

A decorative graphic on the left side of the slide, consisting of a network of light blue lines and circles that resemble a circuit board or a neural network. The lines are vertical and horizontal, with small circles at various points, creating a complex, branching pattern.

Identifying Infrastructure Needs for Growing (Supporting) the EV Market

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The Charging Triangle

Do driving patterns match an EV range?
Will it save people money based on driving patterns (enough usage)?

\$ Vehicle Purchase

- Do customers have sufficient capital?
- Do customers have a garage?
- Can users install charging?



Driving Behavior

- Do EV users drive EVs differently?
- Will they develop a new EV Driving Territory?
- How do users maximize the cost benefits of their EV?

How will charging infrastructure influence market growth?

Will charging expand driving possibilities?



Charging

- When, where, and how much will people use chargers?
- What motivates people to use a specific charger?
- How does pricing change charger usage?
- Is charging reliable?
- How many chargers are available?

OVERVIEW

- New survey 11 States +DC. State of workplace charging
- UC Davis GIS Toolbox Results

NEW SURVEY



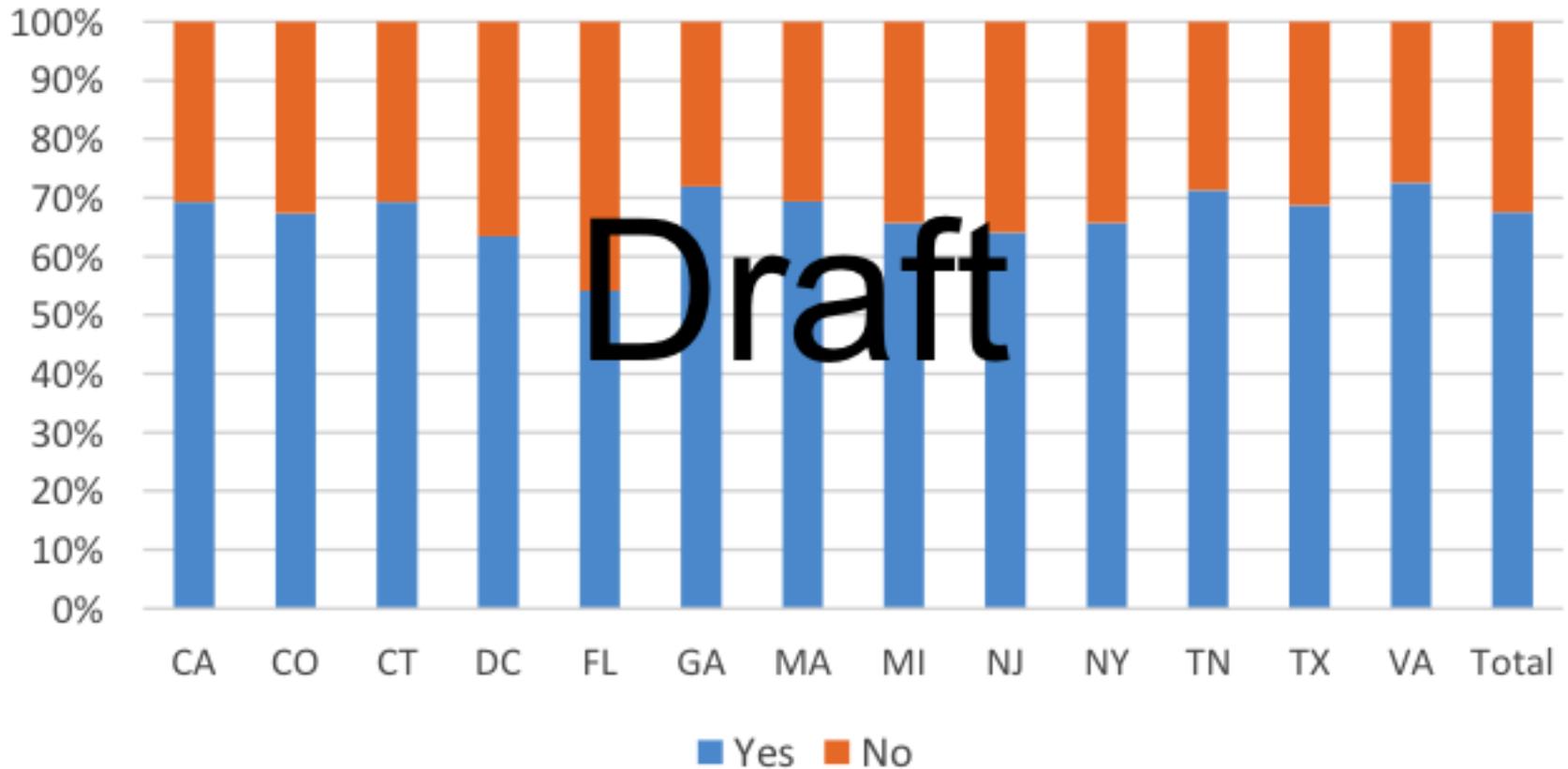
Legend

Survey Deployment

- Not Surveyed
- 2014 Survey
- 2013 California Survey

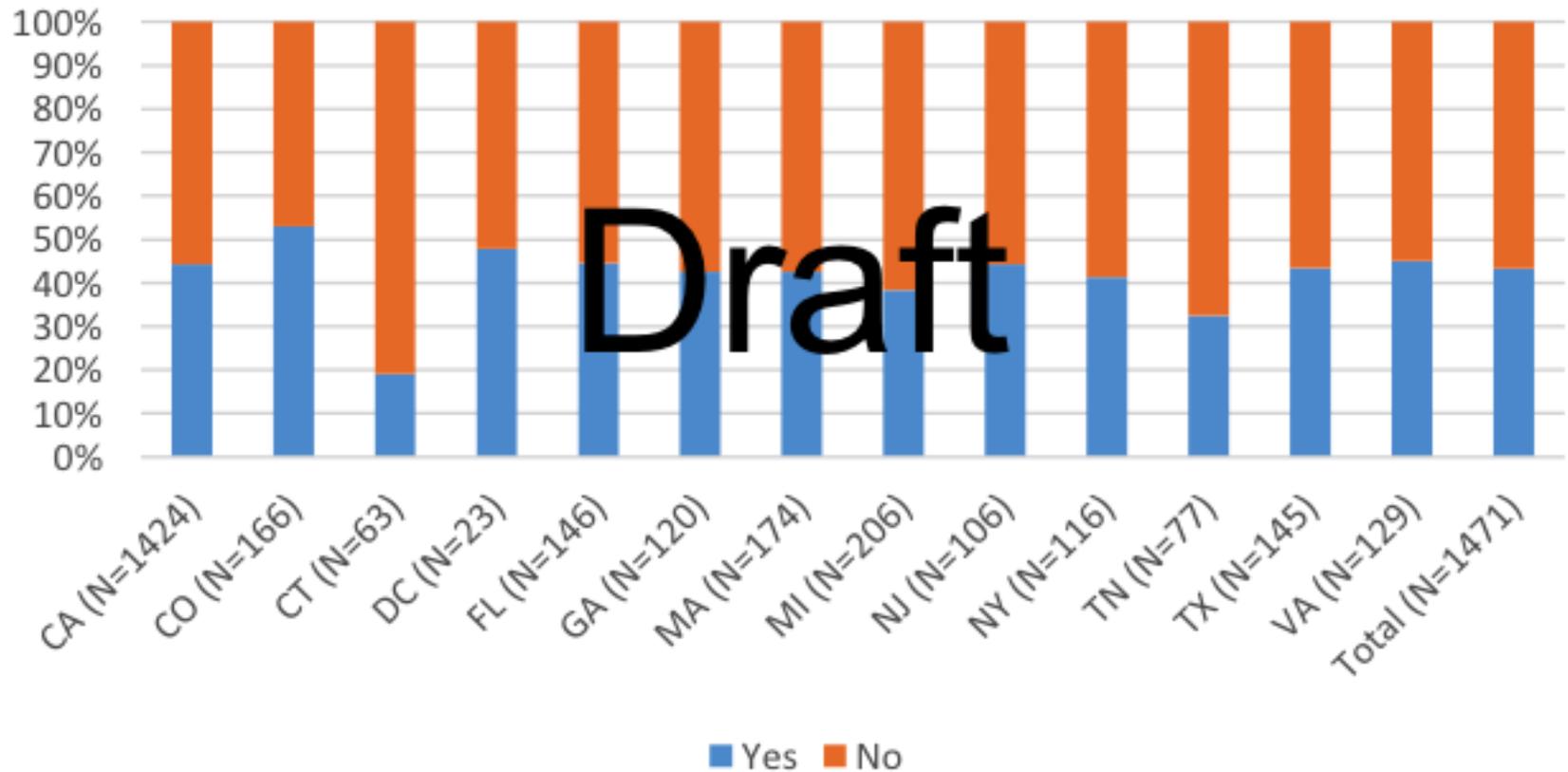
65%-70% OF HOUSEHOLDS COMMUTE WITH PEV

Do You Commute With Your PEV?



LESS THAN HALF CHARGE AT WORK

Is Workplace Charging Available?

