

DC FAST Charging: Who? When? Why?

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DC Fast Motivations and Modeling Approaches

Motivations:

- Long trips / corridor charging
- MUD and others without home charging
- Incidental

Modeling Approach:

- Housing Density
- Corridors long trips
- Coverage



Corridor Coverage model

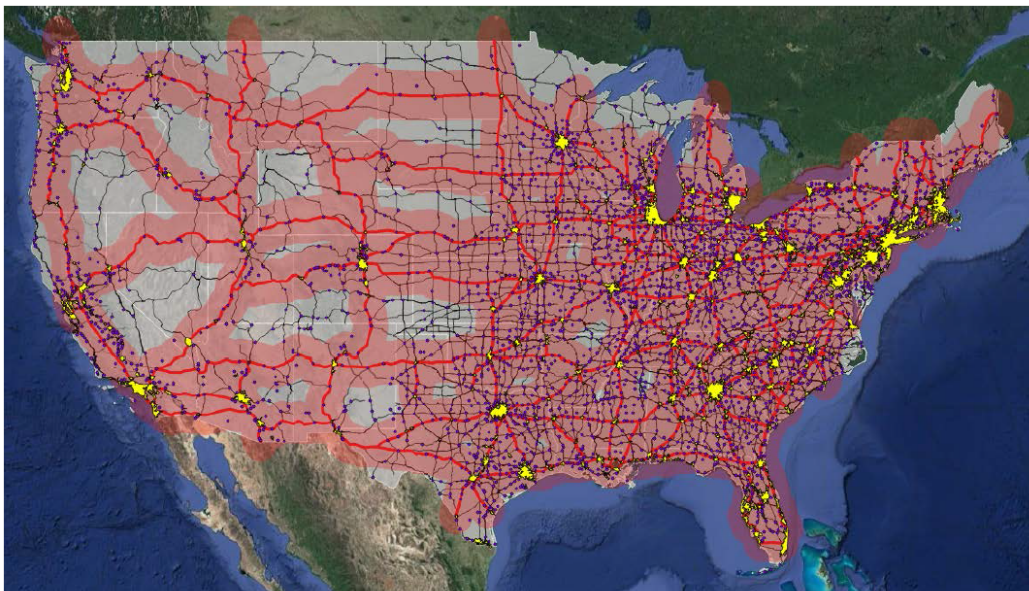
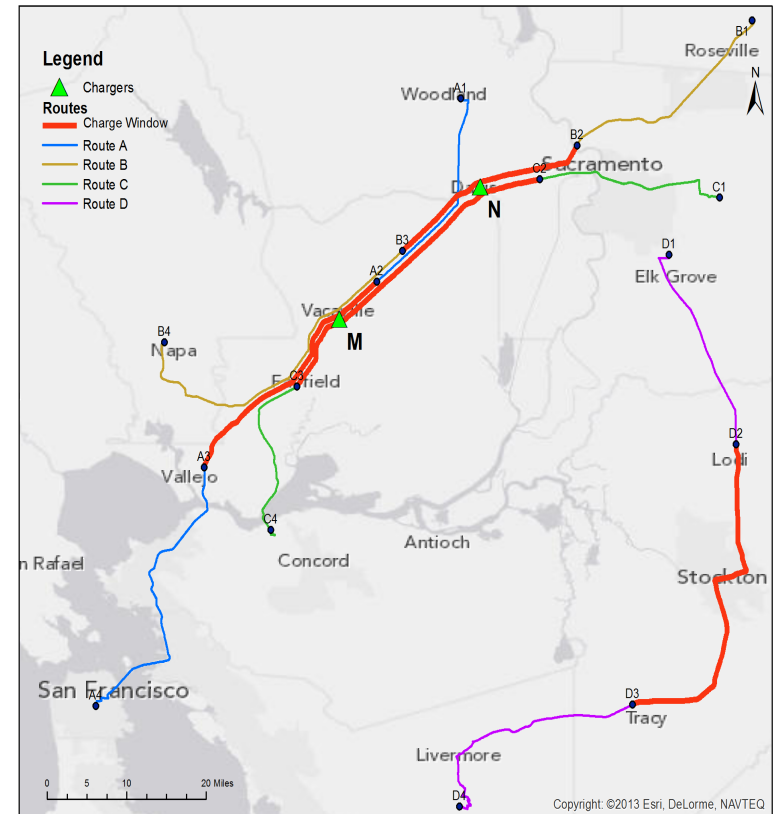


Figure 12. Interstate corridor network (thick red lines) considered in this analysis (70-mile radius red buffer approximates areas that would be served by the proposed DCFC network). Included for reference: yellow polygons represent cities, purple points represent towns, and thin black lines represent the national highway system.

(Satellite imagery credit: © 2017 Google, Map Data © 2017 Tele Atlas)

