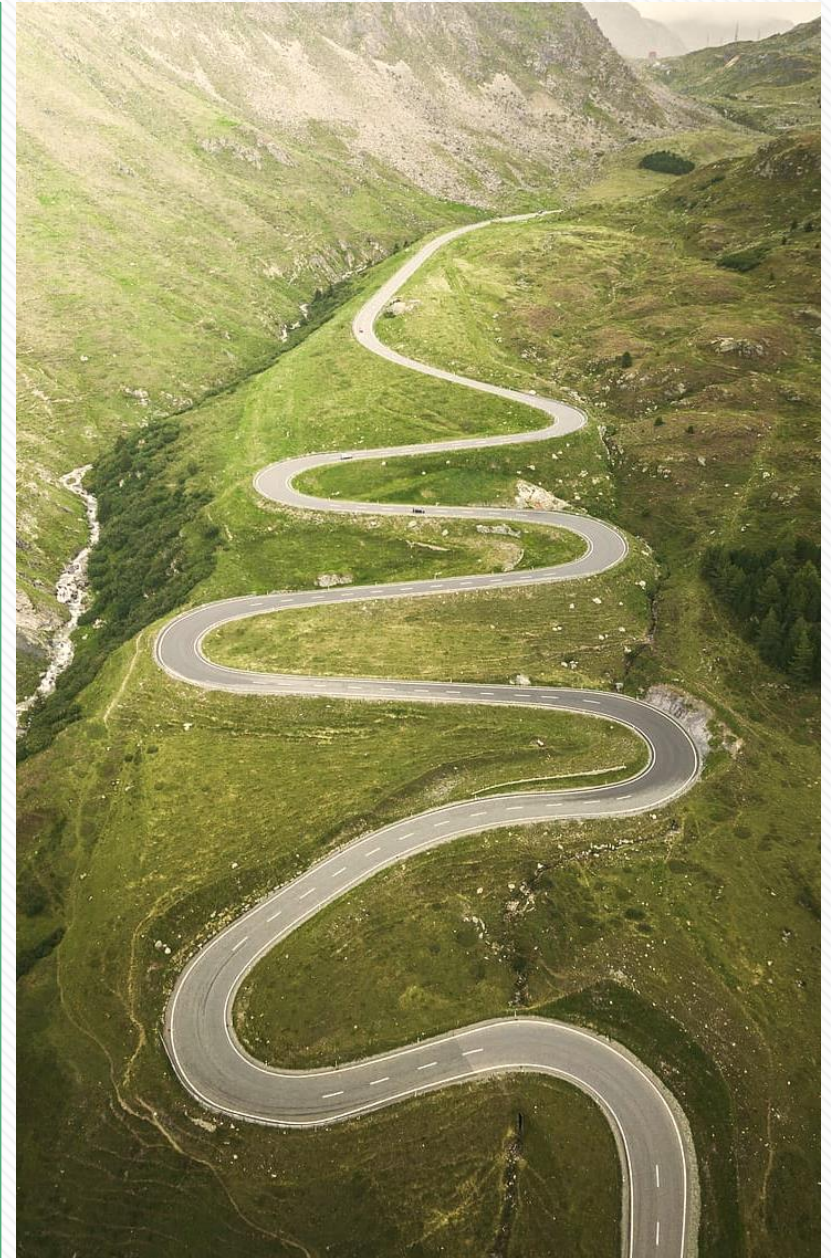


THE PATH TO 100%

A Household-Level EV Adoption Model for California

Trisha Ramadoss, Ph.D. Candidate
EV Research Center, UC Davis
Tuesday November 14, 2023
BECC

In collaboration with Drs. Jae Hyun Lee,
Adam Wilkinson Davis, Scott Hardman, Gil Tal