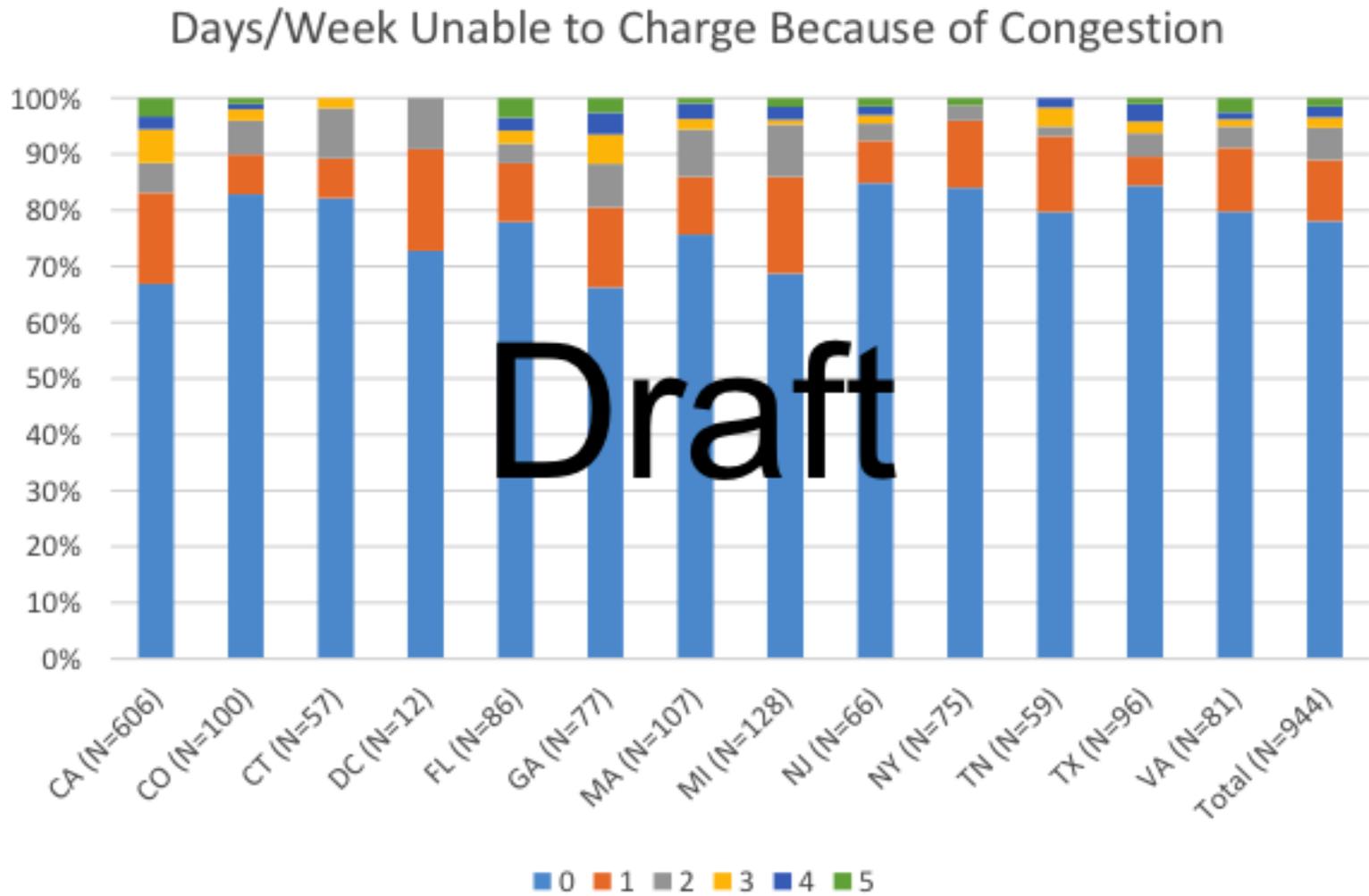


75%-80% OF CHARGING IS FREE

Is Your Charging Free?

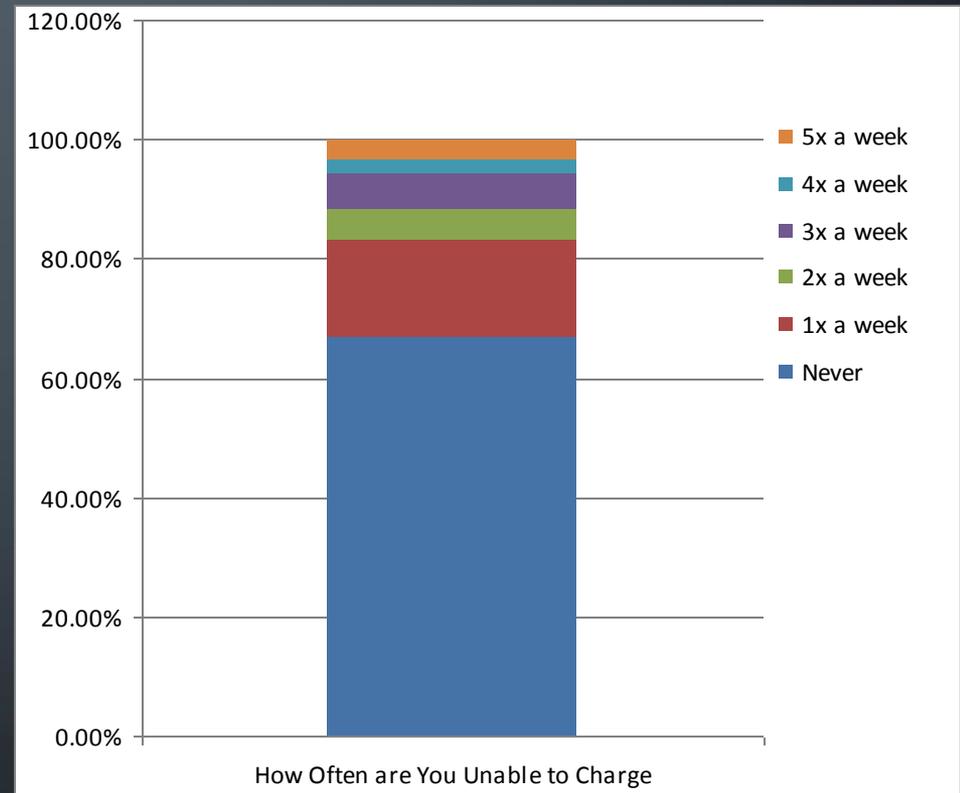


WHAT DO USERS REPORT ABOUT CONGESTION? ABOUT 20%.



