

DOCKETED

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Plug-in Electric Vehicle Usage and Charging at the Household Level



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Research Contractor: Dr. Gil Tal, UC Davis
Contracts* co-funded by CARB and CEC

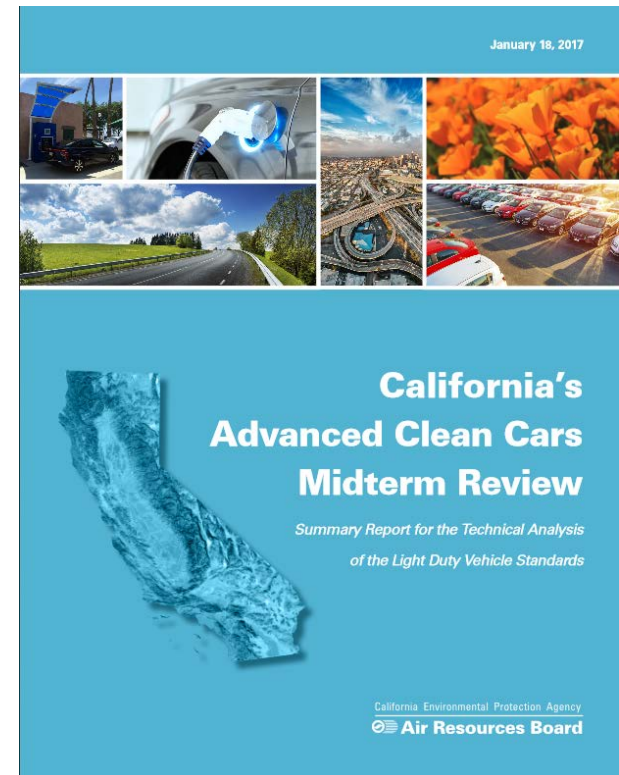


*The contracts are: 12-319 "Advanced Plug-in Electric Vehicle Travel and Charging Behavior" and 16RD009 "Emerging Technology Zero Emission Vehicle Household Travel and Refueling Behavior"₁

Study Motivation



- PEV usage impacts emissions, energy consumption, and electrical grid management
- Limited data on real-world driving and charging patterns
- CARB's Board resolved to study consumers' actual usage of PEVs



