ICAO UNITING AVIATION

All-Electric Airport Shuttle Buses

The WAVE of the Future

ICAO HQ, Montréal, Canada

9 – 10 SEPTEMBER 2014

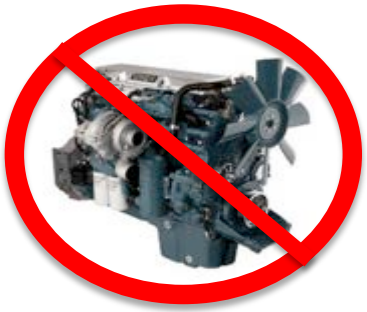
All-Electric Buses | A Better User Experience

Electric vehicles are more comfortable for passengers, drivers & pedestrians on the street

- Quite and smooth operation
- Clean and odor-free
- No soot stains on bus or building
- Creates pedestrian friendly urban environment conducive to outdoor cafés, public spaces, and community events

All-Electric Buses | Lower Maintenance Costs

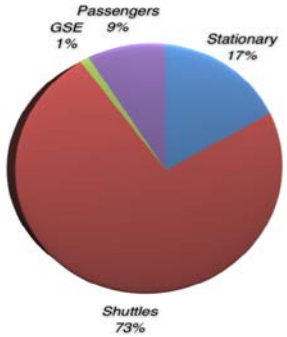
No	Less	More
internal combustion engine	vibration	simplicity
transmission overhauls	wear and tear	
fluid changes	breakable moving parts	
fuel filters	brake repair (regenerative)	
oil leaks		



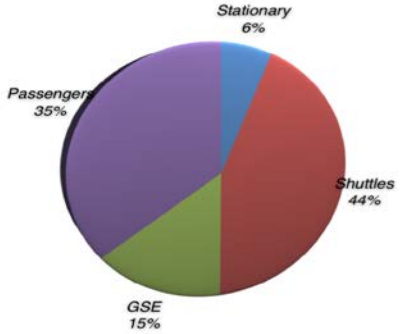
All-Electric Buses | Environmental Excellence

Electric buses have no emissions

- Zero carbon dioxide (CO_2), nitrogen oxide (NO_x), sulfur dioxide (SO_2), and particulate matter (PM) emissions
- Excellent contribution to sustainability goals
- Electric buses are one of the few opportunities airports have for eliminating a substantial component of their emissions inventory



CO_2 Emissions



NO_x Emissions

All-Electric Buses | Lowest Operating Costs

Operating costs are lower than other options

- Overall maintenance about one third less than diesel buses
- Fuel costs are at least 50% lower
  - Electricity $0.41/mile (based on $0.12/kWh)
  - Diesel $0.90/mile (based on $3.89/gal)
  - CNG $0.91/mile (based on $2.50/gal)
- Lower maintenance cost even with full battery replacement in year 6-7

All-Electric Buses | Readily Available

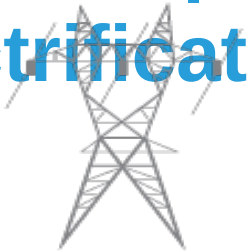
40 foot electric buses are commercially available

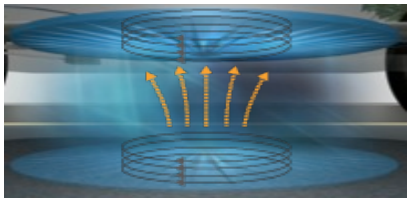
- At least 7 OEM vendors offer new electric buses
- Existing bus fleet can be remanufactured to new condition with electric power train
- All-electric buses are suitable for essentially all airport shuttle services

Most commonly expressed reservations

- Electric buses do not have suitable range for 24/7 airport operations
- Electric buses are too expensive