Wood et al. 2017

Charge Window Illustration



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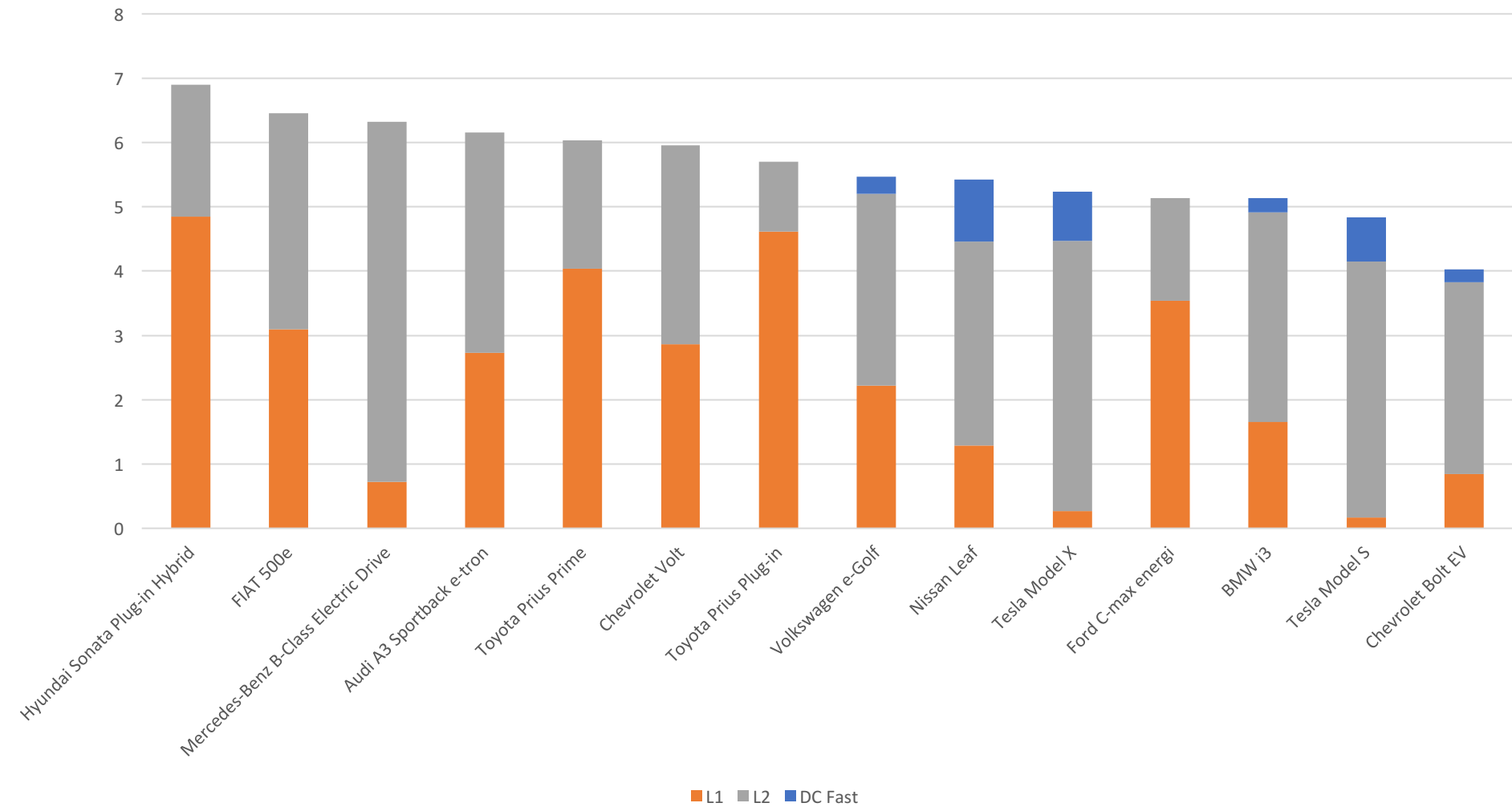
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The charging story 2017

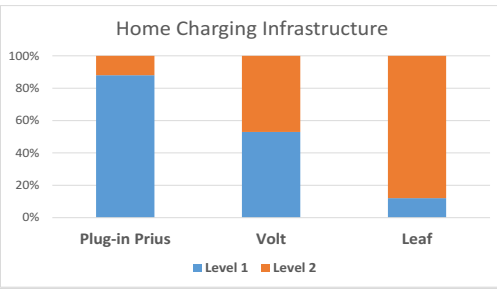
Home >>>work>>>Public

How often do PEV drivers charge?