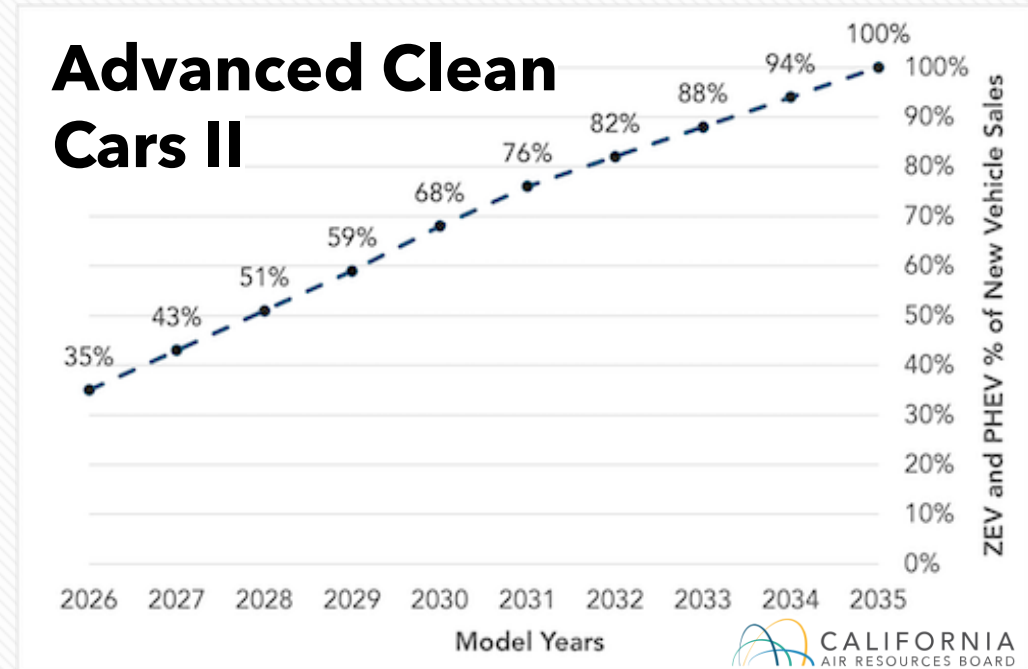


MOTIVATION

Switching to electric vehicles

California is moving towards 100% EVs

CALIFORNIA'S CLIMATE PLAN LAYS THE ROADMAP TO 2045



How do we move from **early adopters** to the **general population**?

RESEARCH QUESTIONS | The path to 100% EVs

How do we move from **early adopters** to the **general population**?



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- Which types of households have **already adopted** an EV?
- How do they compare to the **general population**?
- How quickly is adoption **progressing**?
- Is adoption on track to meet **2045 targets**?