Solution | Wireless Advanced Vehicle Electrification



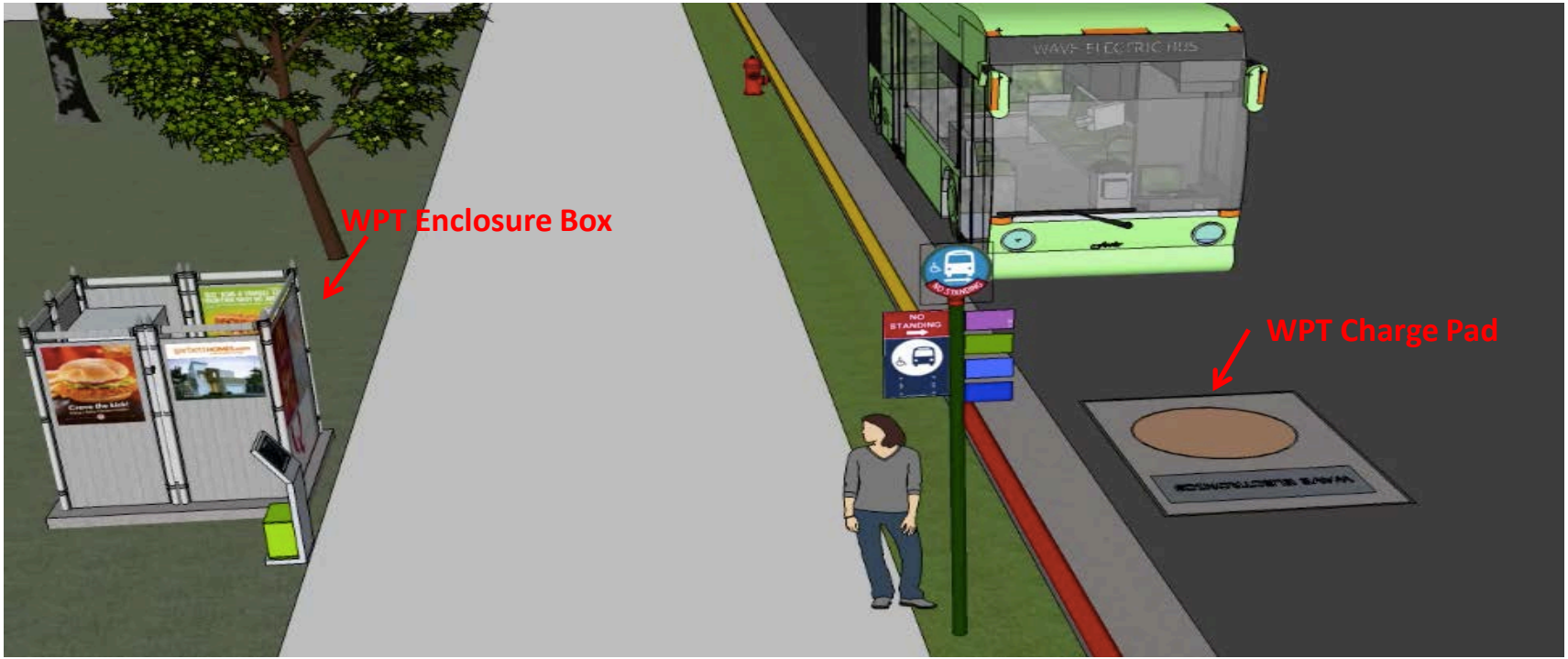


Electric Grid **Wireless Charger** **Vehicle**

WAVE Technology:

- ☑ Safe charging through road and all-weather conditions
- ☑ Simple and cost effective
- ☑ Smaller battery packs and unlimited range
- ☑ Batteries charged "on the go" throughout route
- ☑ No cables or overhead wires

An Elegant Solution | Minimal Infrastructure



WAVE's Wireless Charging | The

- 7.4" Air Gap, 10.5" Magnetic Gap
- Meets ICNIRP Guidelines and ISO/ANSI 14117 Standards (medical devices)

