



THE ELECTRIC CEILING: LIMITS AND COSTS OF FULL ELECTRIFICATION

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*THE VIEWS EXPRESSED HERE ARE MY OWN AND DO NOT NECESSARILY
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Electrification: centerpiece of the energy transition

- Yet reasons to be skeptical about inevitability, or at least optimal pace, of the transition.
- Several under-appreciated costs of full, or even deep, electrification
- 2 categories:
 - Private costs (incurred by potential EV owners)
 - Public costs (exacerbated by policies attempting to overcome private costs)
- Costs of attempting to mitigate GHGs via electrification may rise sharply at some as-yet-unknown level

Can there be “too much” electrification?

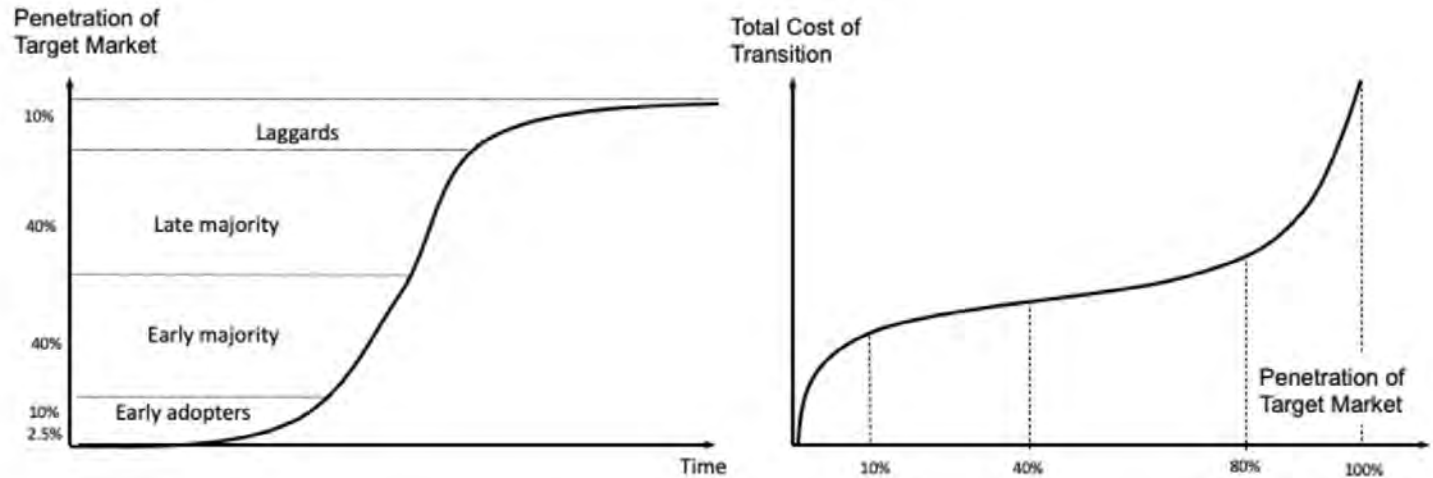
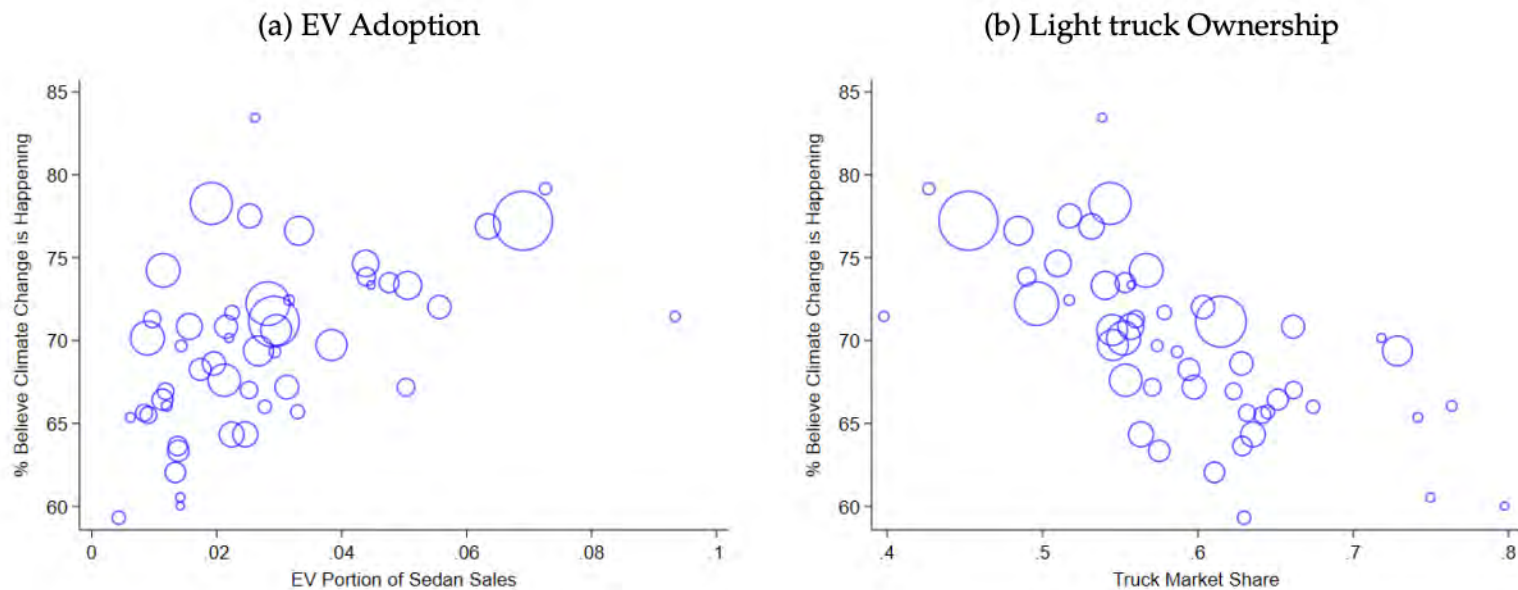