OVERVIEW

From adopters to the general population

1 Identifying different **types of adopters**

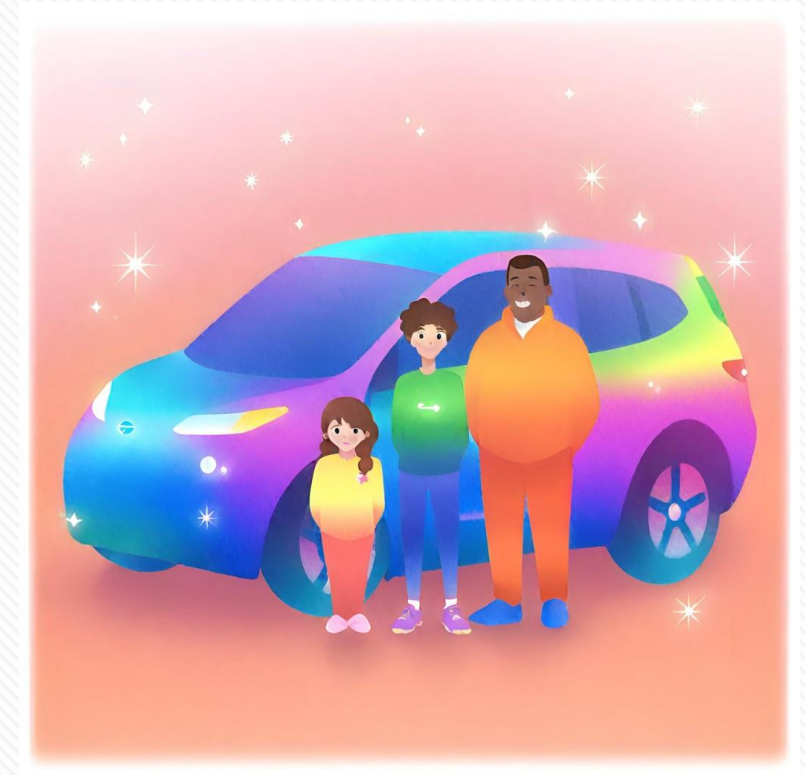
- Clustering

2 Generalizing to the **entire population**

- Scoring Population
- Weighting EV Adoption by Cluster

3 Creating **future scenarios**

- Bass Diffusion - Current & Net Zero
- Comparing to EV Supply using ACCII



