State of Zero-Emission Vehicle Secondary Market and Accessibility Impacts in California's Underserved Communities

Final Project Seminar | August 2026

California Air Resources Board Agreement No. 22STC016
Final report published May 2026 | DOI: 10.7922/G2805103

Data

2023 DMV household registrations (24 million vehicles, 12.5 million households)
S&P Global interstate transfer records, 2016-2023 | Statewide survey of 3,396 vehicle owners

Research Team

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Data Collection and Datasets

- **California DMV household data:** household vehicle registration extracts covering 24 million light duty vehicles in 12.5 million households; used for secondary market analysis and the survey sampling frame
- **Statewide vehicle owner survey:** online questionnaire mailed to an address based random sample of 50,000 California vehicle owners; 3,396 surveys returned; fielded January to June 2025; stratified across eight new and used BEV, PHEV, and ICEV owner groups; results unweighted
- **S&P Global transfer records:** vehicle level interstate transfer records aggregated to a state-by-year panel for 2016-2023, with a 2023 snapshot of each state's BEV and PHEV fleet used to normalize import volumes
- **Analytical approach:** descriptive statistics, exploratory analysis, and econometric modeling; reported relationships are associational rather than causal

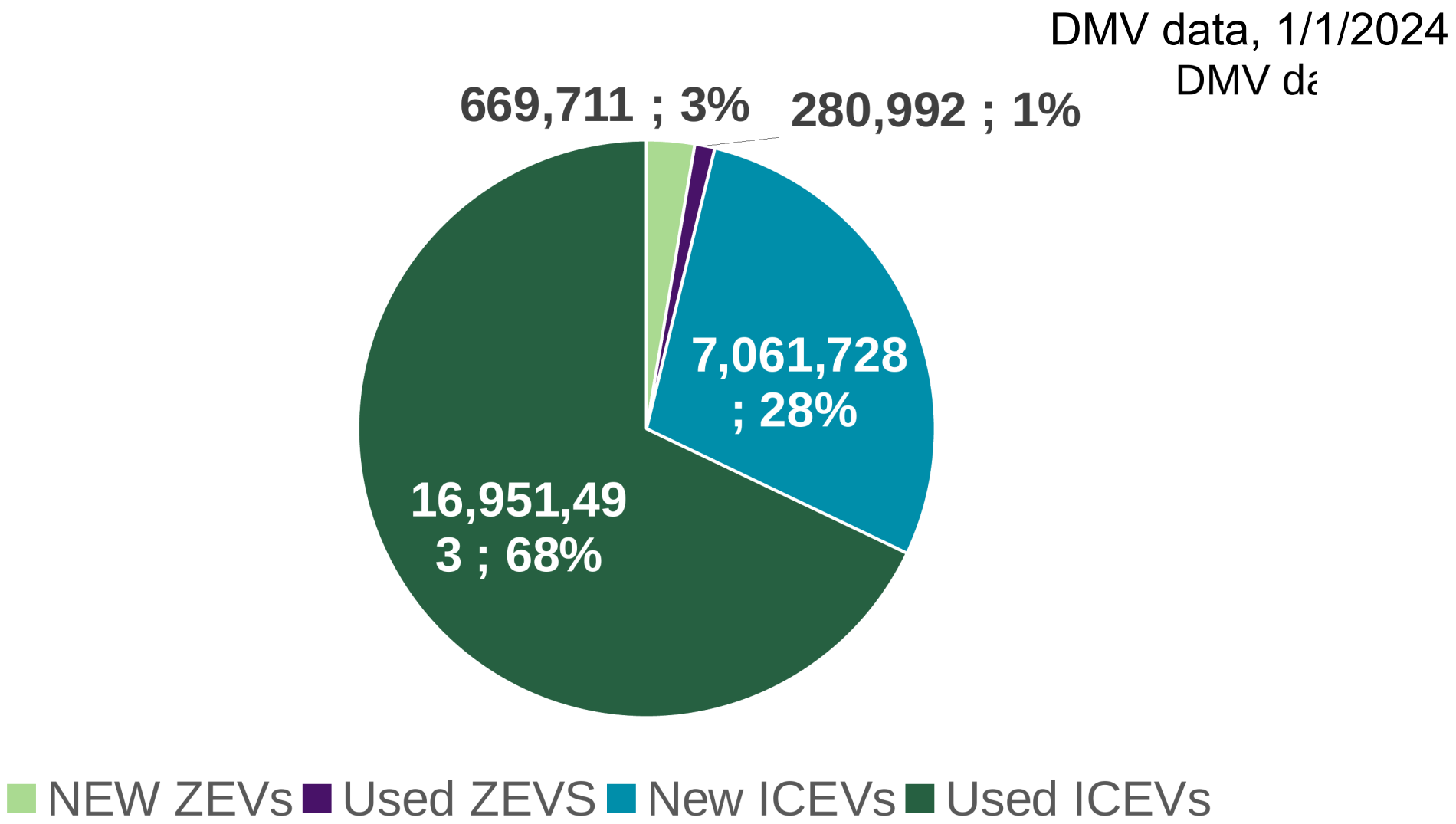
Source: Tal et al. (2026), Sections 6.1 to 6.4

Part I. The Used EV Market in California: Gains and Gaps

Gil Tal

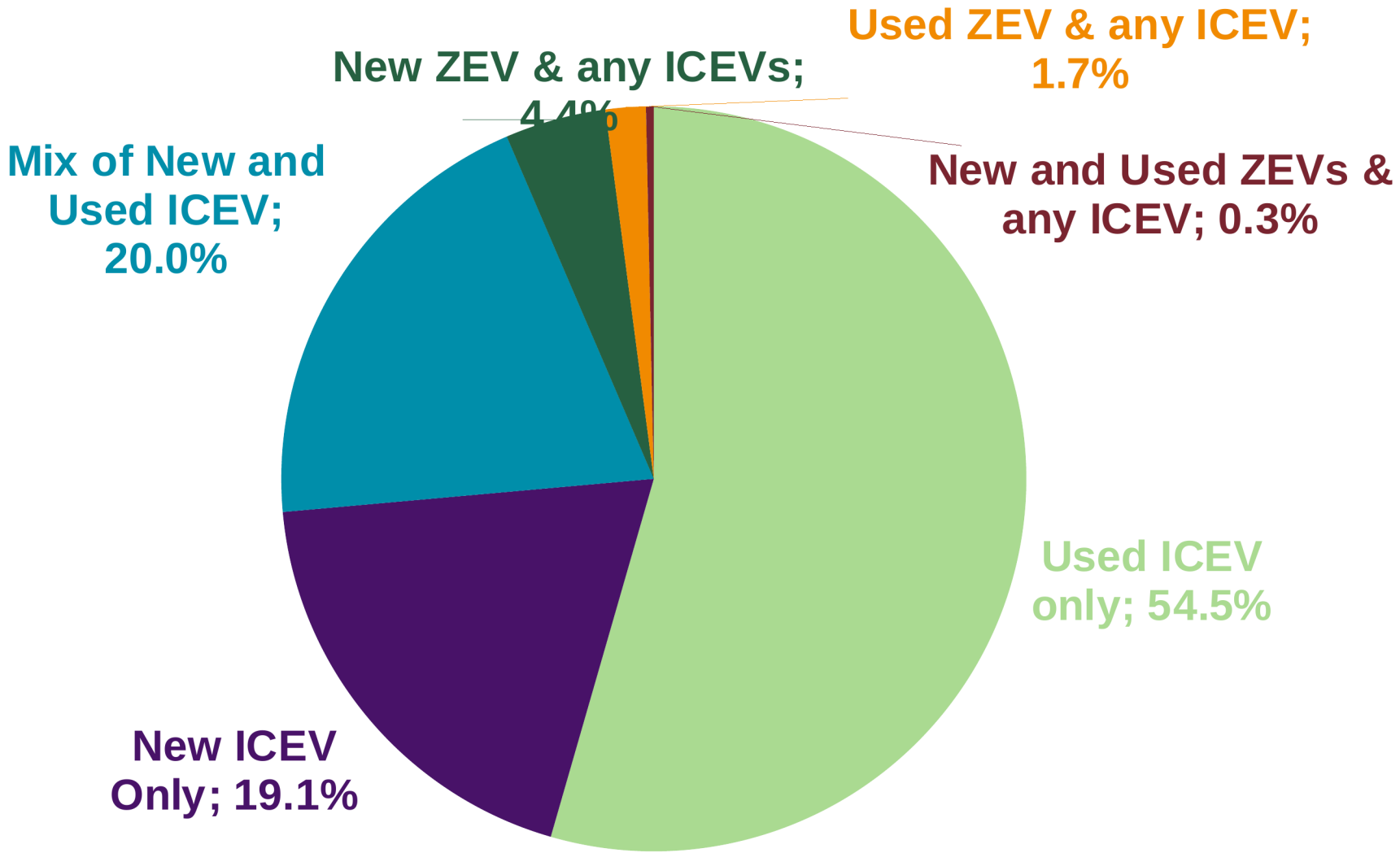
Source: Tal et al. (2026), CARB Agreement No. 22STC016