Figure 1: Adoption S-curve and marginal cost of adoption

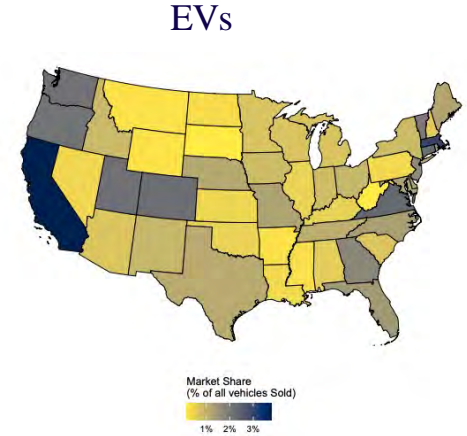
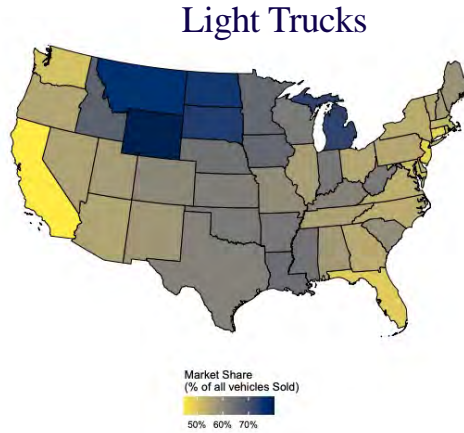
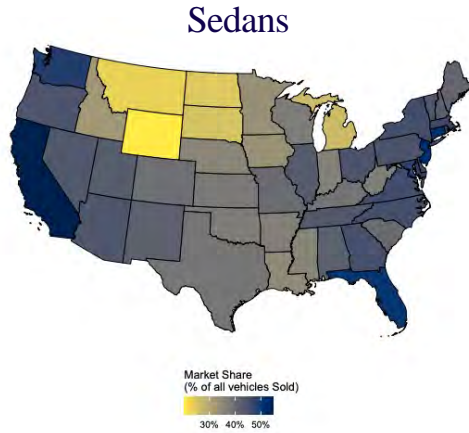
- Typically, electric alternative not (yet) dominant → mixed equilibrium
 - E.g. EVs, space heating

