A decorative graphic on the left side of the slide, consisting of a network of light blue lines and small circles, resembling a circuit board or a neural network, extending from the top to the bottom of the frame.

Identifying Infrastructure Needs for Growing (Supporting) the EV Market

MICHAEL NICHOLAS

GIL TAL

THOMAS TURRENTINE

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

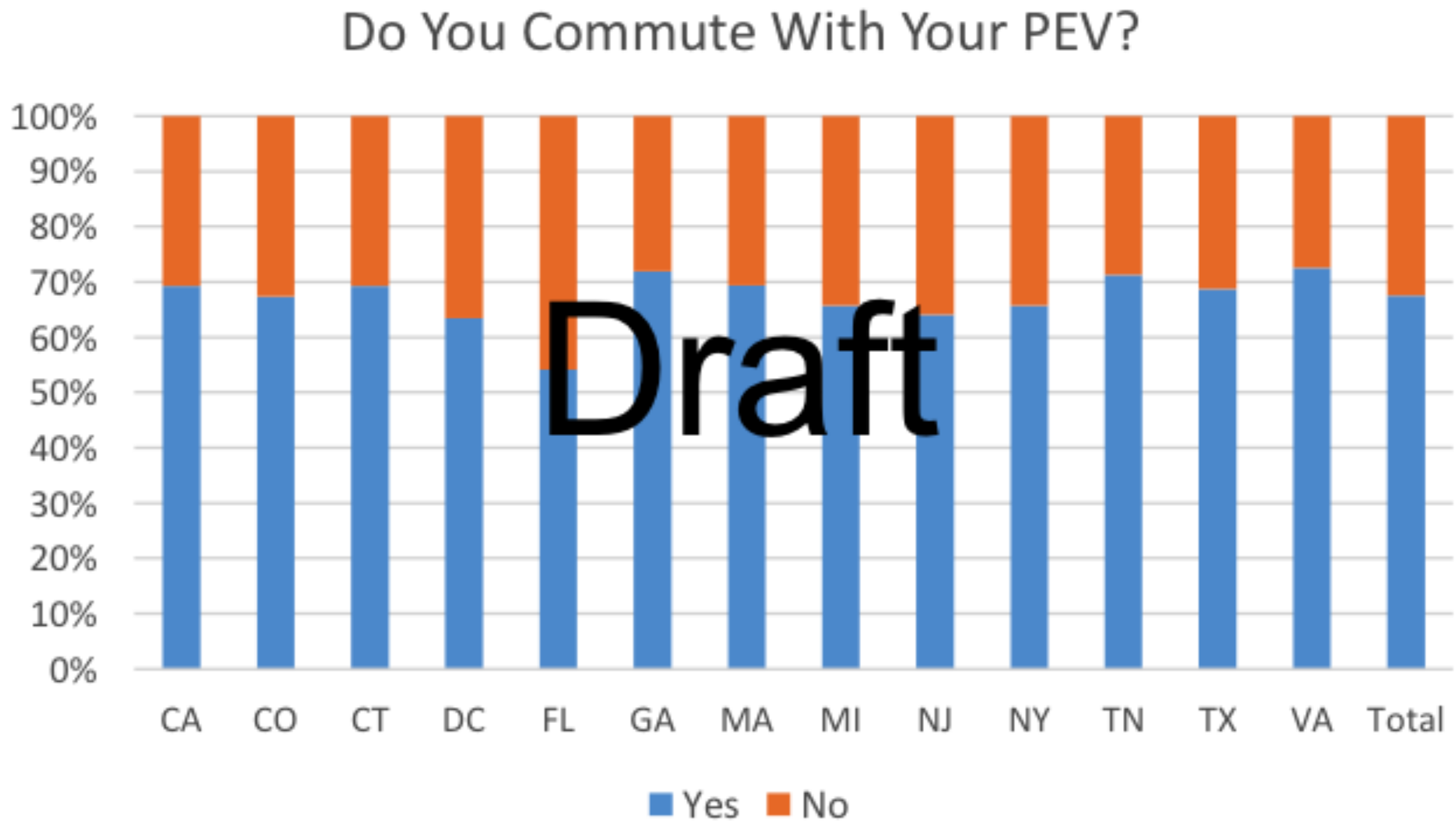


Legend

Survey Deployment

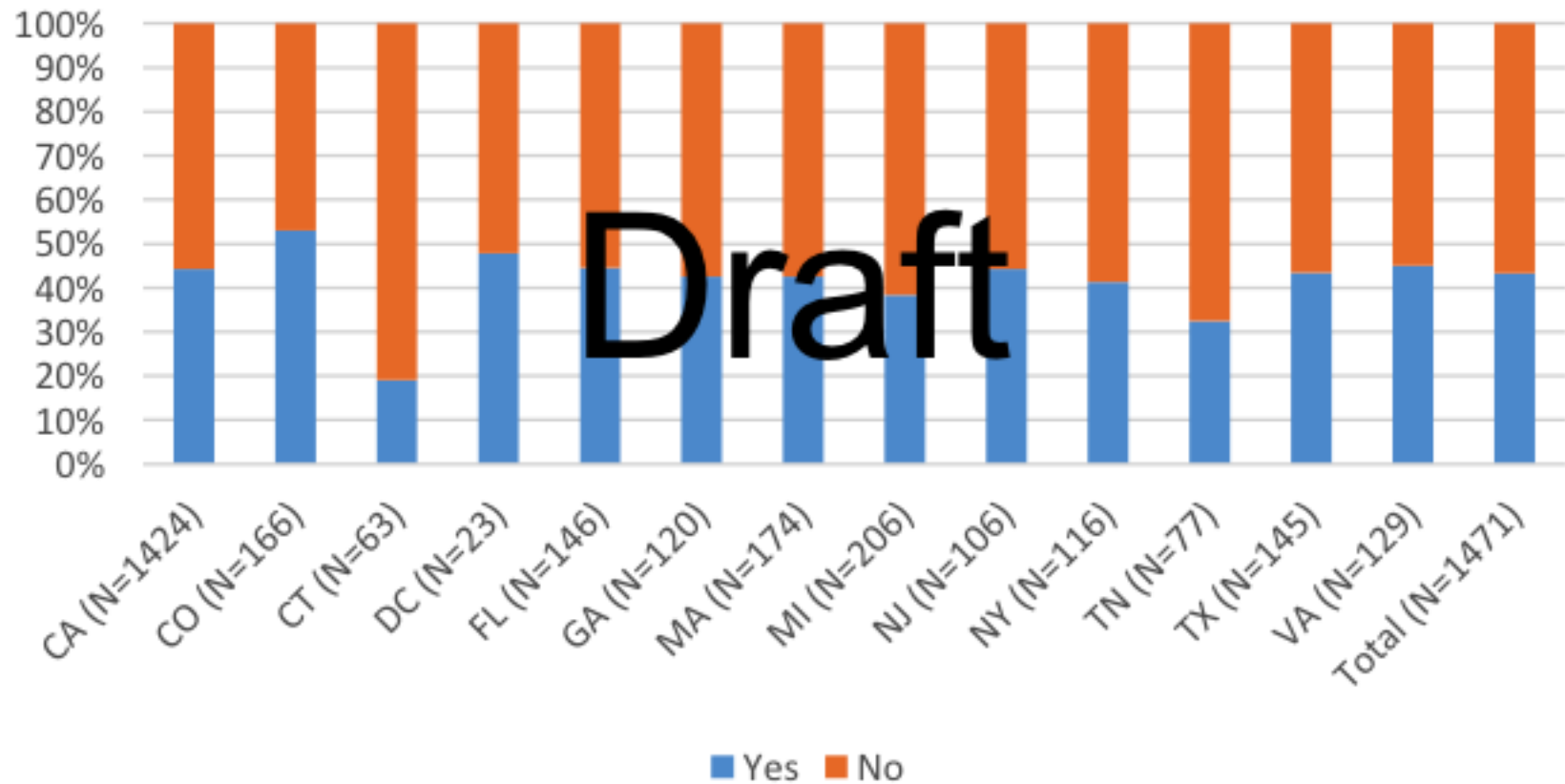
- Not Surveyed
- 2014 Survey
- 2013 California Survey