Most California light duty vehicles were purchased used



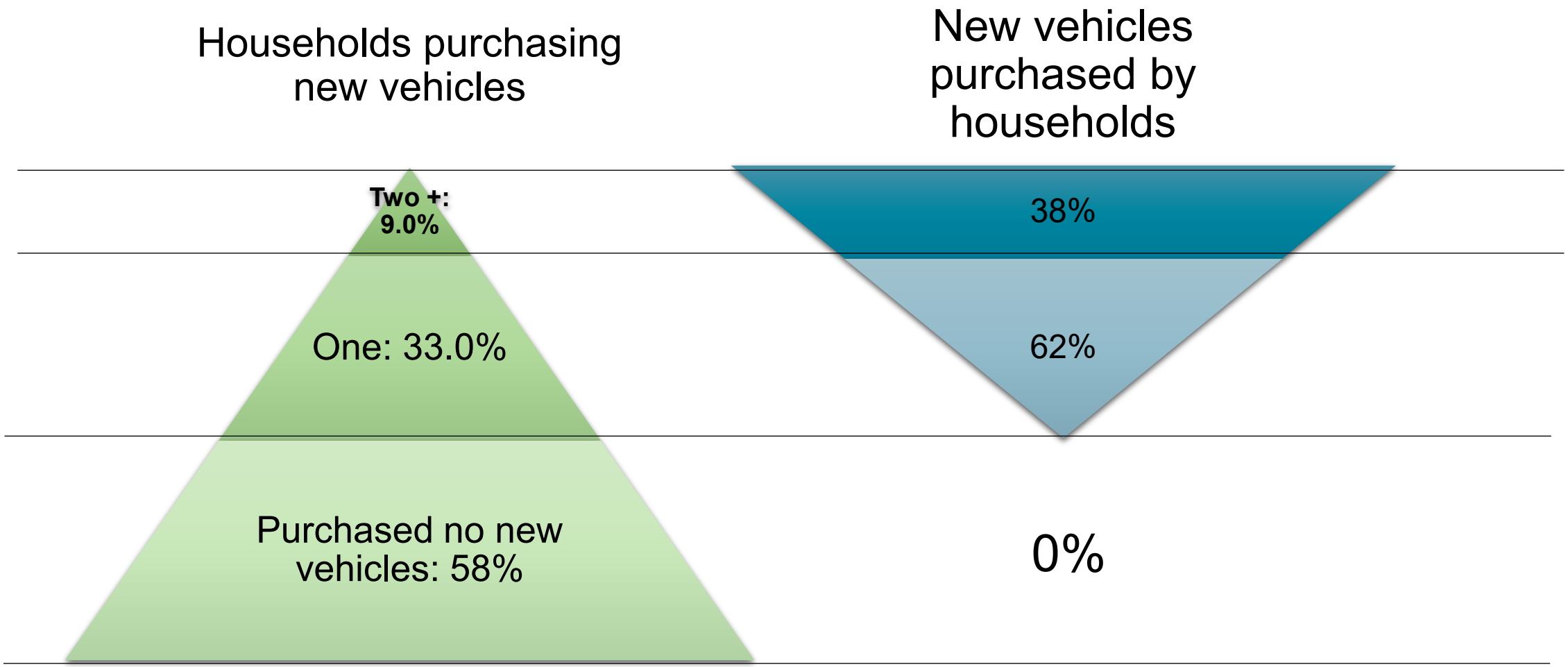
Source: California DMV household vehicle registration data; Tal et al. (2026)

The DMV dataset includes 24 million light duty vehicles owned by 12.5 million households



Source: California DMV household vehicle registration data; Tal et al. (2026)

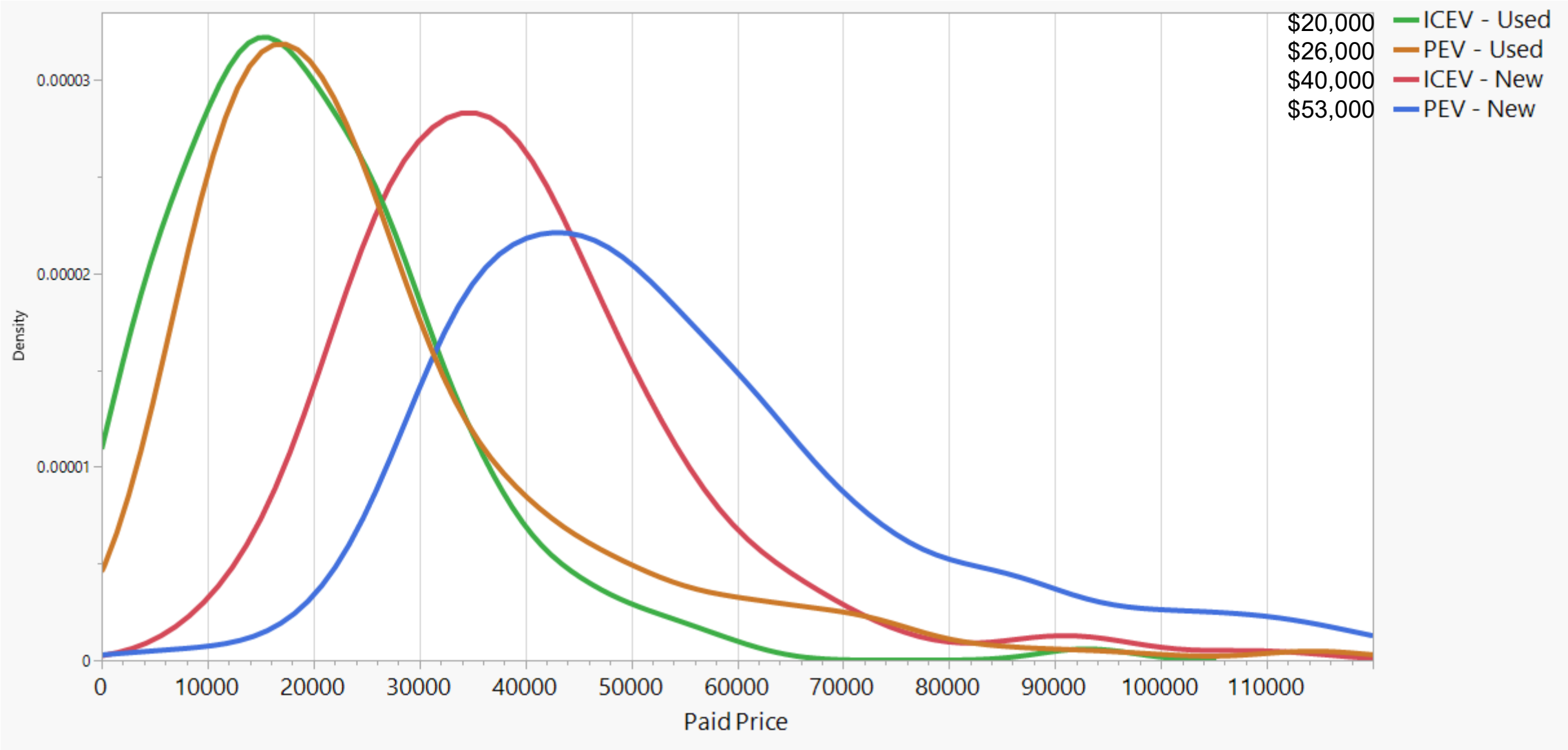
Electrifying the Fleet Means Selling Many New EVs to Few Households



DMV Data from 2022: 42% of California households bought new vehicles between 2017 and 2022

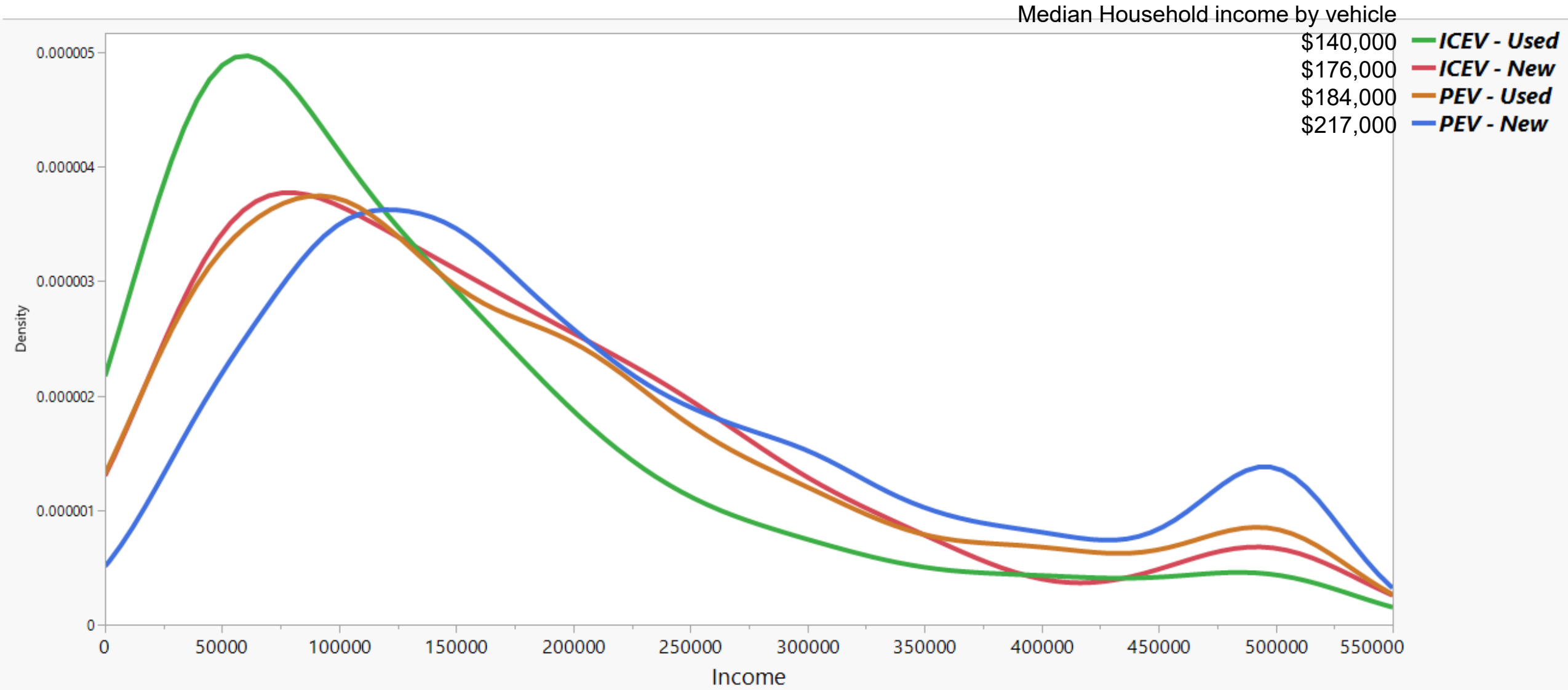
Source: California DMV household vehicle registration data; Tal et al. (2026)

