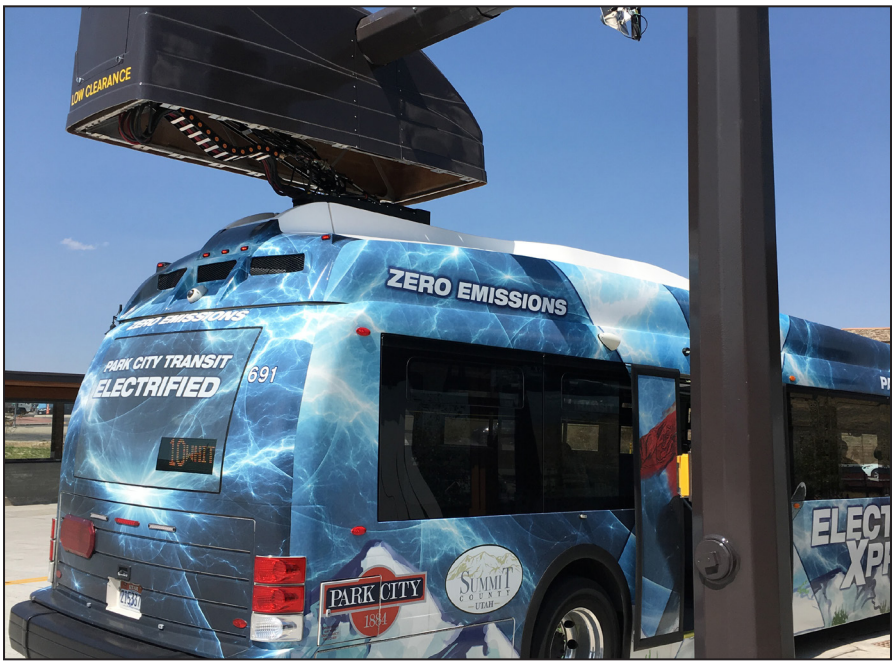
MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 18-359 (project 513) | August 2018

Optimal Deployment of Wireless Charging Facilities for an Electric Bus System



the ISSUE

Wireless charging technology, also called inductive charging, an application of wireless power transfer (WPT), offers the promise of eliminating the range problem of electric vehicles (EVs). To enable dynamic wireless charging for an electric bus system, wireless charging facilities must be built strategically in the road network.

the RESEARCH

Battery electric buses with zero tailpipe emissions have great potential in improving environmental sustainability and livability of urban areas. However, the problems of high cost and limited range associated with on-board batteries have substantially limited the popularity of battery electric buses. The technology of dynamic wireless power transfer (DWPT), which provides bus operators with the ability to charge buses while in motion, may be able to effectively alleviate the drawbacks of electric buses. In this study, we address the problem of simultaneously selecting the location of the DWPT facilities and designing the battery sizes of electric buses for a DWPT electric bus system. The problem is first constructed as a deterministic model in which the uncertainty of energy consumption and travel time of buses is neglected. The methodology of robust optimization (RO) is then adopted to address the uncertainty. Numerical studies demonstrate that the proposed deterministic model can effectively determine the allocation of DWPT facilities and the battery sizes of electric buses for a DWPT electric bus system; and the robust model can further provide optimal designs that are robust against the uncertainty of energy consumption and travel time for electric buses.

MOUNTAIN-PLAINS CONSORTIUM REGION 8

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North Dakota State University
South Dakota State University
University of Colorado Denver
University of Denver
University of Utah
Utah State University
University of Wyoming

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Project Title

Optimal Deployment of Wireless Charging Facilities for an Electric Bus System

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the **FINDINGS**

Both the deterministic model and the robust model are tested with numerical examples. The results demonstrate that our deterministic model can effectively solve the planning problem of a DWPT electric bus system with several overlapping lines, and that the optimal design reduces the battery size as well as the total cost of the electric system dramatically. The comparison between the solutions of the deterministic model and those of the robust model under the worst-case scenario demonstrate that the RO approach provides solutions that are robust against parameter uncertainties.

the **IMPACT**

The DWPT electric bus system, which is clean and sustainable, could be widely adopted in the near future. The proposed modeling framework in this study provides practitioners with an effective tool to determine the optimal allocation of DWPT facilities as well as the battery size of each bus line for a DWPT electric bus system.

For more information on this project, download the entire report at http://www.ugpti.org/resources/reports/details.php?id=920

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.