

Spatial Patterns of Electric Vehicle Accessibility in the United States

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Addressing the “**innovation-needs paradox**”:
The people most likely to benefit from a technology
are often the last ones to adopt it.

Data: 105M vehicle listings from ~60k dealerships (marketcheck.com)
(2016 - 2024, inclusive)

New Vehicles

Type	CV	HEV	PHEV	BEV
Car	13,927,982	885,351	132,823	354,163
SUV	28,005,232	1,101,007	182,339	852,760

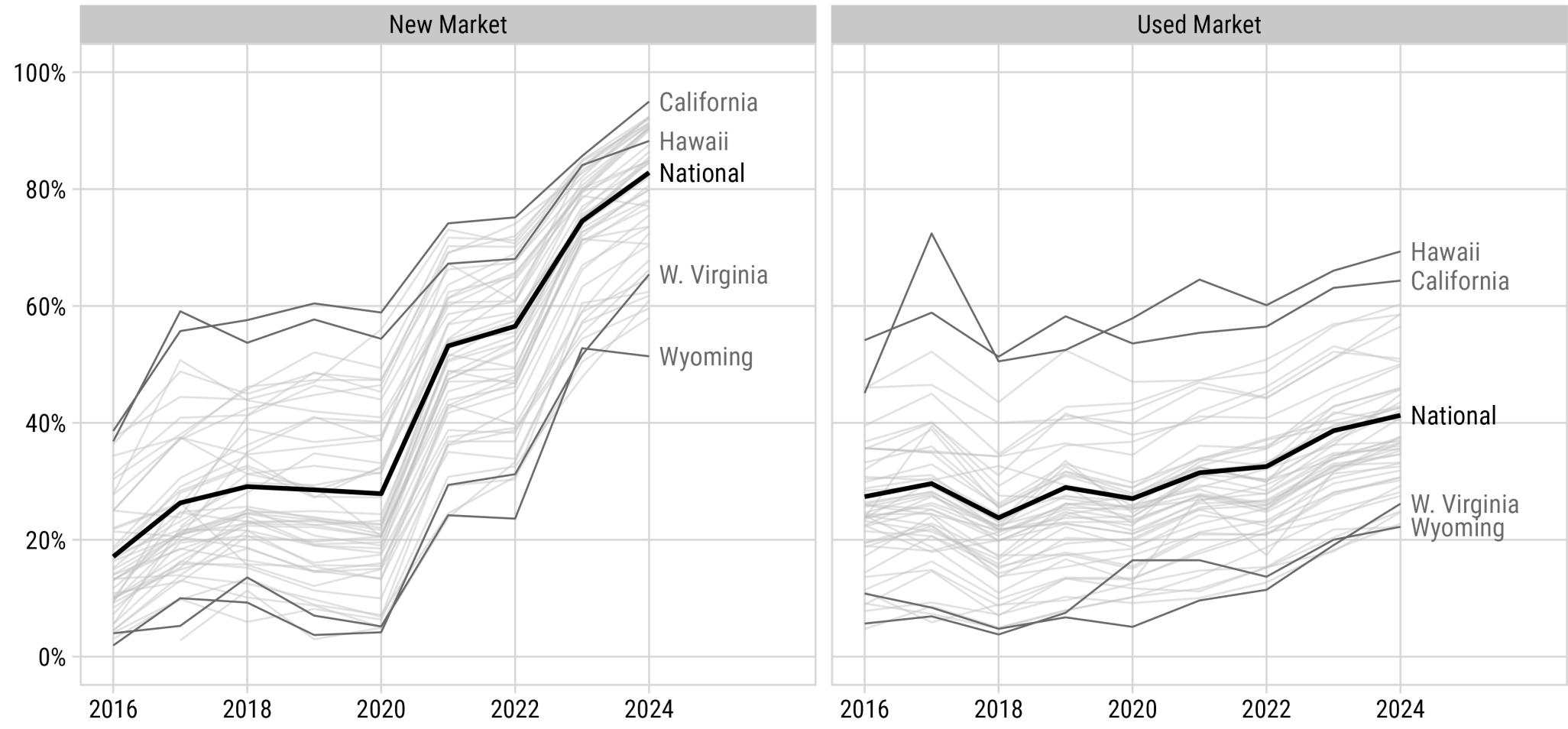
Used Vehicles

Type	CV	HEV	PHEV	BEV
Car	27,533,922	1,401,286	212,627	553,778
SUV	29,172,845	434,992	17,010	236,402

