

Key Takeaways of the Cost/Benefit Analysis for Trolley Buses and BEBs

As part of the Bus Modernization program, MBTA evaluated the next generation of vehicles serving Route 71 and 73 out of the North Cambridge Garage.



\$126m total cost over 14-year service lifecycle

The ETB system requires continuously energized overhead contact system (OCS) to provide power. **Most of the safety concerns that are specific to ETBs stem from OCS.** Issues include de-wirement where the cables from the OCS snap and contact vehicles or pedestrians as well as concerns with employees working in the public right-of-way to maintain the OCS.



ETBs reliance on the **OCS infrastructure makes them vulnerable** to more frequent reliability issues (outages), more resource intensive (e.g. operator training, de-icing, wire maintenance), and impractical for supporting systemwide needs (e.g. Red Line diversions, long-term service planning).



The substitute diesel-hybrid buses that are used during ETB outages consume an estimated 30,000 gallons of diesel per year on average which results into **305 tons of CO₂ emissions.**



Safety



Public and worker safety is a top concern for MBTA. Each technology has safety benefits and drawbacks however **BEBs risks can be effectively managed through additional training and presents less risk to the public.**

Reliability



Despite range limitations, **BEBs are significantly more flexible than ETBs to meet operational and service needs.** Approximately 20% of ETB service is replaced by diesel hybrid.

Emissions



The future improvement in the energy density of BEB battery packs can also **significantly reduce or eliminate the need to rely on any form of fossil fuel-based heaters.**



\$87m total cost over 14-year service lifecycle

Since BEBs do not require continuous exposure to an energized power source, they present **less safety risk to the public and staff.** High voltages are only present in the very confined area of the overhead charging system. The large on-board battery packs can pose a fire risk but this can be effectively managed with additional training and emergency preparedness plan.



With recent advancements in battery range, BEBs present an opportunity to **expand zero-emissions service more broadly** and support systemwide flexibility.



On-board diesel heaters on BEBs would consume an estimated 14,300 gallons of diesel per year resulting in **146 tons of CO₂ emissions.**



Total Lifecycle Cost compared

As part of the Bus Modernization program, MBTA evaluated the next generation of vehicles serving Route 71 and 73 out of the North Cambridge Garage.

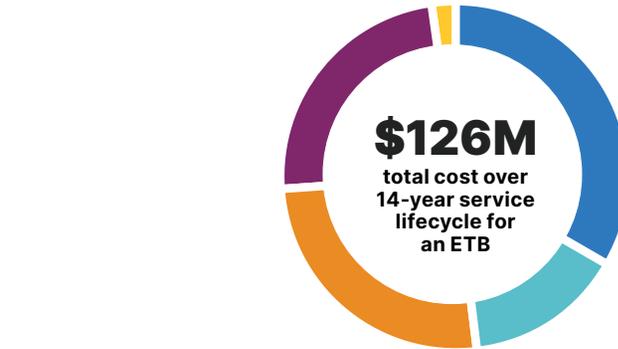


Market Direction

Transit agencies across North America are more widely adopting BEBs, as compared to ETBs, which will result in better support from industry and availability of skills and parts. In addition, the cost of batteries is expected to continue to drop in the coming years.

Standardized Fleet

MBTA is planning on replacing diesel buses with BEBs as it upgrades its other garages. Having a consistent fleet across the system allows the MBTA to freely redeploy personnel and vehicles across the different garages as required, leverage volume purchase ability to get better pricing on parts and components, and standardize and share maintenance resources.



■ Operations

■ Infrastructure Maintenance

■ Infrastructure Capital

■ Vehicle Maintenance

■ Vehicle Capital

\$2.6M in electricity, which includes utility demand charges, and diesel cost associated with operating diesel-hybrid buses during ETB outages. The cost also accounts for support during during ETB outages and running de-icing service in winter months

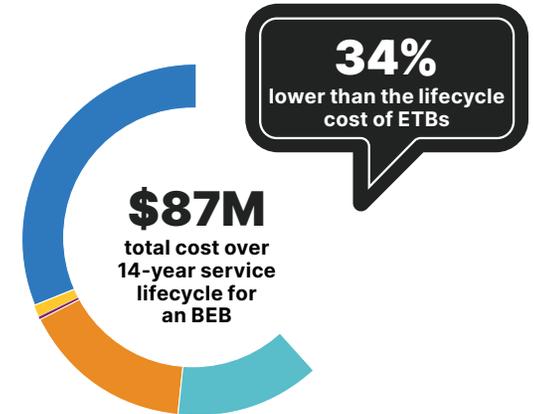
\$30M for the upkeep of the OCS including contact wires, span wires, arm, OCS poles, tree limb removal etc. The estimates are based on the available historic data

\$33M for the design and construction cost of upgrading the existing OCS system and power substation to a state of good repair

\$18M for the material and labor cost associated with the regular upkeep of the ETBs.

\$42M to purchase new vehicles and a mid-life overhaul

Net Present Value for the ETBs Compared to BEBs



\$1.5M in electricity cost to charge the BEBs and diesel cost associated with operating on-board diesel heater during extreme winter months.

\$0.26M for the upkeep of the charging infrastructure including regular filter replacement, contact rail replacement, power supply replacement, etc. The estimates are based on manufacturer recommended maintenance procedure

\$20M to purchase, design and install charging system and related electrical equipment. Also includes cost for removing the OCS system.

\$17M for the material and labor cost associated with the regular upkeep of the BEBs and the on-board diesel heaters.

\$48M to purchase new vehicles, a mid-life overhaul, battery replacement every four years and battery disposal costs.

When evaluating the total cost considerations of a BEB and an ETB, BEBs have greater overall benefits to MBTA, its passengers, and the surrounding community than ETBs.