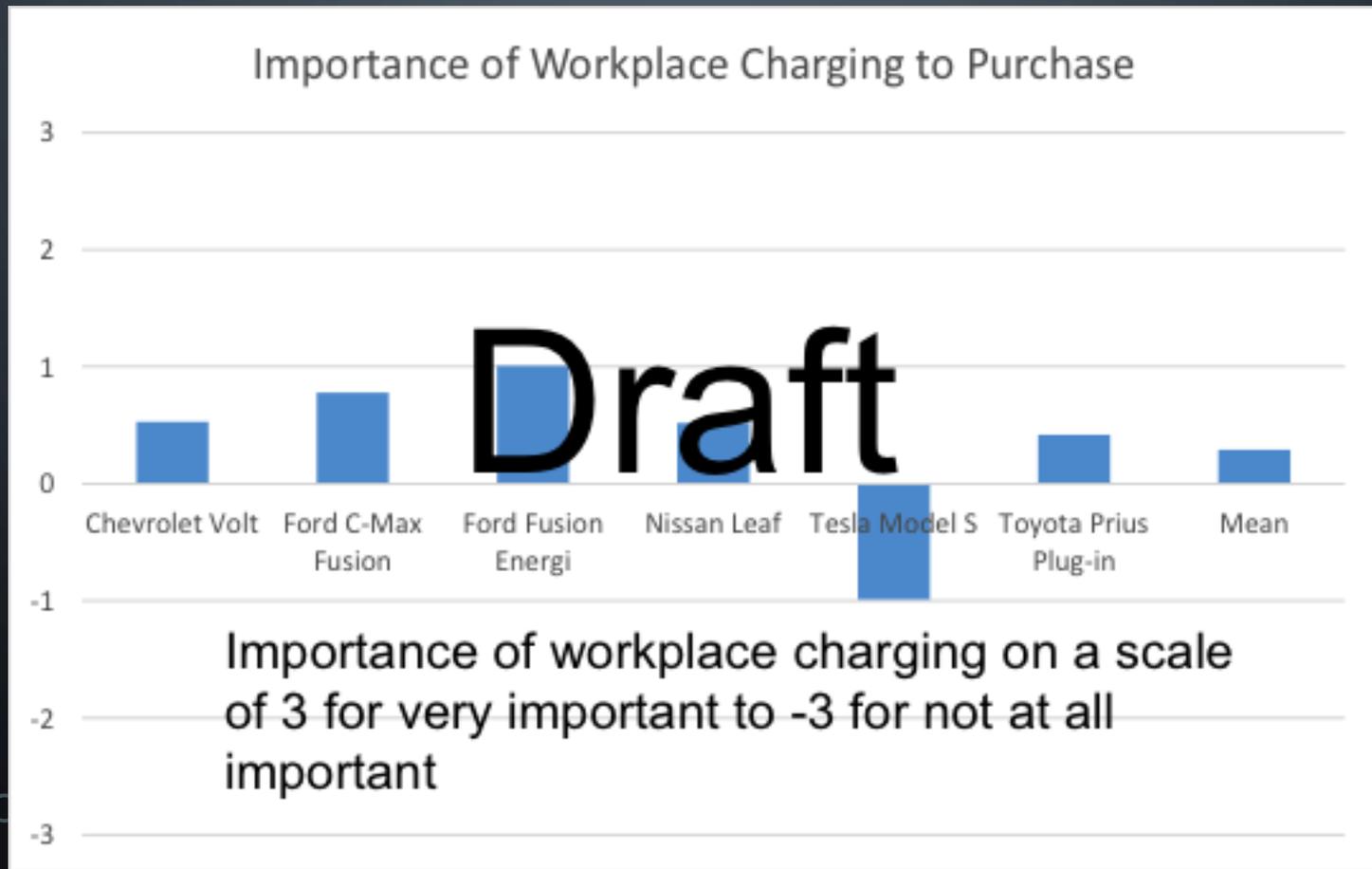
Congestion in California...

- Over 30% of drivers have congestion at work
- Pay systems exist in congested areas. Nevertheless paid chargers are 1.7 times less likely to experience congestion
- At least 53% of people who don't need charging charged anyway with free uncongested charging.



But...What About Sales?