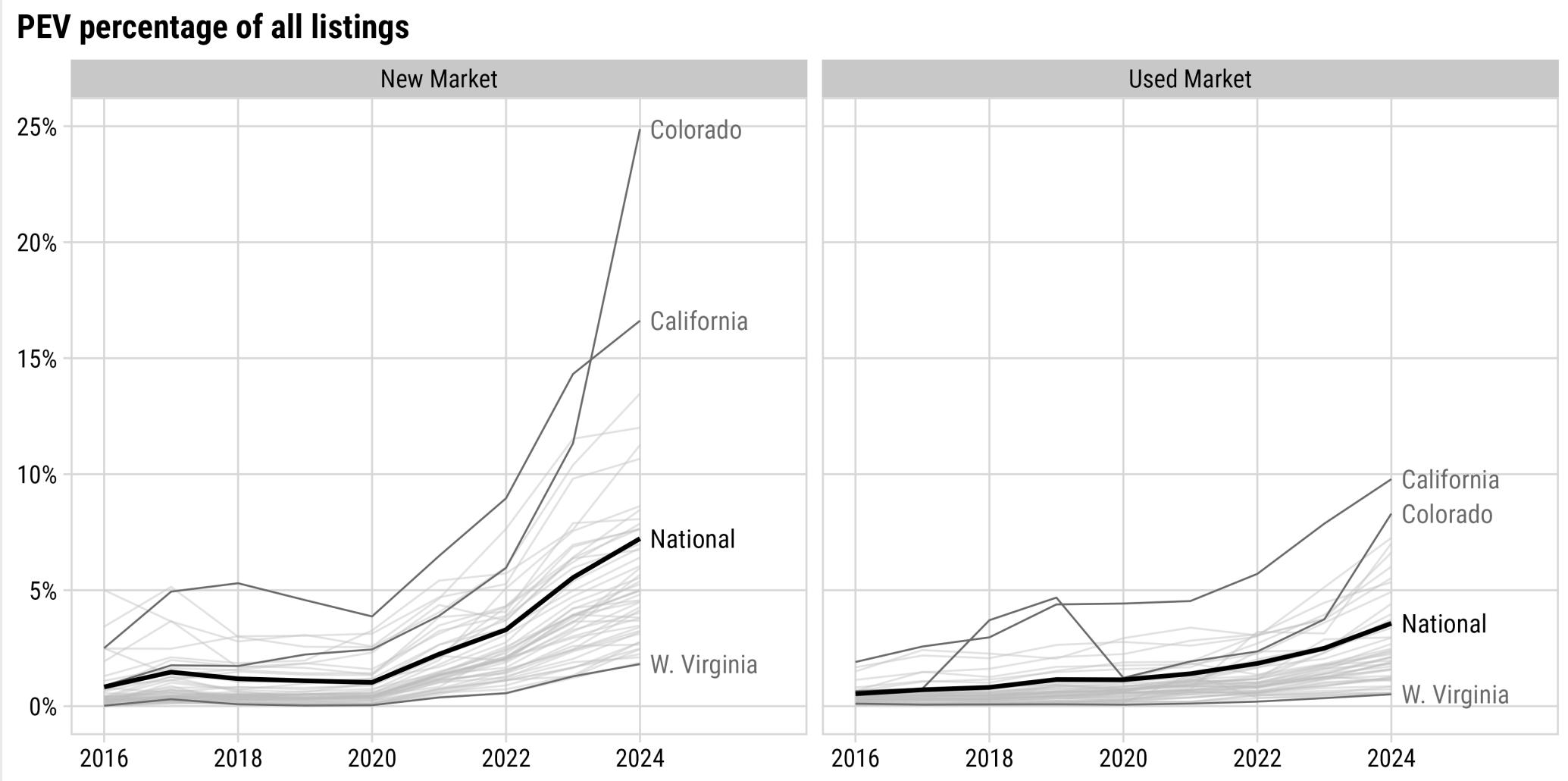
How many dealerships are carrying PEVs?

