NREL
NATIONAL RENEWABLE ENERGY LABORATORY





New EVSE Analytical Tools/Models:

Electric Vehicle Infrastructure Projection Tool (EVI-Pro)

SAE Government/Industry Meeting

Electric Drive Part 2 – Infrastructure

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Eric Wood, Clément Rames, Matteo Muratori

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PEV Charging Analysis – NREL Objective

Provide guidance on plug-in electric vehicle (PEV) charging infrastructure to regional/national stakeholders to:

- Reduce range anxiety as a barrier to increased PEV sales
- Ensure effective use of private/public infrastructure investments

Some key questions related to investment in PEV charging stations…

How many?

What kind?

Where?

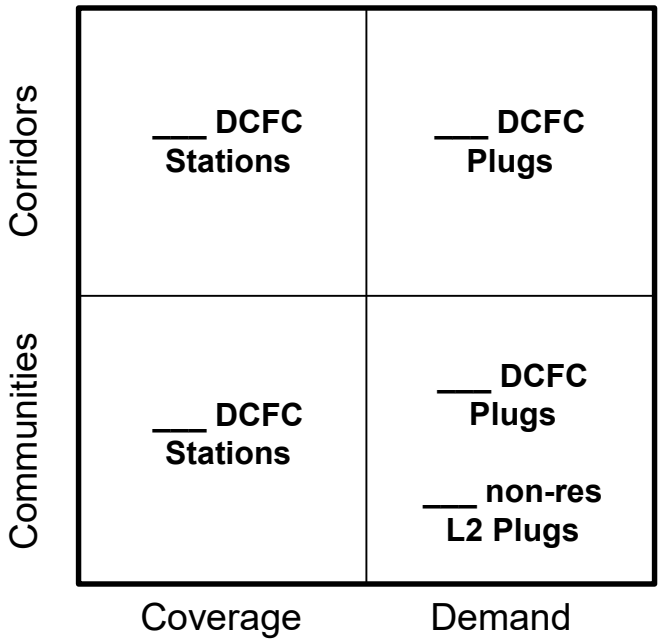
Recent Studies

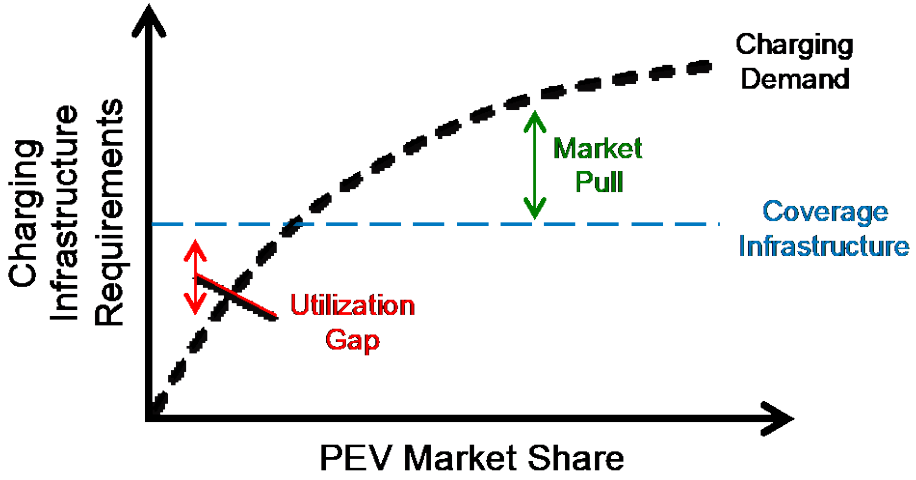
California (2014)
Seattle, WA (2015)
Massachusetts (2017)
Colorado (2017)
National PEV Infrastructure Analysis (2017)
Columbus, OH (2018, forthcoming)
California (2018, forthcoming)

Conceptual Representation of PEV Charging Requirements

Consumers demand for PEV charging is coverage-based
"Need access to charging anywhere their travels lead them"

Infrastructure providers make capacity-driven investments
"Increase supply of stations proportional to utilization"