Used EVs are affordable but still cost more than used gasoline vehicles



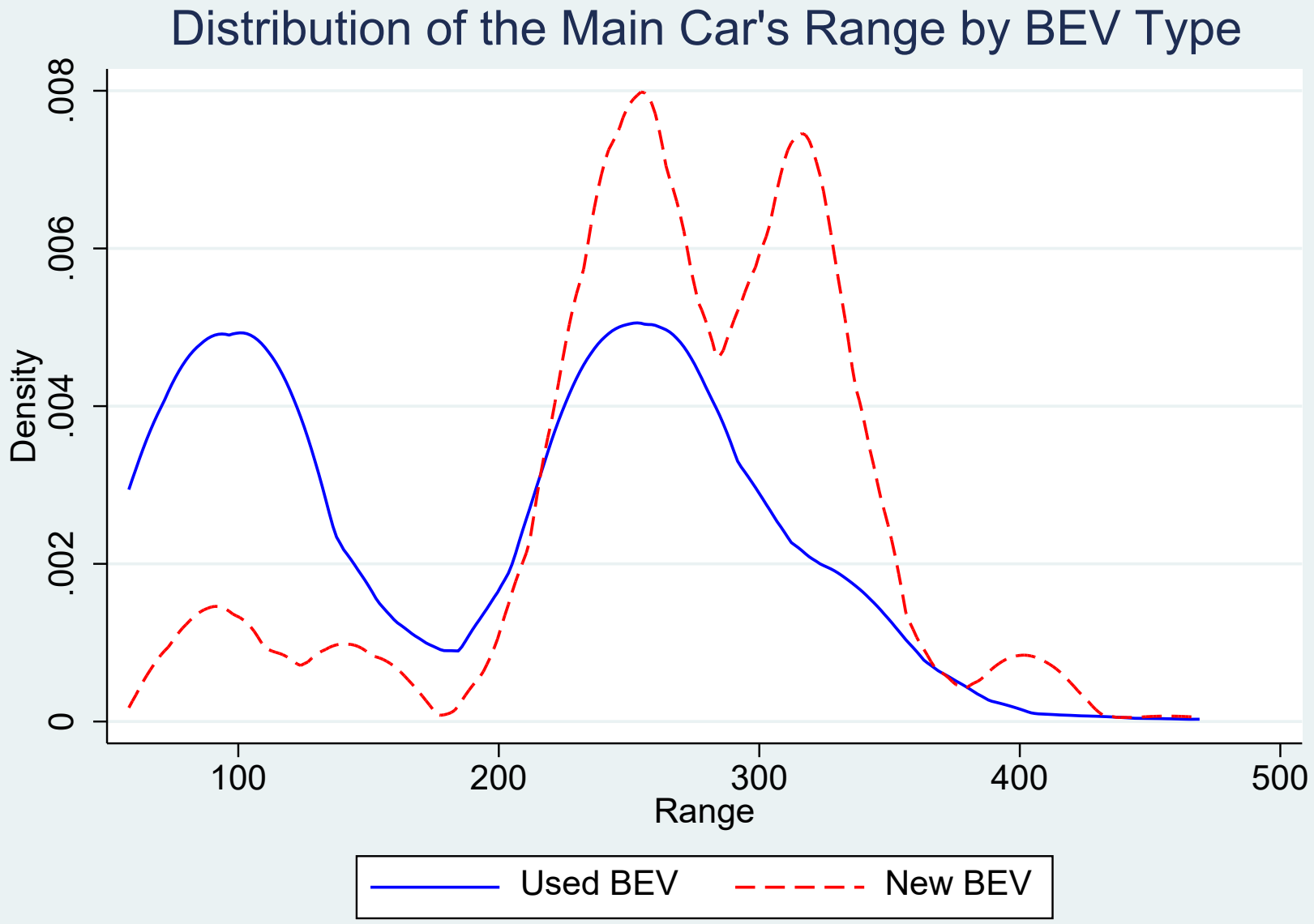
Source: UC Davis EVRC statewide vehicle owner survey, 2025 (n=3,396); Tal et al. (2026)

Used EV buyers have higher incomes than buyers of new gas vehicles



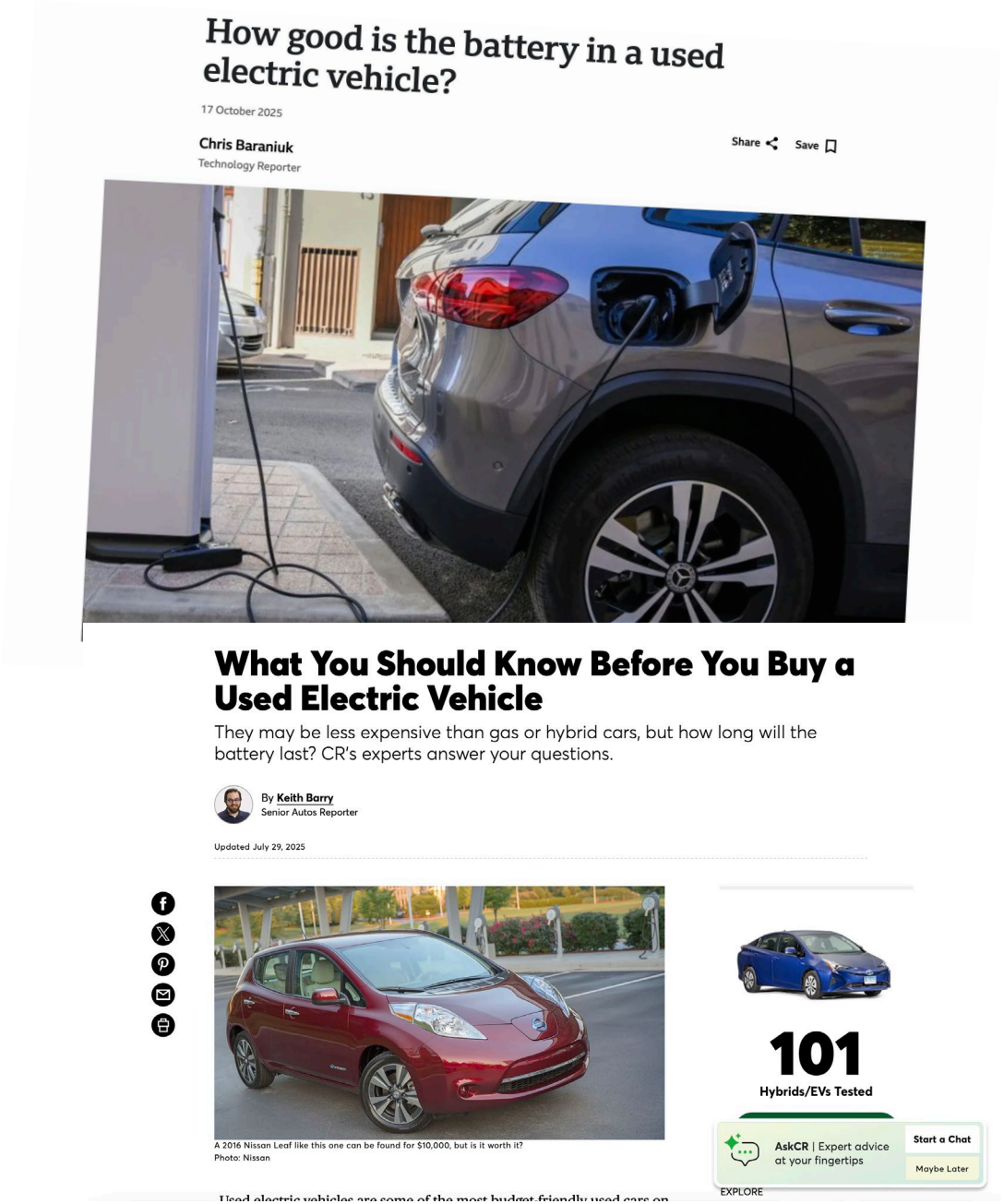
Source: UC Davis EVRC statewide vehicle owner survey, 2025 (n=3,396); Tal et al. (2026)

Two Distinct Groups in Used BEV Ranges



Source: UC Davis EVRC statewide vehicle owner survey, 2025 (n=3,396); Tal et al. (2026)

Is the *battery* of a used PEV the *bottleneck* to used PEV adoption?



How good is the battery in a used electric vehicle?

17 October 2025

Chris Baraniuk
Technology Reporter

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What You Should Know Before You Buy a Used Electric Vehicle

They may be less expensive than gas or hybrid cars, but how long will the battery last? CR's experts answer your questions.

By Keith Barry
Senior Autos Reporter

Updated July 29, 2025

A 2016 Nissan Leaf like this one can be found for $10,000, but is it worth it?
Photo: Nissan