4/5 dealers have new BEV; 2/5 dealers have used BEV

Percentage of dealerships with at least one PEV listing

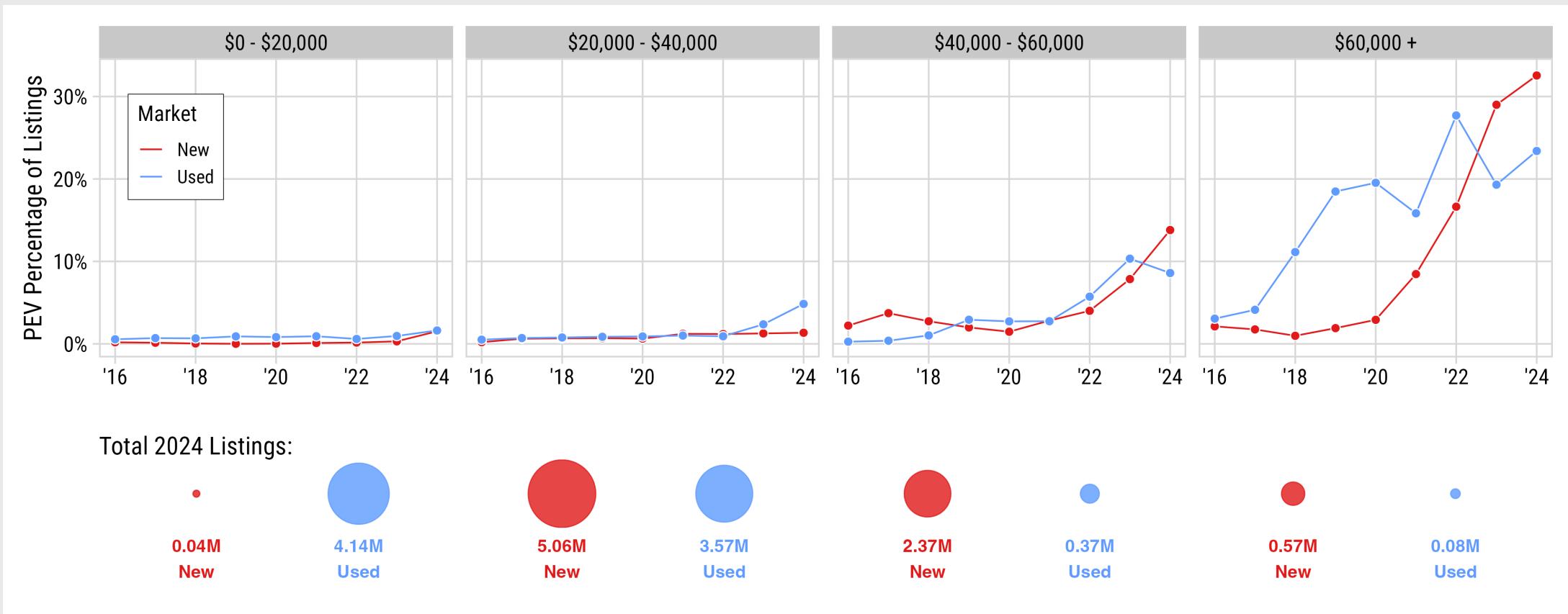


PEVs still a small % of overall listings (7% new, 4% used)