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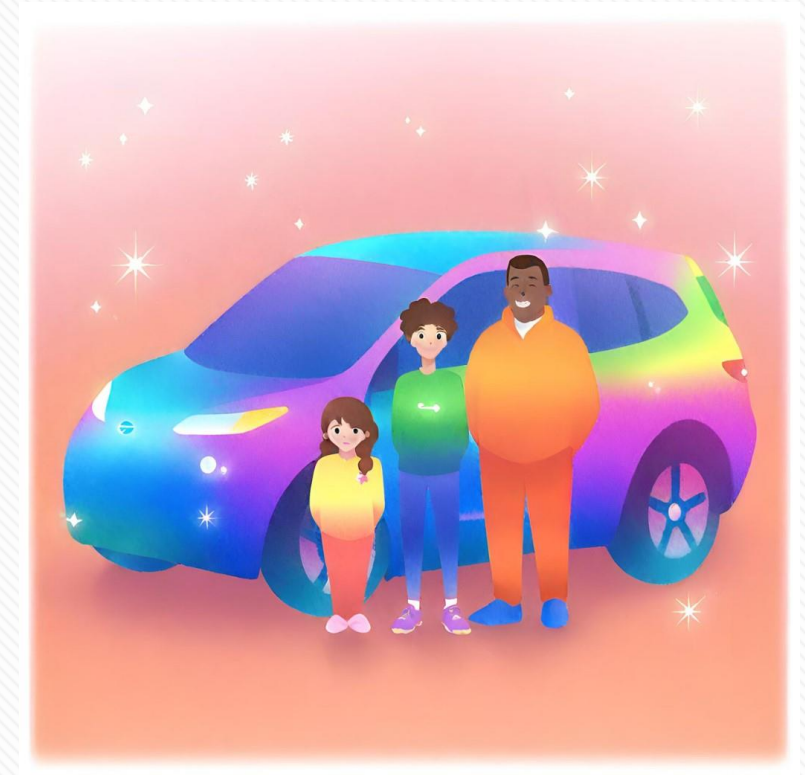
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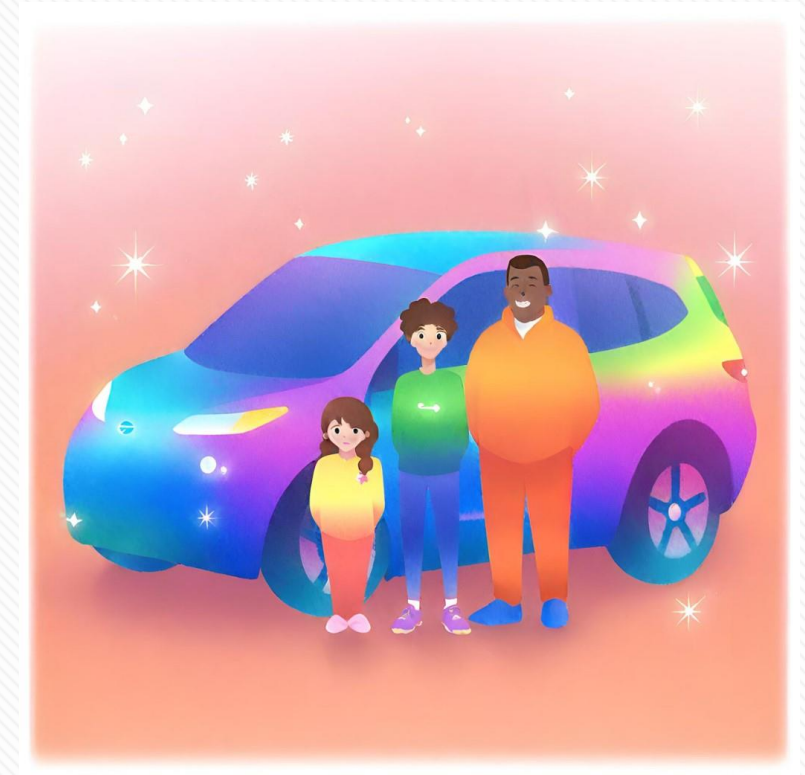
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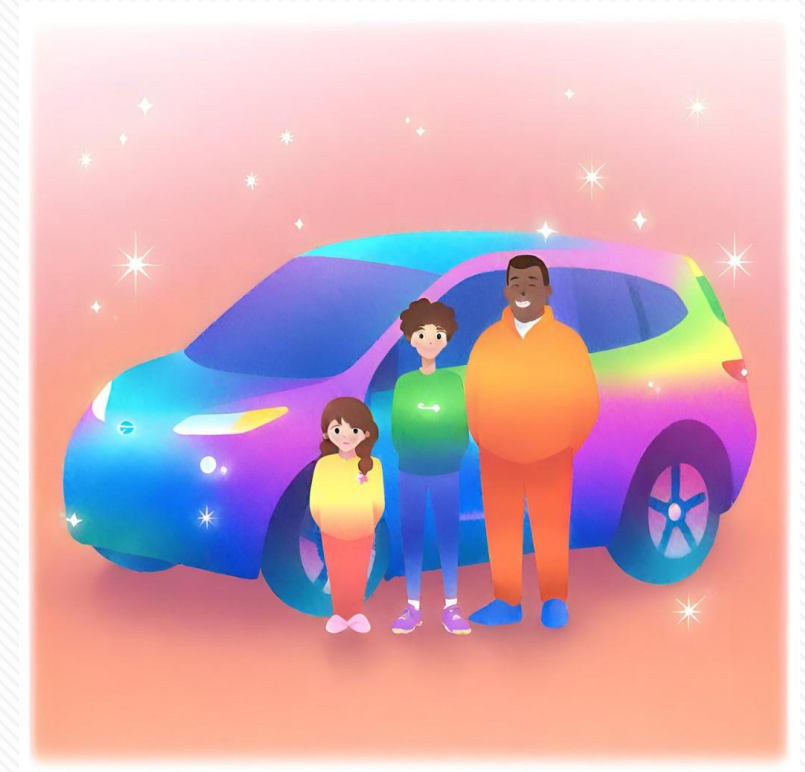
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Identifying different **types of adopters**