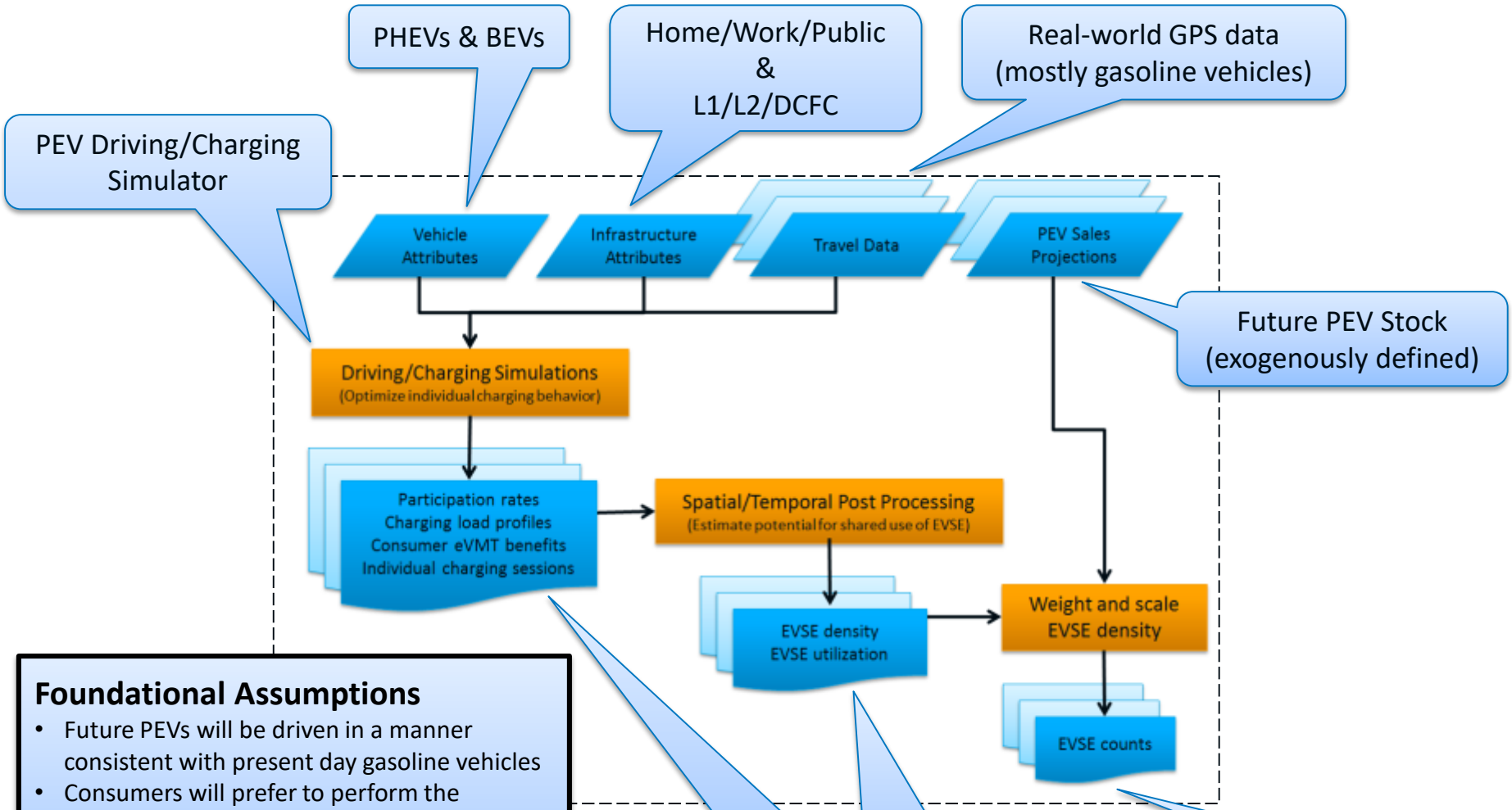


A "utilization gap" persists in a low vehicle density environment making it difficult to justify investment in new stations when existing stations are poorly utilized (see: chicken & egg)

This work quantifies non-residential PEV charging requirements necessary to meet consumer coverage expectations (independent of PEV adoption level) and capacity necessary to meet consumer demand in high PEV adoption scenarios

Coverage and capacity estimates are made both for interstate corridors, cities, towns, and rural areas

Electric Vehicle Infrastructure Projection Tool (EVI-Pro)