65%-70% OF HOUSEHOLDS COMMUTE WITH PEV

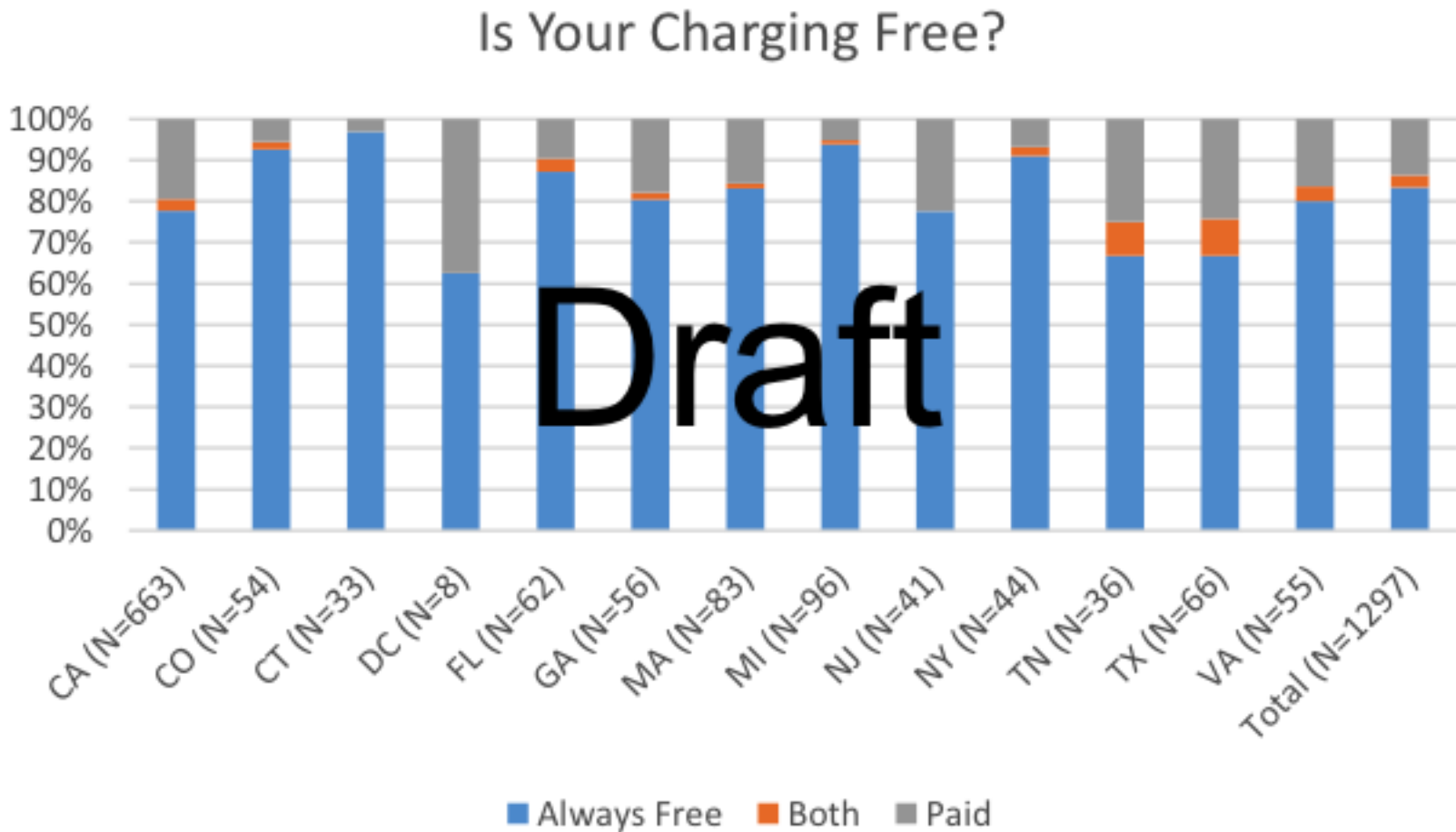


LESS THAN HALF CHARGE AT WORK

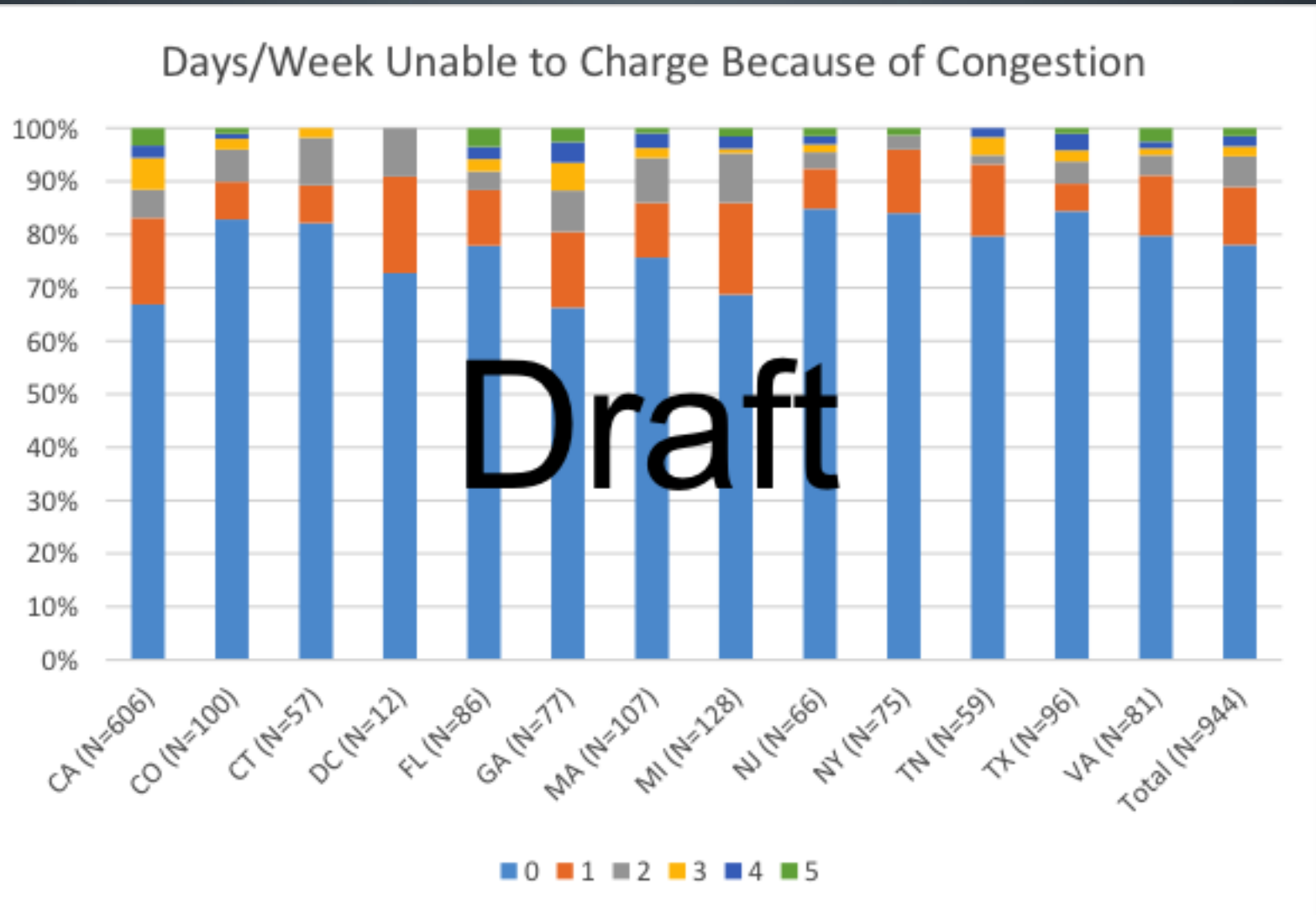
Is Workplace Charging Available?