Sociodemographics

- Income, Age, Gender, Education, Housing Type & Tenure



Land Use

- Rural/Suburban/Urban



Vehicle Fleet (Multi-Vehicle only)

- Fleet size, Vehicle Ages, Vehicle Body Types

Latent Class Clustering

- Survey of EV buyers who apply to CVRP
 - Designed by ITS-Davis EV Research Center
 - Recruitment by CARB
 - Buy EV → Apply CVRP → Recruited
- CVRP Rebate
 - 2010 onwards
 - \$1,000-\$7,500
 - Buying/leasing new EV
 - Changing income & vehicle eligibility





Single-Vehicle

15%

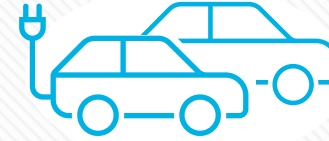
2,896 Households

Slightly younger

More female EV drivers

More Apartments & Rented

More Urban



Multi-Vehicle

85%

16,025 Households

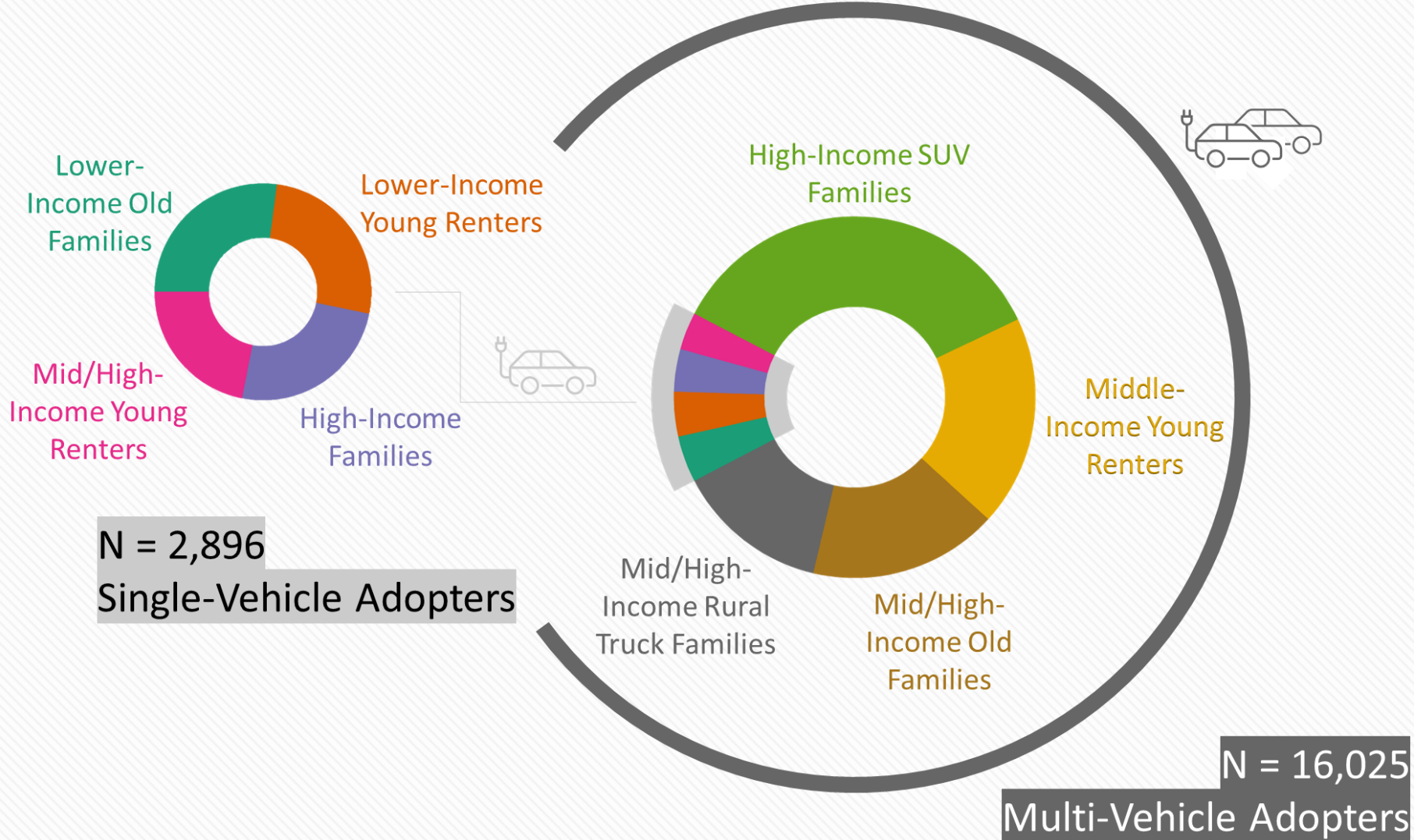
Higher incomes

Larger HH & more drivers

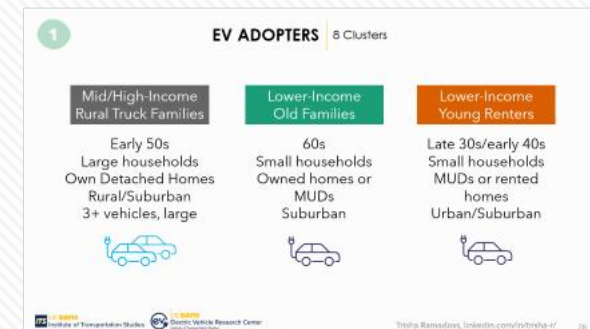
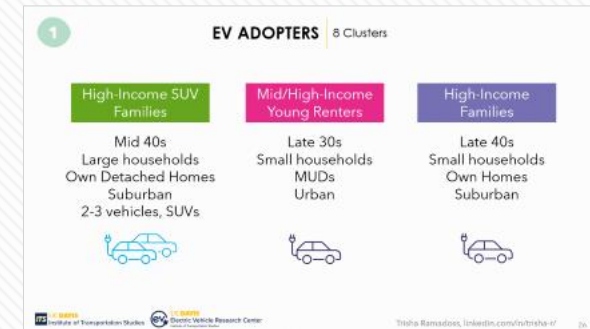
More Owned/Detached houses

More Rural & Suburban

EV ADOPTERS | 8 Clusters



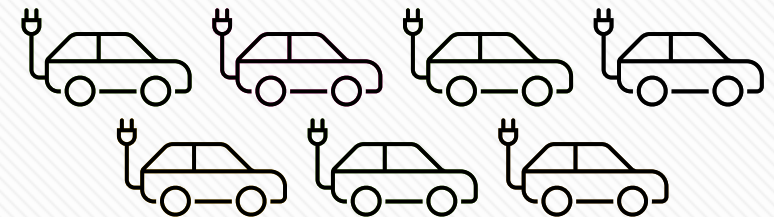
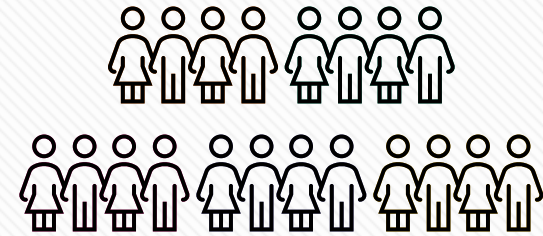
- Unsurprisingly, the largest adopter cluster is **high-income, suburban** & likes to own **SUVs**
- But, we also see interesting clusters
 - Lower-income
 - Rural
 - Renters
 - Own trucks



The slide features two overlapping green circles on the left side. The front circle is a solid medium green, while the back circle is a lighter, semi-transparent shade of the same color.

Generalizing to the **entire population**

- Scoring to calculate the probability a **general household** belongs to a cluster
 - NHTS California Add-on
- Weighting PEV survey to calculate to-date **cumulative adoption** in each cluster
 - CEC ZEV Sales data