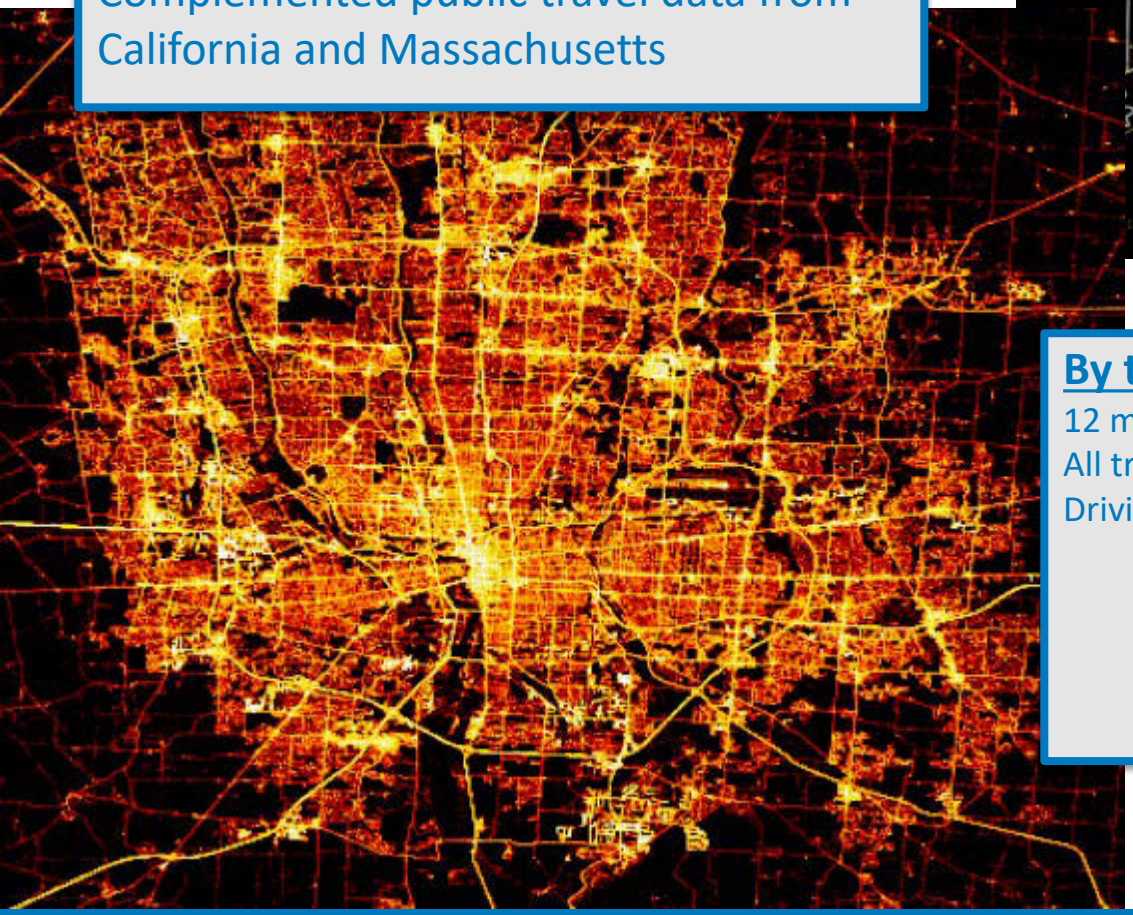
Foundational Assumptions

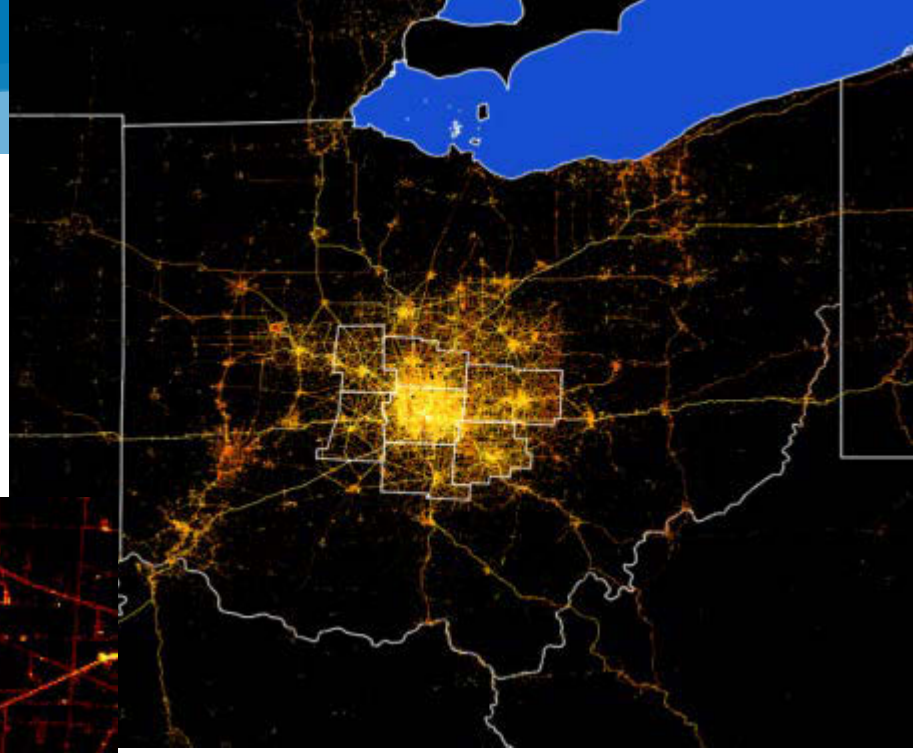
- Future PEVs will be driven in a manner consistent with present day gasoline vehicles
- Consumers will prefer to perform the majority of charging at their home location
- Charging at work/public L2 and corridor/community DCFC stations will be used as necessary to maximize eVMT

GPS Travel Data

Commercial GPS dataset (developed by INRIX) from Columbus, OH used to characterize daily travel patterns

Complemented public travel data from California and Massachusetts





By the numbers:

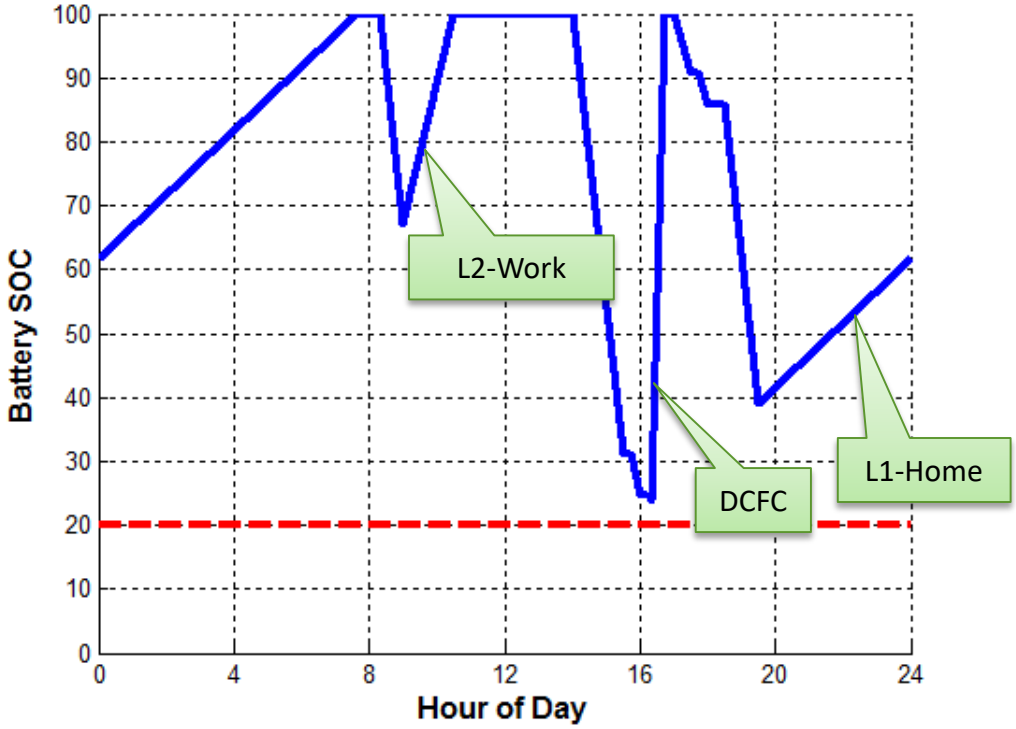
12 months of trips (all of 2016)
All trips intersecting Columbus region
Driving mode imputed by INRIX trip engine