Input Power from Grid

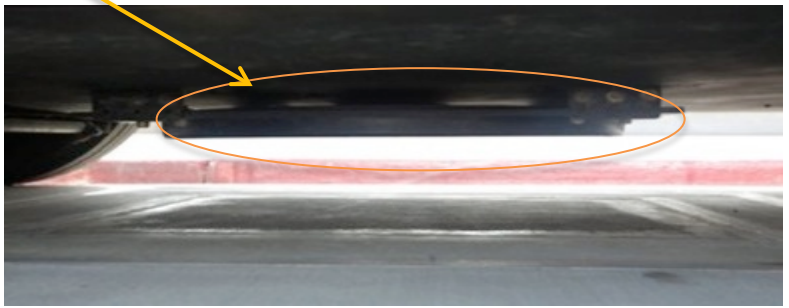
Transmitter Electronics

Magnetic Field

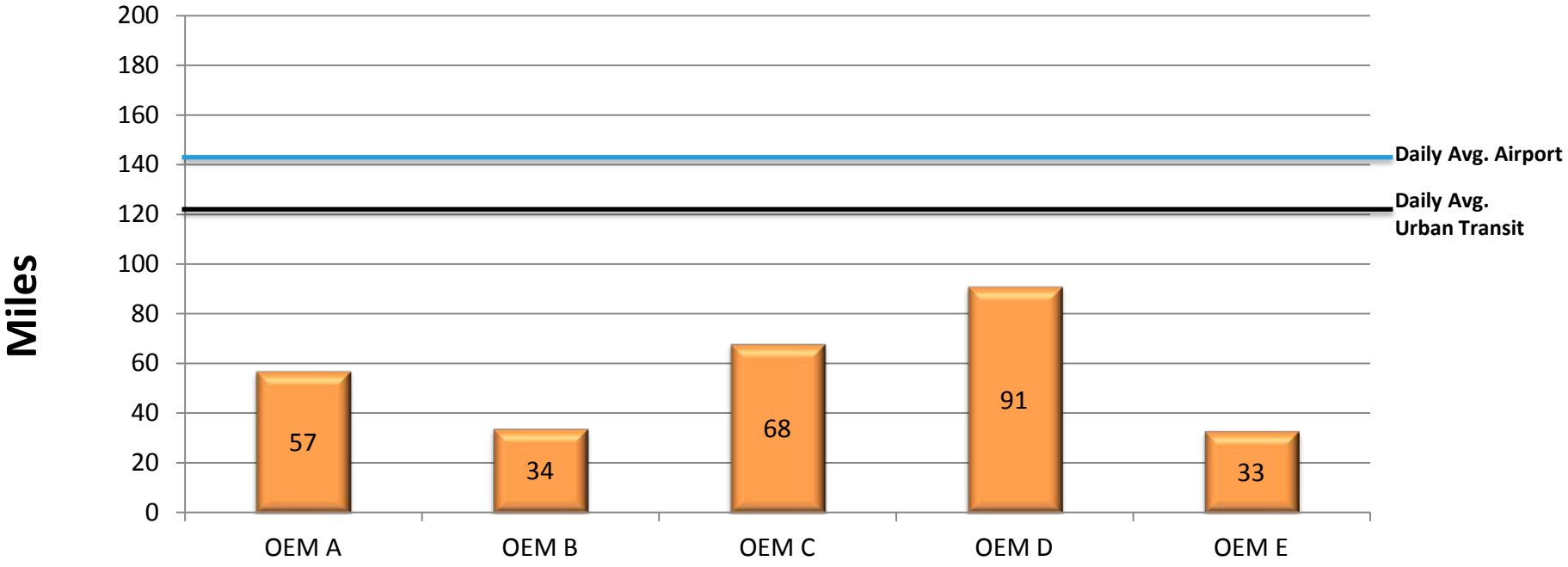
Receiver Electronics

Output Power to Vehicle

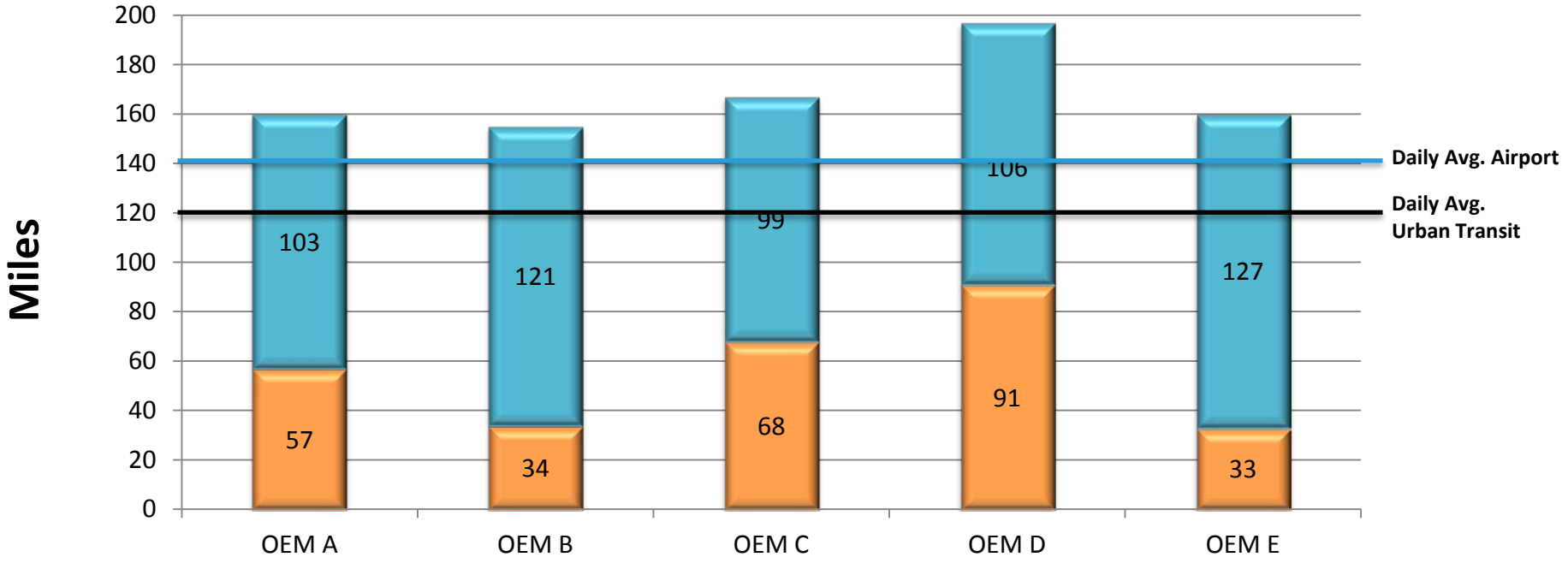
Current



All-Electric Buses | Range Limitations

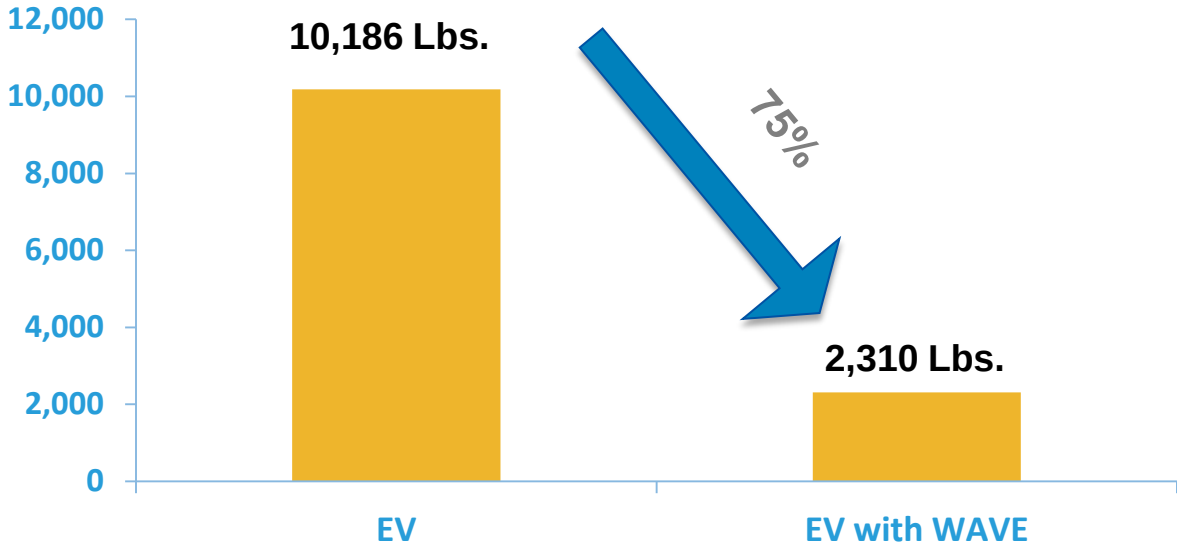