PHEV20s, in Particular, Value Workplace Charging in the Purchase Decision

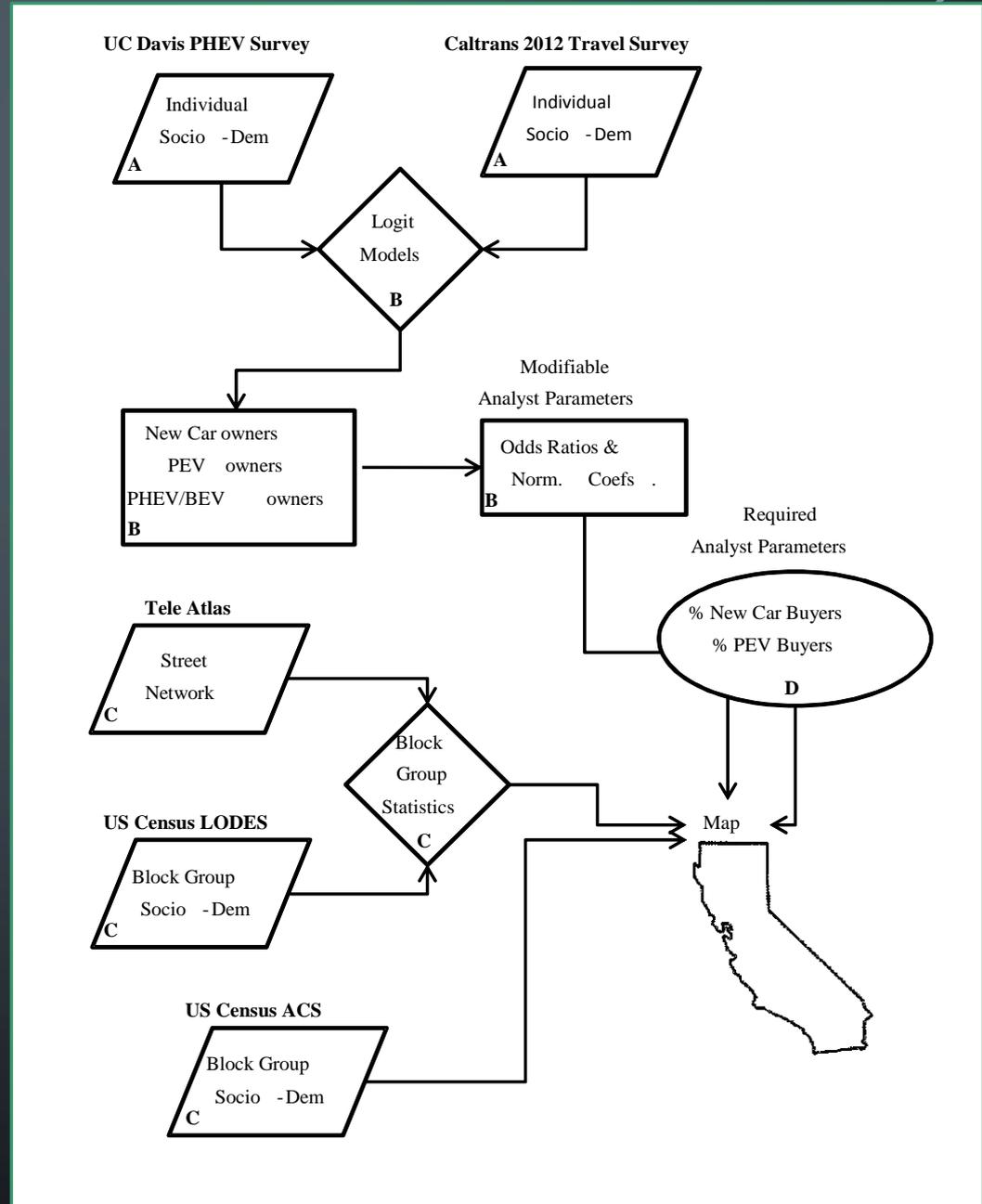


GIS EV CHARGING TOOLBOX FOR CA

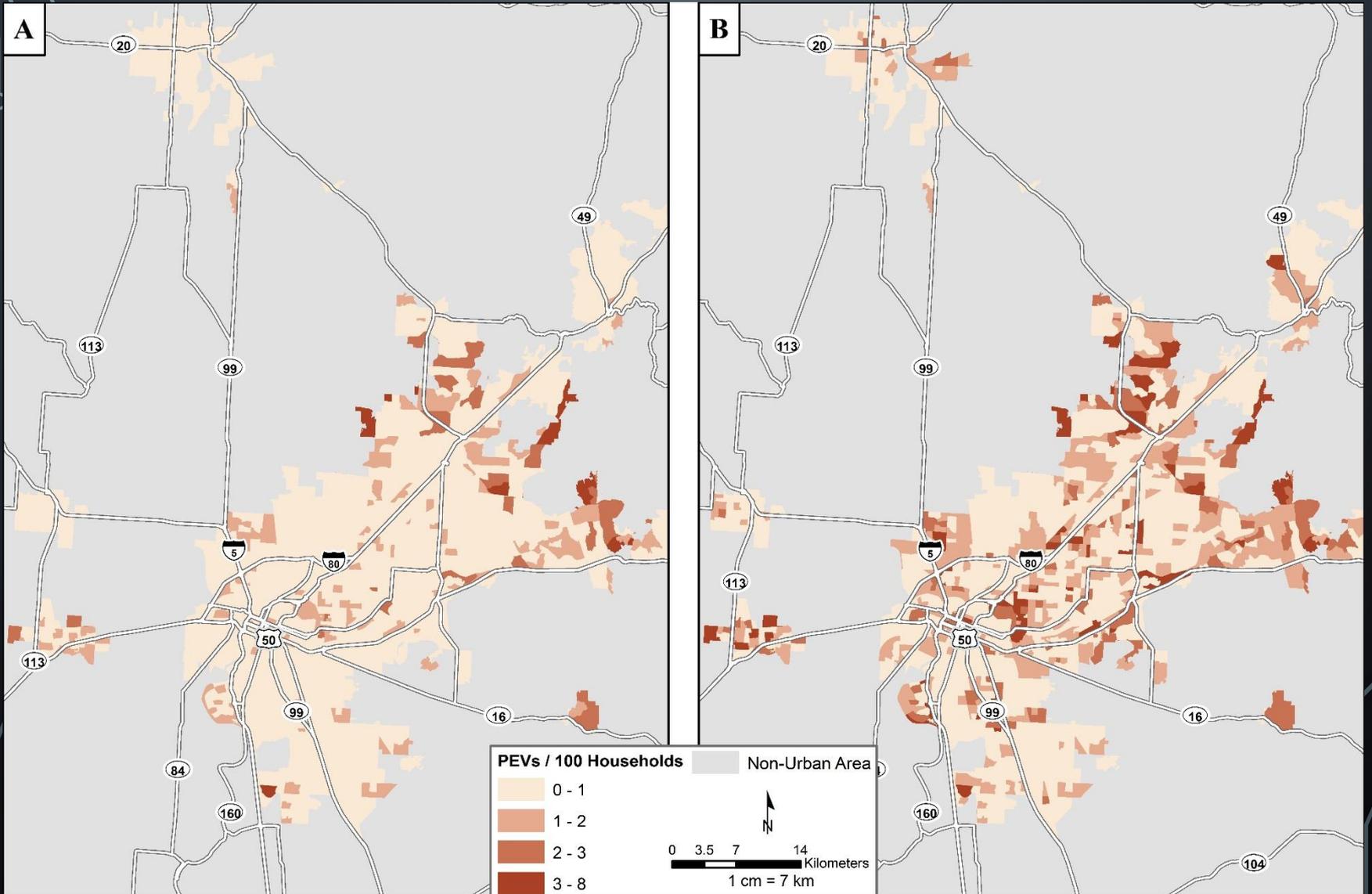
- Market Tool – Not market prediction. Input #PEVs, gives a geographic distribution of buyers based on survey
- Workplace Charging Tool – Given a market distribution and types of vehicles (BEV80,100,150 etc PHEV 10, 20, 30 etc) forecasts where commuters go and what they will use at what price. Based on survey
- Fast Charging Tool - Predicts the need and usage of fast chargers given a battery size.