7.82M device ids
32.9M trips
1.04B miles
2.58B waypoints

Driving/Charging Simulations

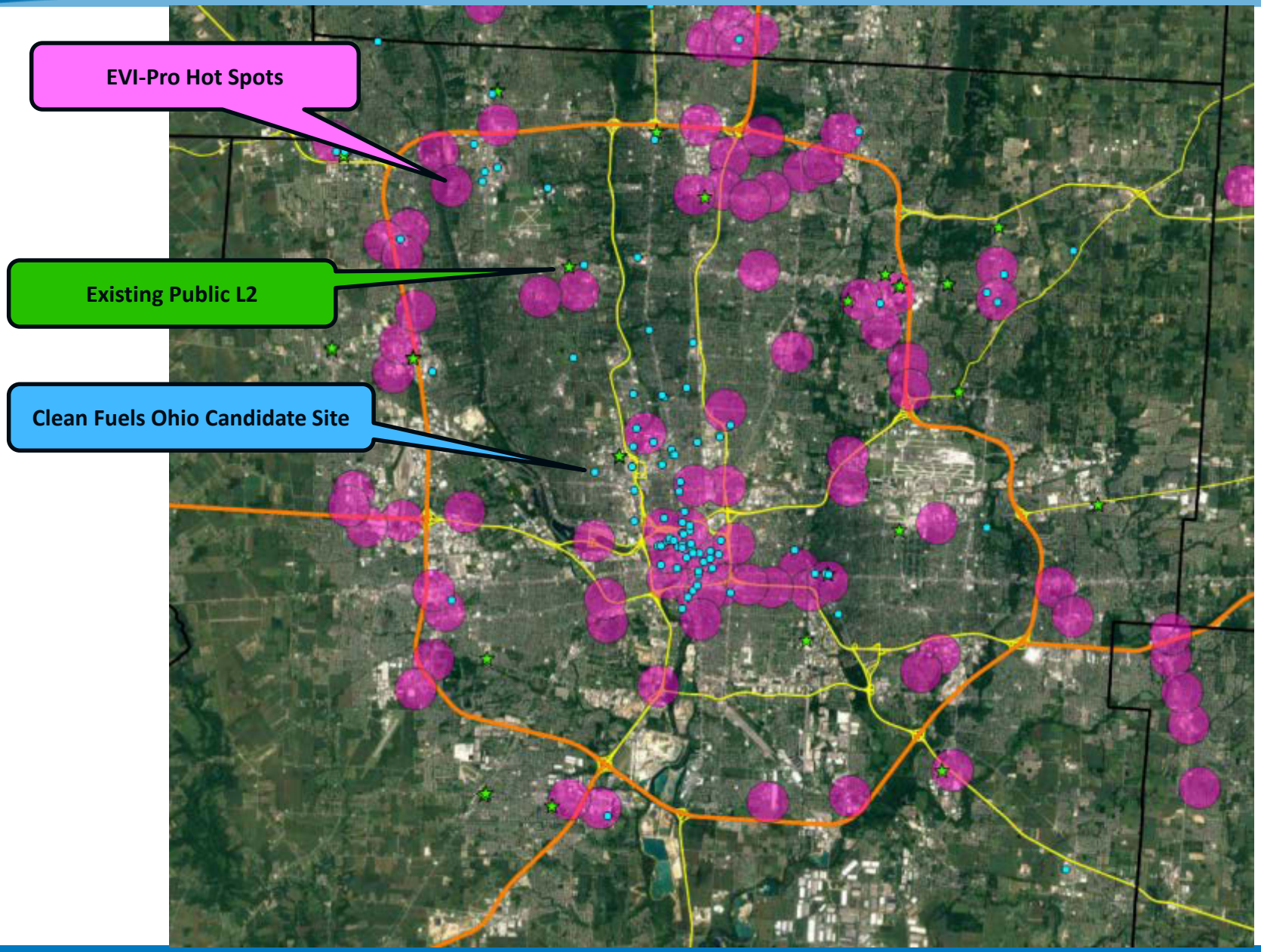
Destination	Departure	Arrival	Drive Miles	Dwell Hours	Simulated Charging
Work	8:20 AM	9:00 AM	32.8	5.00	L2
Non-Res	2:00 PM	3:30 PM	68.9	0.25	---
Non-Res	3:45 PM	4:00 PM	6.3	0.25	---
Non-Res	4:15 PM	4:20 PM	0.9	0.67	DCFC
Non-Res	5:00 PM	5:30 PM	9.2	0.25	---
Non-Res	5:45 PM	6:00 PM	5.0	0.50	---
Home	6:30 PM	7:30 PM	46.8	12.83	L1

Simulated charging behavior for a BEV100 under an example travel day



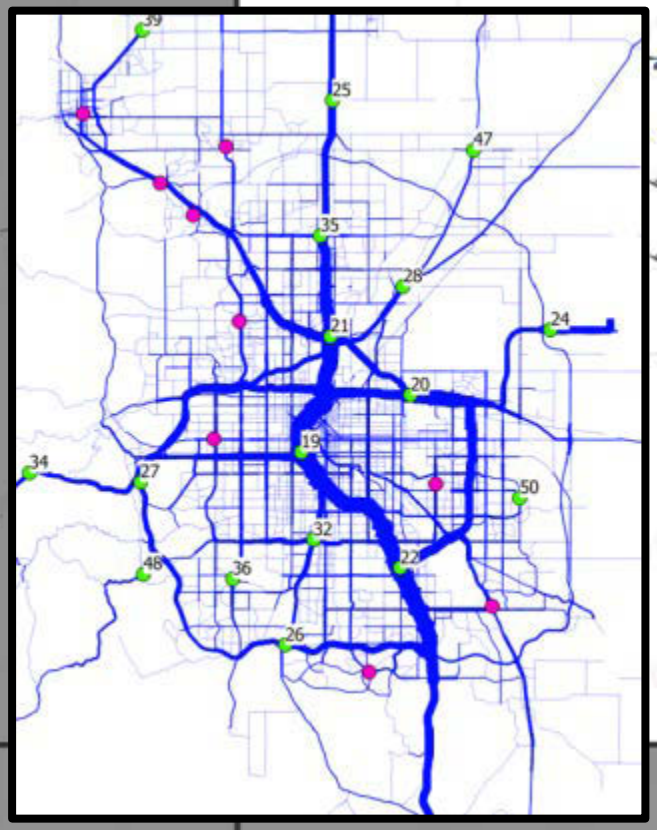
Bottom-up simulations are used to estimate percent of vehicles participating in non-residential charging, derive aggregate load profiles, and investigate spatial distribution of demand

