MIT CEEPR

MIT Center for Energy and Environmental Policy Research

RESEARCH BRIEF

Policies for Electrifying the Light-Duty Vehicle Fleet in the United States

Cassandra Cole, Michael Droste, Christopher R. Knittel, Shanjun Li, James H. Stock

The decarbonization of the light-duty vehicle (LDV) fleet in the United States is an important policy priority for the coming decades. Government policy has the potential to accelerate the transition of the LDV fleet to electric vehicles. We consider several forms of government policy: subsidized construction of charging stations, refundable tax credits for electric vehicles, and a tradable permit system for vehicle manufacturers. Our objective is to evaluate forms of these policies that are capable of achieving a target 50% sales share of zero emissions vehicles by 2030. Our results indicate that charging station subsidies are extremely effective relative to alternative proposals, as measured by impact for a given fiscal expenditure.

The decarbonization of the light duty vehicle (LDV) sector is a major policy priority in the United States. In 2019, 58% of U.S. transportation carbon emissions arose from the operation of LDVs. The Biden Administration has declared a target of 50% new vehicle sales in 2030 consisting of zero-emissions vehicles: battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs) and hydrogen fuel cell vehicles. In Europe, the UK government has announced an even more aggressive ban on the sale of new gasoline and diesel cars and vans in 2030, with hybrid cars and vans phased out by 2035.

As automakers increase their production of electric vehicles and components – notably electric batteries – to meet these goals, replacing conventional internal combustion engine (ICE) vehicles with EVs appears to be the most promising pathway for decarbonizing LDVs in the near future. Moreover, doing so increasingly appears economically feasible: prices of lithium-ion battery packs decreased by 16% annually between 2017 and 2019, with average battery prices reaching $137/kWh and reports of some battery packs reaching less than $100/kWh in 2020. Yet deep EV penetration is not a certainty, and policy may play an important role in expediting and supporting the transition. To this end, a variety of policies have been

proposed to spur electrification of the US EV fleet. Broadly, these include building charging infrastructure, subsidizing the costs of purchasing or driving EVs, and regulatory approaches that use existing legal authorities of the Environmental Protection Agency (EPA) to regulate CO2 emissions and the Department of Transportation (DOT) to regulate the fuel economy.

In order to evaluate this suite of policies for expediting electrification of the LDV fleet, we applied a joint model of charging station supply and EV demand. We then simulate the diffusion path of EVs under different policy scenarios including refundable tax credits, charging station subsidies, and tradeable allowances, and varied the size of the subsidies and total program budgets for both vehicles and charging stations to obtain the share of battery EVs, the reduction in greenhouse gases, and total governmental outlays.

Specifically, the three policies we evaluated are as follows: (1) government-subsidized production of new charging stations through a cost-sharing program in which the government pays a percentage subsidy to each charging station built until the federal budget allocation is spent, at which point the program ends; (2) a rebate for the purchase of electric vehicles that reduces the sticker price of electric vehicles, reducing the price of EVs relative to ICEs through a point-of-sale rebate to the consumer, a point-of-sale dealer rebate, or a refundable tax credit; (3) and a policy that sets both the fuel efficiency of ICE vehicles and mandates the fraction of EVs sold, both by class of vehicle.

Based on the application of the model to these policies, we make two important findings. First, there is a great deal of heterogeneity (in terms of impact on EV penetration per dollar of government expenditure) across the policies studied. Second, none of the three policies studied in isolation is capable of reaching 50% EV penetration in the market for new vehicles without a very large price tag; instead, a combination of policies is likely to provide the most impact on EV penetration.

Two reasons are cited to explain these conclusions. First, for individuals who cannot install their own chargers, for example because they park on a street or live in an apartment building, buying an EV simply is not an option, regardless of how deep the subsidy is. For them, providing additional charging stations makes it possible to purchase an EV. Even for consumers who have their own personal charging stations, the current low density of on-the-road level 3 chargers makes long-distance travel challenging at best. For them, additional level 3 chargers reduce range anxiety and make it possible to use EVs in the way that drivers now use ICEs.

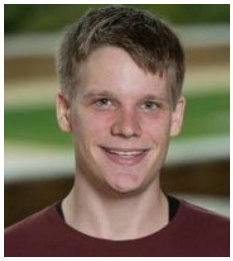
Second, much of spending on tax credits is inframarginal; it consists of transfers to individuals who would have purchased an electric vehicle whether or not the tax credit we study exists. And although individuals are highly responsive to changes in the relative price of cars or electric vehicles, an appreciably large subsidy for EV purchases would amount to hundreds of billions of dollars in government transfers.

References

Cole, C., M. Droste, C. R. Knittel, S. Li, and J. H. Stock (2021), “Policies for Electrifying the Light-Duty Vehicle Fleet in the United States,” MIT CEEPR Working Paper 2021-014, September 2021.

About the Authors

Cassandra Cole is a PhD student in Public Policy at Harvard University. Cassandra is interested in climate change and environmental issues, particularly in developing countries. Prior to beginning at Harvard, she was a research assistant at the Federal Reserve Bank of Philadelphia, where she worked in the consumer finance section of the research department. Cassandra has a Bachelor of Science in Applied Mathematics-Economics from Brown University.



Michael Droste is a Ph.D. candidate in economics at Harvard University. He has broad research interests in macroeconomics, public finance, and applied econometrics

Christopher R. Knittel is the George P. Shultz Professor of Applied Economics at the Sloan School of Management, Director of the Center for Energy and Environmental Policy Research, and Co-Director of the MITEI Low-Carbon Energy Center for Electric Power Systems Research at the Massachusetts Institute of Technology. He joined the faculty at MIT in 2011, having taught previously at UC Davis and Boston University. Professor Knittel received his B.A. in economics and political science from the California State Uniersity, Stanislaus in 1994 (summa cum laude), an M.A. in economics from UC Davis in 1996, and a Ph.D. in economics from UC Berkeley in 1999. His research focuses on environmental economics, industrial organization, and applied econometrics.

Shanjun Li is a Professor of Applied Economics and Policy and holds Kenneth L. Robinson Chair in the Dyson School of Applied Economics and Management at Cornell University. He serves as the co-director of Cornell Institute for China Economic Research (CICER). He is a research associate at the National Bureau of Economic Research (NBER) and a university fellow at Resources for the Fu-ture (RFF). His research areas include environmental and energy economics, urban and transportation economics, empirical industrial organization, and Chinese economy.

James H. Stock is Vice Provost for Climate and Sustainability, Harvard University; the Harold Hitchings Burbank Professor of Political Economy, Faculty of Arts and Sciences; and a member of the faculty at the Harvard Kenne-dy School. His current research includes energy and environmental economics with a focus on fuels and on U.S. climate change policy. He is co-author, with Mark Watson, of a leading undergraduate econometrics textbook. In 2013-2014 he served as Member of President Obama's Council of Economic Advisers, where his portfolio includ-ed macroeconomics and energy and environmental policy. He was Chair of the Harvard Economics Department from 2007-2009. He holds a M.S. in statistics and a Ph.D. in economics from the University of California, Berkeley.