75%-80% OF CHARGING IS FREE

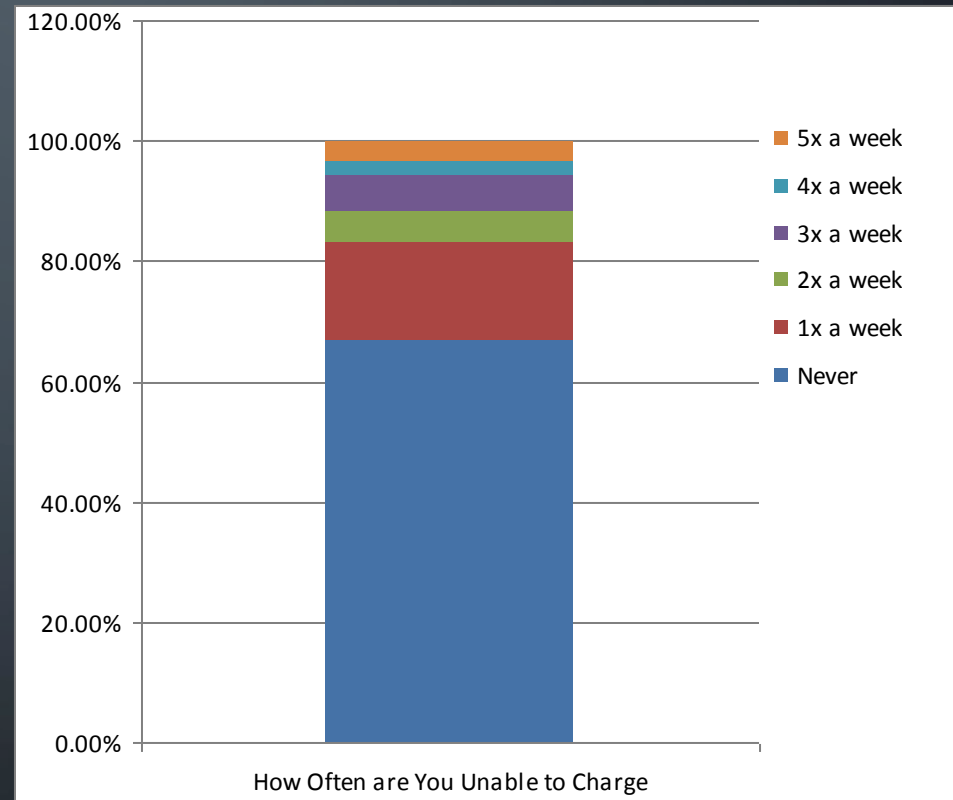


WHAT DO USERS REPORT ABOUT CONGESTION? ABOUT 20%.