EVI-Pro Hot Spots, Existing Stations, CFO Candidates



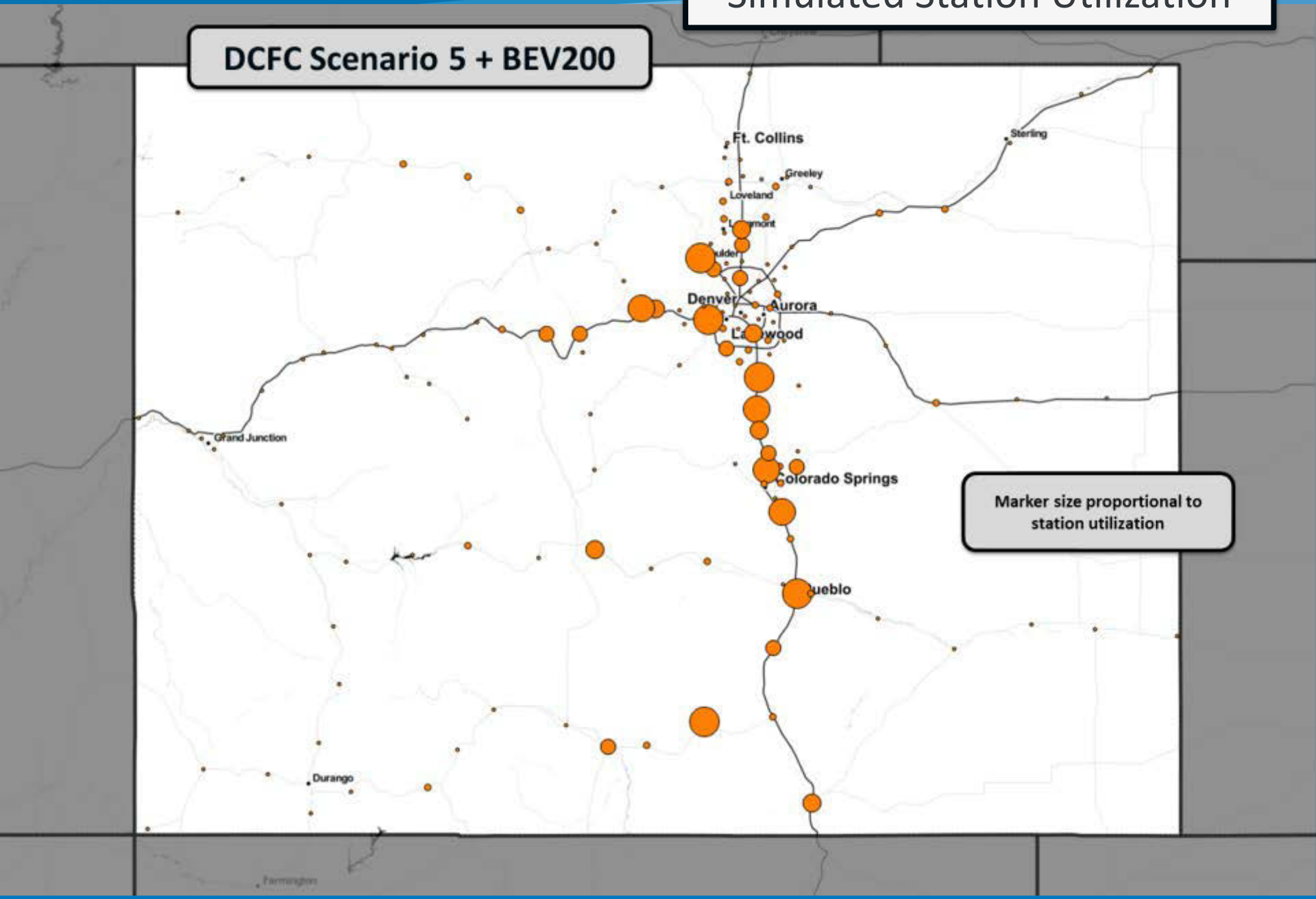
Hypothetical DCFC Network

DCFC Scenario 5



18 existing DCFC stations
31 new interstate stations
47 new highway stations
50 new "traffic-based" stations