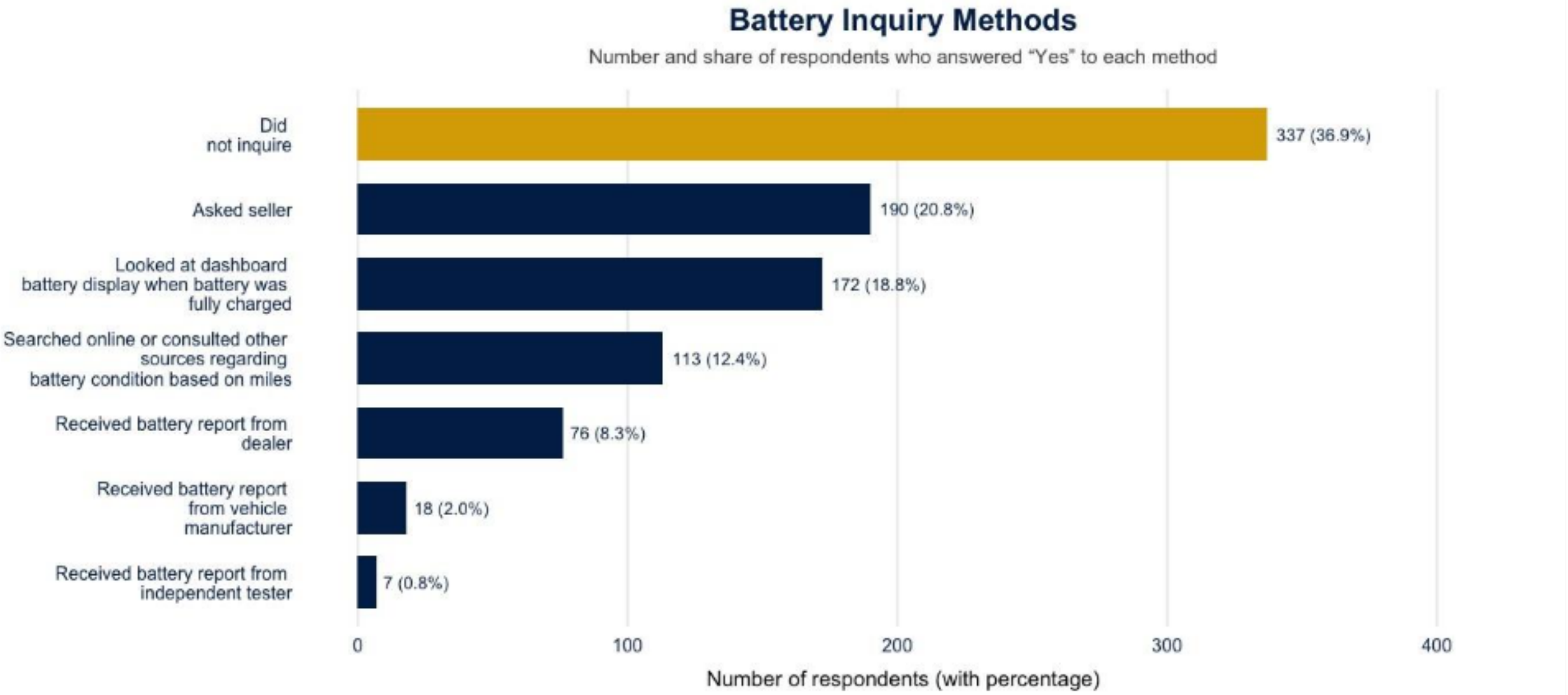
101
Hybrids/EVs Tested

AskCR | Expert advice at your fingertips
Start a Chat
Maybe Later

EXPLORE

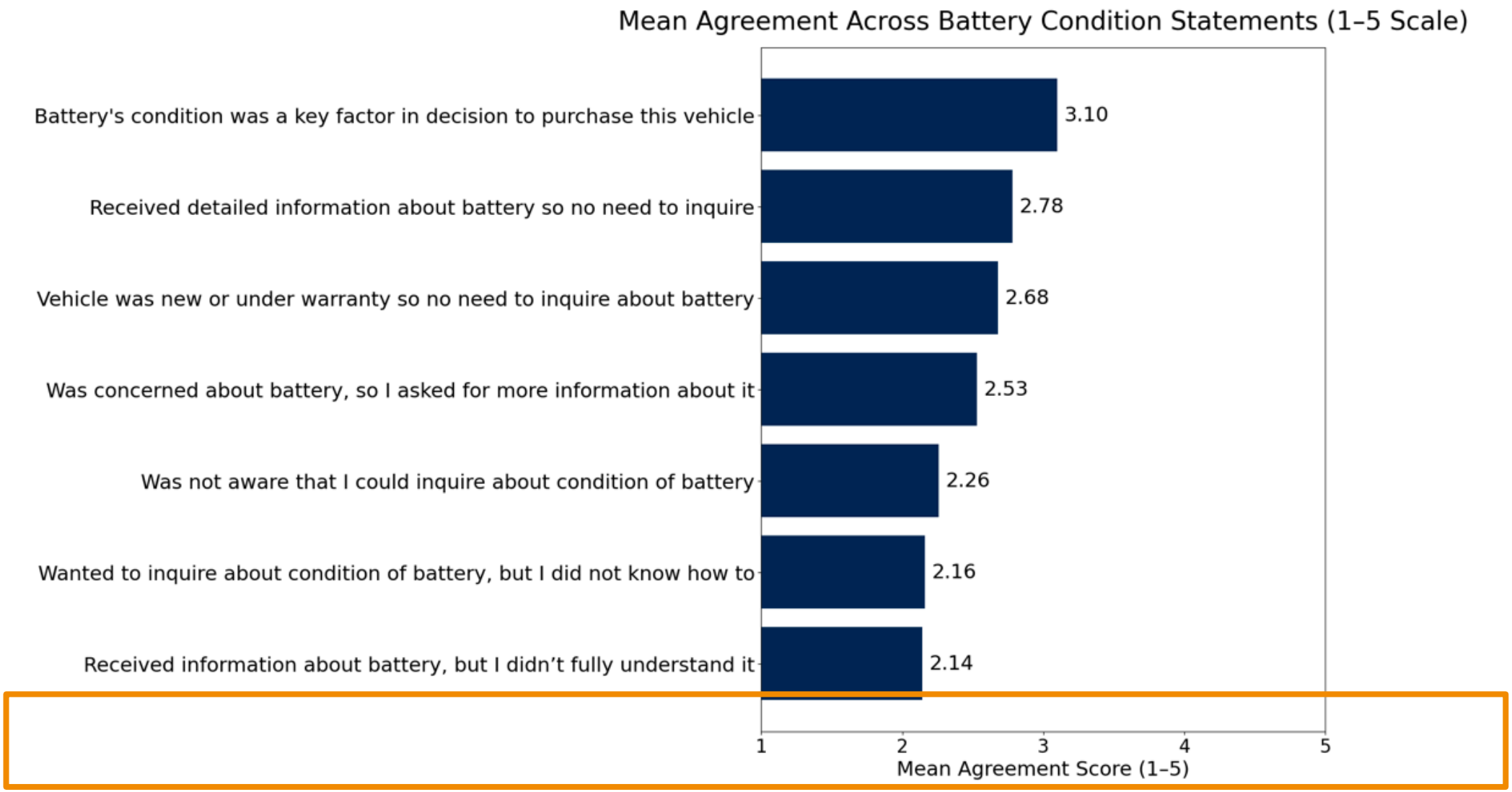
Source: Tal et al. (2026); images from online used EV buying guides

Original question. How did you inquire about the battery condition? Multiple response options possible



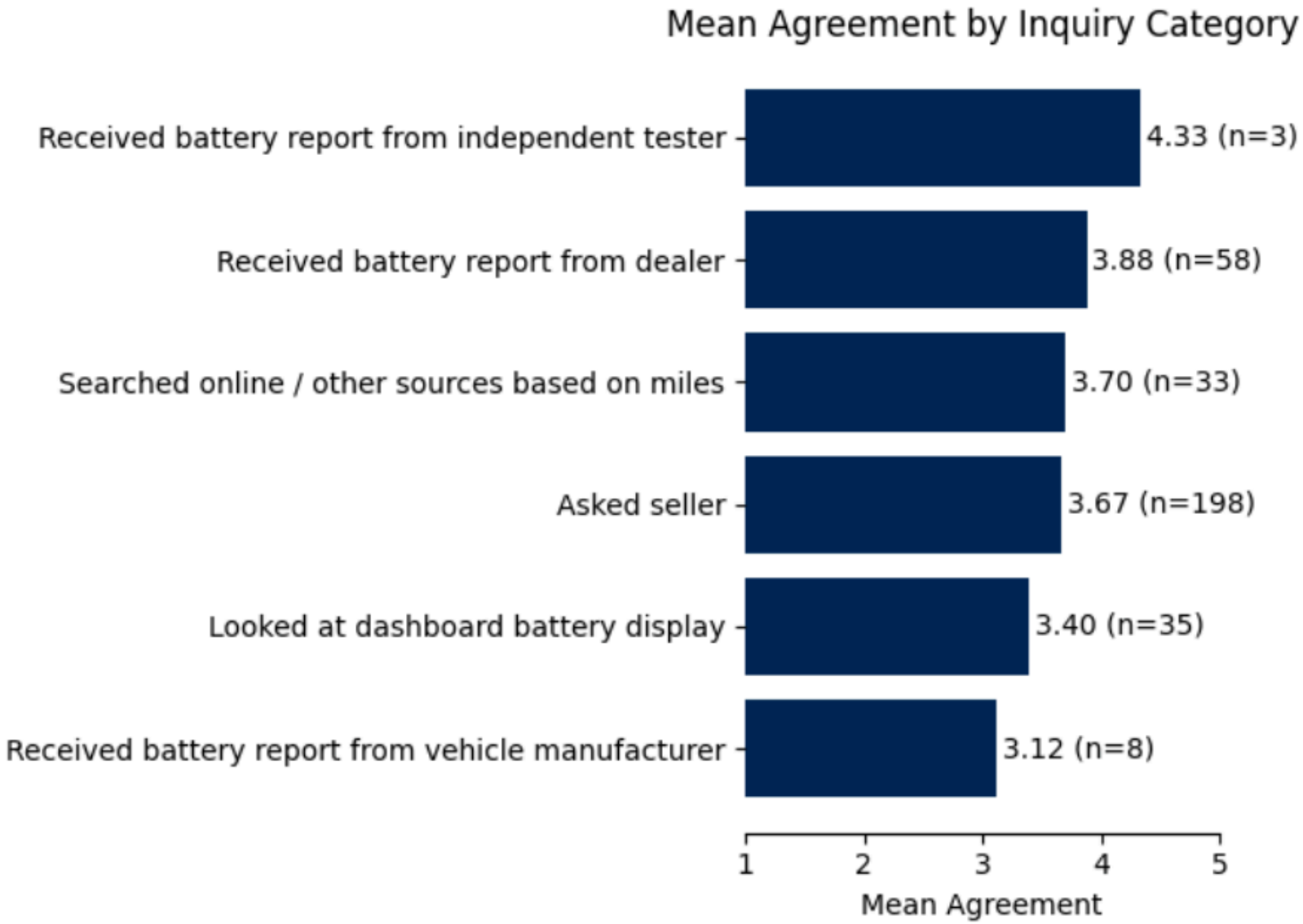
Source: UC Davis EVRC statewide vehicle owner survey, 2025 (n=3,396); Tal et al. (2026)