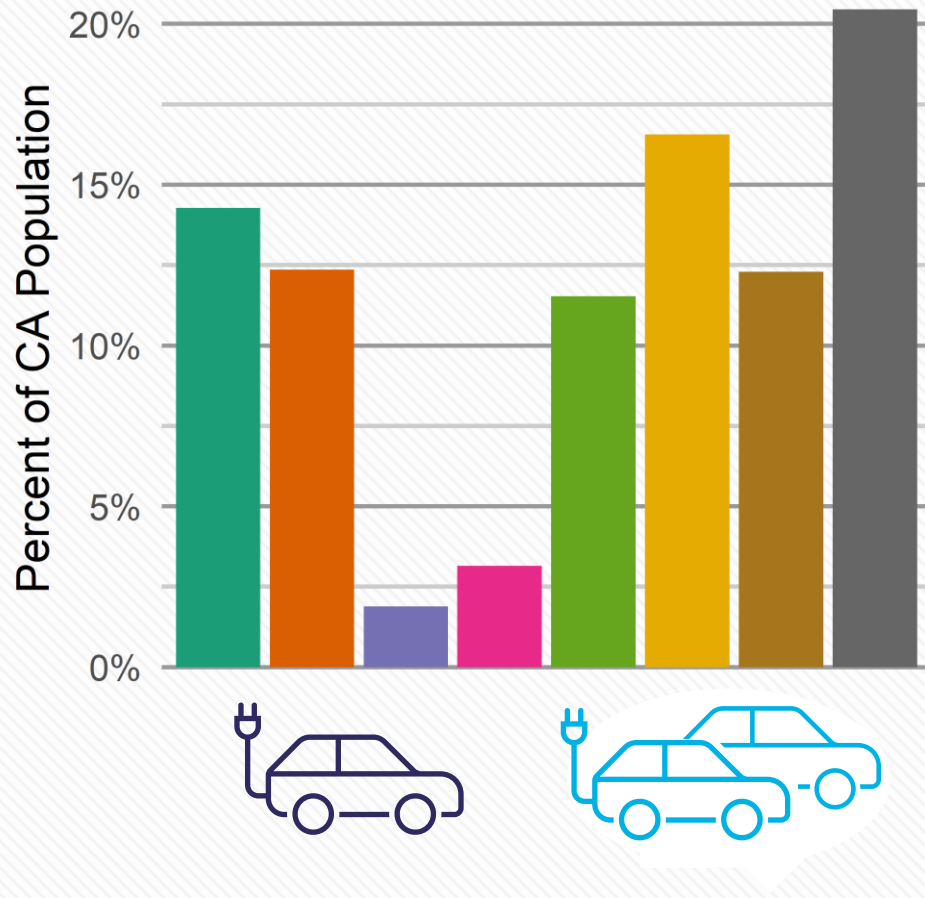


1

2

GENERAL POPULATION

8 Clusters



Mid/High-Income Rural Truck Families

Middle-Income Young Renters

Lower-Income Old Families

Lower-Income Young Renters

Mid/High-Income Old Families

High-Income SUV Families

Mid/High-Income Young Renters

High-Income Families

Creating **future scenarios**

1

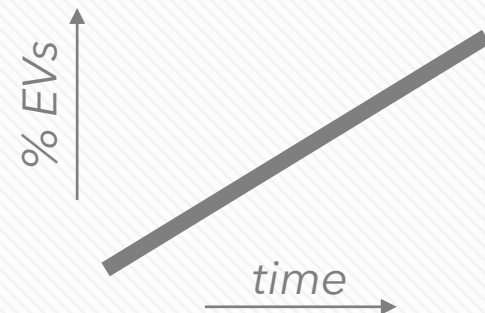
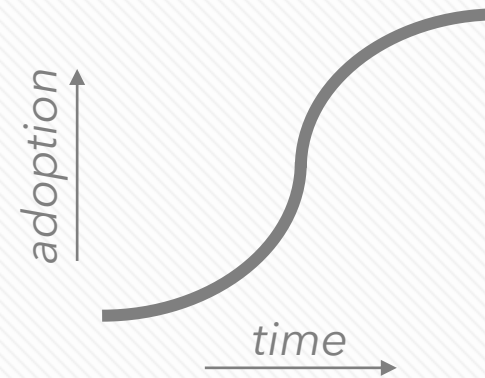
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FUTURE SCENARIOS

Methods & Data

- Using Bass diffusion to create **two scenarios** fitting to:
 - Past cluster adoption **BAU**
 - Past cluster adoption + full adoption by 2045 **Net Zero**
- Comparing to CA **EV supply**, assuming a similar vehicle fleet in 2035
 - NHTS California Add-On
 - Advanced Clean Car II Targets