MARKET TOOL

- Predict PEV Owner Distribution
- Based on a stochastic sample of households
- Sample is stratified by Independent Variable Effects
- Sample is stratified by scenario planning parameters
 - % New Car Buyers
 - % PEV Buyers
 - % BEV Buyers



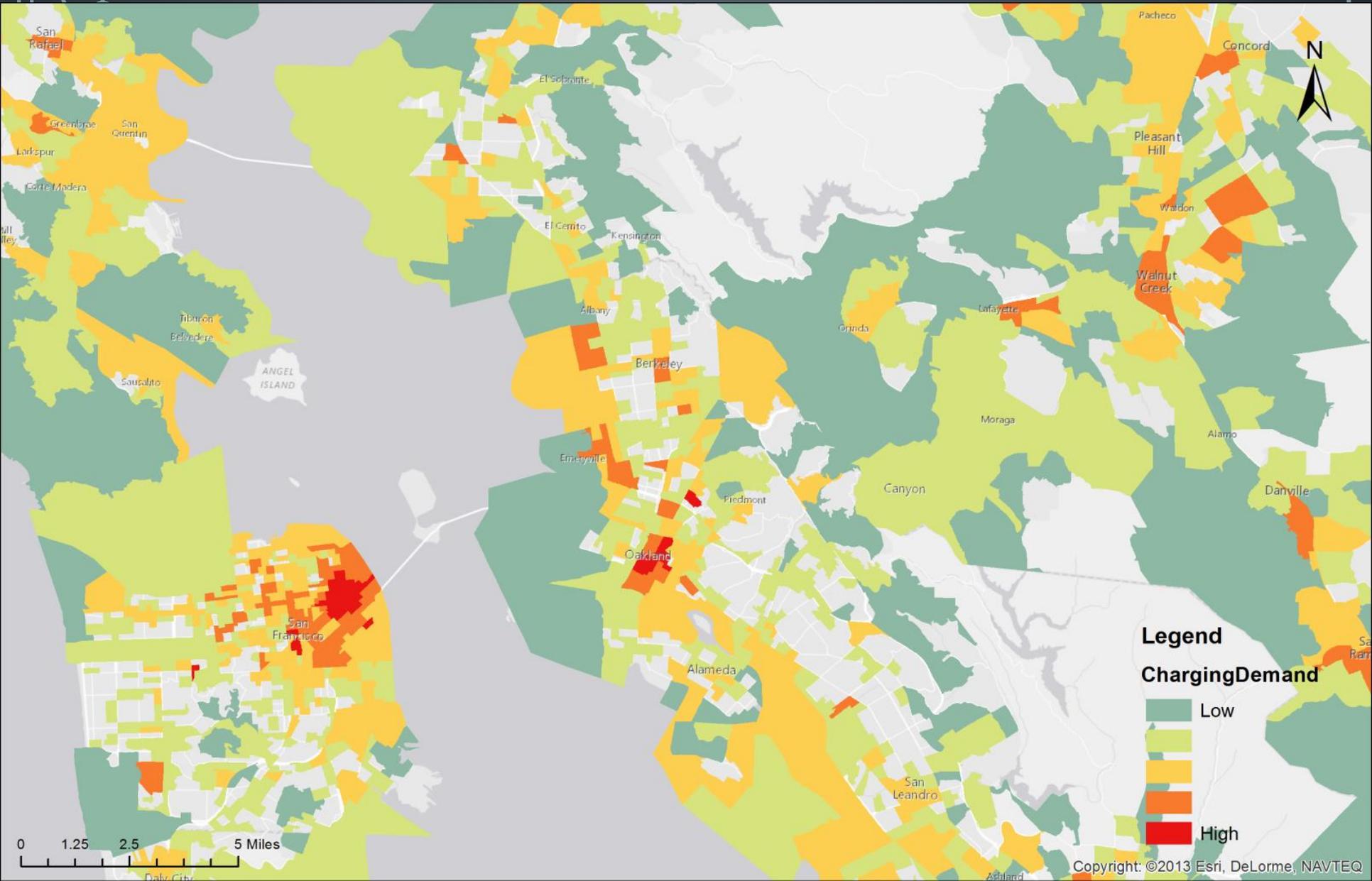
PRICE EQUALIZATION



WORKPLACE CHARGING TOOL

- Relies on LEHD Origin-Destination Employment Statistics (LODES) Dataset.
- Detailed spatial distribution of workers' employment and residential location.
- Free work charging
 - Every vehicle charges at work. Switch from home to work.
 - BEV80 with 15 mile commute will charge 30 mi/day
 - PHEV20 with a 15 mile commute will charge 15 mi/day
- Same price as home
 - BEV80 with 15 mile commute will charge 15 mi/day
 - PHEV20 with a 15 mile commute will charge 15 mi/day
- Paid work charging
 - BEV80 with 15 mile commute will charge 0 mi/day
 - PHEV20 with a 15 mile commute will charge 15 mi/day