Statements about Battery Condition



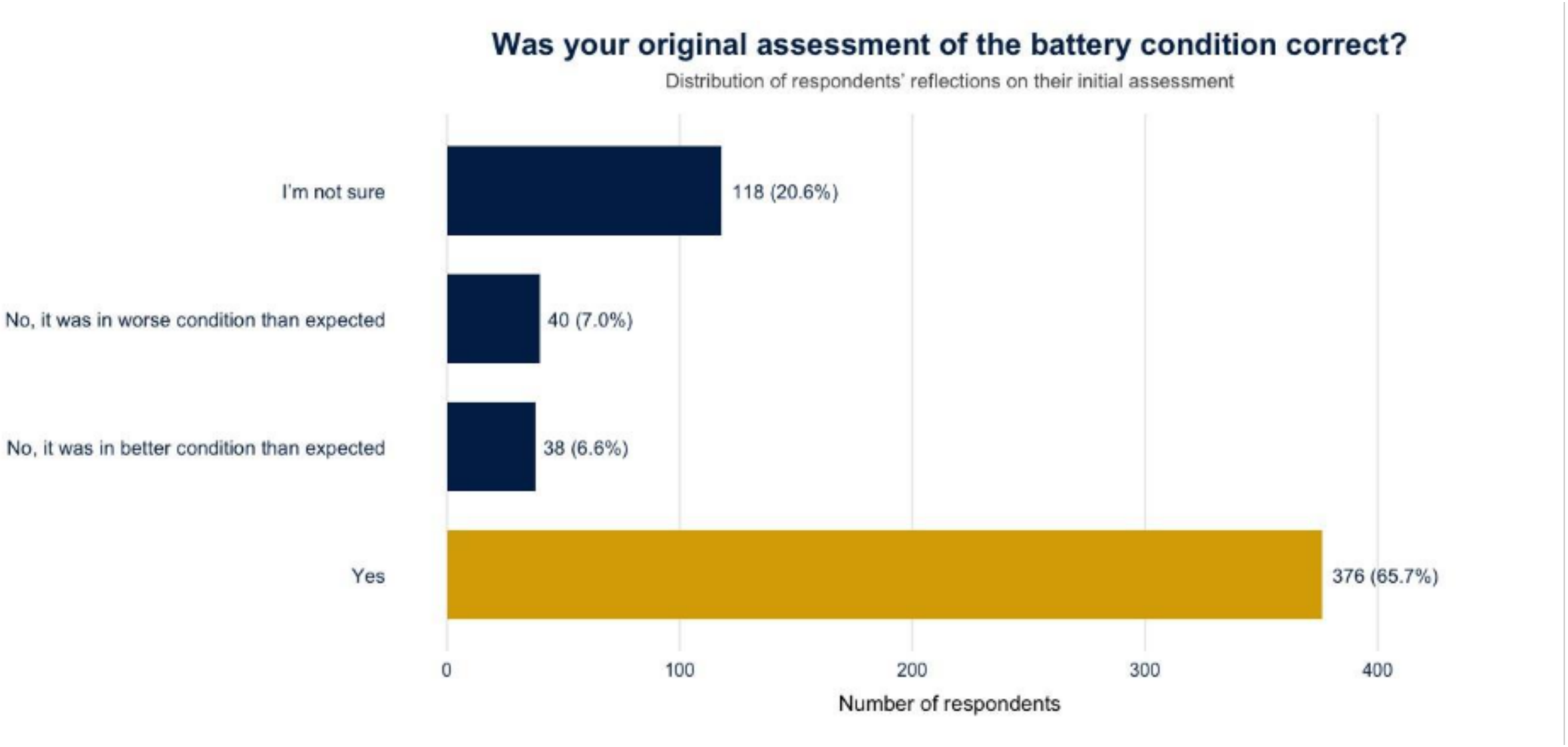
Source: UC Davis EVRC statewide vehicle owner survey, 2025 (n=3,396); Tal et al. (2026)

The Battery's Condition was a Key Factor in my Decision to Buy this Vehicle (by Inquiry Method)



Source: UC Davis EVRC statewide vehicle owner survey, 2025 (n=3,396); Tal et al. (2026)

Was Your Original Assessment of the Battery Condition Correct?



Source: UC Davis EVRC statewide vehicle owner survey, 2025 (n=3,396); Tal et al. (2026)

What do we know about the supply of used EVs to the secondary market in California?

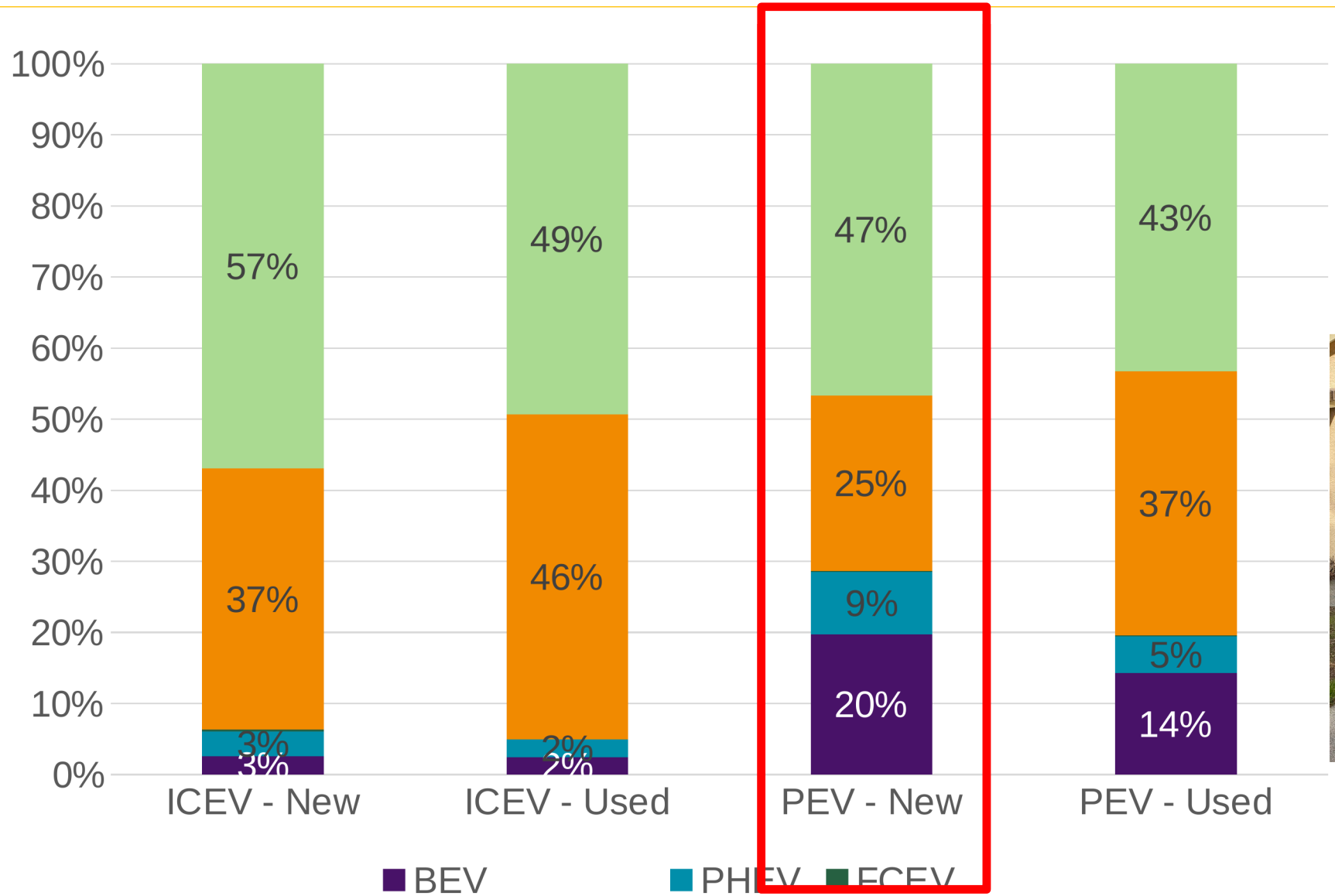
How fast can the secondary market grow?

Why not every second time buyer adds to the secondary market?



Source: Tal et al. (2026)

Every 10 new EV purchases result in 3 used EVs entering the market





Source: California DMV household vehicle registration data; Tal et al. (2026)

Part II. How State-Level Incentives for New Electric Vehicles Reshape Interstate Used-EV Flows

Aviv Steren

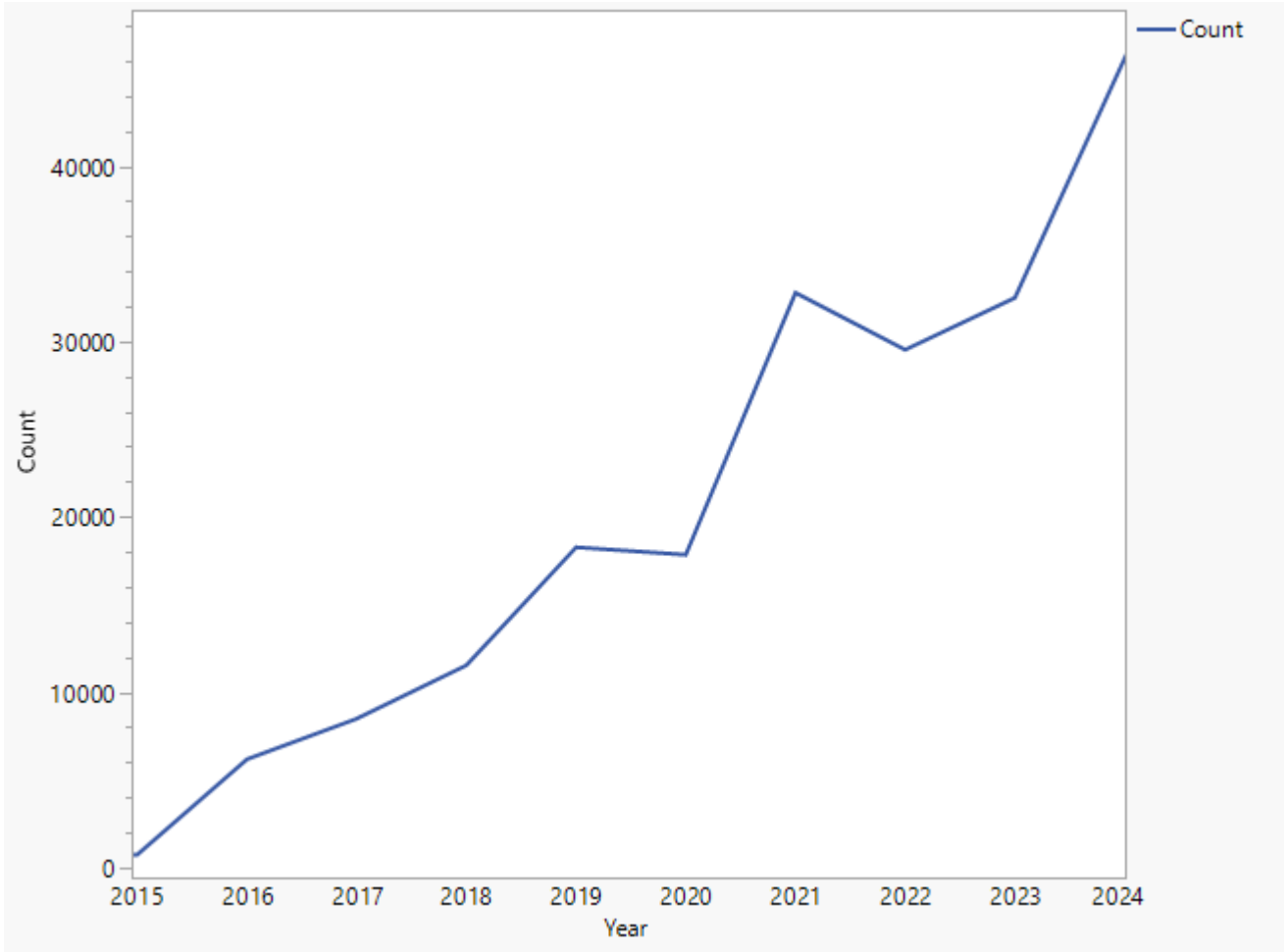
Source: Tal et al. (2026), CARB Agreement No. 22STC016

Why tracking used EVs matters for the national fleet?