PEV affordability still a major challenge

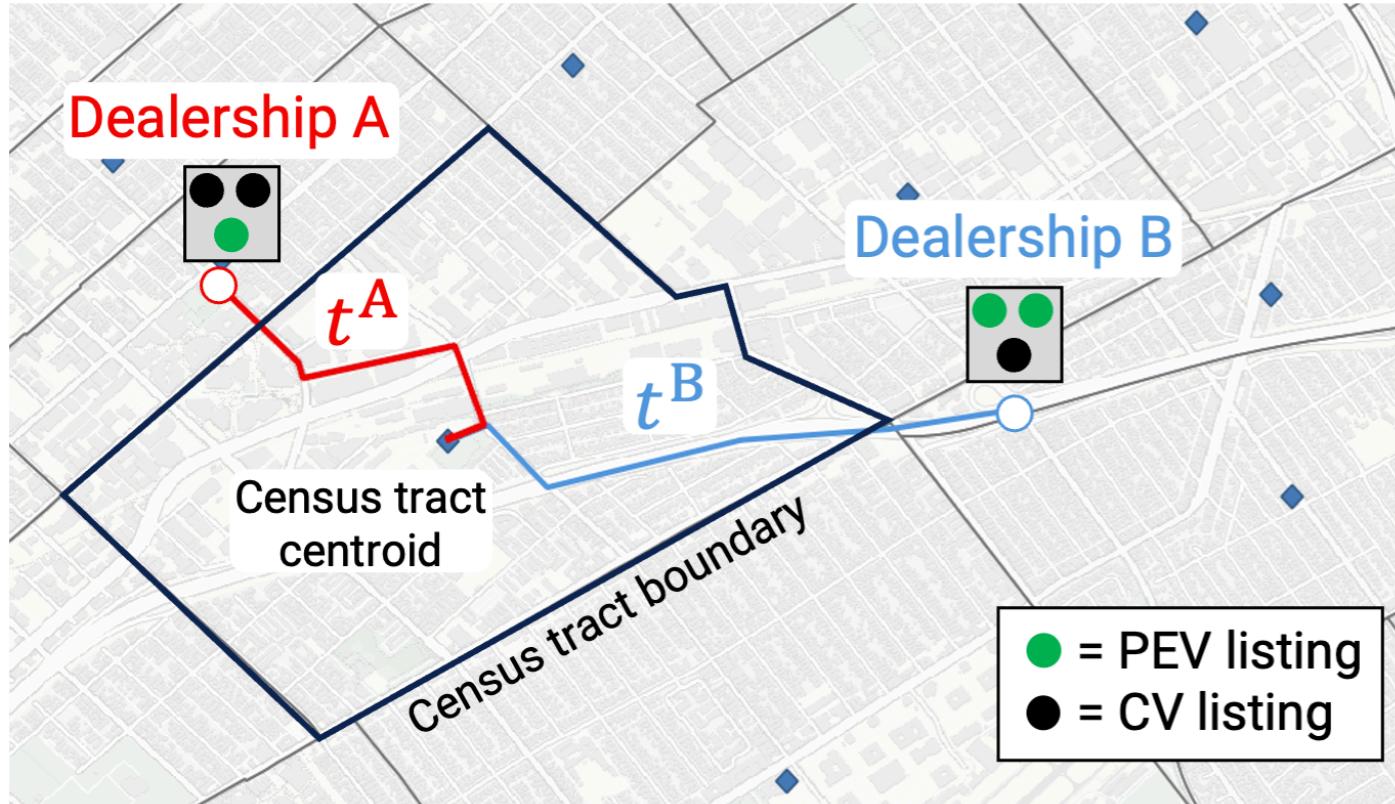
Majority of growth in high-price segments



How hard is it to get to a PEV dealer?