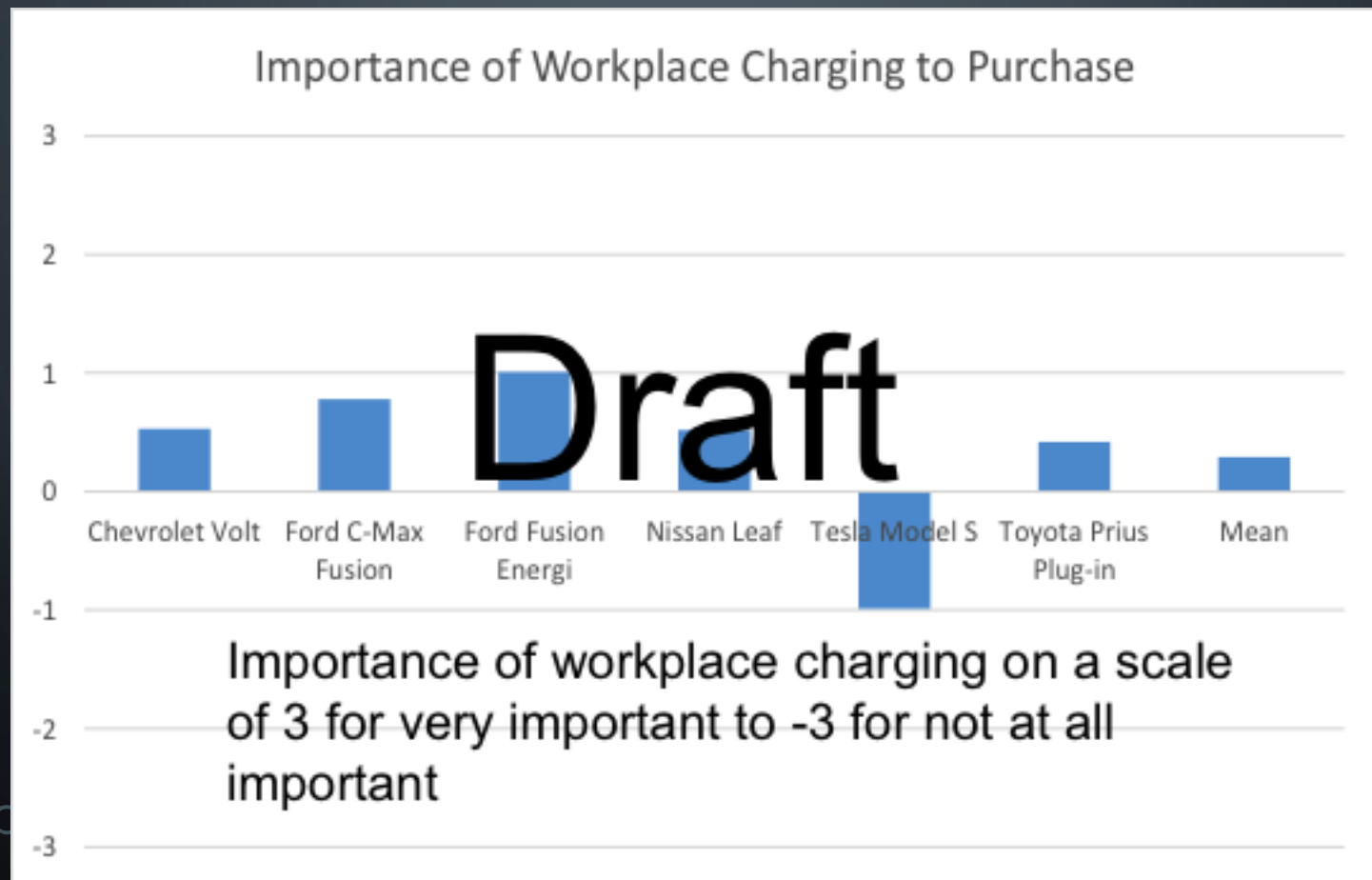
Congestion in California...