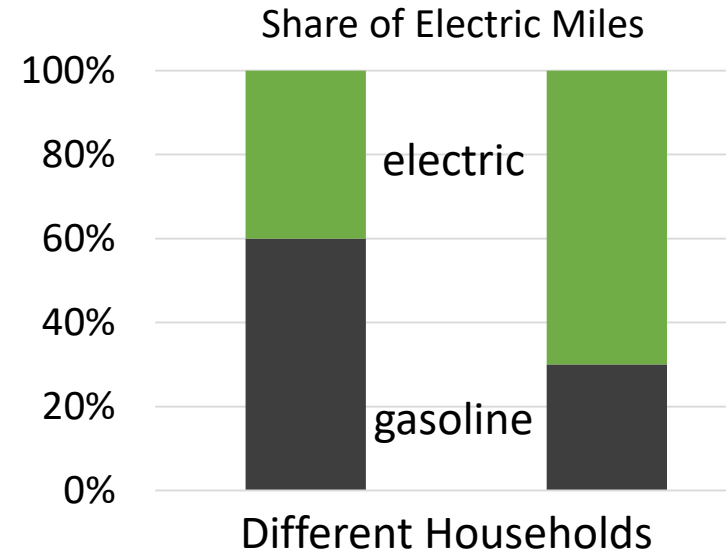
Study Design

Study household context to determine emissions

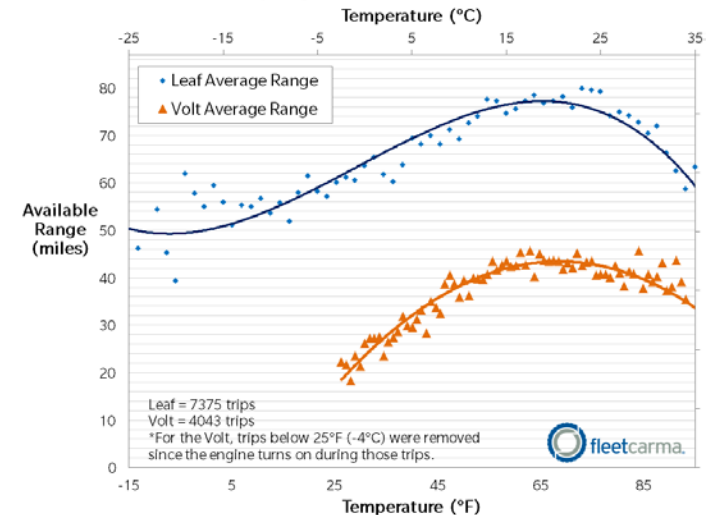
- Number of cars, drivers, household members

Long-term study to understand changes in behavior

- Due to seasonal differences
- Due to increased PEV experience



Nissan Leaf & Chevrolet Volt: Range vs. Temperature
Spanning All Model Years in the FleetCarma Database



Importance and Challenges



Importance of studies

- No other source for this type of data!
- Because PEV infrastructure is an expensive investment, it needs to be well-informed

Challenges in this field

- Expensive methodology resulting in lots of granular data, but limited number of households
- Shift away from personally owned vehicles towards new mobility services?

Study Overview



New and used PEV owners recruited from Clean Vehicle Rebate Project and DMV registration data

Recruitment survey:
~14,000 completed

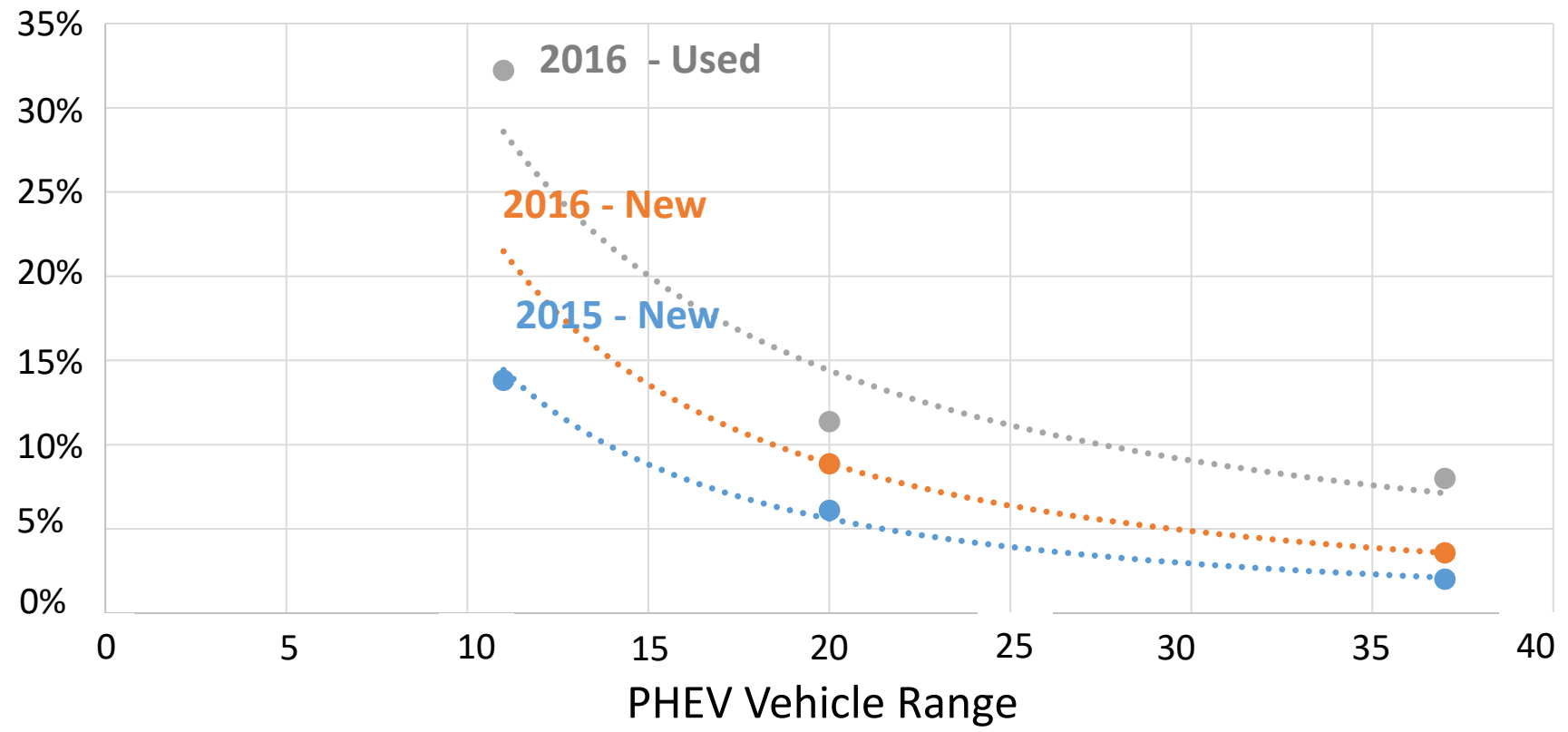
Logging of vehicles:
324 PEVs & 271 ICEs
~ 300 households

