



## RESEARCH BRIEF

# Providing the Spark: Impact of Financial Incentives on Battery Electric Vehicle Adoption

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*To spur investment in zero-emitting battery electric vehicles (BEVs), the US federal government, many states, and some municipalities and utilities offer incentives for the adoption of BEVs. We examine one tool at policymakers' disposal for reducing the retail price gap between BEVs and ICEVs: direct financial incentives for consumers that purchase BEVs. Our analysis estimates that state-level subsidies in the form of vehicle purchase rebates were responsible for an 11 percent increase in overall BEV registrations in the United States from 2011 to 2015—an 8 percent increase per \$1,000 of incentive<sup>1</sup>. In an extension of our analysis, we derive estimates of program costs and emissions benefits from existing incentive programs.*

Battery electric vehicles (BEVs) offer one pathway to reducing emissions from light duty vehicles; however, BEVs are generally more expensive than their internal combustion engine vehicle (ICEV) counterparts, due in large part to the current cost of batteries. National and subnational entities around the world offer incentives to BEV adopters in an effort to narrow this price gap between BEVs and ICEVs. Are these policies effective in driving BEV purchases? Does the format of the incentive matter to prospective buyers? In this study, we examine the use of vehicle rebates and consumer tax credits for BEVs. We analyze a data set of vehicle registrations and incentive offerings to quantify the role that these incentives have on vehicle purchases in the United States.

Controlling for the availability of vehicle charging infrastructure, fuel price levels, and local demographics, our analysis demonstrates a measurable increase in BEV adoptions in the presence of state-level purchase incentives. Specifically, we estimate that from 2011 to 2015 state-level incentives increased adoption 11 percent, or 7 percent per \$1,000 of incentive value offered. Examining these trends by incentive type, our results indicate that vehicle rebates have significant effects on BEV adoption levels (8 percent per \$1,000 of incentive). Our estimates did not identify a positive effect for incentives offered as tax credits, though we caution that the lack of significant findings may be a result of limited policy variation in our data. Additionally, we allowed effects to differ

across vehicle type, focusing on differences between purchases of Tesla models and non-Tesla models. We found no evidence that response levels differed based on the vehicle make that consumers ultimately purchased.

As decarbonization benefits are a commonly-cited rationale for transportation sector electrification, we use our results to derive preliminary estimates of welfare effects of these policies. We employ existing measures of regional emissions damages in the US to compare total program costs to estimated environmental benefits<sup>2</sup>. As one would expect, aggregate environmental benefits are highest in regions with cleaner (i.e., lower-emitting) electricity generation, however program costs—in particular, the level of free-ridership—outweigh these estimated benefits in all states that offer rebates. The decreasing emissions intensity of electricity generation in the US as well as additional benefits associated with

increased adoption, such as long-term market growth, economies of scale advantages, network externalities, and accelerated innovation, could substantially affect net welfare outcomes.

Results of this analysis highlight three important observations about the future of transportation sector electrification: (i) incentives that mitigate the price disparity between BEVs and ICEVs are effective means to promote BEV adoption; (ii) within our sample, direct vehicle rebates appear most effective in driving new BEV registrations; and (iii) BEV adoption incentives as an instrument to solely achieve near-term carbon emission reductions should be carefully considered in the context of the emissions intensity of generation and against other instruments. This last point illustrates the importance of undertaking further work to quantify non-emissions consequences of BEVs and hence providing a more complete picture of their benefits and costs.

## References

- [1] Clinton, Bentley C. and Daniel C. Steinberg. 2019. "Providing the Spark: Impact of Financial Incentives on Battery Electric Vehicle Adoption." MIT CEEPR Working Paper 2019-015.
- [2] Holland, Stephen P., Erin T. Mansur, Nicholas Z. Muller, and Andrew J. Yates. 2016. "Are There Environmental Benefits from Driving Electric Vehicles? The Importance of Local Factors." *American Economic Review*, 106(12): 3700–3729, <http://dx.doi.org/10.1257/aer.20150897>

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## About the Authors



Bentley Clinton is a Postdoctoral Associate with the MIT Energy Initiative (MITEI) specializing in economic analysis of energy markets. His research focuses on current and future trends toward deep decarbonization in the electric power sector and on quantifying the challenges and opportunities for expanded electrification of transportation networks. Ben previously served as a researcher at the National Renewable Energy Laboratory studying transportation economics and policy, and a Senior Analyst at Analysis Group where he specialized in issues of energy, environmental, and antitrust economics.



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