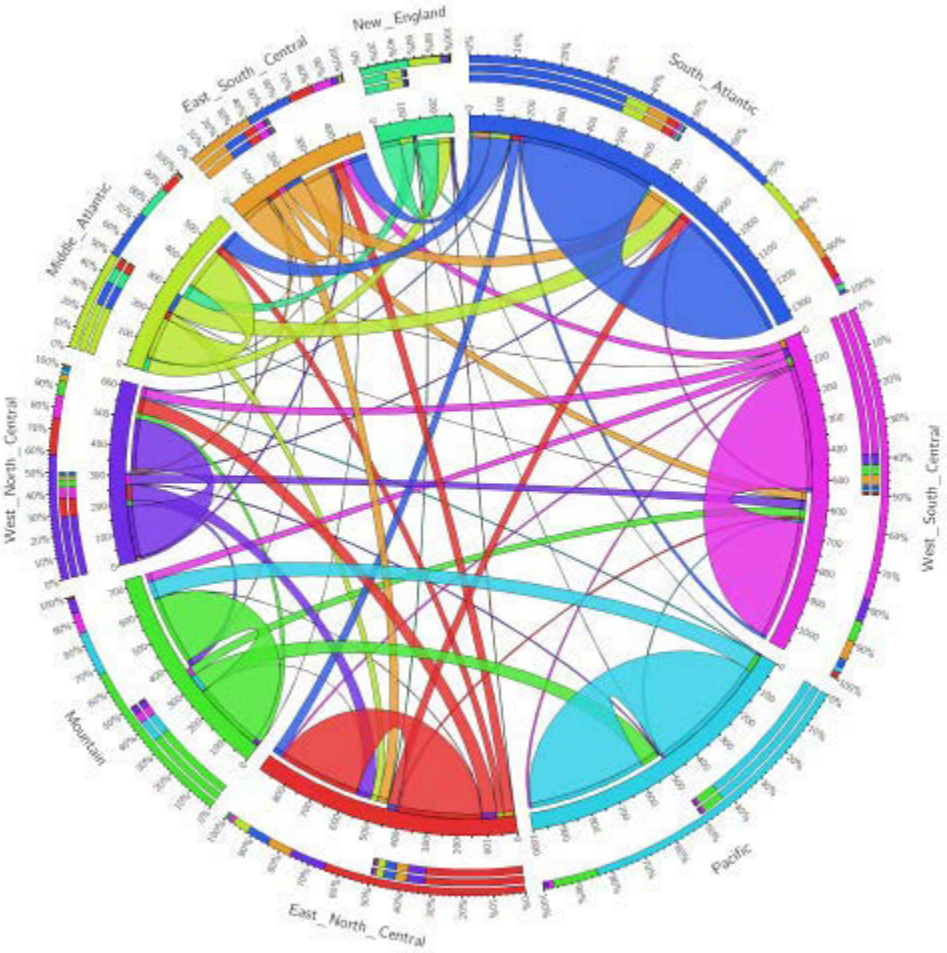
Simulated Station Utilization

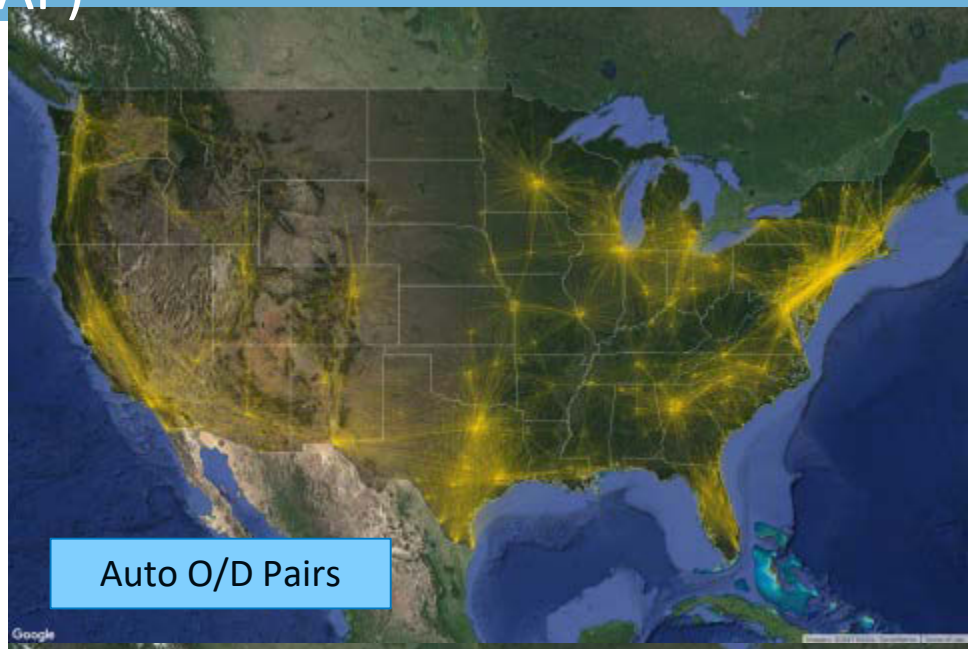


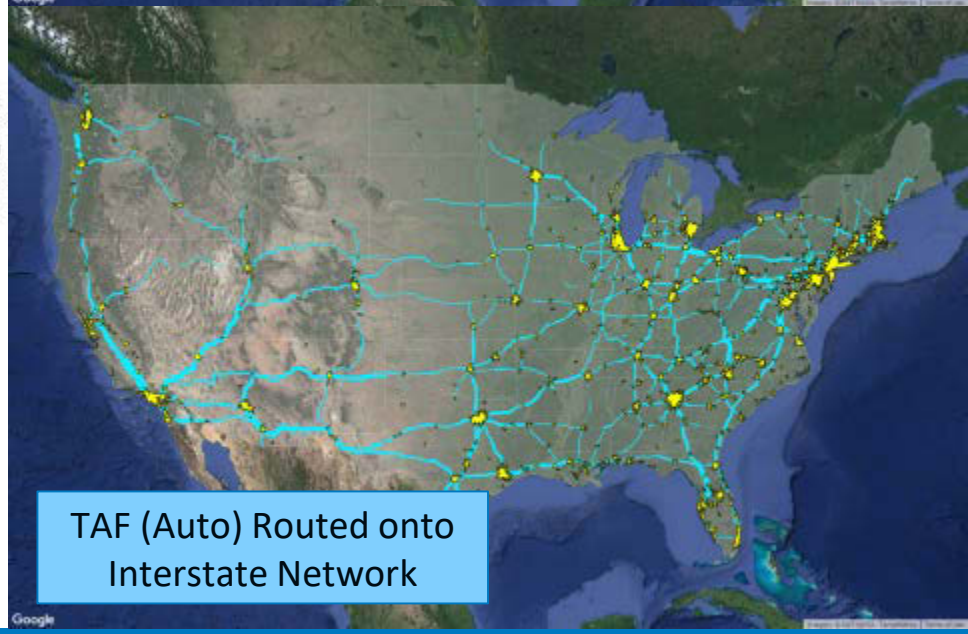
Long Distance Travel Data From FHWA Traveler Analysis Framework (TAF)