All-Electric Buses | WAVE Range Extension



Inductive Charging | Less Battery, Extended Range

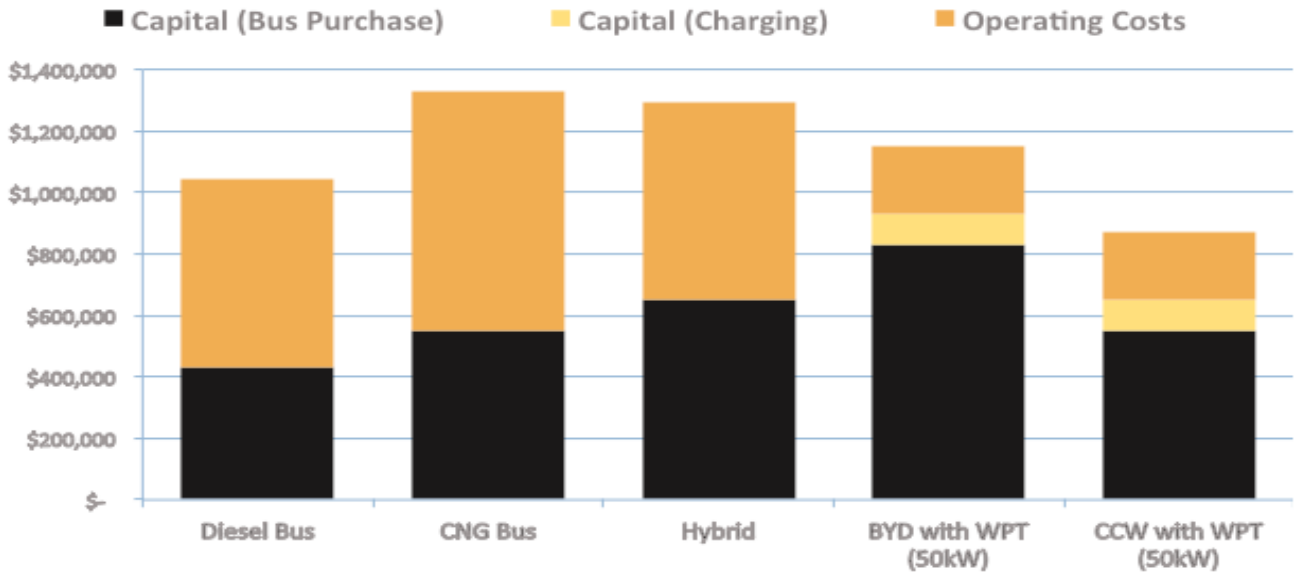
Pounds of Battery Required for 130 Mile Route



Weight difference = weight of 45 passengers

All-Electric Buses | Lowest Cost of Ownership

Electric bus lifecycle costs are lower than conventional buses



Total Cost of Ownership for Alternative Bus Technologies

WAVE

Wireless Advanced Vehicle Electrification

WAVE Services

- Full service, turnkey solution, including electric vehicle(s) and WAVE charging system
- Service level agreements
- System maintenance

Contact

Sandy Webb

Senior Advisor

(410) 626-1002

sandy@waveipt.com