Charging event per week

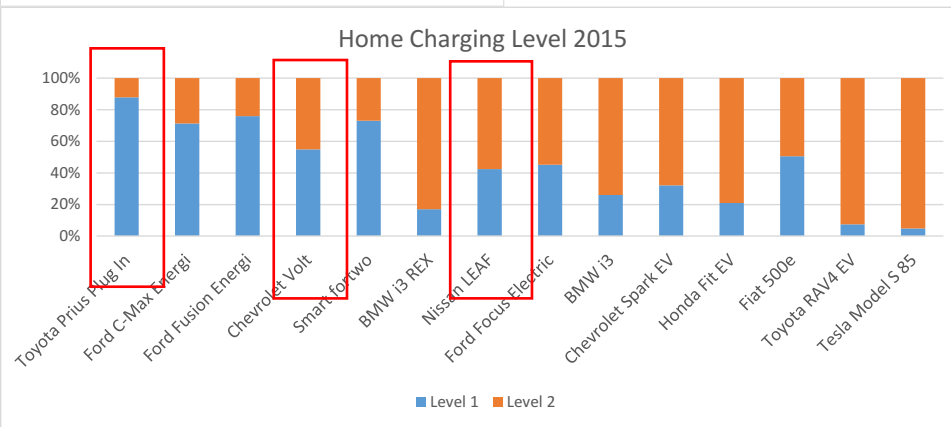


Home Charging 2013-2017



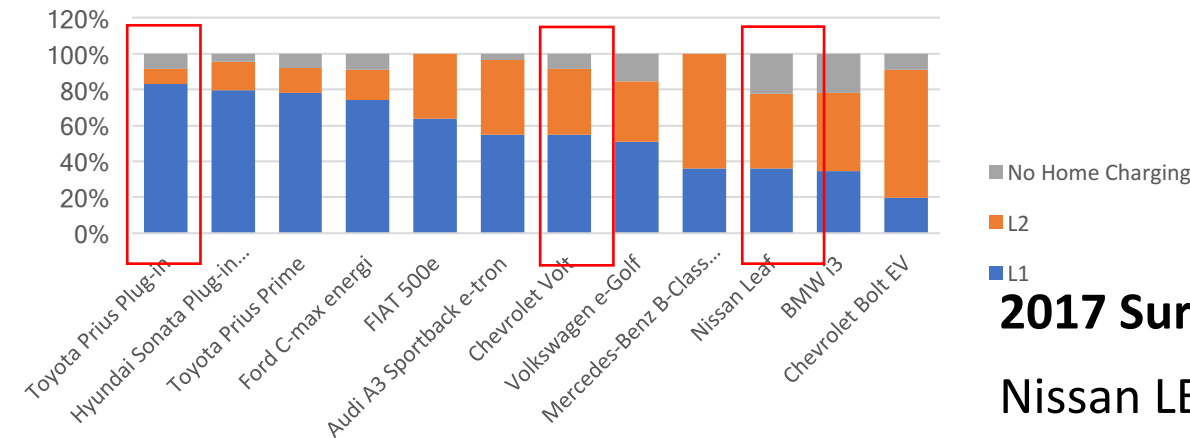
2013 Survey

Nissan LEAF Level 2 home Charging 86%



2015 Survey

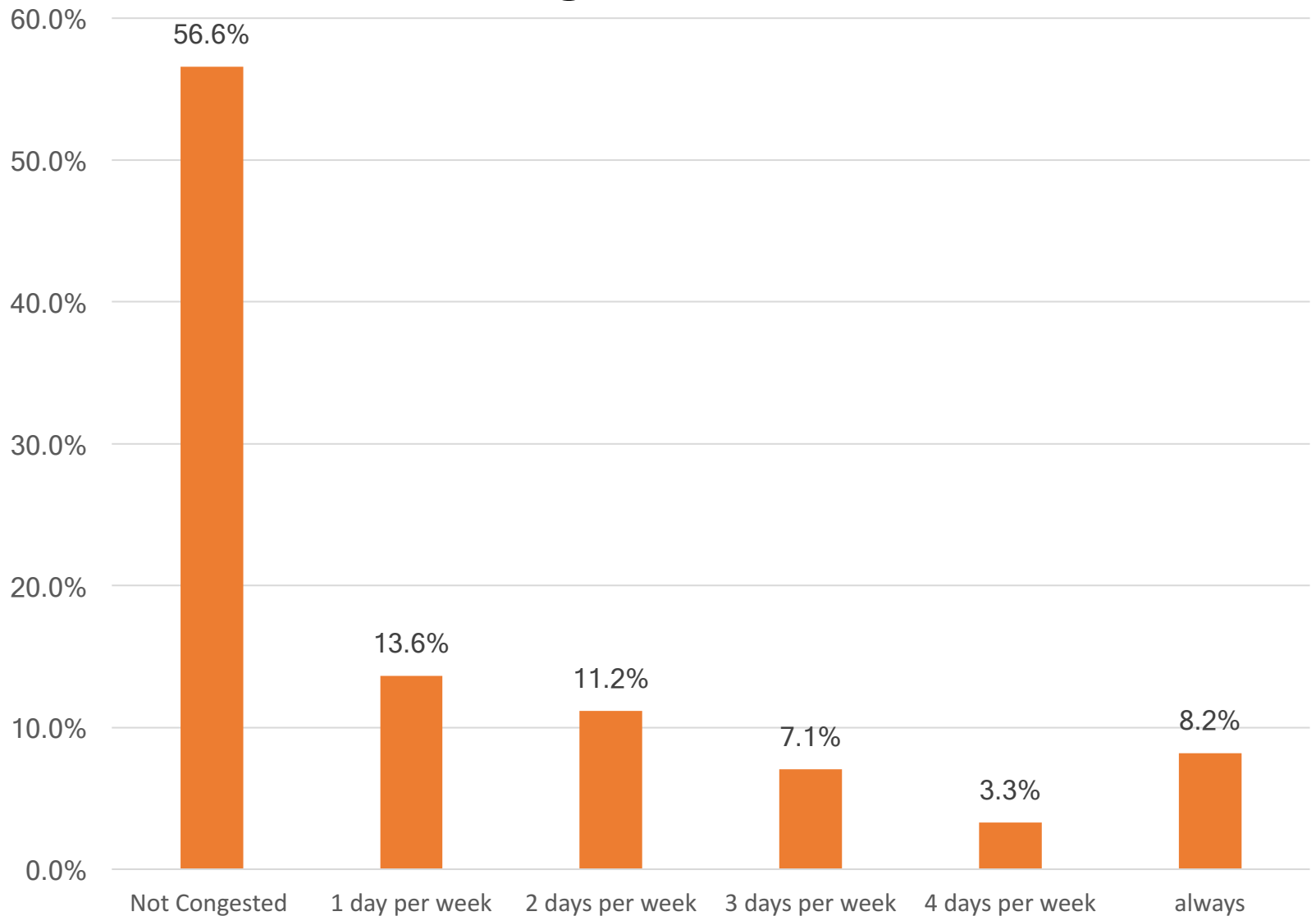
Nissan LEAF Level 2 home Charging 60%