- We are interested in modeling the fleet of EVs in the U.S.
- California is a critical source of inventory
- Three policy-relevant implications:
  - **Policy effectiveness:** CA incentives may benefit other states
  - **Equity:** Fewer affordable EVs remain in California
  - **Climate:** EVs may move to dirtier grids

Source: Tal et al. (2026)

Annual California-origin used PEV exports



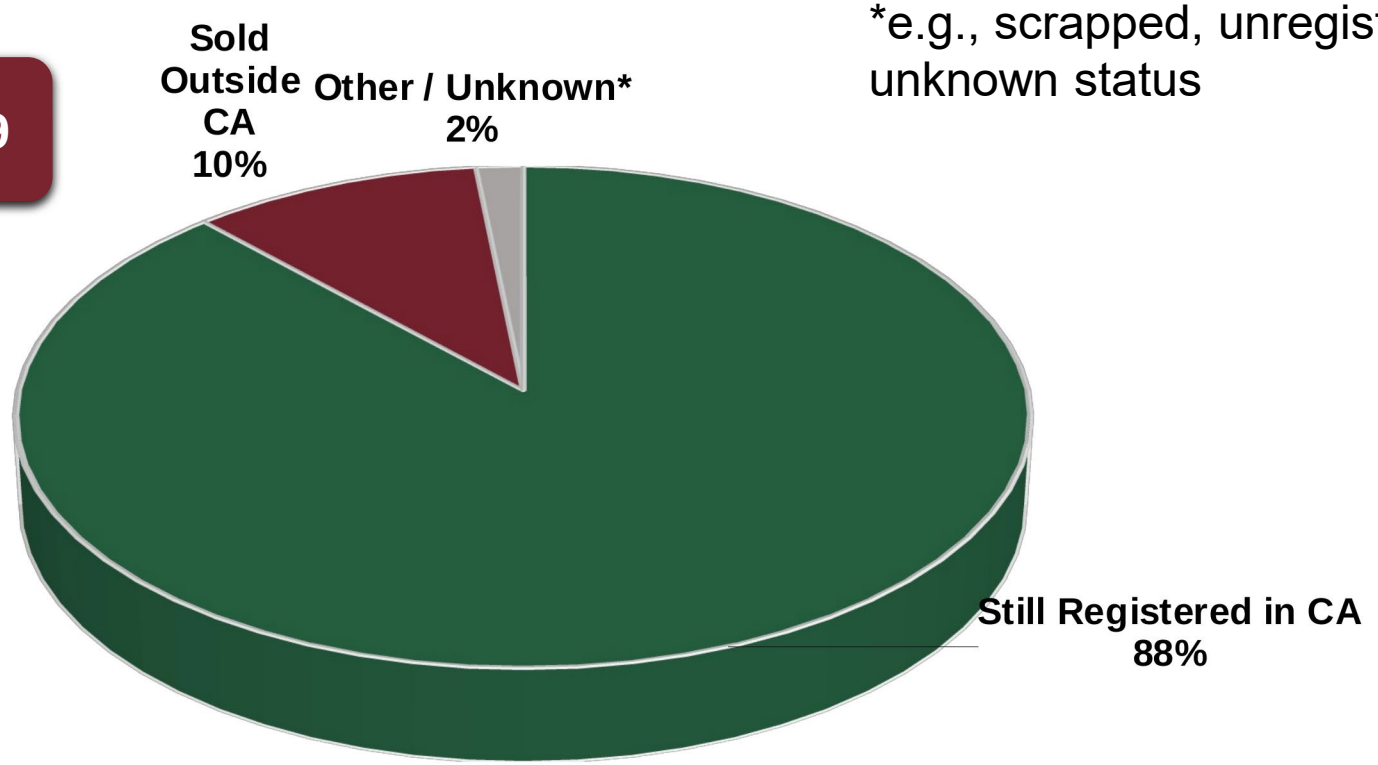
Source: S&P Global interstate vehicle transfer records, 2016-2023; Tal et al. (2026)

10% of California's PEV fleet leaves the state annually, 75% Sold to New Owners

≈ 25%

≈ 75%

219,989

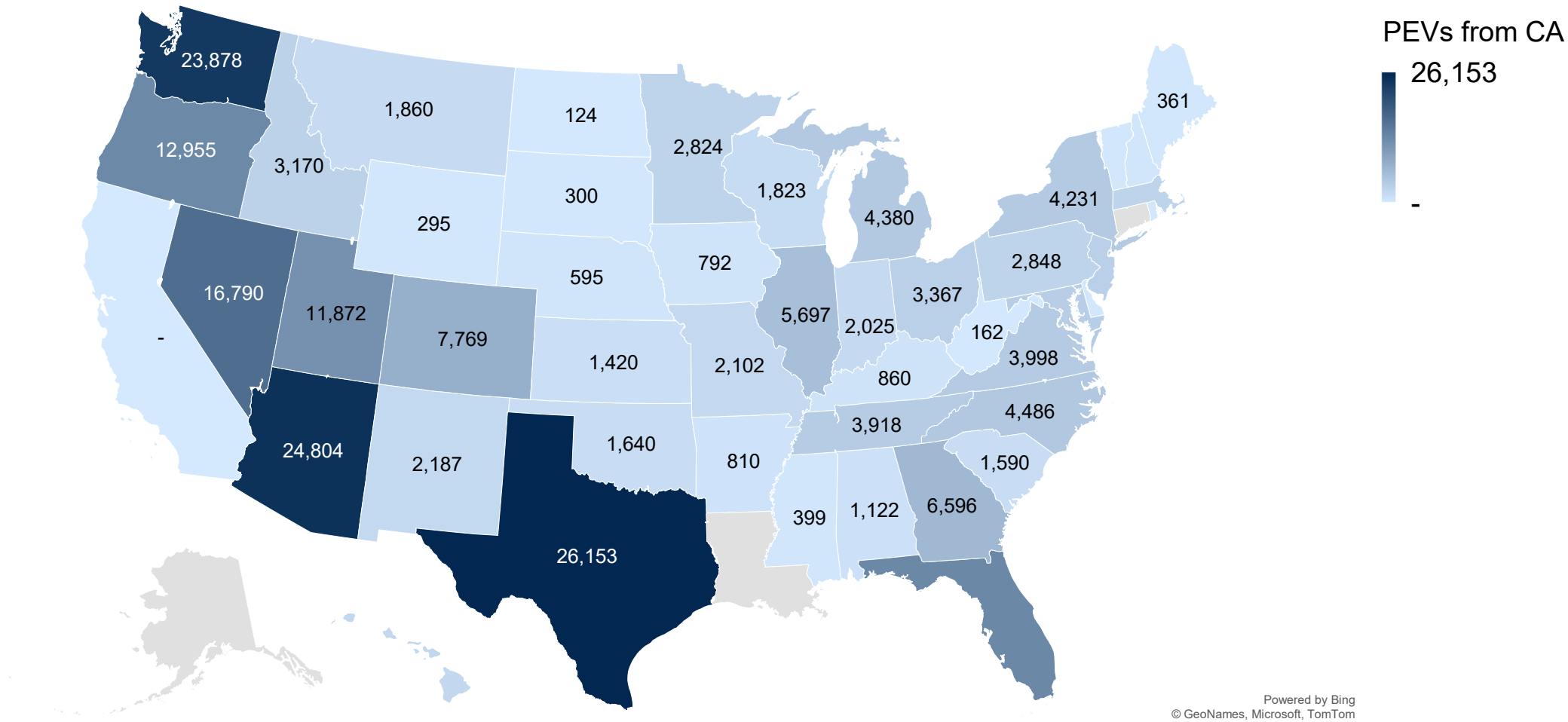


*e.g., scrapped, unregistered, or unknown status

Key Question: What policy environments in destination states act as the primary absorbers for this volume?

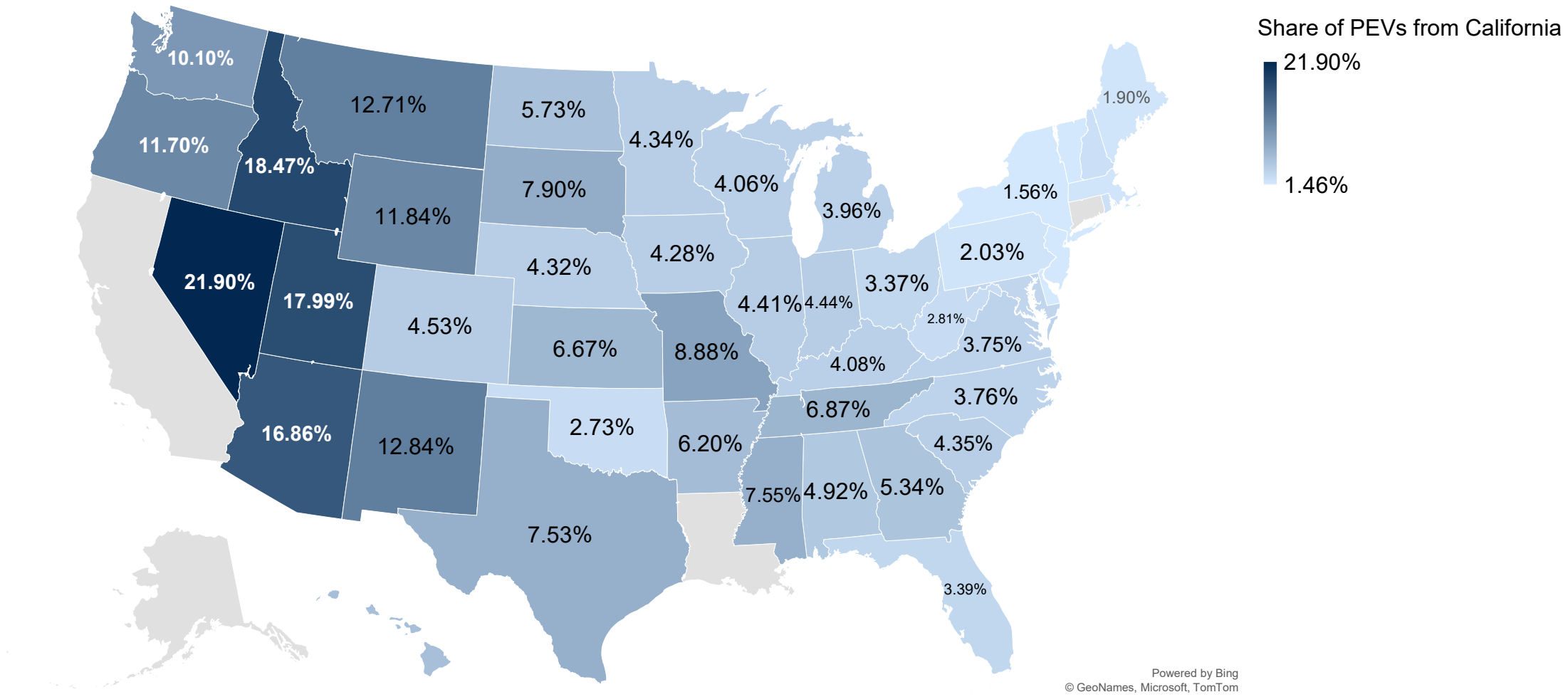
Source: S&P Global interstate vehicle transfer records, 2016-2023; Tal et al. (2026)

