



EFFECTIVENESS OF WIRELESS CHARGING FOR ELECTRIC TRANSIT BUSES: AN INDUSTRY REPORT

Background

In response to a federal mandate, the Federal Transit Administration (FTA) directed CALSTART to conduct literature research and qualitative interviews to study the effectiveness of wireless charging as an alternative to wired charging, including recommendations for deploying wireless charging for public transportation.

Wireless charging, also known as inductive charging, is a type of power transfer used to charge a vehicle without a physical connection. While standards for high-power wireless charging do not currently exist, the SAE International standard for high-powered wireless charging (J2954-2) is under development and is expected to be released in late 2025 or early 2026. High-powered wireless charging for transit buses is not widely deployed not is there a robust standards regime in the U.S. Standards in development by the Society of Automotive Engineers (SAE) are not fully adopted or implemented.

Wireless charging, an option for on route charging, can be deployed at depots where space constraints preclude the installation of plug-in charging. This report outlines the effectiveness of wireless charging as an alternative to wired charging for transit by examining the availability, capability, and limitations of both charging types. Current battery electric bus (BEB) range limitations indicate that reliable on route charging may prove necessary for BEBs to be viable one-to-one replacements for fossil fuel buses.

Objectives

CALSTART examined potential barriers to wireless charging technology for public transit and developed recommendations for further research and knowledge sharing. Researchers gathered qualitative data from multiple sources and conducted research and review of literature to understand the current state of the technology and industry standards.

This report includes an analysis of:

1. Wireless charging including industry standards, advantages, and disadvantages.
2. Transit agency feedback including current practices and experiences, lessons learned from deployments, as well as barriers to charging.
3. Charging company feedback including market segmentation, barriers to funding, standards and interoperability, and education.
4. Vehicle equipment manufacturer feedback including discussion from the point of view of manufacturers experienced with wireless technology compared to those without such experience, standards and interoperability, and the market for wireless technology.
5. Research findings and potential actions to reduce barriers to the adoption of wireless charging technology for transit agencies interested in integrating the technology into their fleets.

Findings and Conclusions

CALSTART's research indicates that high-power wireless can effectively fulfill certain specific use cases. Some fleets might be able to use it as the primary source of charging, while most fleets will use it for on route charging to extend the range of a BEB. However, challenges such as space constraints, disruptions to operations during equipment installation, and variability in uptime experiences and across manufacturers need to be overcome.

High-power inductive charging standards are needed to increase market adoption. Setting of standards in conjunction with other standards committees nationally or internationally can accelerate the process and standards for interoperability across equipment providers. It can reduce the risk of stranded assets if a manufacturer goes out of business. Until standards are developed by both the BEB OEMs and the wireless charging manufacturers, transit agencies are generally unwilling to invest significantly in high-power wireless charging technology.

CALSTART's study identifies several key points that may inform implementation recommendations to reduce barriers in the adoption of wireless charging technology for transit agencies:

1. **Funding:** Adding wireless charging equipment is an expensive undertaking. The primary cost drivers are the necessary software integration and any additional land purchase or right-of-way permitting related to installing the charging infrastructure on route.
2. **Nascent Technology:** Wireless charging must be adopted at scale to realize the benefits of reliable wireless charging. Transit vehicle OEMs and fleets have reported concerns regarding the potential dissolution of wireless charger purveyors, which could result in stranded assets.
3. **Education:** Additional research, including more case studies and best practice reports, can help the industry make informed decisions about the benefits of wireless vehicle charging options, such as their potential space efficiency and reduced human involvement in charging.

Benefits

CALSTART's research indicates that high-power wireless charging has the potential to resolve space constraints at depots where plug-in charging may not be an option. Wireless charging minimizes the ground-level infrastructure footprint in bus depots and transit facilities. Reliable en-route charging may be necessary for BEBs to be viable one-to-one replacements for fossil fuel buses.

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