- 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

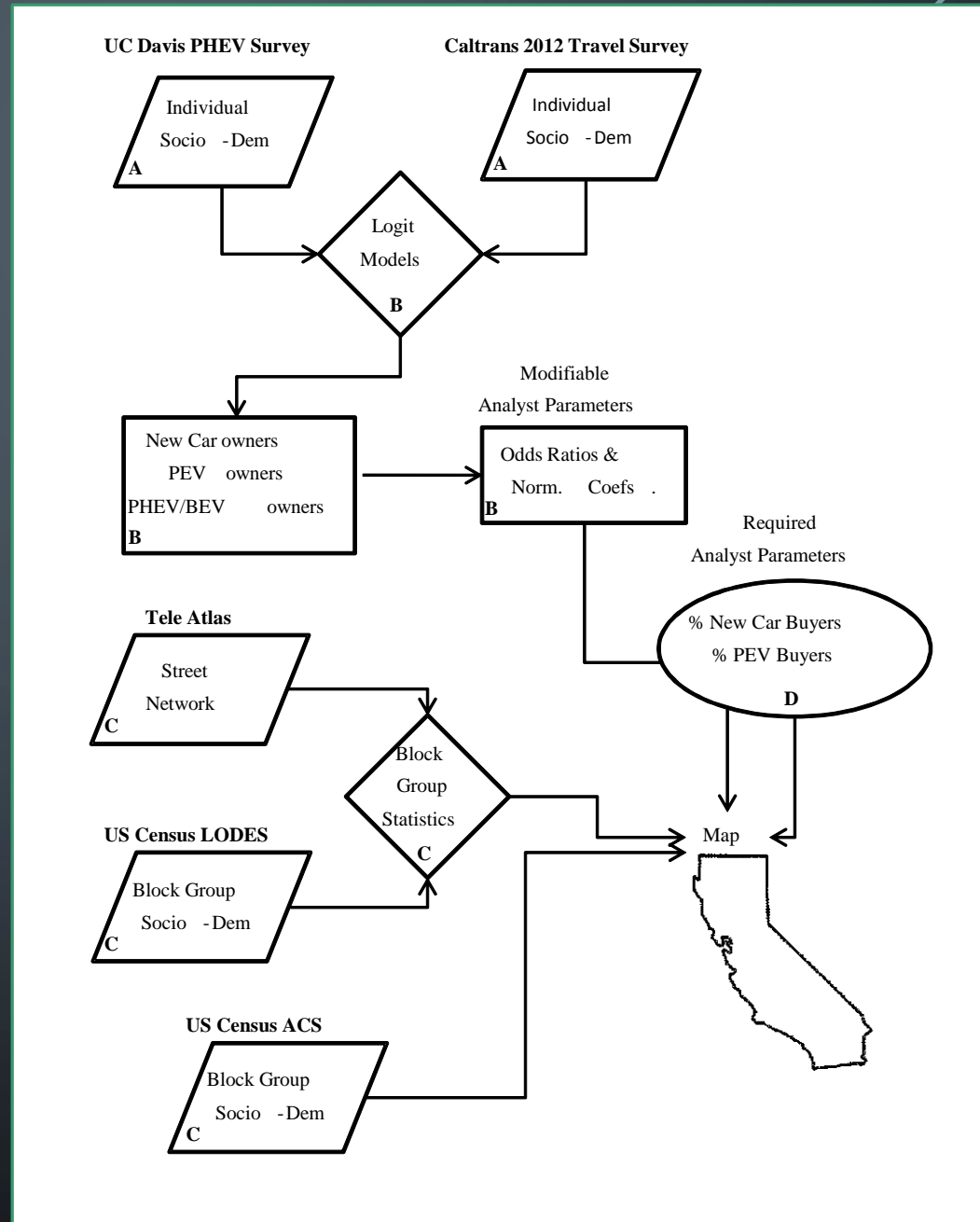


GIS EV CHARGING TOOLBOX FOR CA

- 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

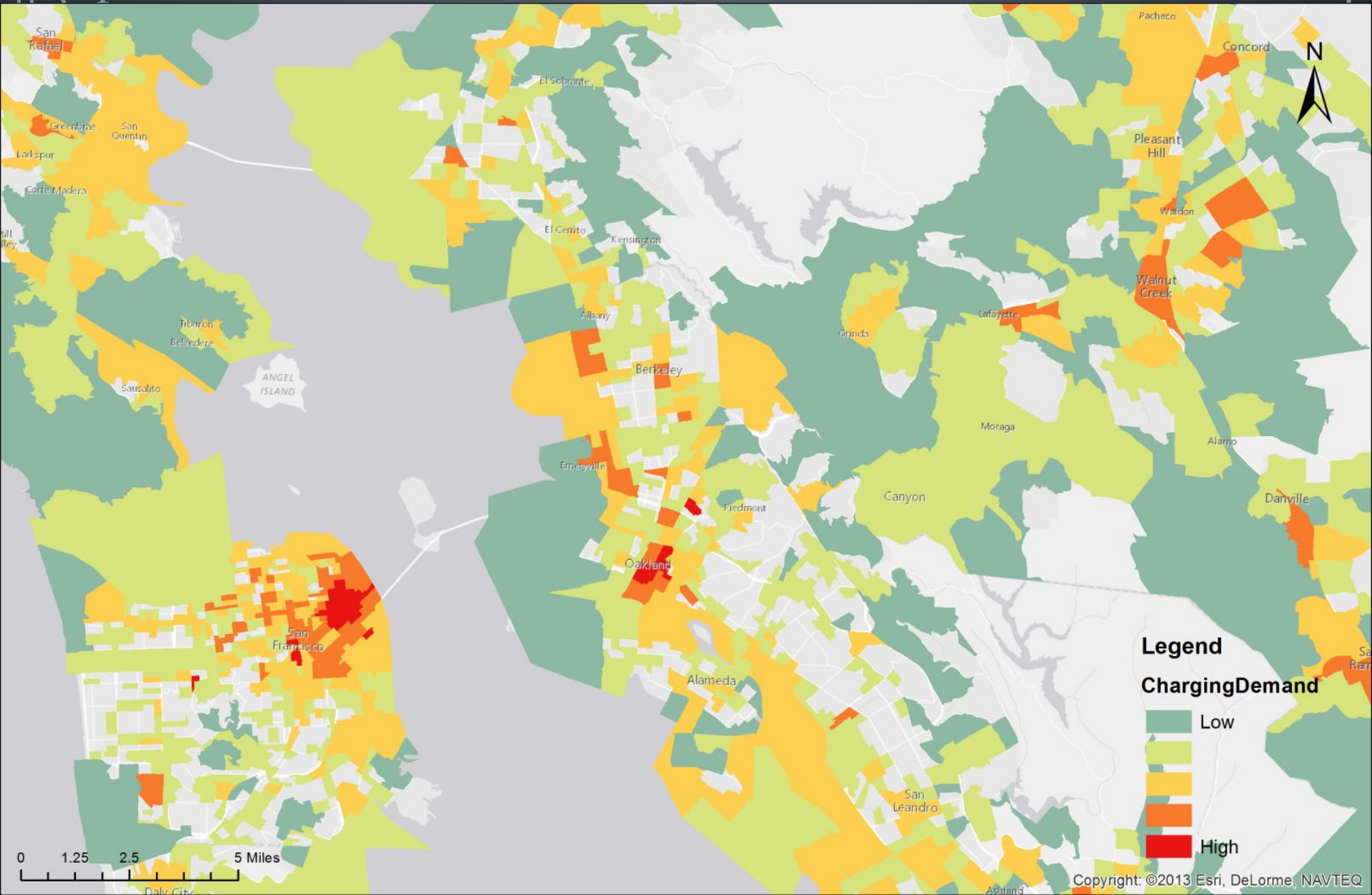


PRICE EQUALIZATION



WORKPLACE CHARGING TOOL

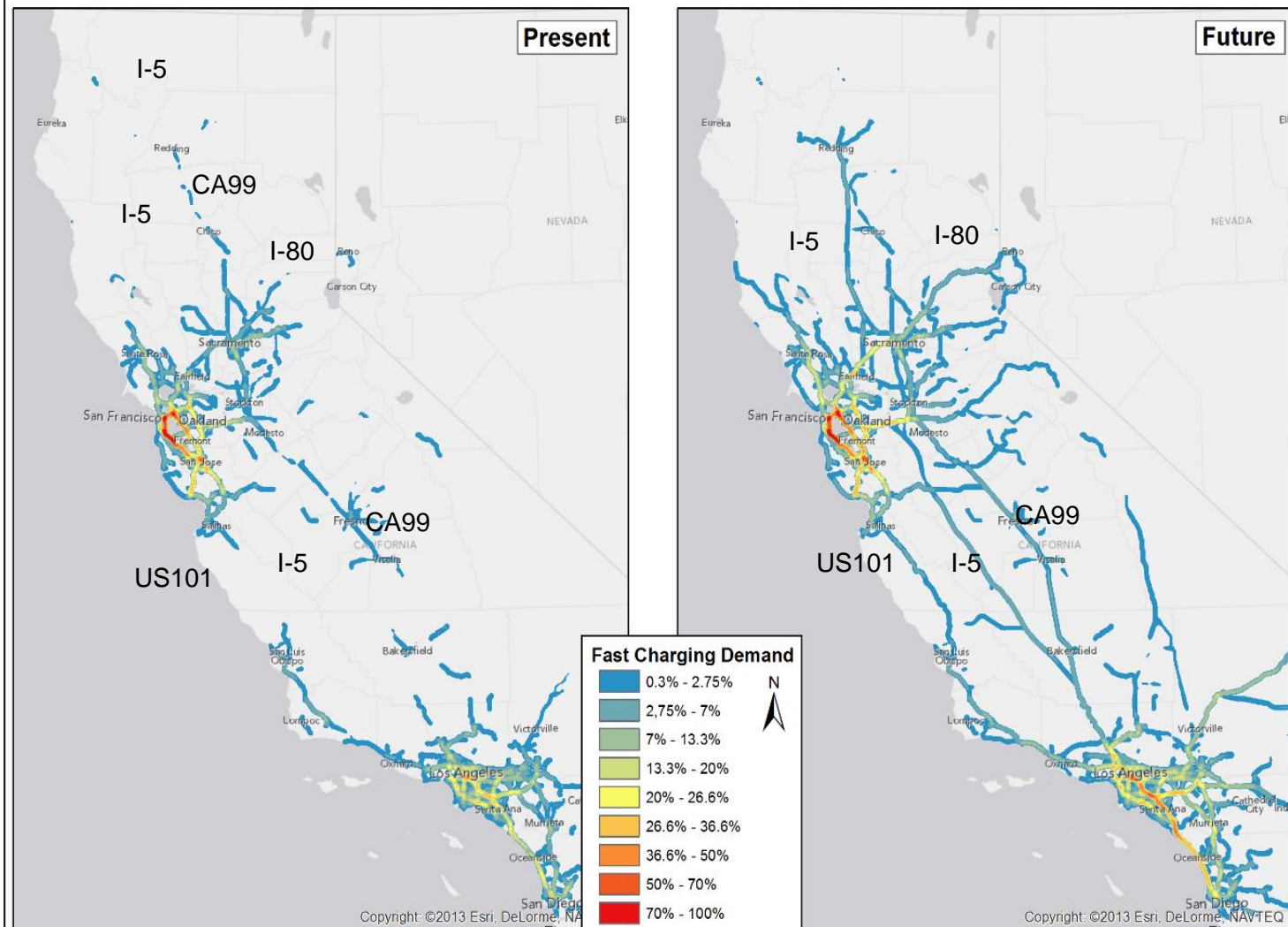
- Relies on LEHD Origin-Destination Employment Statistics (LODES) Dataset.
- Detailed spatial distribution of workers' employment and residential location.
- Free work charging
 - Every vehicle charges at work. Switch from home to work.
 - BEV80 with 15 mile commute will charge 30 mi/day
 - PHEV20 with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