Interviews:
20 done

Survey: not all PHEVs are plugged in



Percent Plugging In Less than Four Times a Month

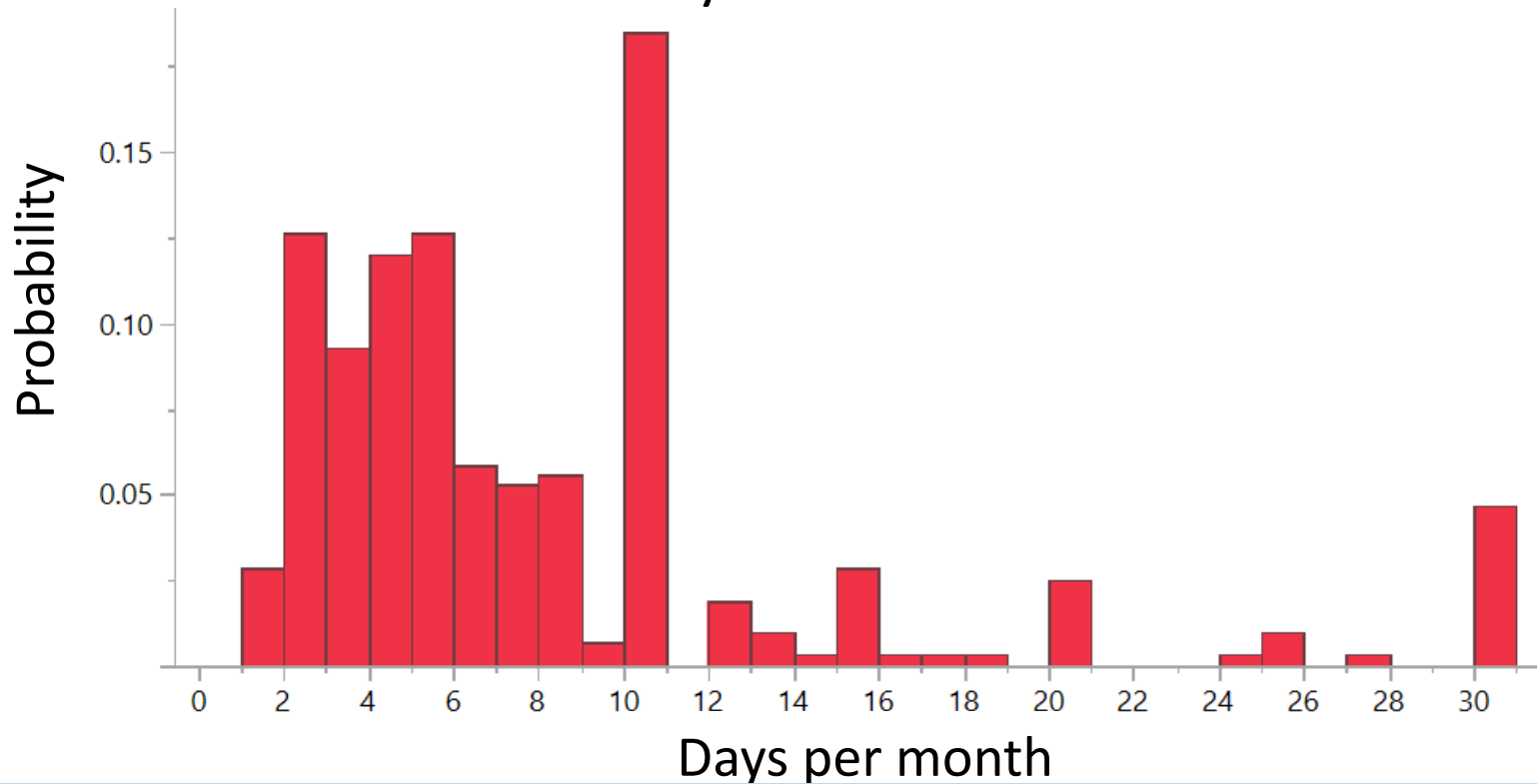


In 2016, a third didn't plug in their 10-mile range PHEV