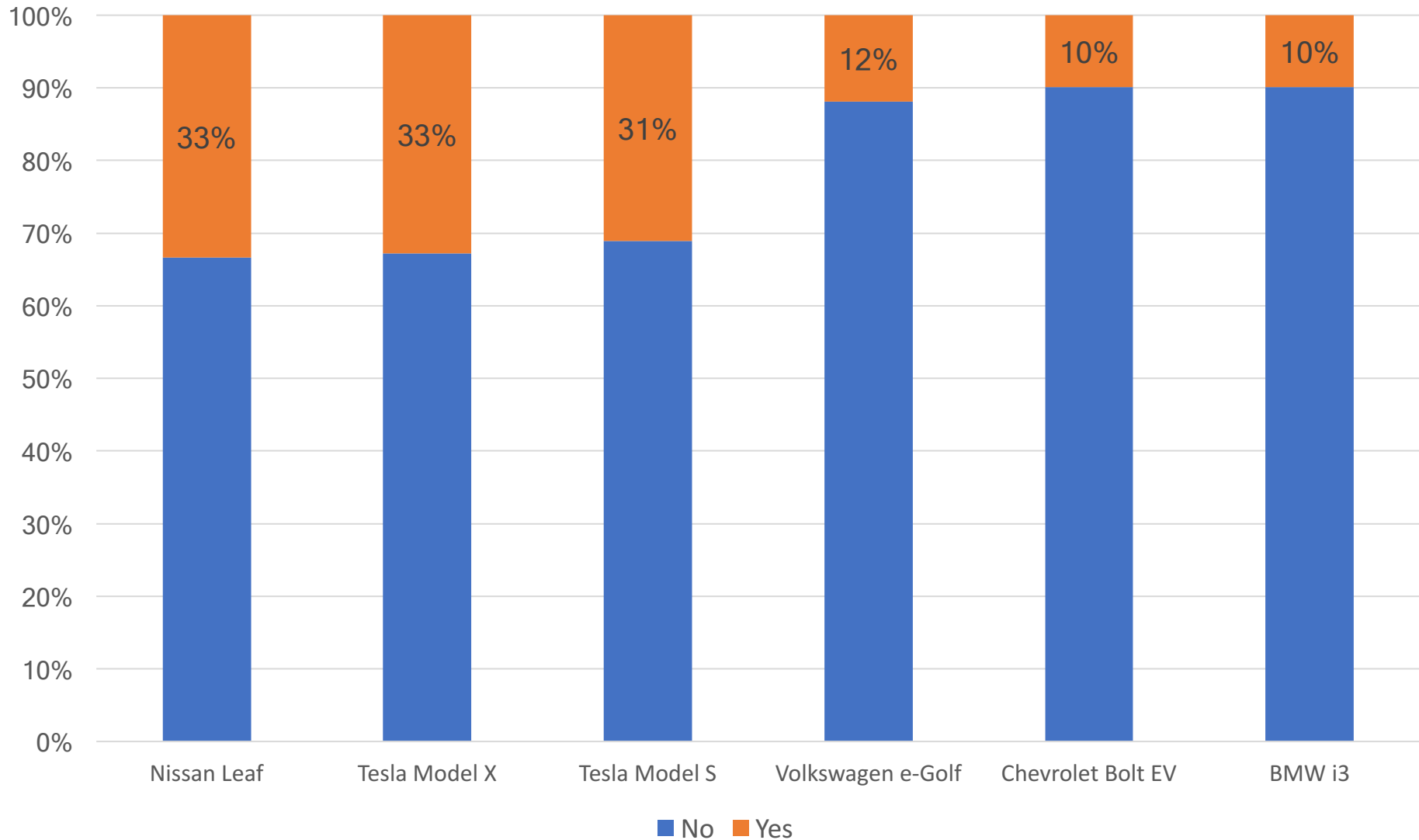
2017 Survey

Nissan LEAF Level 2 home Charging 42%

About half have workplace charging, but is it congested?



Who is using DC Fast?



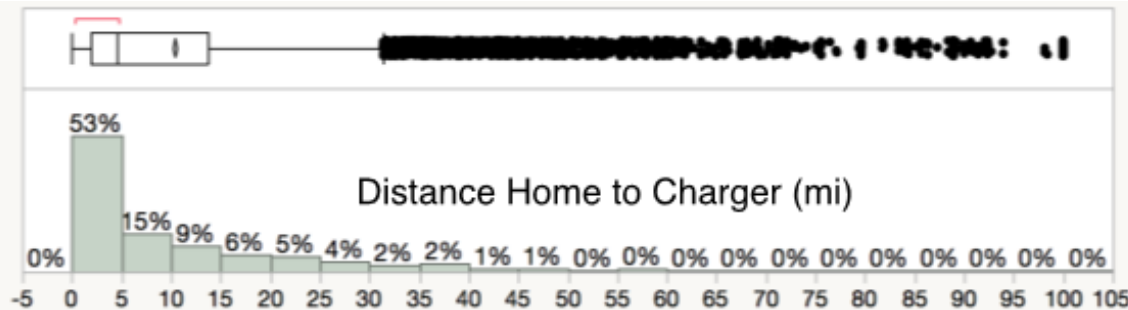
How often do drivers use DC fast?