Private costs: heterogeneous preferences

Climate Change Beliefs vs Vehicle Choice

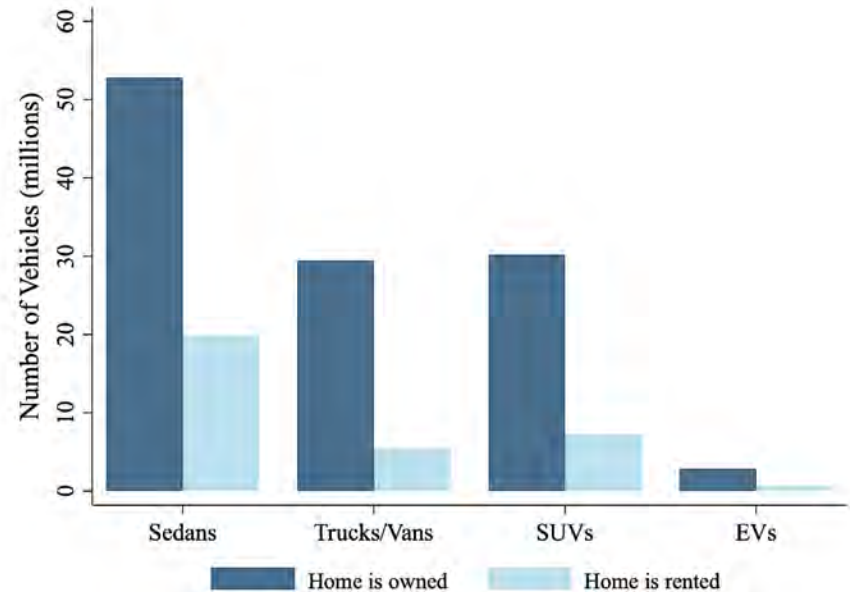


Market share by vehicle type (2017-18, Maritz)



Physical barriers

- At-home charging
 - MUDs comprise 31% of US housing
 - 1 in 6 EVs owned by renters
- Electricity service level
 - L2 charging requires >200amp service
 - ~20% of homes (est.) don't have this
 - Upgrade: \$1,000-\$2,500/hh
- Distribution system upgrades
 - \$200-\$2,000/hh (Brockway et al 2022)
 - Depends on ability to optimize demand over time and space