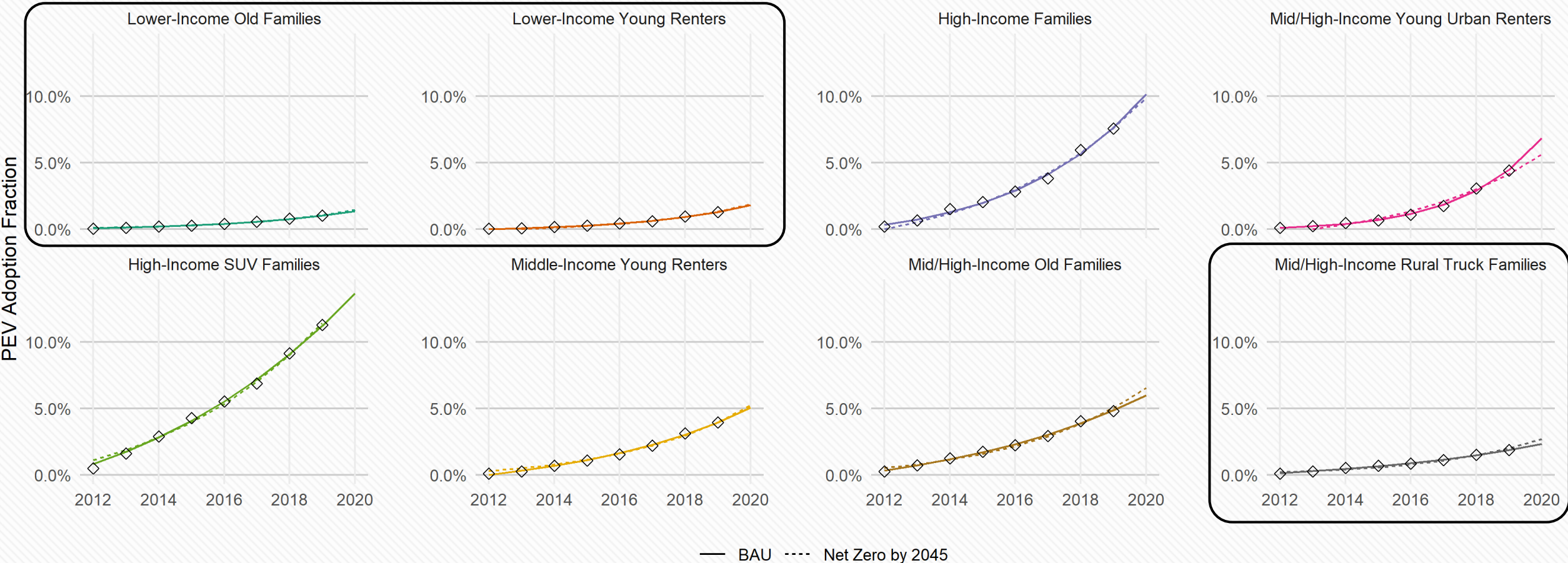




FUTURE SCENARIOS

Comparing to Past Data

Large segments of the population have low current adoption

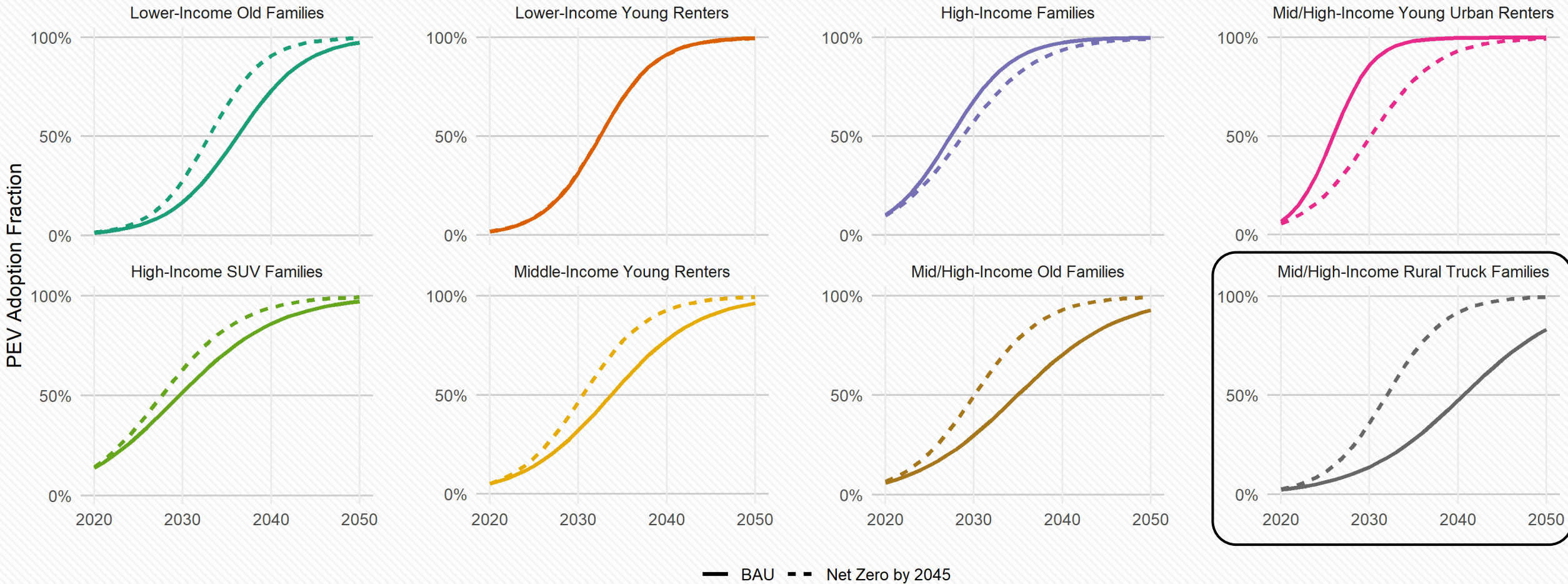




FUTURE SCENARIOS

Current Trajectory & Net Zero

Large segments are falling short of 2045 net-zero goals



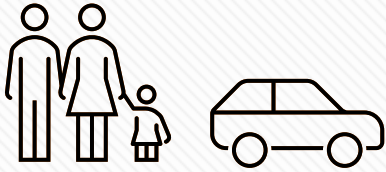
1

2

3

ACCII TARGETS

Clusters & Vehicles



Cluster membership α

- Vehicle age
- Number of vehicles



Correlates to **probability of EV ownership** assuming ACCII targets are met



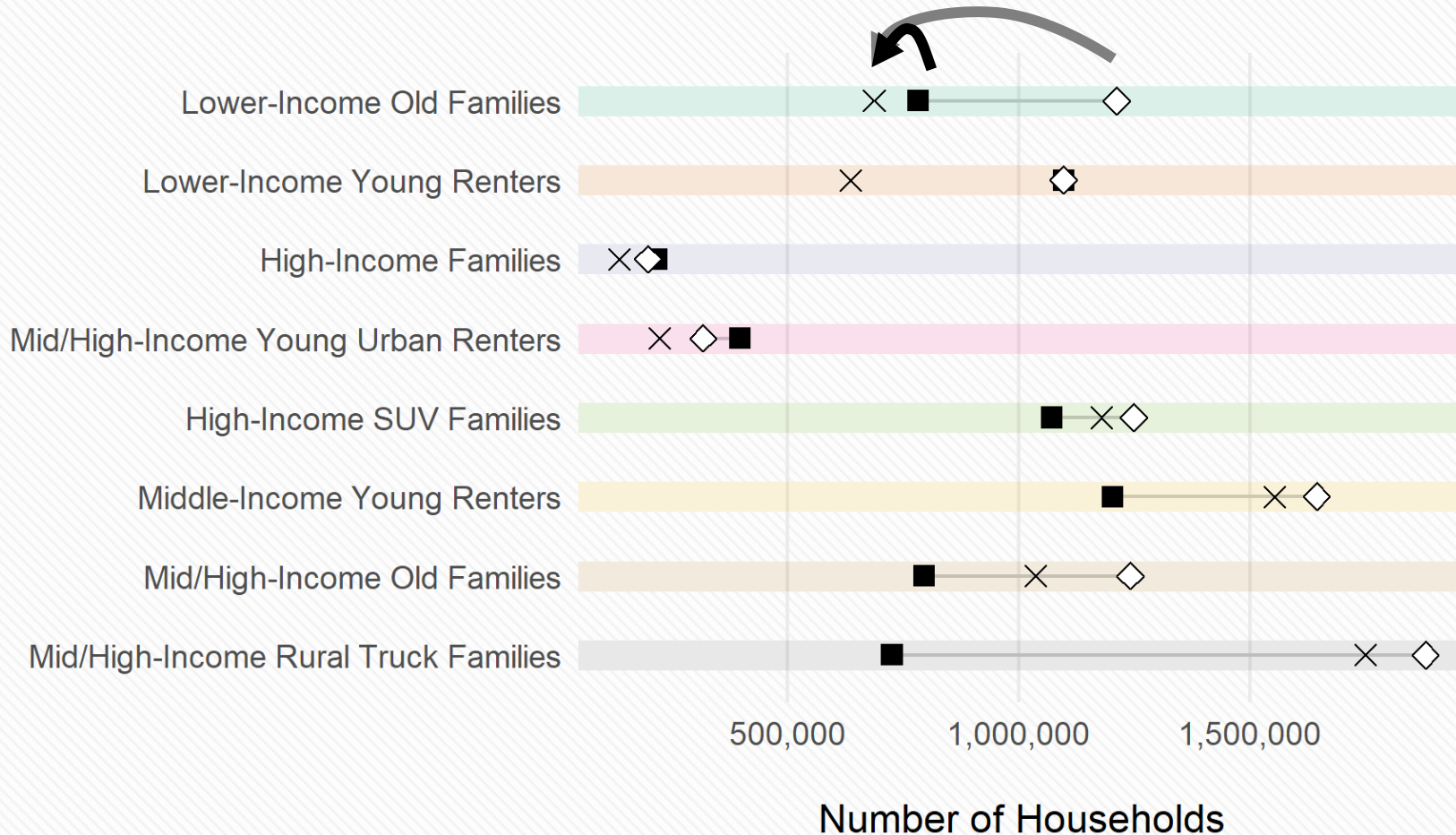
We calculate an **expected value** of adoption given similar fleet in 2035



2035 SCENARIOS

Bass Diffusion & ACCII Targets

■ BAU × Expected Value, ACCII ◇ Net Zero by 2045



Not enough (older) EVs to meet current adoption rate for single-vehicle HH

Not enough EVs for 2045 net zero goals for all clusters

TAKEAWAYS

What does this tell us?

- Total of **8 clusters** adopting at different rates
 - Some clusters at very low rate currently
- Some are **falling short** of 2045 goals, need targeted policies
 - Rural Truck Families ~ different EV body types, charging
