Zero-Emission Vehicles? Not Without Climate Policy.

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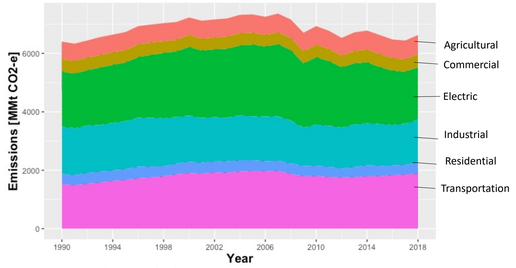
Federal, state, and corporate stakeholders are shifting from gas and diesel vehicles to electric powertrains to reduce emissions.

From 1990 to 2018, greenhouse gas emissions in the transportation sector rose nearly 25%.[1]



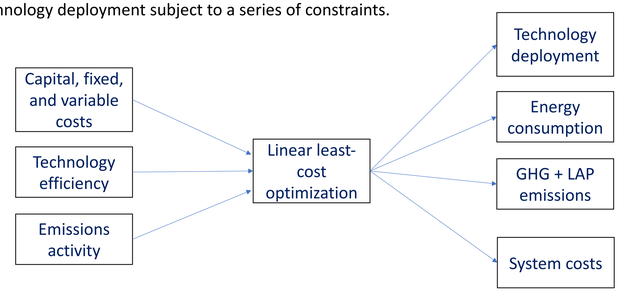
To address rising transportation emissions, corporate stakeholders have started committing to producing only zero-emission vehicles and state and federal governments have begun adopting zero-emission vehicle (ZEV) standards.

Without comprehensive climate policy to reduce electric-sector emissions, however, battery electric and hydrogen fuel cell vehicles will not be "zero-emission." In fact, under the current grid mix, an EV may be worse for GHG emissions than a very efficient gasoline car.[2]

I explore how we can achieve deep reductions in economy-wide emissions by combining policy instruments in the transportation and electric sectors.

Methods

We use Temoa, the Tools for Energy Model Optimization and Analysis[3], to simulate the effects of standalone policies and policy interactions on system-wide greenhouse gas (GHG) and local air pollutant (LAP) emissions. Temoa finds the least-cost solution by optimizing fuel use and technology deployment subject to a series of constraints.

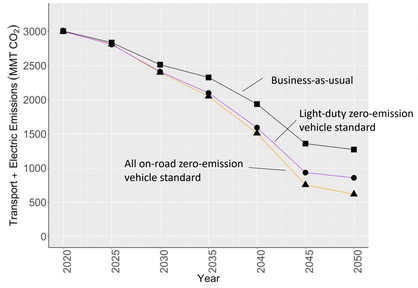


Modeled Standalone Policy Instruments:
1) Zero-emission vehicle standards: 50% of sales by 2030, 100% by 2050
   a) Light-duty vehicles
   b) All on-road (cars, trucks, buses)
2) Clean electricity standard: 80% clean by 2030, 100% by 2050
3) Economy-wide carbon tax: $50/ton

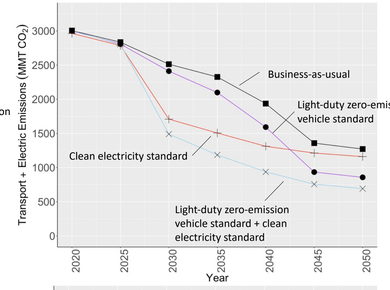
Modeled Policy Interactions:
1) Light-duty zero-emission vehicle standard + clean electricity standard
2) Light-duty zero-emission vehicle standard + economy-wide carbon tax
3) All on-road zero-emission vehicle standard + clean electricity standard

Without climate policy, vehicle electrification does not achieve deep decarbonization.

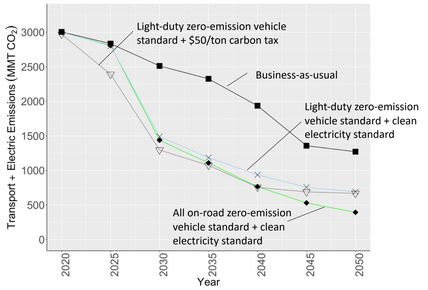
When designing zero-emission vehicle standards, **including medium- and heavy-duty vehicles** increases abatement potential.



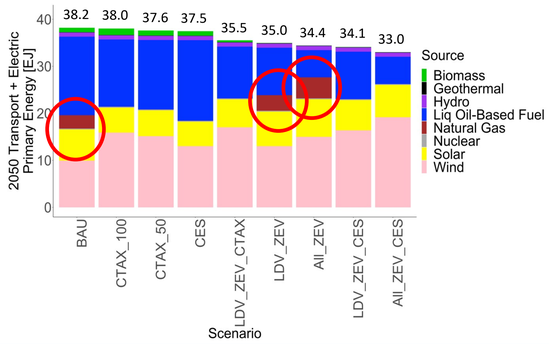
A clean electricity standard leads to steep emissions declines in 2030-2040, but **without policies that encourage electrification, emissions reductions level off by 2040.**



A combined carbon tax and light-duty zero emission vehicle standard leads to similar cumulative emissions reductions as a clean electricity standard + an all on-road ZEV standard. However, due to the **high cost of decarbonizing the transportation sector,** emissions reductions in 2045 and 2050 are greater when the modeled policy instrument **mandates additional electrification** rather than continuing to tax.



Under a standalone zero-emission vehicle standard, natural gas generation increases to meet elevated electricity demand.



By 2050 under ZEV standards, the model uses **over 2,400 TWh of electricity** for vehicle charging. In 2019, total US electricity use was only 3,954 TWh[4].

Impacts to Infrastructure and US Electricity Consumption

Using charger capacities from NREL[5], we estimate that 13 million L2 and 590,000 DCFCs may be required to serve electrified light-duty vehicles under the modeled zero-emission vehicle standards.

Conclusions and Policy Implications

- A carbon tax + ZEV standard leads to the lowest cumulative emissions of the modeled scenarios, but reductions plateau in later years, **indicating potentially diminishing benefits from the tax.**
- **A clean electricity standard complements electrification standards in the transportation sector**. Under a standalone light-duty zero emission vehicle standard, transportation and electric sector emissions fall only 8% compared to the BAU. Adding a clean electricity standard leads to 27% lower emissions than the BAU. With a standalone all on-road ZEV standard, emissions fall 11%, while a combined all on-road ZEV + clean electricity standard leads to 31% lower emissions than the BAU.
- We recommend including all on-road vehicles in any zero-emission vehicle standard to maximize emissions abatement.
- **Policymakers could implement additional policies in other sectors to achieve greater emissions reduction**, such as minimum electrification standards in commercial and residential buildings. We show the efficacy of sector-specific technology standards in the transportation sector; additional work is necessary to explore synergistic emissions reductions in other economic sectors.

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