Vehicle accessibility metric:

Road travel time from census tract centroid to nearest dealership with a target vehicle



Times to first 3 ● (PEVs)

$$t_1^{\text{PEV}} = t^A$$

$$t_2^{\text{PEV}} = t^B$$

$$t_3^{\text{PEV}} = t^B$$

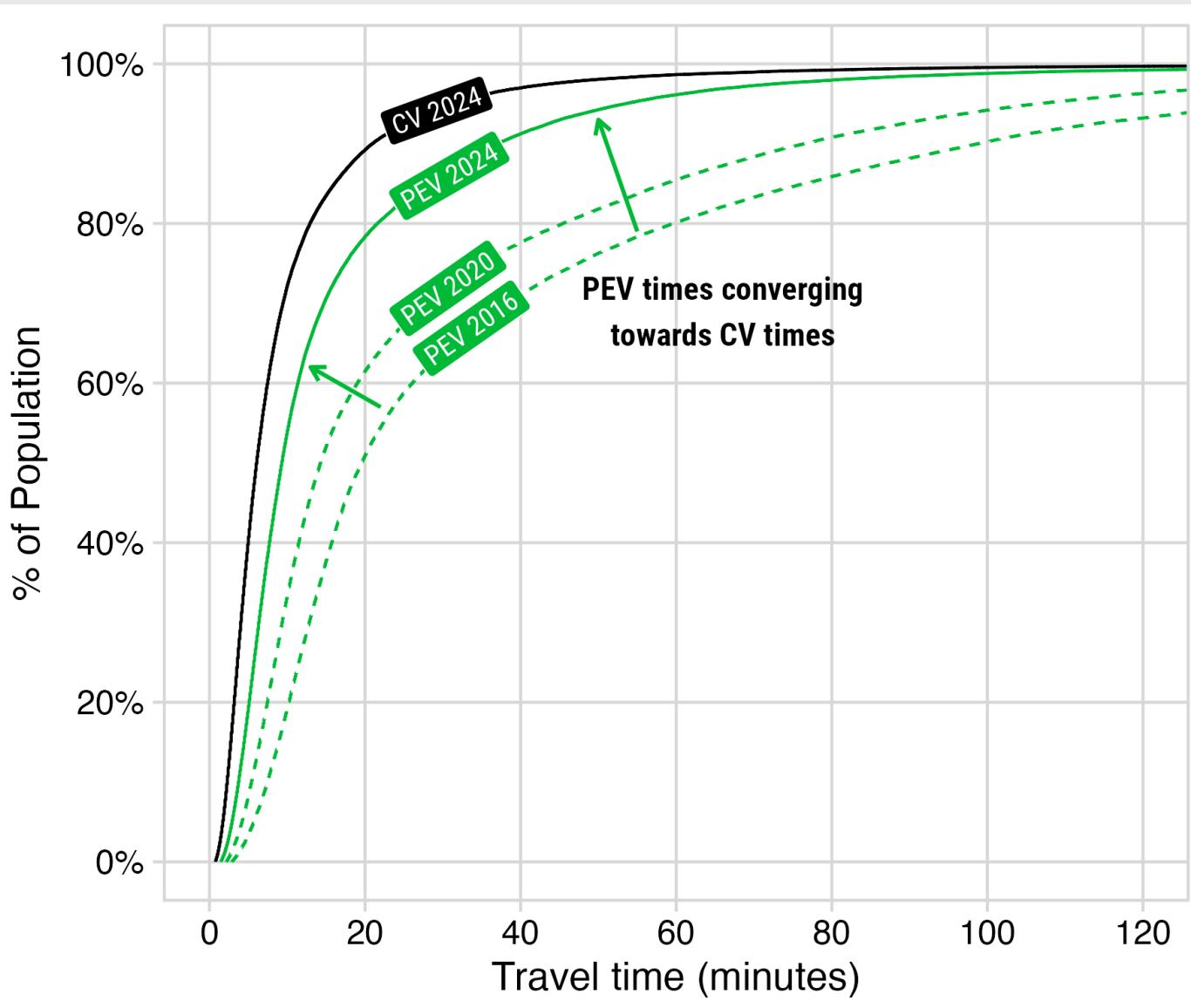
Times to first 3 ● (CVs)