- There **aren't enough (older) EVs** for BAU adoption for some clusters, or for Net Zero targets across all clusters
 - Will people buy old, used ICEVs from other states?
 - Will households have fewer vehicles?

THANK YOU

Trisha Ramadoss
tvramadoss@ucdavis.edu



Photo by Trisha Ramadoss

Appendix

High-Income SUV Families

Mid 40s
Large households
Own Detached Homes
Suburban
2-3 vehicles, SUVs



Mid/High-Income Young Renters

Late 30s
Small households
MUDs
Urban



High-Income Families

Late 40s
Small households
Own Homes
Suburban



EV ADOPTERS

8 Clusters

Middle-Income
Young Renters

Late 30s
Households w children
MUDs or rented homes
Urban/Suburban
2 vehicles, sedans



Mid/High-Income
Old Families

Late 60s
Small households
Own Detached Homes
Urban/Suburban
2-3 vehicles



Mid/High-Income Rural Truck Families

Early 50s
Large households
Own Detached Homes
Rural/Suburban
3+ vehicles, large



Lower-Income Old Families

60s
Small households
Owned homes or
MUDs
Suburban



Lower-Income Young Renters

Late 30s/early 40s
Small households
MUDs or rented
homes
Urban/Suburban



1

2

3

ACCII Targets | EV Share