TAF Auto Trips by Census Division

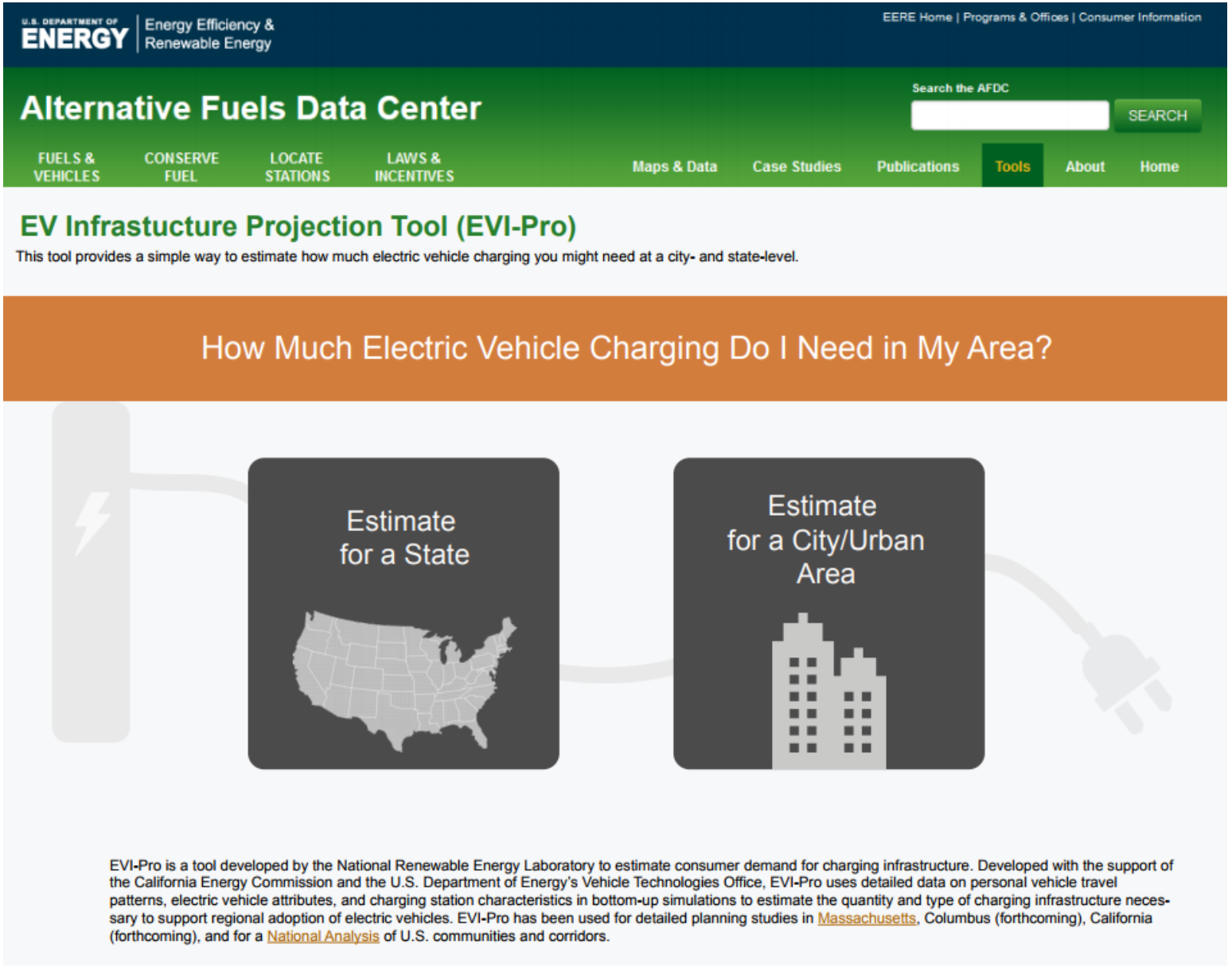
Implies that the majority of long distance auto travel is regional and limited to intra-division movements