Survey: a quarter without level 2 charger at home feel limited

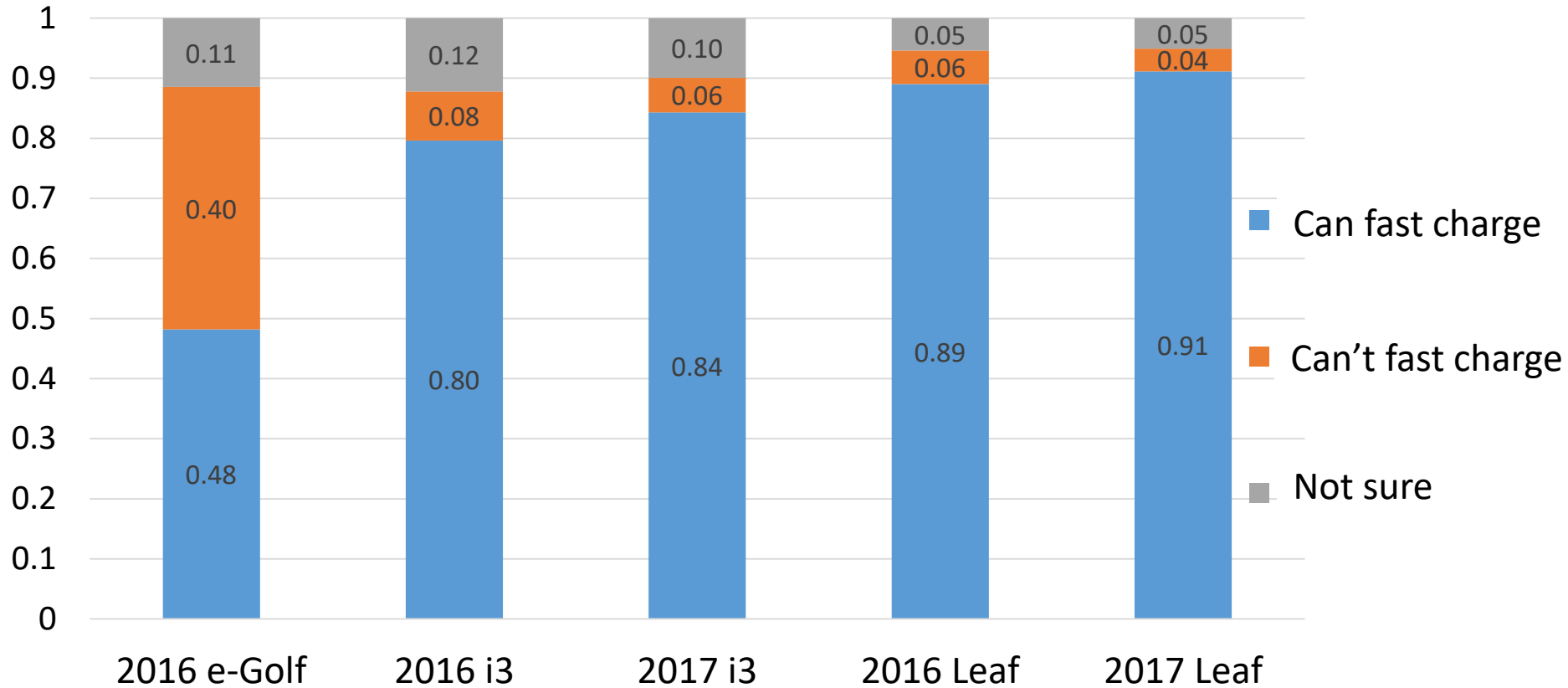


How many days per month would using a level 2 charger at home increase your electric travel?