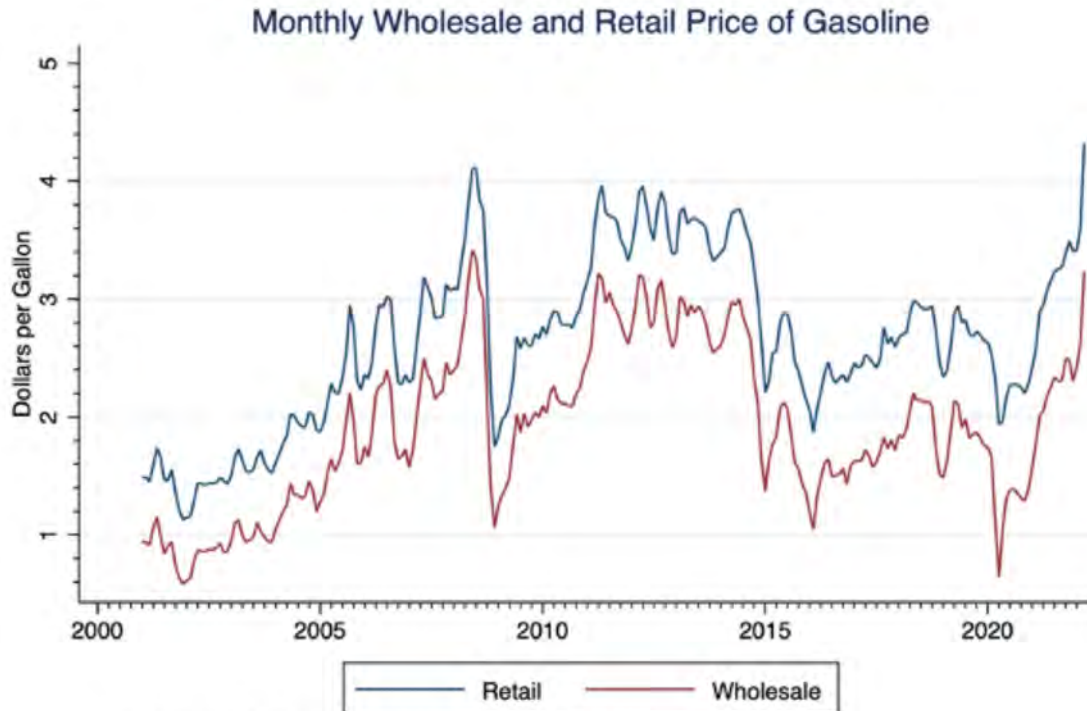


Source: NHTS 2017

Public costs

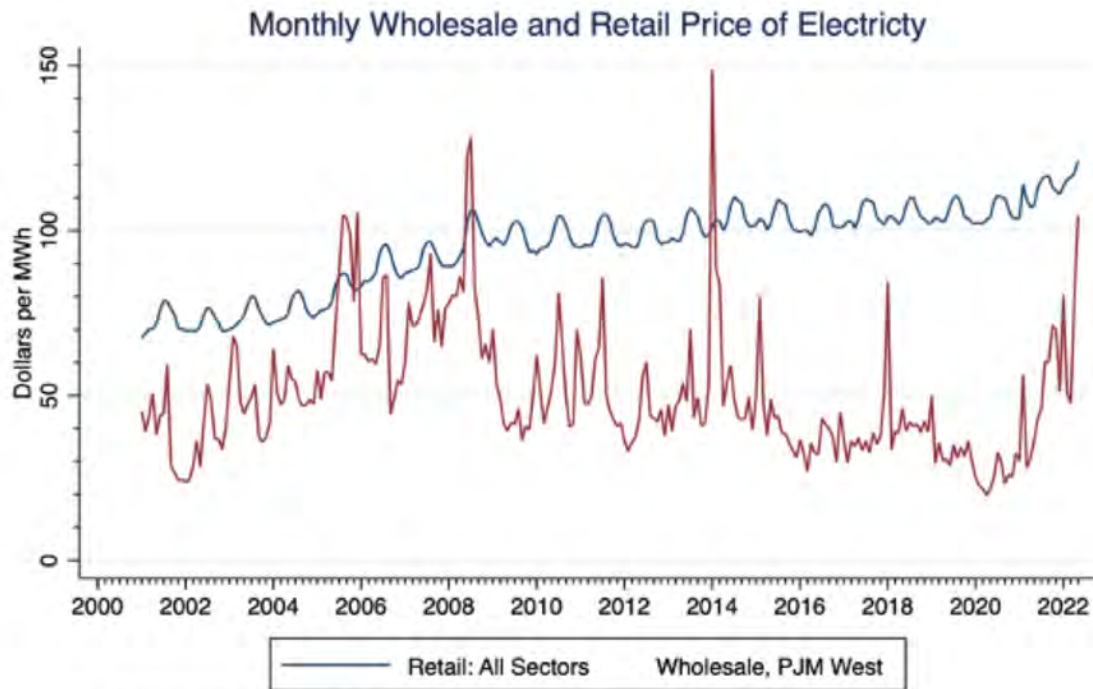
- Remaining CO₂ & local pollutants in electricity sector
 - US 60% gas + coal
- Relative inefficiency of electricity sector
- Non-carbon externalities

Electricity sector regulation shrouds price discovery



One segment of time = one quarter. Time: January 2001 - March 2022
Values are national averages across all grades and formulations. Source EIA

Electricity sector regulation shrouds price discovery



One segment of time = two months. Time: January 2001 - May 2022.
Retail price is national average of all customer classes, Wholesale Price
is from PJM West Intercontinental Exchange (ICE) trading hub.

