contractors qualify for funds, limited to 70% of bus cost
 - Funds can also be used for electric infrastructure

> Funds could be available within 6 months

BLUE BIRD

\$5 Billion - Big Win for Clean School Buses!

EV Ecosystem

END OF LIFE

Determine recycling program for used batteries after use

SERVICE & SUPPORT

Connect with local dealer and powerdrive service provider to service bus throughout its lifetime

TELEMATICS

Set up a solution to track bus performance, diagnostics and more

DEPLOYMENT

Build and deliver buses, as well as offer driver, safety and technician training services



ASSESSMENT

Determine what bus best fits the customer's needs based on terrain, climate and route planning

FINANCING

Identify financing through grants, tax breaks, subsidies or lending services

INFRASTRUCTURE

Assess infrastructure needs and connect to the right partners for energy sourcing and infrastructure installation

V2G/V2X

Create vehicle-to-grid plan with payback potential and utility involvement

Why does this matter to you?

- Electrification of vehicles is gaining momentum nationwide
 - (F-150 Lightning, Rivian, Tesla, etc.)
- School buses have the ideal duty cycle for electrification
- Enormous community support for zero emission school buses
- Passage of Infrastructure Bill will lead to greater adoption across the country
- More stringent EPA regulations in 2024 and 2027 may make diesel engines a thing of the past
- We foresee that nearly 100% of new Blue Birds built will be electric within 10 years



Thank You!