Coming soon… Online version of EVI-Pro

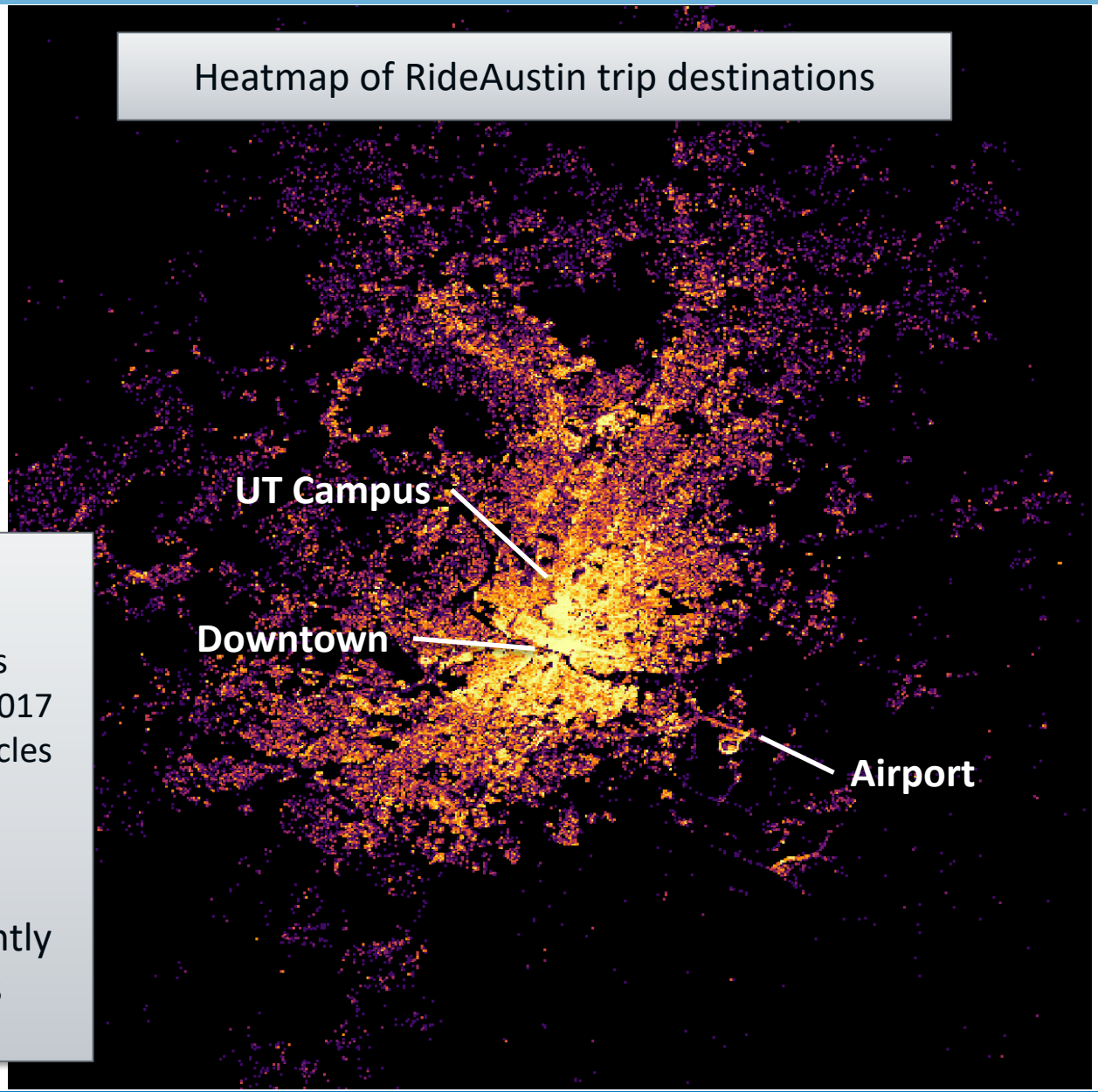


Electrification of TNCs: A Case Study on RideAustin

By the numbers

- Sample duration: 10 months
- Period: June 2016 to April 2017
- 4,961 unique drivers & vehicles
- 261,000 unique riders
- 1.49 million trips

Largest TNC dataset currently available to researchers

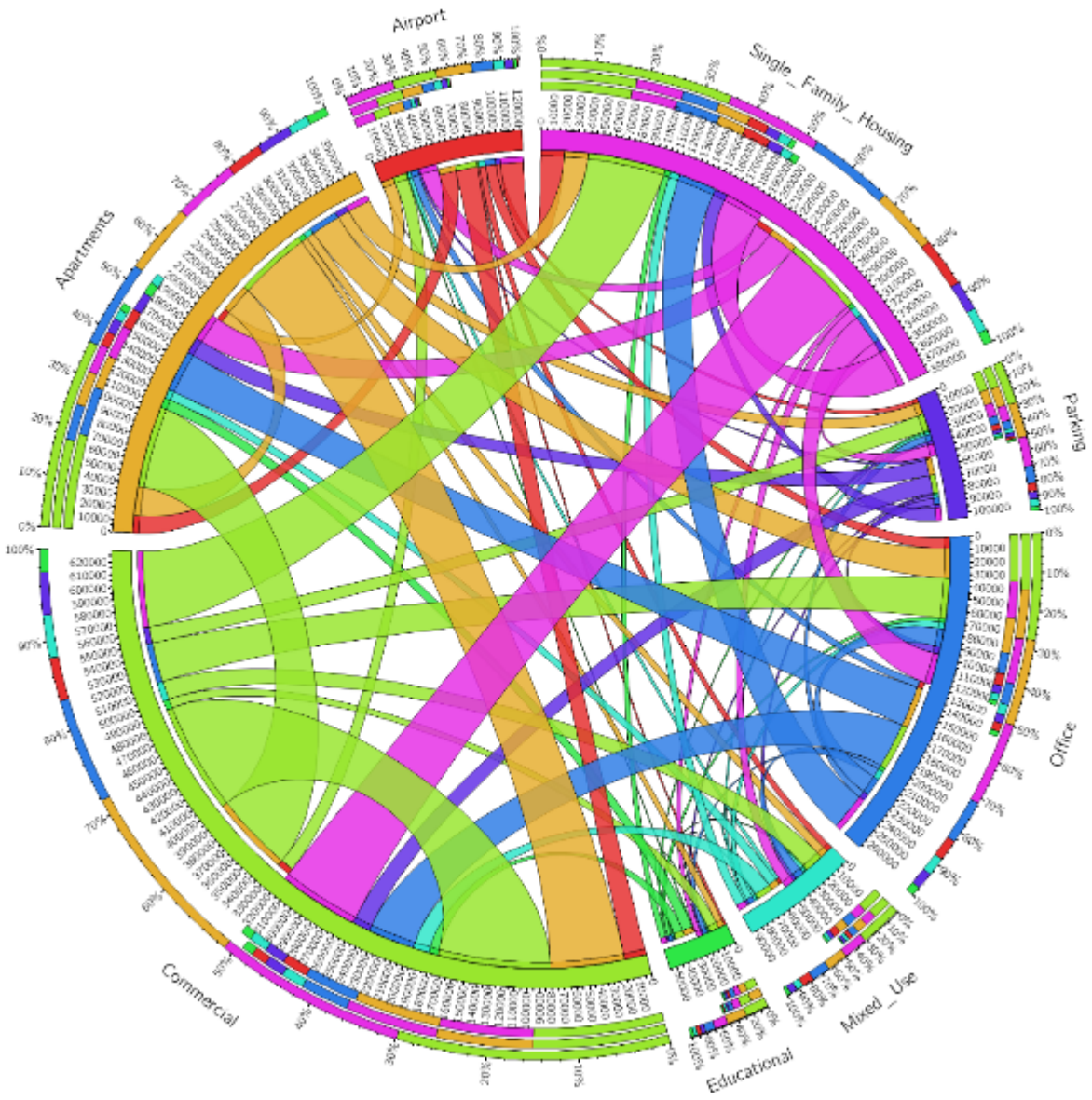


Electrification of TNCs: Preliminary Results

- Residential locations are significant trip generators
  - Approximately evenly split between apartments and single family homes
- Commercial locations are largest land use type
- Airport may be underrepresented due to local knowledge of RideAustin

- Time of day activity shifts much later in the day than traditional vehicle activity patterns

- Approximately 90% of shifts are less than 150 mi
- Approximately 50% of drivers have no shifts above 200 mi
  - All shift totals include dead-heading and commuting



Thanks! Questions?

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