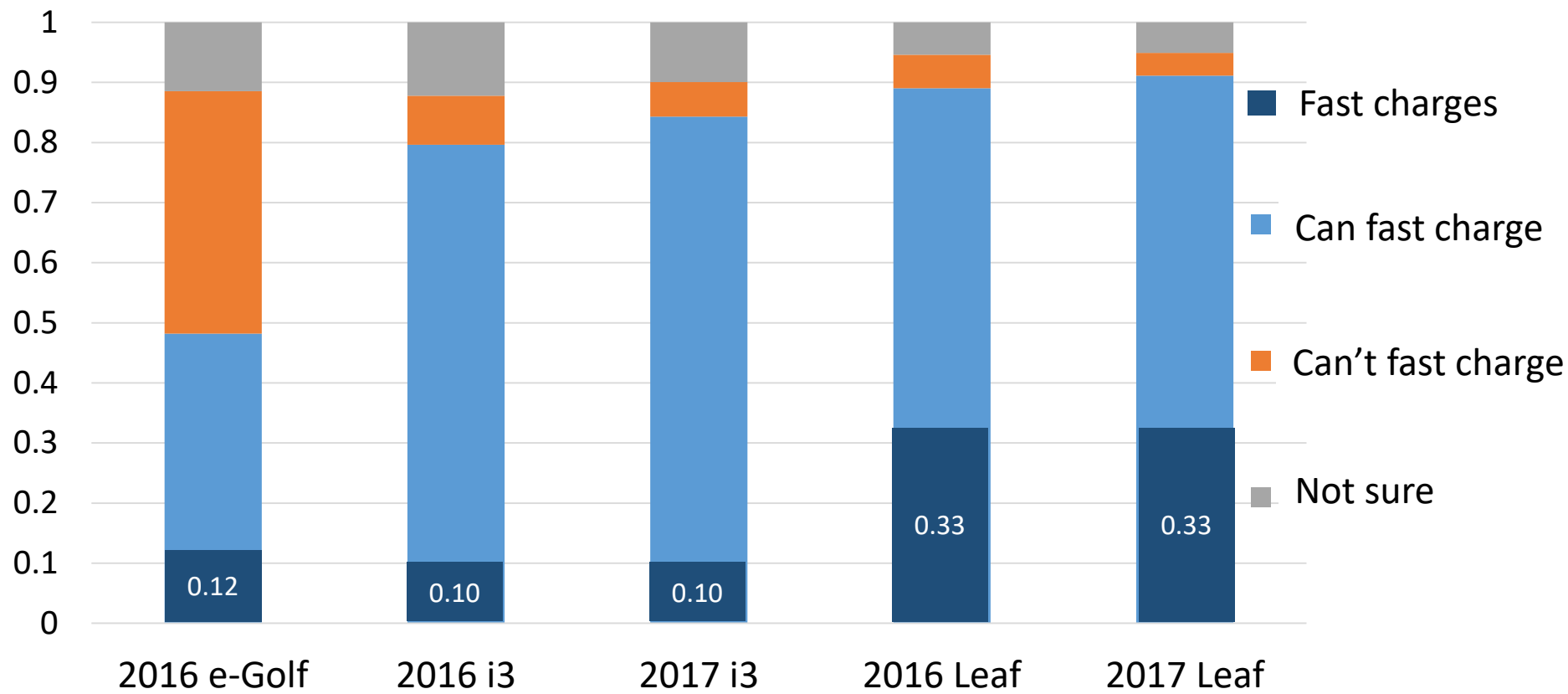
On average, they would increase their electric miles on eight days each month; some would everyday

Survey: only some BEVs are fast-charge-capable



Only 48-91% of recent model year BEVs can fast charge
5-12% don't know if they can fast charge