- About 60% not using DCFC at all
- Many users did less than 2 events after signing for a provider
- 10-15% are “regular users” $N > 2$

		<u>Mean</u>		<u>Median</u>	
<i>Make model</i>	<i>N</i>	Free	Paid	Free	Paid
<i>BMW i3</i>	473	21	24	6	14
<i>CHE SPARK</i>	251		27		16
<i>KIA SOUL</i>	284		35		19
<i>NISSAN LEAF</i>	7716	29	36	15	19
<i>VW Golf</i>	217		33	0	19

Days between charging events for $N > 2$

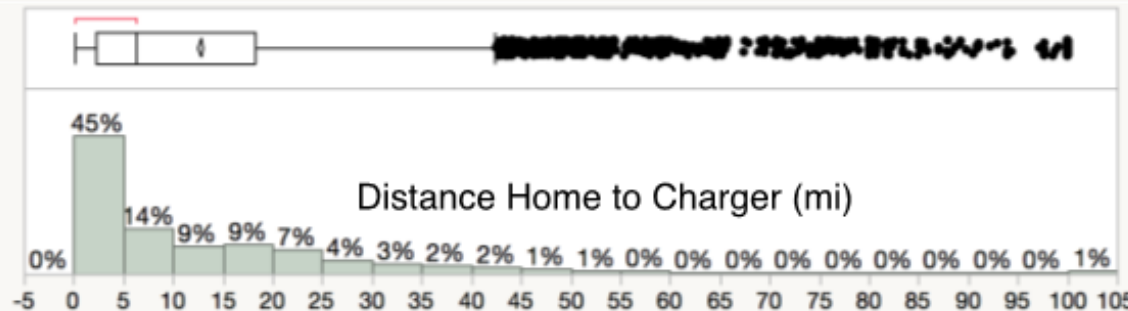
Most usage happens near home



Quantiles		
100.0%	maximum	100
99.5%		88.93386476
97.5%		46.3848667
90.0%		27.31054511
75.0%	quartile	13.69021586
50.0%	median	4.549218743
25.0%	quartile	1.8783327
10.0%		0.895947791
2.5%		0.428089318
0.5%		0.110198598
0.0%	minimum	0

Summary Statistics	
Mean	10.371438
Std Dev	13.904554
Std Err Mean	0.0884761
Upper 95% Mean	10.544856
Lower 95% Mean	10.198019
N	24698

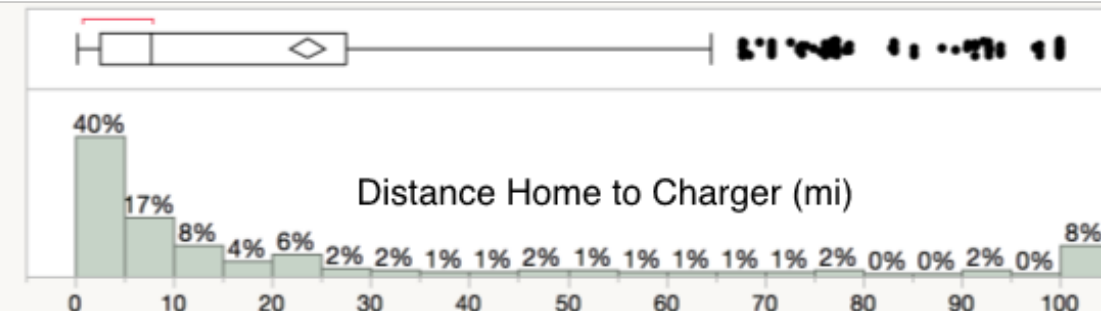
Nissan Leaf 24kWh
Free-Prepaid Charging



Quantiles		
100.0%	maximum	100
99.5%		100
97.5%		54.08354755
90.0%		31.22237444
75.0%	quartile	18.31553927
50.0%	median	6.183704148
25.0%	quartile	2.302309716
10.0%		0.80850276
2.5%		0.354319314
0.5%		0.121123892
0.0%	minimum	0.051639793

Summary Statistics	
Mean	12.726319
Std Dev	15.852251
Std Err Mean	0.1258631
Upper 95% Mean	12.973025
Lower 95% Mean	12.479613
N	15863

Nissan Leaf 24kWh
Paid Charging
10-20 cents per min



Quantiles		
100.0%	maximum	100
99.5%		100
97.5%		100
90.0%		91.50674441
75.0%	quartile	27.45581963
50.0%	median	7.685912084
25.0%	quartile	2.410203146
10.0%		1.277362008
2.5%		0.693749586
0.5%		0.095352576
0.0%	minimum	0.095352576

Summary Statistics	
Mean	23.468792
Std Dev	31.884689
Std Err Mean	0.9095074
Upper 95% Mean	25.253152
Lower 95% Mean	21.684431
N	1229

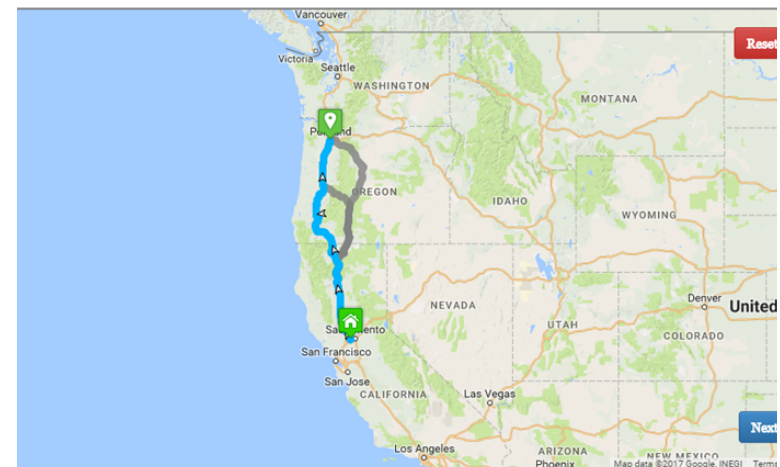
Chevrolet Bolt
Paid Charging
10-20 cents per min

BEVs and Long Road Trips: It's not about miles per day

- The longest road trip per year takes more than 5 days over 700 miles and in half the trips have more than 2 passengers in the car
- BEV households use other cars for the task
- Bigger vehicles
- AWD vehicles
- Rentals
- Or a Tesla if they have one.