$$t_1^{\text{CV}} = t^A$$

$$t_2^{\text{CV}} = t^A$$

$$t_3^{\text{CV}} = t^B$$

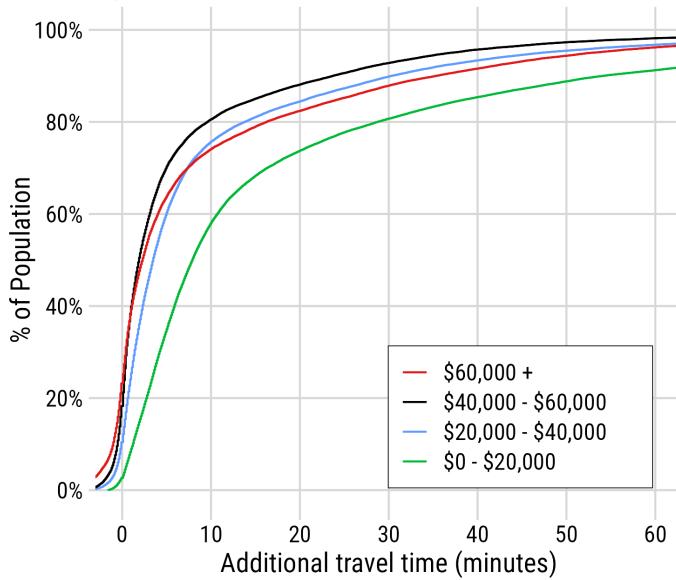
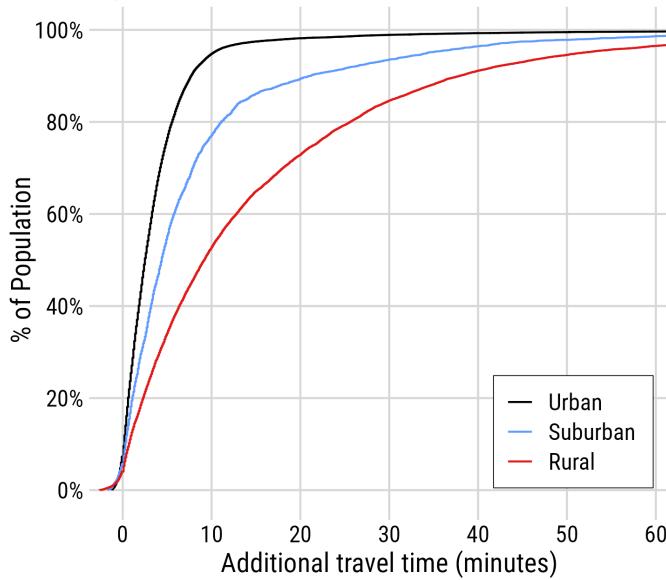
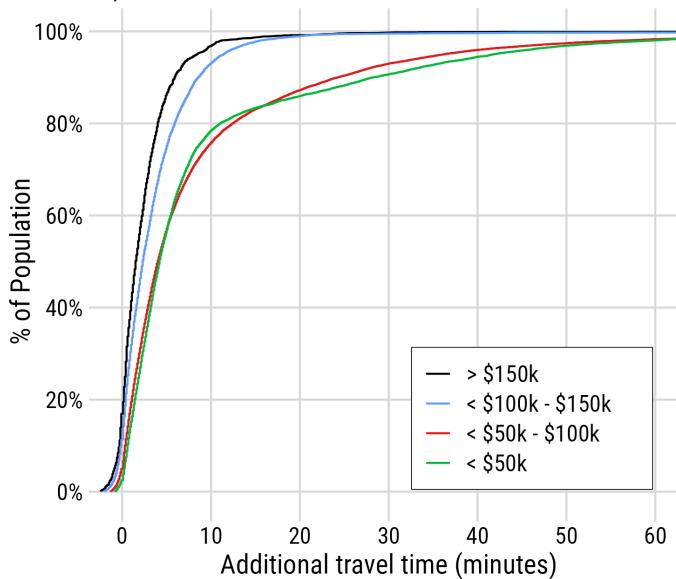
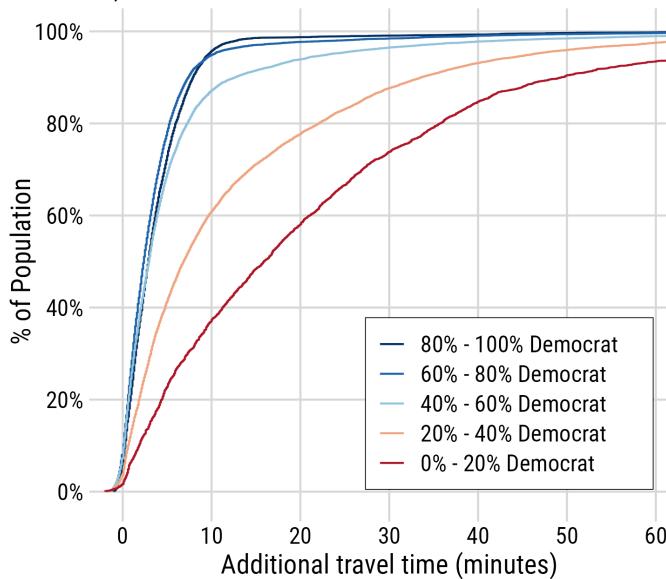
*Road travel times obtained using Open Source Routing Machine (OSRM)