Survey: only a fraction of BEVs capable actually fast charge

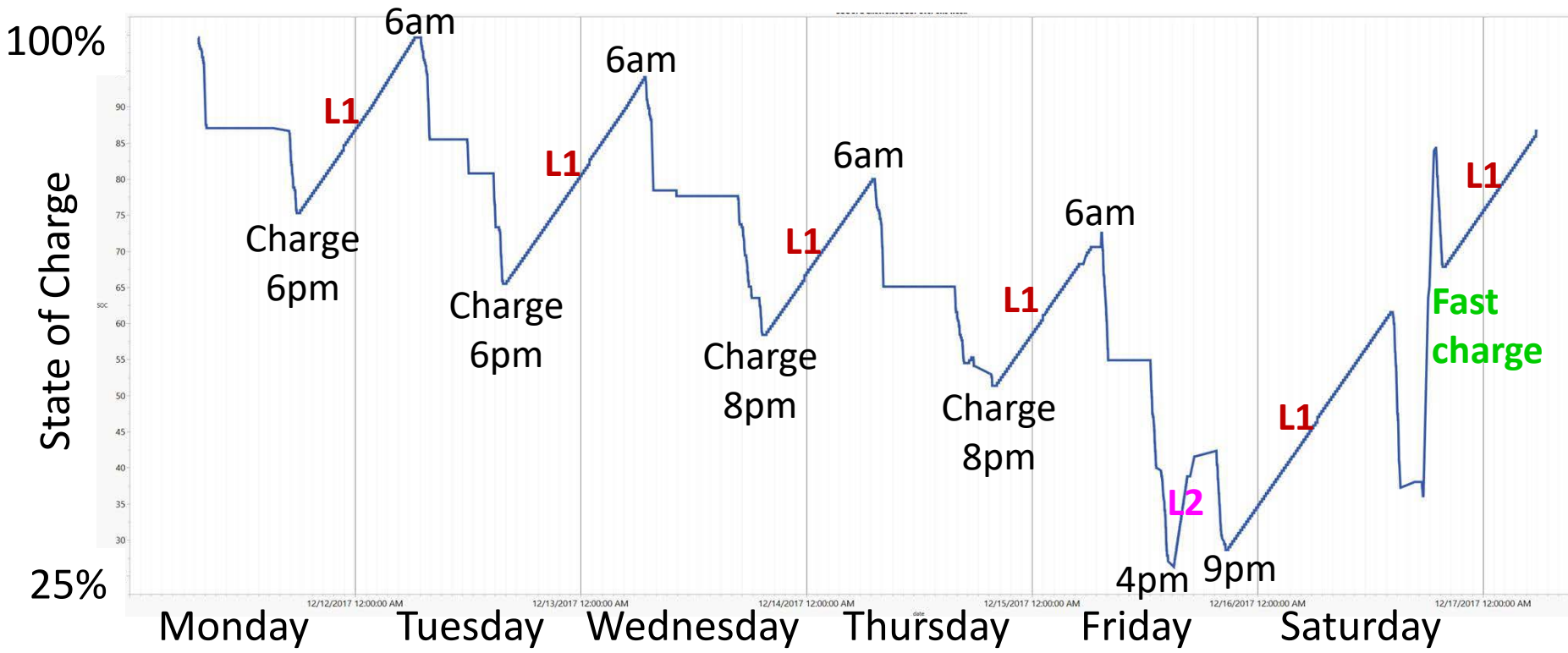


Only a fraction of BEVs capable actually fast charge

Logging: observe actual behavior, but context is missing



State of Charge of a Chevy Bolt During One Week



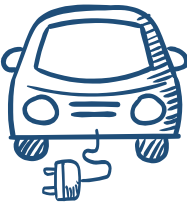
Every household is unique and aggregating data smooths out individual patterns

Lessons Learned



- Some PHEVs don't plug in
 - Should we incentivize electric miles?
- Some folks feel limited by not having a level 2 charger at home
 - Should identify barriers and perhaps incentivize chargers in certain types of housing
- Some BEVs can't fast charge
 - Should ensure modeling assumptions reflect this
- Most fast-charge-capable BEVs don't fast charge
 - Are folks meeting their travel needs without fast charging or are they using other vehicles for longer trips?

