

Benefits of Zero Emission School Buses



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Webinar Topics

Topics

Presenters

Benefits of Electric School Buses

➤ Jim Reynolds & Robert Lupacchino

Suitable Conditions for Operating Electric School Buses

➤ Joe Angeli & Urvi Nagrani

Service, Maintenance, and Warranty Support

➤ Joshua Goldman

State and Local Funding

➤ Lisa Jennings

Summarizing the Webinar, and Question and Answers Session

➤ Radhika Majhail



Benefits of Electric School Buses

Jim Reynolds

President & CEO, Adomani

Robert Lupacchino

Chief Operating Officer, First Priority GreenFleet

Electric School Buses Can Benefit Your Fleet

- Lower operating cost
- No diesel/fuel storage or procurement
- Potential back-up power (Vehicle 2 Grid)
- Zero emission school buses:
 - Improve public health
 - Reduce risk to children's health
 - Reduce carbon footprint
- Funding may be available



Fleet Manager's Pathway to Electric School Buses



Economics: Initial Investment

eLion Type C 75-mile **All Electric Bus** vs. Conventional Diesel Bus

COST TO PURCHASE	Diesel	Electric
MSRP (including 8% tax)	\$139,100	\$347,750
-Less incentives (e.g. HVIP*)		(\$130,000)
Customer cost (initial capital investment)	\$139,100	<u>\$217,750</u>
<i>Additional investment for electric bus</i>		\$78,650

**Local incentives exist beyond HVIP that can further reduce the cost of purchase based on geography*



Economics: Operating Expenses/Payback

eLion Type C 75-mile **All Electric Bus** vs. Conventional Diesel Bus

OPERATING EXPENSES PER YEAR (Average over 16 years bus life)	Diesel	Electric
- Maintenance cost (Note 1)	\$9,075	\$1,770
- Diesel fuel (Note 2)	\$5,930	\$0.00
- Battery power (kWh) (Note 3)	<u>\$0.00</u>	<u>\$2,714</u>
Yearly cost of ownership	\$15,005	\$4,484
Savings over diesel per year		\$10,521
Payback period (in years) for <i>additional investment</i> of \$78,650		7.48



Economics: Total Savings

eLion Type C 75-mile **All Electric Bus** vs. Conventional Diesel Bus

SAVINGS OVER LIFE OF BUS	Diesel	Electric
Savings over remaining life of bus (after payback period)		\$89,686
- Less cost of battery (at 8 years) (Note 4)		(\$45,600)
Total savings over 16 year life of electric bus		\$44,086

Notes:

- Does not include cost of charging infrastructure which varies
- Does not include significant savings related to reduction in healthcare costs as a result of clean air