PEV travel times are converging towards conventional vehicle times

80% of pop:

- CV in ~12 min
- PEV in ~22 min (2024)
- PEV in ~60 min (2016)

A) Price Segment**B) Urbanicity****C) Income bracket****D) 2020 Presidential Election Vote**

Additional travel times (PEV - CV) by demographic blocks shows disparities

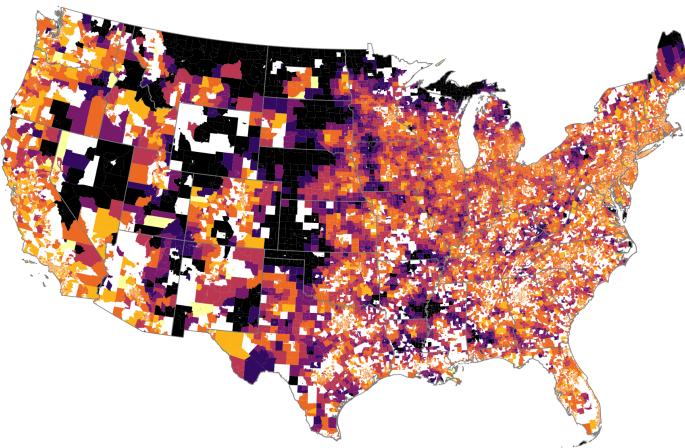
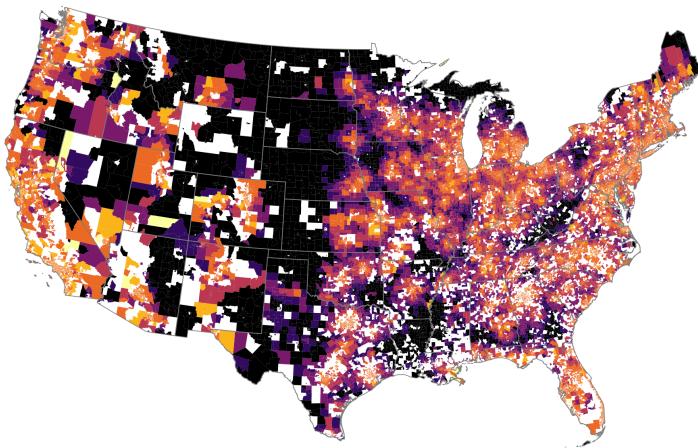
Places with worse PEV access:

- Lower income areas
- Rural areas
- Republican strongholds

Additional time to 10th nearest PEV by census tract and price bin (2024)

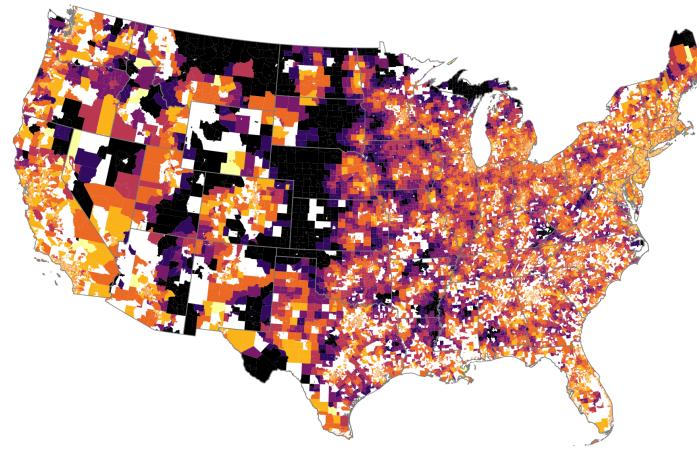
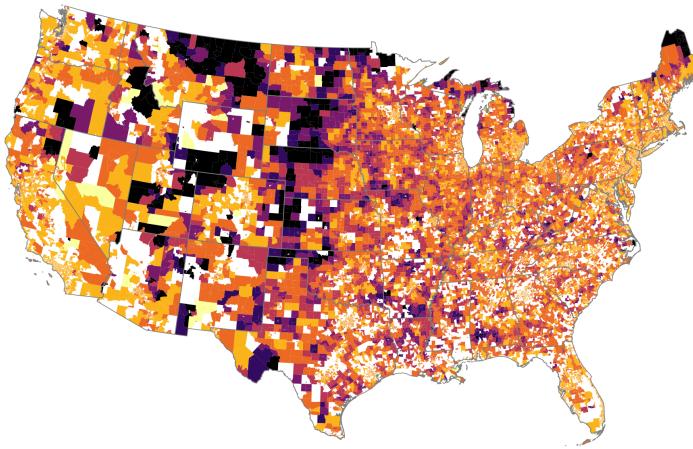
\$0 - \$20,000

\$20,000 - \$40,000



\$40,000 - \$60,000

\$60,000 +



Additional travel time to nearest BEV (Minutes)



“PEV Deserts” exist in some areas, particularly in <\$20,000 price range

Key Finding: EV accessibility is spatially concentrated

Transportation electrification will be **geographically clustered** rather than evenly distributed



Grid planning must account for **uneven adoption patterns**

Leveraging vehicle *listings* can be useful for high-resolution planning

Concentrated demand

- Urban, higher-income areas
- Requires targeted grid investments
- Peak demand challenges

Missed opportunities

- Rural wind resources underutilized
- Limited distributed load balancing
- Reduced renewable integration potential

Affordability gap limits mass-market electrification

- Only **1.3%** of new vehicles under \$40k are EVs
- **94%** of used market is under \$40k with minimal EV options



Dealerships matter for the energy transition

- Direct experience increases willingness to adopt
(Roberson & Helveston, 2020; Agrawal et al., 2022)
- Geographic barriers limit consumer exposure
 - 60+ minute travel penalties in rural areas
 - Abundant conventional options nearby
 - Limited EV education opportunities



Thanks!

Slides:

<https://jhelvy.github.io/2025-btr7-ev-spatial/>

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Extra Slides

Policy coordination needed for equitable transition

Current patterns reinforce existing inequalities

Expand access

- Direct-to-consumer sales
- Rural dealership incentives
- Charging infrastructure investment

System benefits

- More distributed demand
- Better renewable integration
- Grid stability support