Click on the map below to indicate the route your household took on its longest road trip in the last 12 months:

Click on the map below to indicate the route your household took on its longest road trip in the last 12 months:
If you took to your destination:
If you did not take the exact route you took, please drag it to match.



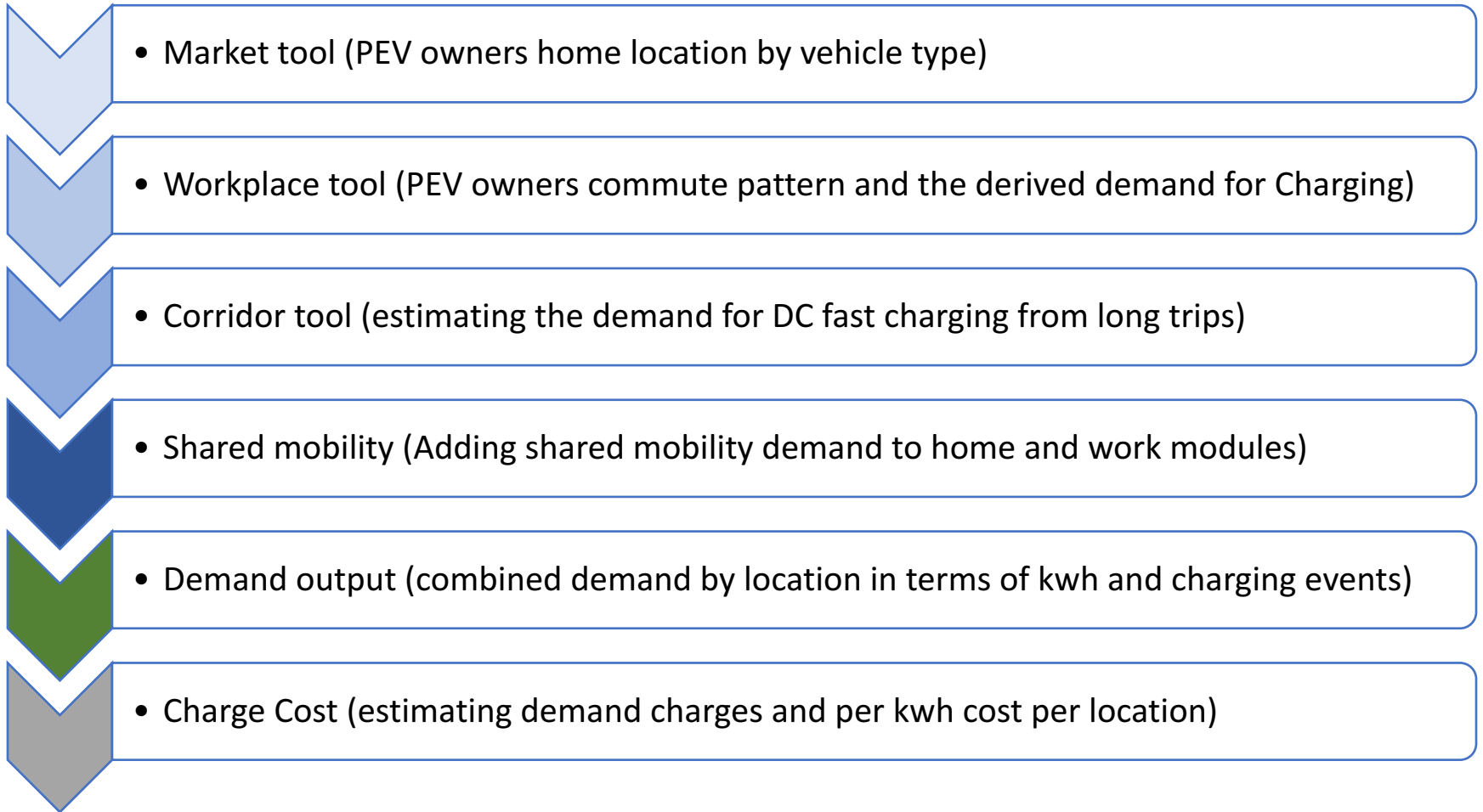
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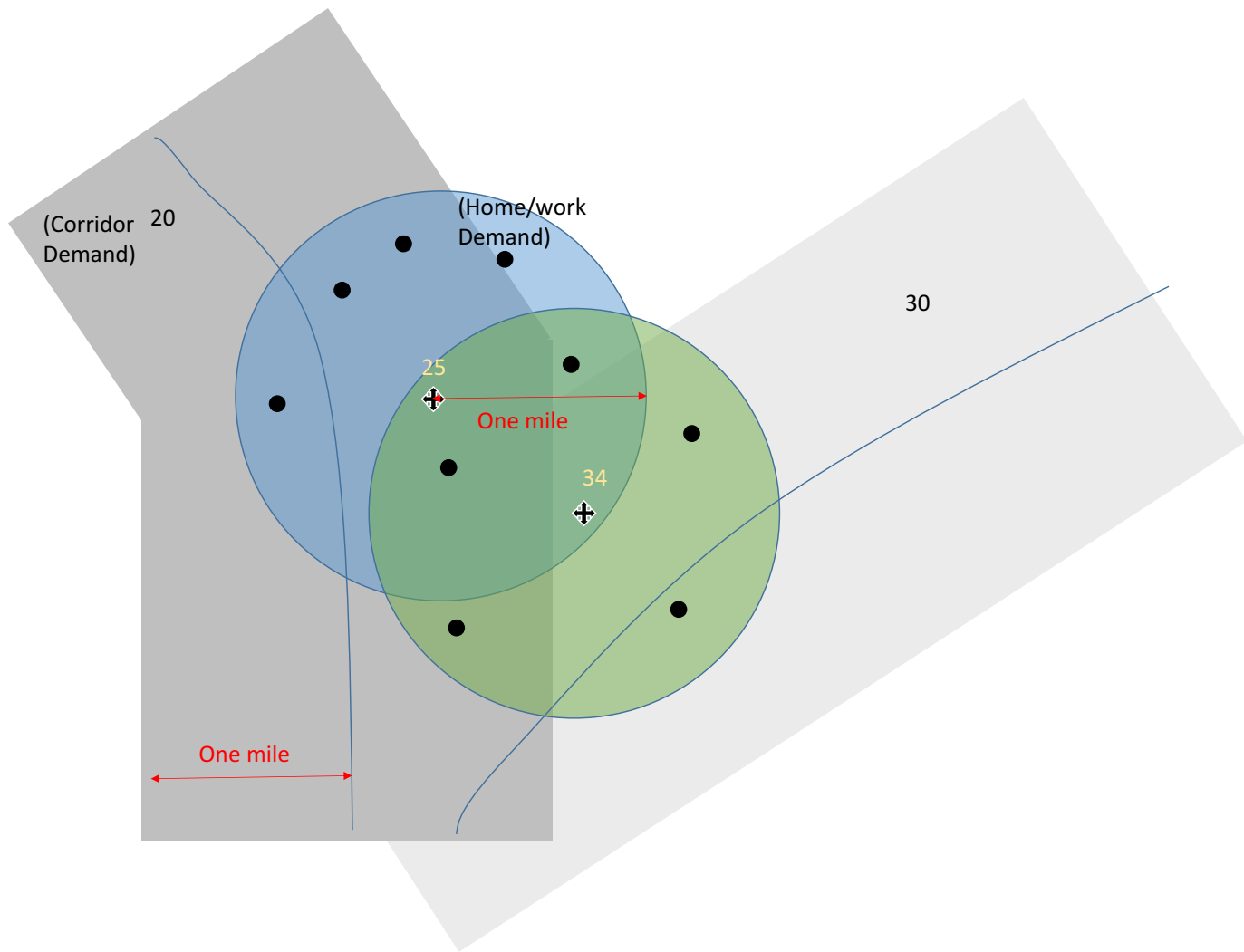
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Modeling DCFC