Suitable Conditions for Operating Electric School Buses

Joe Angeli
School Bus Sales Manager, Creative Bus Sales

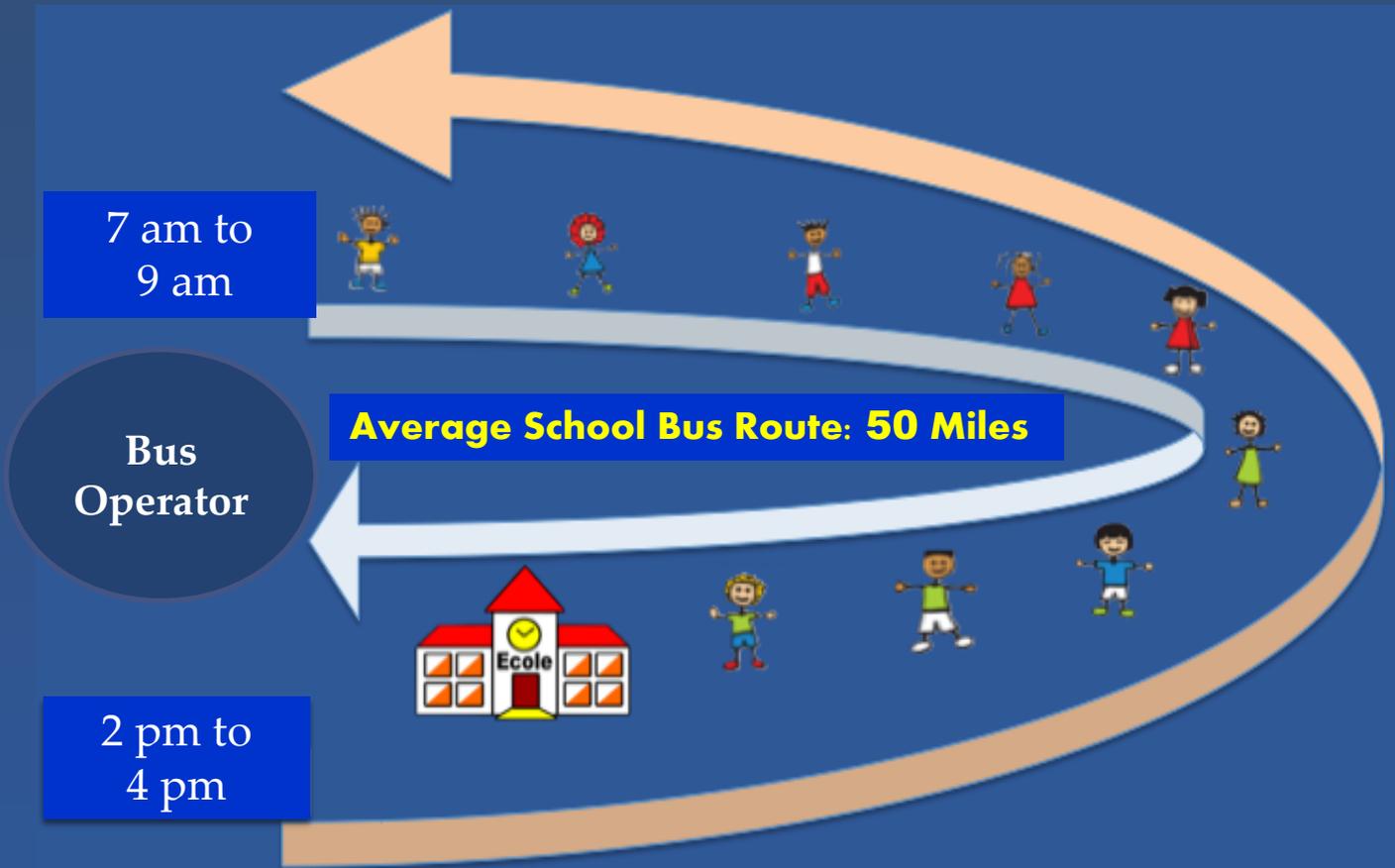
Urvi Nagrani
Director of Marketing & Business Development, Motiv

Manufacturers Claim Range Approaching 100 miles

- Customized battery packs (don't pay extra for range you don't need!)
- Opportunity charging extends the range



An Example for Charging Electric School Buses



School buses can be charged between AM & PM bus runs and over night.

Electric School Buses likely Suit Your Routes

- Home-to-School routes with starts and stops
 - Shorter rural routes
 - Intercity routes
 - Suburban routes
- Grades of less than 13%
- Inside temperature requirements impact vehicle range
- Park in the same spot to charge



Charging Infrastructure for Electric School Buses

- Assess available power
- Charger type
- Optimum location of the charger
 - Near existing electrical wiring
 - On the side of the building

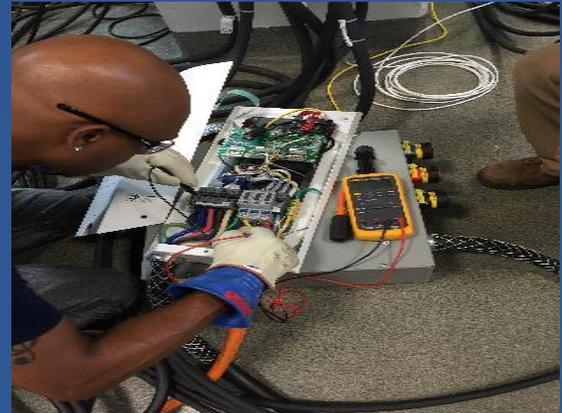


Service, Maintenance, and Warranty Support

Joshua Goldman
Vice President, Business Development, TransPower USA

Electric School Buses Require Less Maintenance

- Fewer moving parts
- Remote software diagnostic
- School buses using standard OEM parts



Technical Support Available for Electric School Bus Technicians

- Onsite technician training
- Electrical system maintenance
- Vendor service centers



Electric School Bus Warranty

- Typical warranty for 3 years or 50,000 miles
- Additional warranty available
- Batteries may have pro-rated warranty for 3 to 6 years
- Incentive programs may require additional warranty



