



Reply to Gagnon et al.: Short-run estimates vs. long-run conjectures

Stephen P. Holland^{a,b} , Matthew J. Kotchen^{b,c,1}, Erin T. Mansur^{b,d} , and Andrew J. Yates^e

Gagnon et al. (1) provide a useful reminder of the distinction between “short-run” and “long-run” estimates and their applicability for policy analysis. In our recent article (2), we estimate marginal CO₂ emissions of changes in electricity load in the United States for each year 2010–2019. Our primary contribution is to show that while average emissions declined substantially, marginal emissions have increased. To illustrate applicability of our estimates, we then use them to forecast how the Biden administration’s electric vehicle (EV) sales target might change emissions in 2030.

Gagnon et al. (1) suggest that we have not sufficiently characterized our estimates as being short run and therefore conditional on the existing sources of electricity generation and transmission capacity. While we do not explicitly use the term short run, this is how we interpret the results and why we qualify the forecasting exercise four times in the paper as dependent on “no significant and concurrent changes in the electricity sector.” Gagnon et al.’s (1) comment is a helpful clarification that the phrase we employ means the conditions of short-run analysis in this context.

They also point to previous papers that do emphasize this point in greater detail (3, 4) and upon which our paper builds. We would add to this list another reference (5) that first developed the approach for econometric estimates of marginal emissions and is the paper for which we provide updated estimates for CO₂. That paper concludes with the observation that “the general methodology holds the fuel mix for electricity generation constant and as such should be used for short- to medium-run analyses... a long run analysis should also attend to the endogenous changes in fuel mix as well as upgrades and replacements of existing electricity generating units” (p. 265).

There is, however, an inescapable degree of subjectivity in how researchers define short- or long-run analysis in applied work. Our view in the PNAS paper (2) is that a decade

hence is reasonable to interpret as short run for the type of calculations we provide on the 2030 EV target. Indeed, the fundamental insight of our paper is that marginal emissions have remained relatively constant—and even increased—over the last decade despite unprecedented changes in how electricity is generated. The shift from coal to natural gas and to other low-emission sources of energy has not brought down marginal emissions.

Will the next 10 y be very different? We remain skeptical as long as coal and natural gas remain part of the generation mix. That is why we emphasize that the full promise of EVs for reducing emissions depends on complementary policies that decarbonize both average and marginal emissions in the electricity sector. The approach that Gagnon et al. (1) advance as long-run analysis differs because they assume that an array of complementary policies take place, along with other modeled results about precisely when electricity is generated and how it is dispatched. Rather than argue in favor of one approach or the other—use of short-run estimates vs. long-run conjectures—we believe that there is room for both. A range of possible impacts is most informative when needing to make predictions about an uncertain future.

Author affiliations: ^aDepartment of Economics, Bryan School of Business and Economics, University of North Carolina at Greensboro, Greensboro, NC 27402-6170; ^bNational Bureau of Economic Research, Cambridge, MA 02138-5398; ^cSchool for the Environment, Yale University, New Haven, CT 06511; ^dTuck School of Business, Dartmouth College, Hanover, NH 03755-3514; and ^eDepartment of Economics, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599

Author contributions: S.P.H., M.J.K., E.T.M., and A.J.Y. wrote the paper.

The authors declare no competing interest.

Copyright © 2022 the Author(s). Published by PNAS. This article is distributed under [Creative Commons Attribution License 4.0 \(CC BY\)](https://creativecommons.org/licenses/by/4.0/).

¹To whom correspondence may be addressed. Email: matthew.kotchen@yale.edu.

Published November 28, 2022.

1. P. Gagnon, J. Bistline, M. Alexander, W. Cole, Short-run marginal emissions rates omit important impacts of electric-sector interventions. *Proc. Natl. Acad. Sci. U.S.A.* **119**, e2211624119 (2022).
2. S. Holland, M. Kotchen, E. Mansur, A. Yates, Why marginal CO₂ emissions are not decreasing for US electricity: Estimates and implications for climate policy. *Proc. Natl. Acad. Sci. U.S.A.* **119**, 11 (2022).
3. S. Holland, E. Mansur, N. Muller, A. Yates, Are there environmental benefits from electric vehicles? The importance of local factors. *Am. Econ. Rev.* **106**, 3700–3729 (2016).
4. S. Holland, E. Mansur, N. Muller, A. J. Yates, The environmental benefits of transportation electrification: Urban buses. *Energy Policy* **148**, 111921 (2021).
5. J. Graff Zivin, M. Kotchen, E. Mansur, Spatial and temporal heterogeneity of marginal emissions: Implications for electric cars and other electricity-shifting policies. *J. Econ. Behav. Organ.* **107**, 248–268 (2014).