Western US states emerge as the largest recipient markets



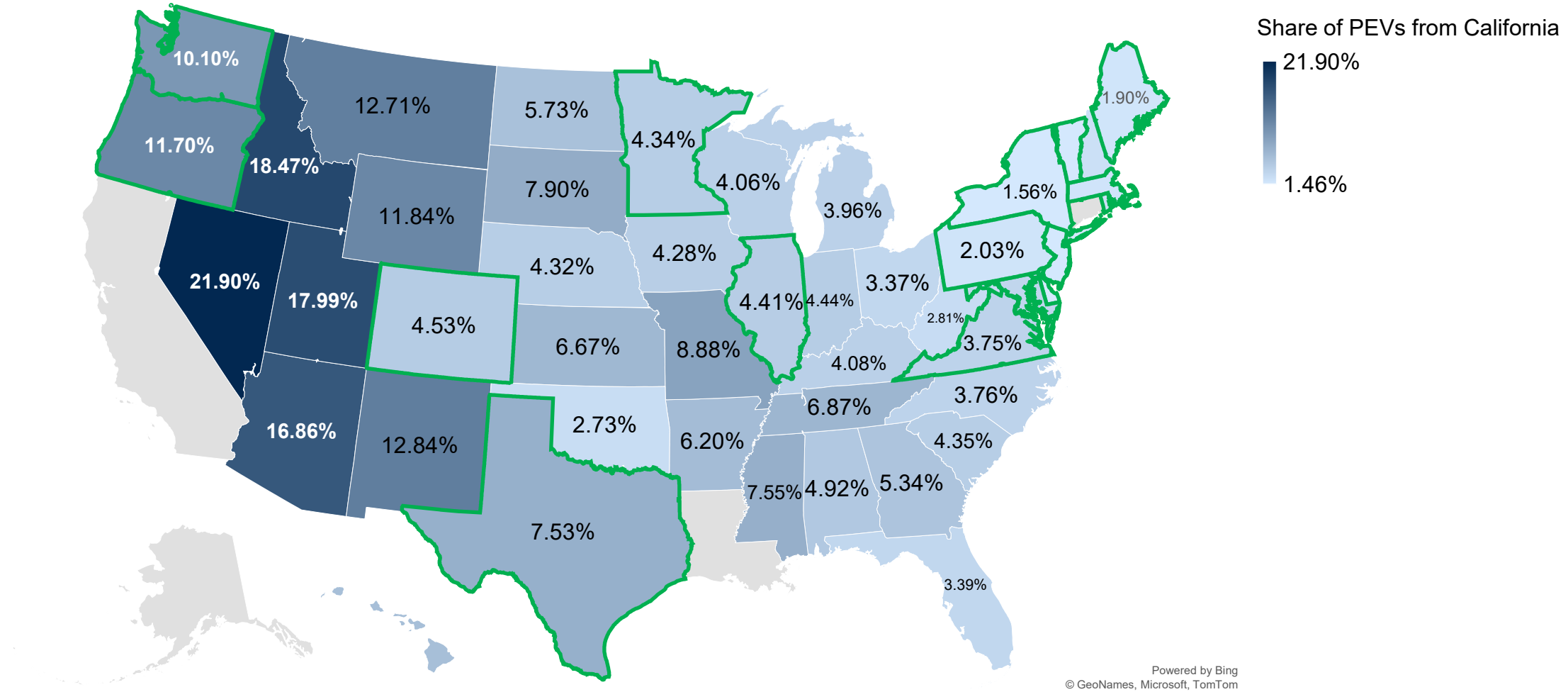
Source: S&P Global interstate vehicle transfer records, 2016-2023; Tal et al. (2026)

Share of PEVs from California of local PEV fleet



Source: S&P Global transfer records and 2023 state fleet snapshot; Tal et al. (2026)

States offering purchase incentives for new EVs



Source: US DOE Alternative Fuels Data Center, Laws and Incentives database; Tal et al. (2026)

Hypothesis: The regulatory gap

Regulatory Imbalance

Demand for CA's used EVs is a function of the **Regulatory Gap.** If you can buy a **New EV** for a competitive price, you are significantly less likely to import a used one from CA.

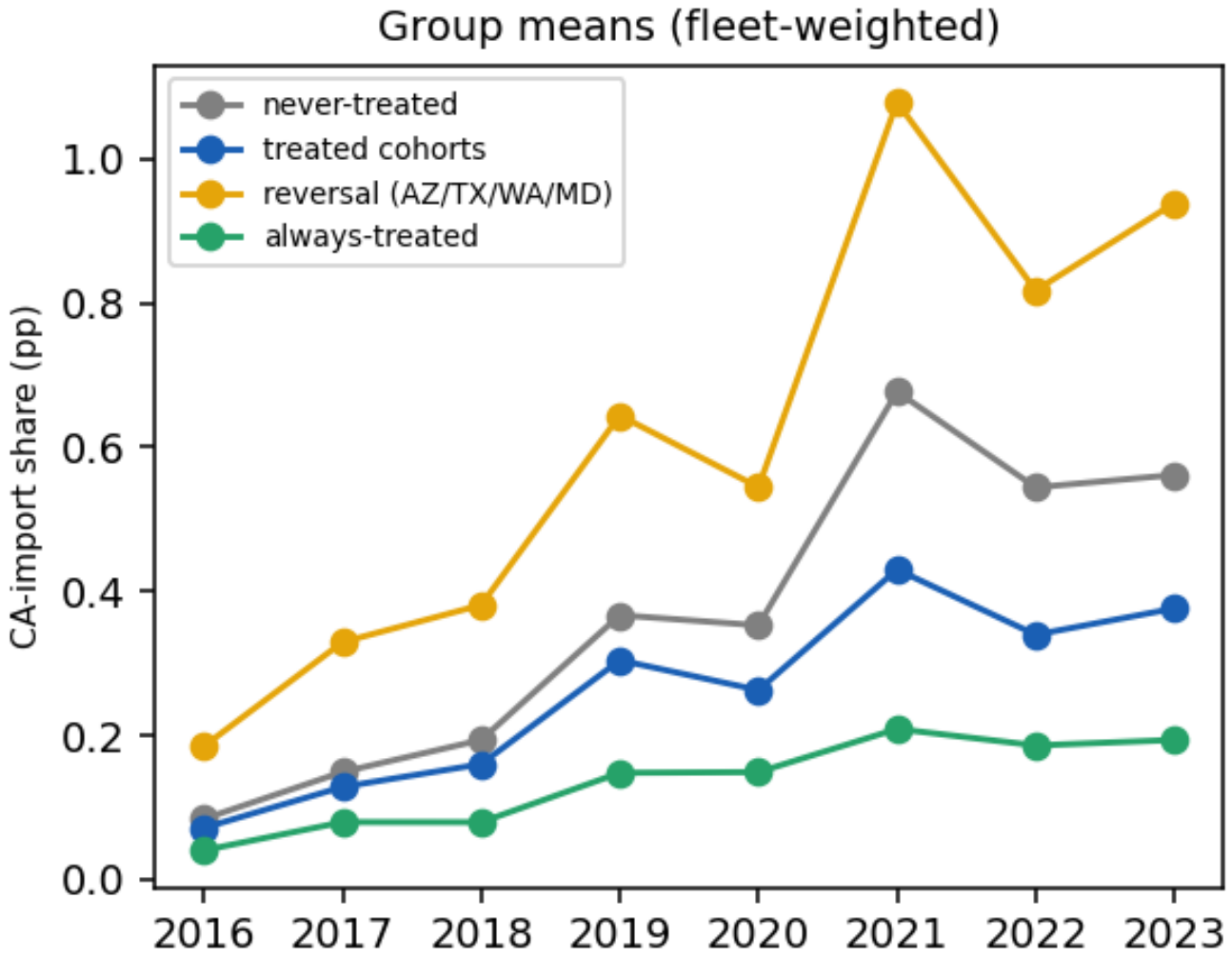
Flow Direction

Consequently, **flows concentrate in "laggard" states**, where used imports are the main affordable clean option.