State and Local Funding

Lisa Jennings
Air Pollution Specialist, Air Resources Board

State and Local Funding

- Carl Moyer Program
http://www.arb.ca.gov/msprog/moyer/air_district_contacts.htm
- Lower-Emission School Bus Program
<http://www.valleyair.org/lists/list.htm>
- Low Carbon Transportation and Fuels Investments (GGRF)
 - HVIP – <http://www.californiahvip.org>
 - Zero-Emission Truck and Bus Pilot Commercial Deployment Project
 - Rural School Bus Pilot Project

coming soon



Summarizing the Webinar

Radhika Majhail
Air Pollution Specialist, Air Resources Board

Summarizing Benefits of Electric School Buses

- Electric school buses are zero tailpipe emission and improve public health
- Lower operating cost over vehicle's life
- State and local funding may be available



Fleet Manager's Pathway to Electric School Buses



Vendor Contact Information

Company	Contact	Email	Phone
Adomani	Jim Reynolds, President & CEO	jim.reynolds@me.com	(949)200-4613 ext. 5003
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Complete Coach Works	Ryne Shetterly, ZEPS Sales Manager	rshetterly@completecoach.com	(800) 300-3751
First Priority Green Fleet	Jon Van Bogart, Western Regional Sales	jvb@firstpriorityglobal.net	(805)610-3671
Motiv	Urvi Nagrani, Director of Marketing & Business Development	urvi@motivps.com	(650) 830-3341
TransPower	Joshua Goldman, VP Business Development	Joshua@transpowerusa.com	(858) 449-4629

Question and Answer Session

Radhika Majhail
Air Pollution Specialist, Air Resources Board

Questions and Answers

- Type questions now in 'gotowebinar chat'
- Send questions later (by 07/22/16):
Radhika.Majhail@arb.ca.gov
- Written response to the questions will be posted at:
<http://www.arb.ca.gov/msprog/truckstop/tb/schoolbus.htm>
- Contact Information for ARB staff:

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Reference Materials

Provided by the Panelists

Economics Study References Provided By Robert Lupacchino, First Priority GreenFleet

Note 1: Resource: Noel, L. & McCormack R. 2014. "A cost benefit analysis of a V2G-capable electric school bus compared to a traditional diesel school bus." *Applied Energy*, 126: 246-265

Note 2: Calculations based on 12,060 miles/year @ 6 mpg. U.S. Energy Information Administration forecasts crude oil to increase at 5% CAGR per year over the next 25 years from \$40 per barrel to \$136 in 2040 with a commensurate increase in gas and diesel retail prices. Based on a retrospective examination of oil and gas prices from 2000 through the present (J. Hamilton, *oil-price.net*), diesel gas price is forecasted at \$4.24 in 2040. Currently at \$2.30, the average price of diesel gas over the next 16 years is estimated \$2.95 per gallon.

Note 3: Calculations based on 12,060 miles/year @ 1.5 kWh per mile (Lion Bus) at \$0.15 kWh. Report by UC Davis, Energy Efficiency Center, 2013, projects the price of electricity to increase from \$0.12 kWh to \$0.21 kWh over the 25 year period with an average annual rate of \$0.15 per kWh over the next 16 years.

Note 4: Evans, Simon, "EV Battery Costs Already Probably Cheaper than 2020 Projections," *The Carbon Brief*, March 2015 www.cleantechnica.com. Industry-wide costs of batteries have fallen by 14% per year overall and by 8% for market-leading firms from 2007 through 2015, or an average of 11%. Present, cost of battery packs is \$29,000 per pack. At 4 packs for a Type C, 75 mile electric bus, total battery cost today is \$116,000. At current rate of reduction at 11% per year, projected battery cost in 8 years is \$45,600



Health Study References Provided By Jim Reynolds, Adomani

- <http://money.cnn.com/2016/06/10/news/economy/economic-cost-air-pollution/index.html>
- <https://www.sciencedaily.com/releases/2016/03/160329101031.htm>
- [http://www.euro.who.int/en/media-centre/sections/press-releases/2015/04/air-pollution-costs-european-economies-us\\$-1.6-trillion-a-year-in-diseases-and-deaths,-new-who-study-says](http://www.euro.who.int/en/media-centre/sections/press-releases/2015/04/air-pollution-costs-european-economies-us$-1.6-trillion-a-year-in-diseases-and-deaths,-new-who-study-says)
- <http://journalistsresource.org/studies/environment/pollution-environment/health-effects-costs-air-pollution-research-roundup>