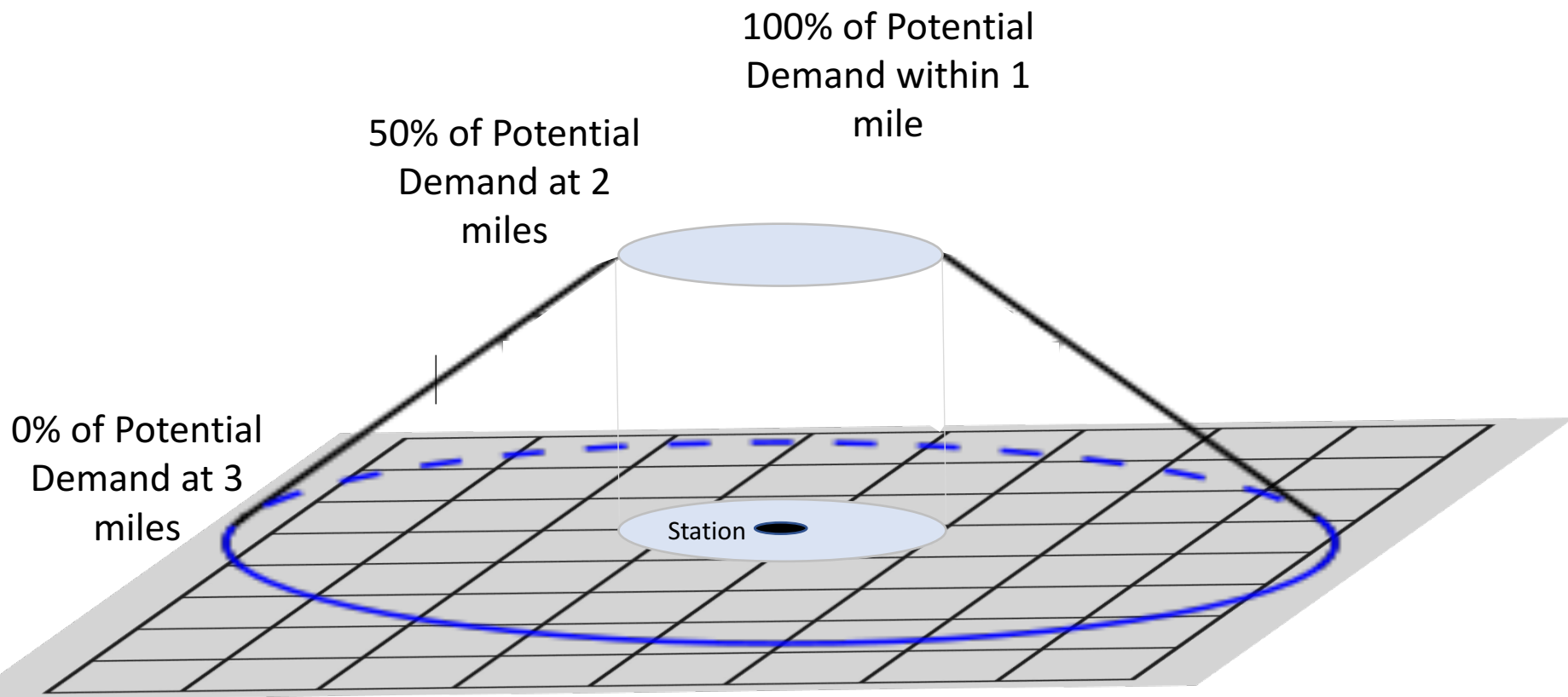
UC Davis EV Toolbox Modules



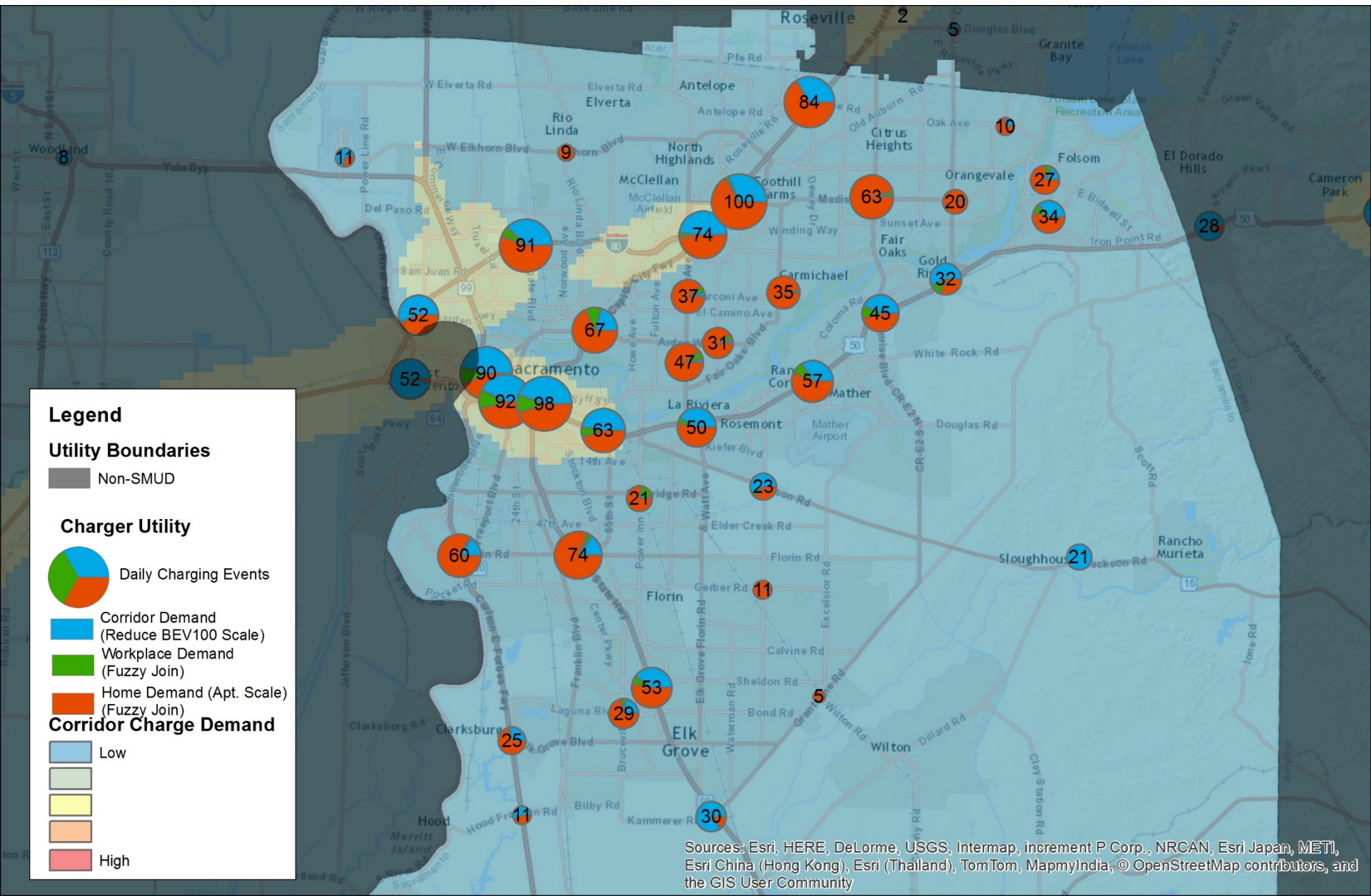
Demand is a combination of all 3 sources of demand (corridor, home and work)



Graduated Demand Allocation. Potential Demand Drops Gradually with Distance with different sensitivity for home and work replacement



Demand Scenario: 2025 with Low Corr. Demand for BEV 80. 1.5 Million vehicles.



Nobody goes
there anymore.
It's too crowded

- DCFC is being used mostly within the vehicle range
 - Not expected to change
 - Pricing has a major impact
- We don't know who is not using the chargers
 - But we know it's not dependable
- Multi-Use Chargers are the best way to get higher utilization rate
- Don't yet know the impact of shared mobility



Coverage first or Dependable first?

- Can you trust the network?
 - Coverage
 - Technical Reliability
 - Congestion

Planning options:

1. Clustering vs coverage
2. Redundancy
3. Paid vs “all you can eat”
4. Consolidated report system (and reservations) in apps

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Thank you



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