THE ELECTRIC CEILING: LIMITS AND COSTS OF FULL ELECTRIFICATION

DAVID RAPSON ® JAMES BUSHNELL

FEDERAL RESERVE BANK OF SAN FRANCISCO
CLIMATE CONFERENCE
NOVEMBER 4, 2022

THE VIEWS EXPRESSED HERE ARE MY OWN AND DO NOT NECESSARILY REPRESENT THE VIEWS OF THE FEDERAL RESERVE BANK OF DALLAS OR THE FEDERAL RESERVE SYSTEM.
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?

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

Figure 1: Adoption S-curve and marginal cost of adoption
Private costs: heterogeneous preferences

*Climate Change Beliefs vs Vehicle Choice*

(a) EV Adoption  
(b) Light truck Ownership

Source: Archsmith, Muehlegger & Rapson 2021
THE ELECTRIC CEILING

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

Sedans

Light Trucks

EVs

Source: Archsmith, Muehlegger & Rapson 2021
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
Electricity sector regulation shrouds price discovery
Electricity pricing is relatively inefficient

Figure 4: Relative Price Deviation from Social Marginal Cost

Source: Borenstein & Bushnell 2022
VSL of lives lost from +700lb weight ≈ climate benefits of avoided GHG

Source: Shaffer, Auffhammer & Samaras 2021
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
The Electric Ceiling

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