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



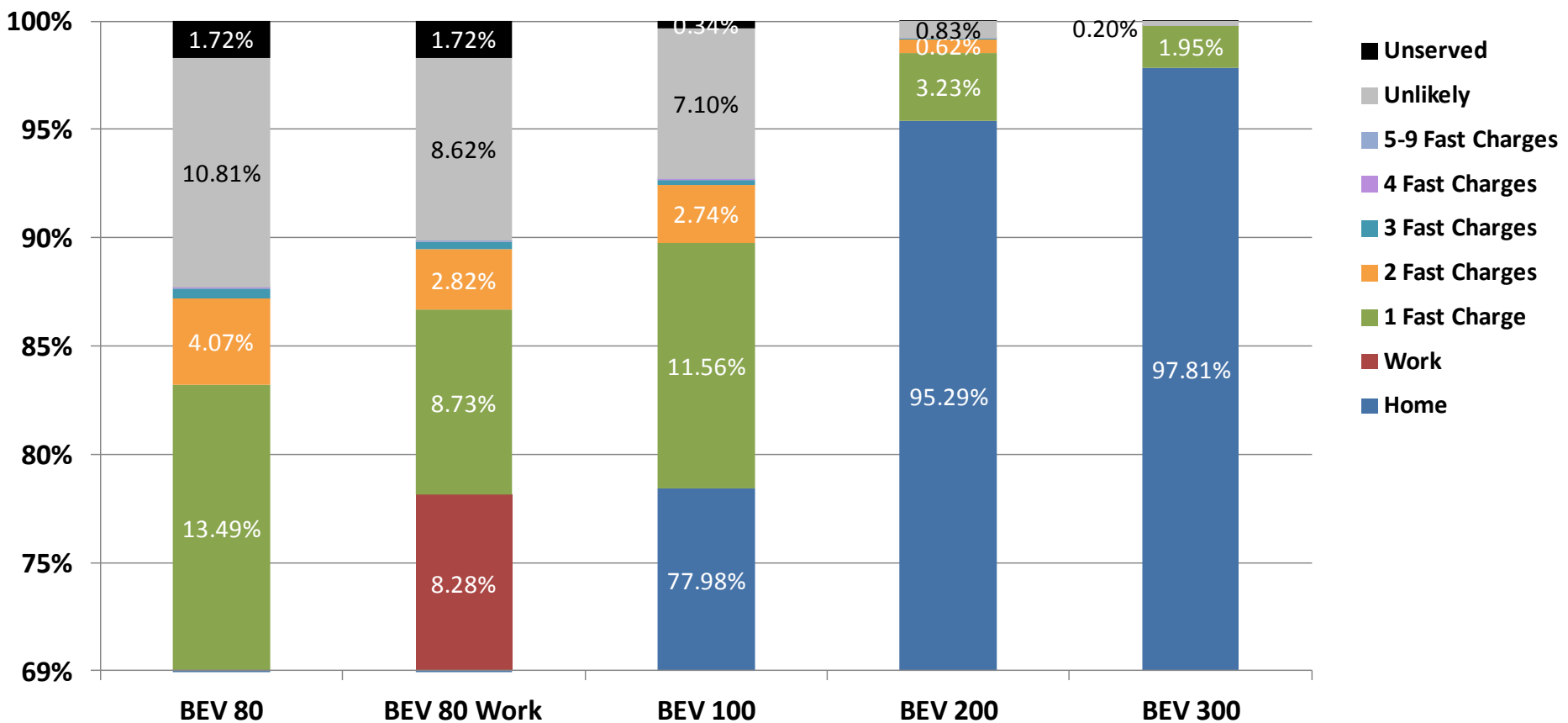
SAMPLE RESULTS

- 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	291	13167	0.11	44.41	0.0024
Work Purpose	80	250000	8040	11486.88	0.47	14.61	0.0322
	150	125000	471	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/>