Source: Tal et al. (2026)

Raw trends in California-origin used-PEV import shares

- Reversal states exhibit the highest and fastest-growing reliance on California supply
- Treated states track controls before adoption and then flatten
- Always-treated states are the lowest



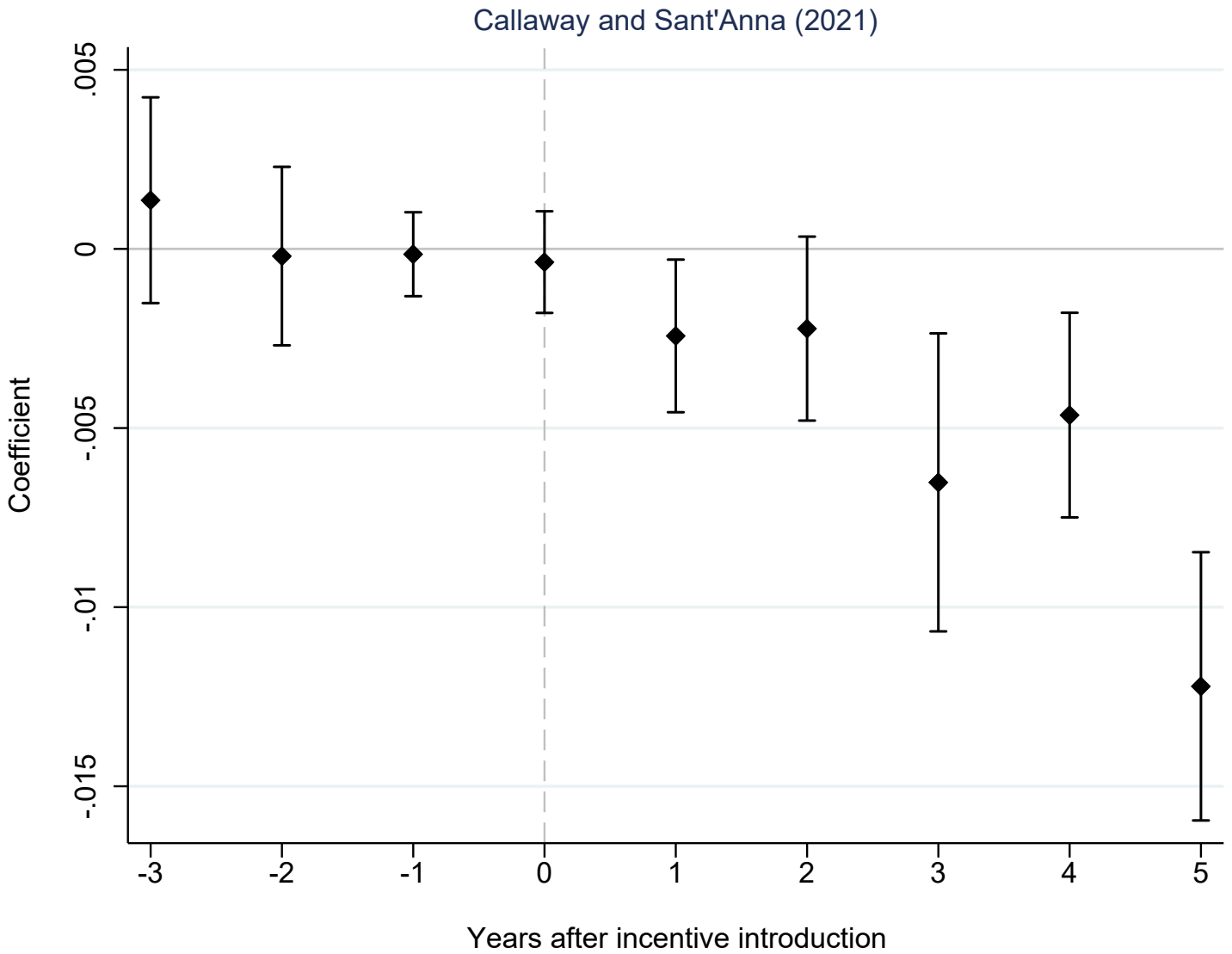
Source: S&P Global interstate vehicle transfer records, 2016-2023; Tal et al. (2026)

Econometric findings

	Outcome: county imports of California-origin used PEVs as a share of the 2023 PEV fleet			
	(1)	(2)	(3)	(4)
Incentive available	-0.144	-0.087	-0.167***	-0.199***
	(0.106)	(0.090)	(0.040)	(0.053)
County + year FE	Yes	Yes	Yes	Yes
Distance-decile x year FE	No	No	Yes	Yes
Fleet weights	No	Yes	Yes	Yes
Sample	All cohorts	All cohorts	All cohorts	Early cohorts
Observations	19,552	19,552	19,552	18,200

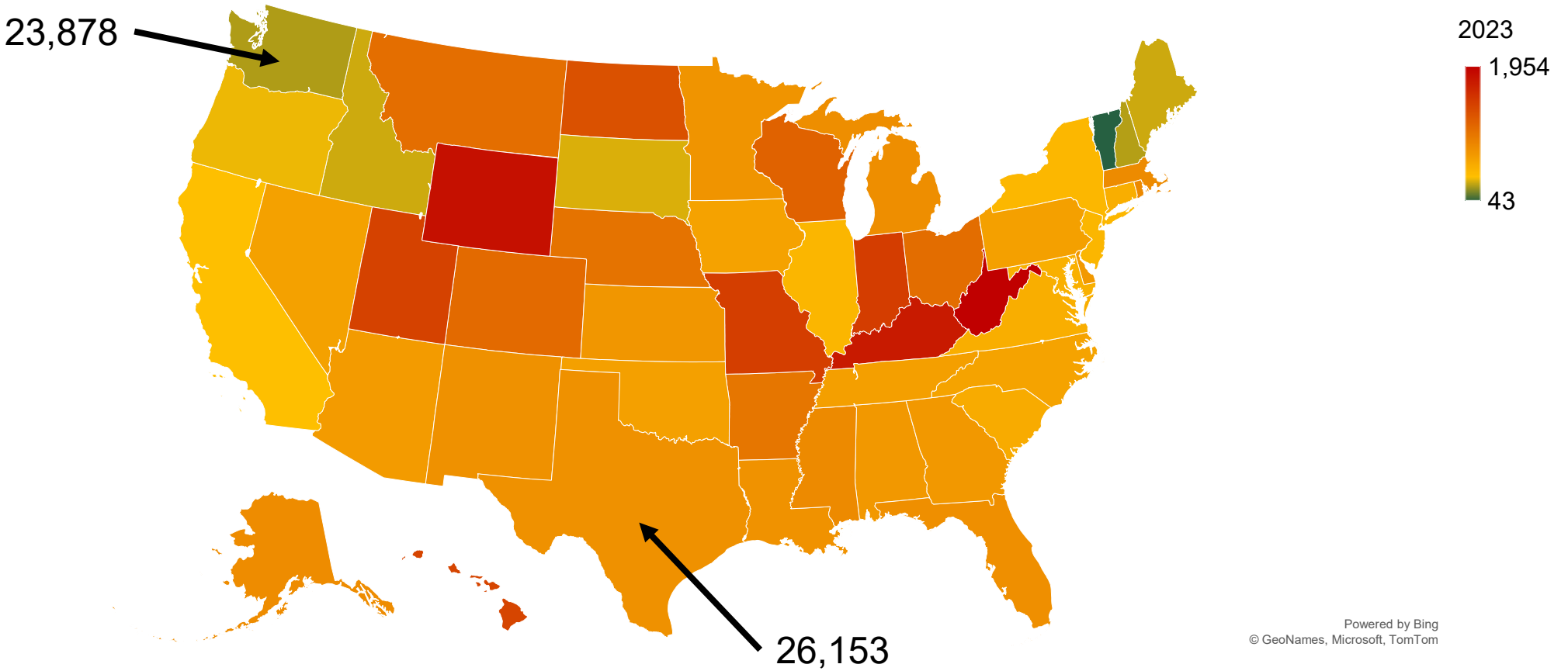
Source: Authors' econometric analysis of S&P Global records (2016-2023) and AFDC incentive data; Tal et al. (2026)

Staggered DiD estimators reveal treatment effect evolution over time



Source: Authors' econometric analysis of S&P Global records (2016-2023) and AFDC incentive data; Tal et al. (2026)

State Annual CO2 Total Output Emission Rate (lb/MWh)



Source: Tal et al. (2026), Figure 36

Weighted average relative intensity of exports:

$$Relative\ Intensity\ Index = \frac{\sum_s E_s r_s}{\sum_s E_s}$$

- E_s = number of PEVs imported from CA to state s
- r_s = grid emissions relative to CA in state s (≈0.1- 4.9)

- >1 if dirtier; <1 if cleaner

- We get: **Relative intensity=1.79**

On average, exported BEVs from California are operated in states were **grid emissions are about 79% higher** than California's.

Source: Authors' calculations from S&P Global transfer records; Tal et al. (2026)

This raises a strategic dilemma

The Retention Case

Focus: Equity & local benefit

Keep used EVs in-state to maximize grid benefits and provide affordable options for California's low-income populations.

The Leadership Case

Focus: National market seeding

Accept exports as California's role as the "National EV Engine," forcing laggard states to build infrastructure for incoming clean vehicles.

Source: Tal et al. (2026)

Takeaways

- ~10% of California PEVs are leaving the state.
- States with strong PEV environment import fewer used PEVs from California.
- Exported PEVs often end up in states with dirtier grids.
- The bigger the policy gap, the greater the PEV leakage from California.



Source: Tal et al. (2026)

Conclusions

Key findings and policy discussion

Source: Tal et al. (2026), CARB Agreement No. 22STC016

Key findings from the final report

- **Buyer profile:** used PEV buyers have incomes similar to new gasoline vehicle buyers and show greater cost sensitivity
- **Home charging:** essential rather than optional; limited access is a key equity barrier for renters and multi-unit housing
- **Battery information:** about two thirds of buyers inquire, most rely on seller statements; information gaps may suppress the market
- **Incentives:** new and used buyers respond similarly; without incentives about 21% of current PEV buyers would not choose a PEV
- **Exports:** over 240,000 used PEVs left California in 2016-2023, to grids about 79% more carbon intensive on average
- **Use patterns:** used PEVs are driven like new PEVs, but the used market concentrates short-range, older-generation vehicles

Source: Tal et al. (2026), Final Report, DOI 10.7922/G2805103

The used electric vehicle market is the key path to affordable zero emission vehicles in California

- When the first owner sells a ZEV(~30%)
  - Many ZEVs are purchased as second vehicles in the household (~25%)
  - When the vehicle remains in California(~85%)
- When used EVs reach households that benefit the most

Policy discussion

How to support faster turnover of first owners

- What effect do incentives have when supply is limited?
- How to encourage vehicles to remain in California

How to reduce risk for new adopters of used technology

- Education for buyers and sellers
- Battery health indicator
- Battery warranty
- Support for charging access and incentives

Source: Tal et al. (2026)

Thank You!

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- *Dr. Sina Nordhoff, Market and consumer adoption*
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- *Dr. Scott Hardman, Consumer behavior, Global Policy*

Report: Tal et al. (2026), DOI 10.7922/G2805103



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