SAMPLE RESULT – FREE WORK CHARGING

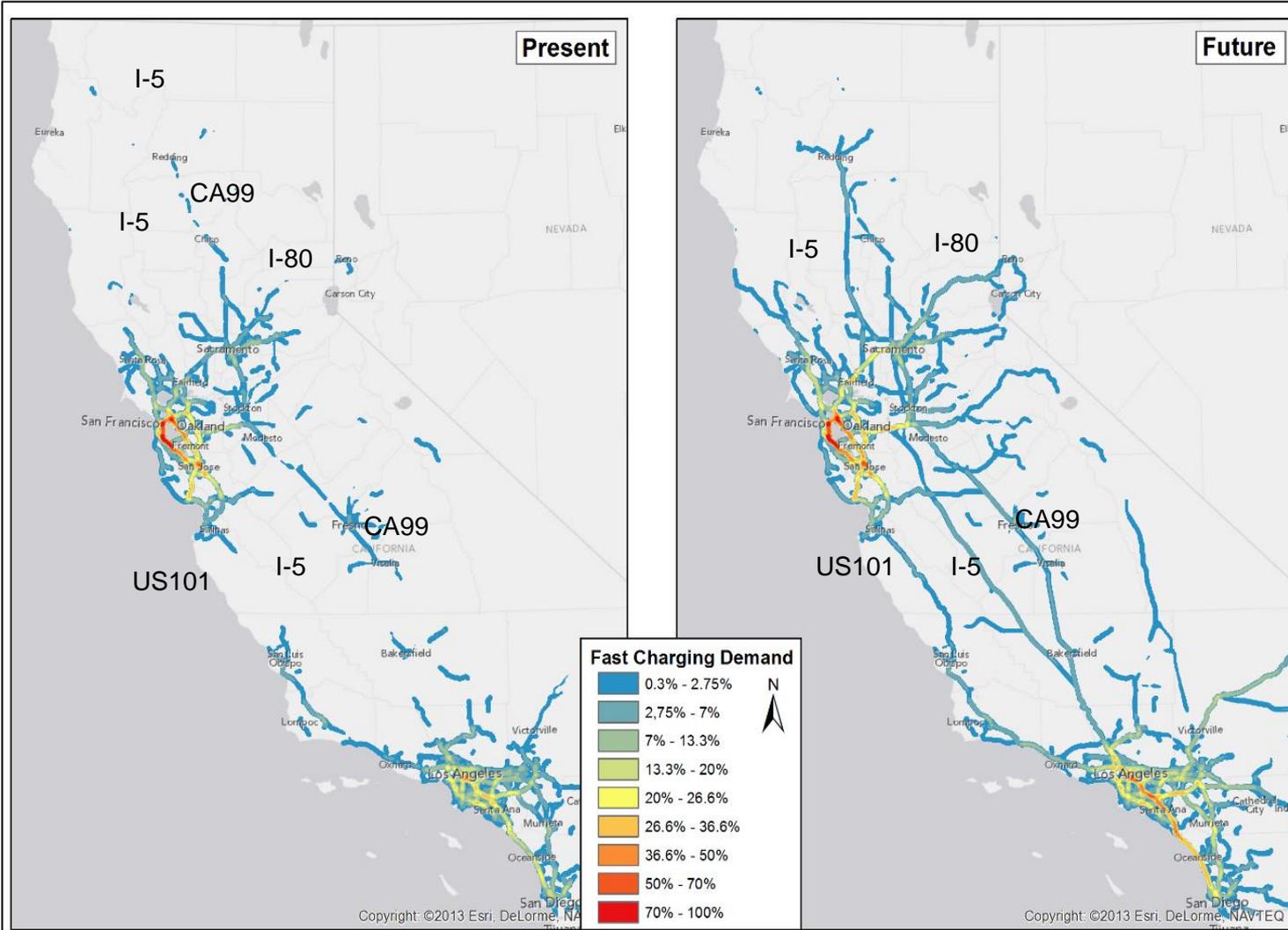


HOW MANY WORKPLACE CHARGERS? 4, 3, 1

- Free = 8 events per 10 PEVs at work (4 chargers)
- Same cost as home = 5+ events per 10 PEVs (3 chargers)
- More than home = 2 events per 10 PEVs (1 charger)

- We are at about 1 charger per 10 vehicles now
- As the market continues to grow, current chargers will always be behind
- Consider fast charger “release valve” to pick up slack