Electricity pricing is relatively inefficient

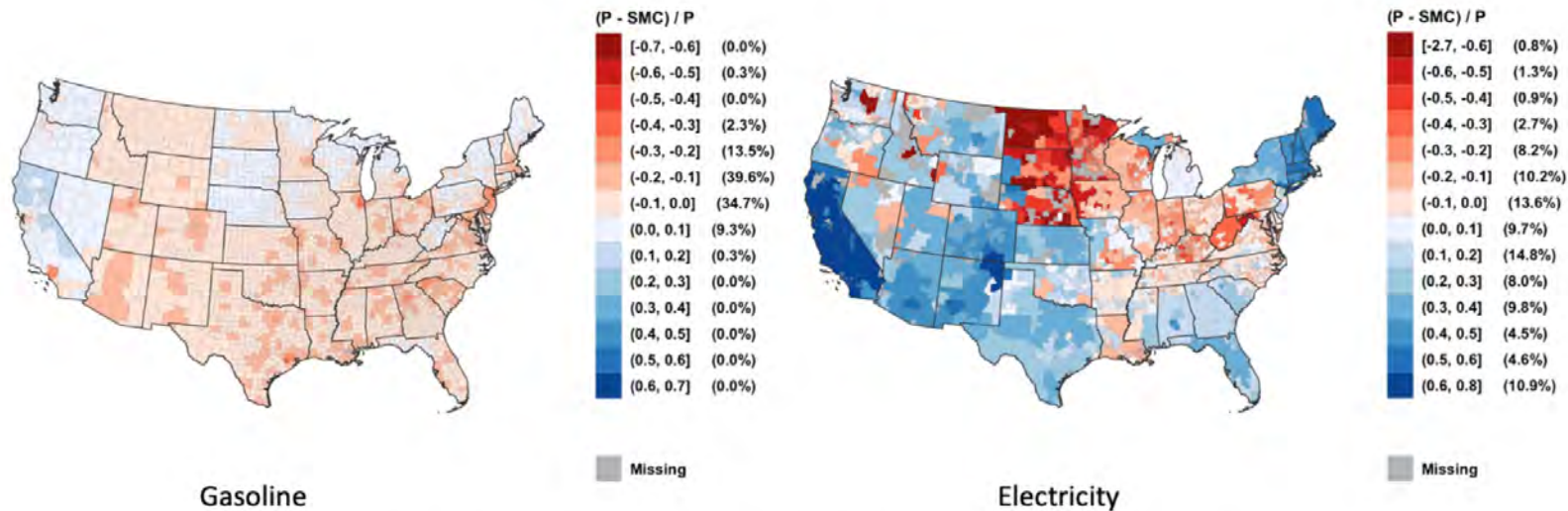
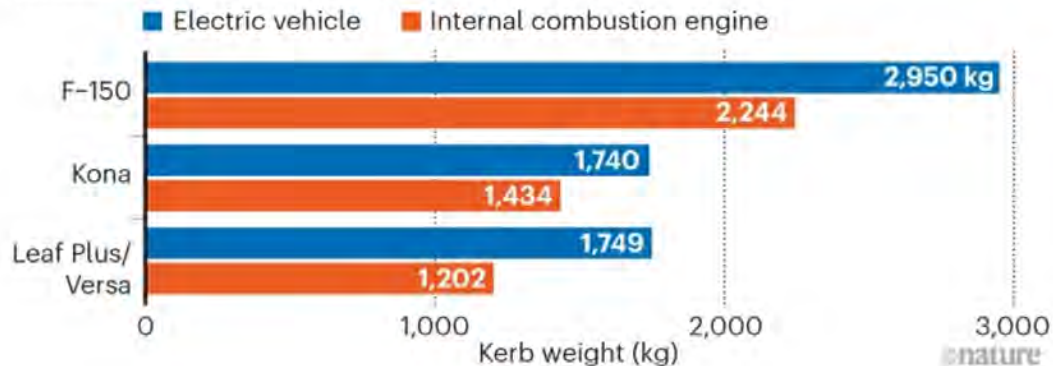


Figure 4: Relative Price Deviation from Social Marginal Cost

“Pounds that kill”

HEAVIER ELECTRIC FLEET

Bulky batteries and their supports mean electric vehicles weigh more than petroleum predecessors.



- VSL of lives lost from +700lb weight ≈ climate benefits of avoided GHG

What is the optimal mix of technologies?

- Full electrification requires changing the source of >80% of energy end uses in the US economy
- “All or nothing” mindset typically ignores optimality of $MC = MB$
- Cost of 100% electrification using today’s tech would exceed even extreme forecasts of SCC
 - Commitments to full electrification are therefore a bet on sector-specific, future innovation
- More likely that the optimal scenario has a mix of technologies

Rigid bans and mandates impose at least 2 risks

1. Drive up electricity costs rapidly, and risk undermining the electrification goal
 2. Foreclose more efficient, lower cost abatement pathways
- Important to retain flexibility
 - Cost containment
 - Alternative compliance mechanisms
 - Frequent re-evaluation
 - Market-based approaches likely to be increasingly important as electrification progresses

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