Lessons Learned (continued)



- Surveys and interviews complement logged data and vice versa
 - Logged data lets us see current patterns, but surveys/interviews help inform how these patterns may change with time
 - People want more infrastructure than they use

Acknowledgments



Dr. Gil Tal and his research team at UC Davis

PEV owners that have participated in this research

More Information

Interim Report

<https://phev.ucdavis.edu/wp-content/uploads/2017/08/25.-Advanced-Plug-in-Electric-Vehicle-Travel-and-Charging-Behavior-Interim-Report-.pdf>

Low Carbon Transportation Research

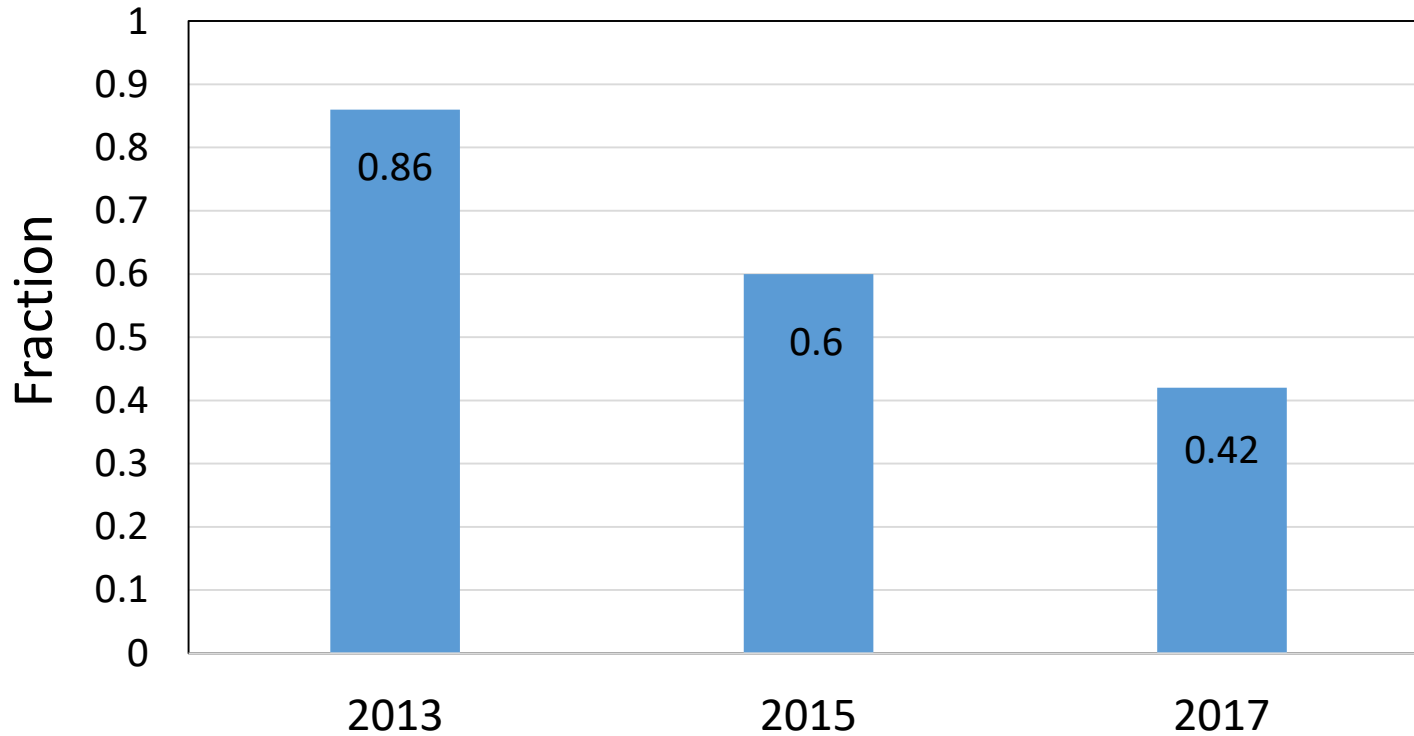
<https://ww2.arb.ca.gov/research/research-program-transportation-choices>

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Extra Slide: Percent Nissan Leaf Households that have L2 Charger



Fraction of Leaf households that have a Level 2 Charger at home different survey years



Leaf households rely less on L2 home charging over time