FAST CHARGER DEMAND FROM CURRENT VEH, CURRENT LOCATIONS DEMAND FROM FUTURE VEH, FUTURE LOCATIONS



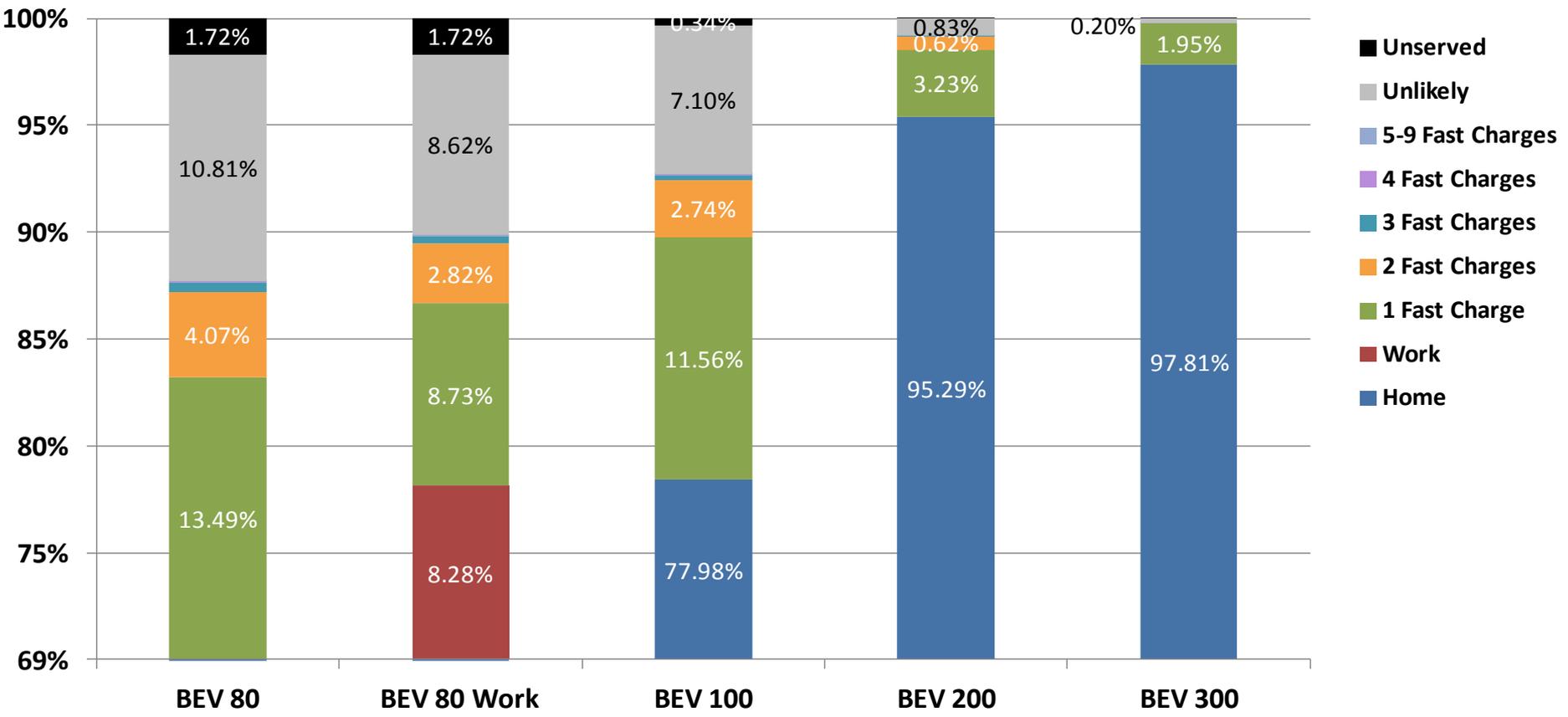
SAMPLE RESULTS

- Statewide, consumption in kWh decreases per car as battery size grows, as shown in the table, even though per charge energy is higher.

| Tour Purpose | BEV Range (Mi.) | # Cars | Total Charge Events | Total Consumption (kWh) | Average Consumption (kWh/Car/Day) | Average Consumption (kWh/Charge) | Average Charge Events/Car |
|------------------|-----------------|--------|---------------------|-------------------------|-----------------------------------|----------------------------------|---------------------------|
| Non Work Purpose | 80 | 250000 | 6731 | 83562.61 | 0.33 | 12.42 | 0.0269 |
| | 150 | 125000 | 1244 | 28906.56 | 0.23 | 23.25 | 0.0099 |
| | 300 | 125000 | 29 | 13167 | 0.11 | 44.41 | 0.0024 |
| Work Purpose | 80 | 250000 | 8040 | 11486.88 | 0.47 | 14.61 | 0.0322 |
| | 150 | 125000 | 47 | 12176.45 | 0.10 | 25.71 | 0.0038 |
| | 300 | 125000 | 73 | 3411 | 0.03 | 46.31 | 0.0006 |
| All Purposes | 80 | 250000 | 14770 | 201049.48 | 0.80 | 13.61 | 0.0591 |
| | 150 | 125000 | 1717 | 41083.01 | 0.33 | 23.92 | 0.0137 |
| | 300 | 125000 | 369 | 16578 | 0.13 | 44.93 | 0.0030 |

DECLINING NUMBER OF FAST CHARGERS NEEDED AS BATTERIES GET LARGER

% of Statewide Vehicle Miles Possible with Different Sized Batteries. 334 QC Location Case. Survey Scaled.



QUESTIONS?

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- Find Papers at
<http://www.its.ucdavis.edu/research/publications/>