



## **New EVSE Analytical Tools/Models:** Electric Vehicle Infrastructure Projection Tool (EVI-Pro)

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Electric Drive Part 2 – Infrastructure  
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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...

#### Recent Studies

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

How many?

What kind?

Where?

# Conceptual Representation of PEV Charging Requirements

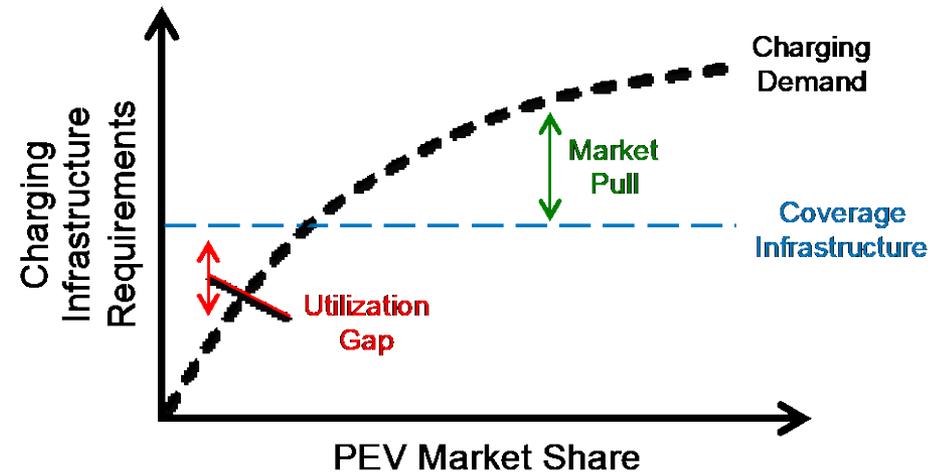
**Consumers demand for PEV charging is coverage-based**

“Need access to charging anywhere their travels lead them”

**Infrastructure providers make capacity-driven investments**

“Increase supply of stations proportional to utilization”

Corridors	___ DCFC Stations	___ DCFC Plugs
	___ DCFC Stations	___ DCFC Plugs ___ non-res L2 Plugs
Communities	Coverage	Demand

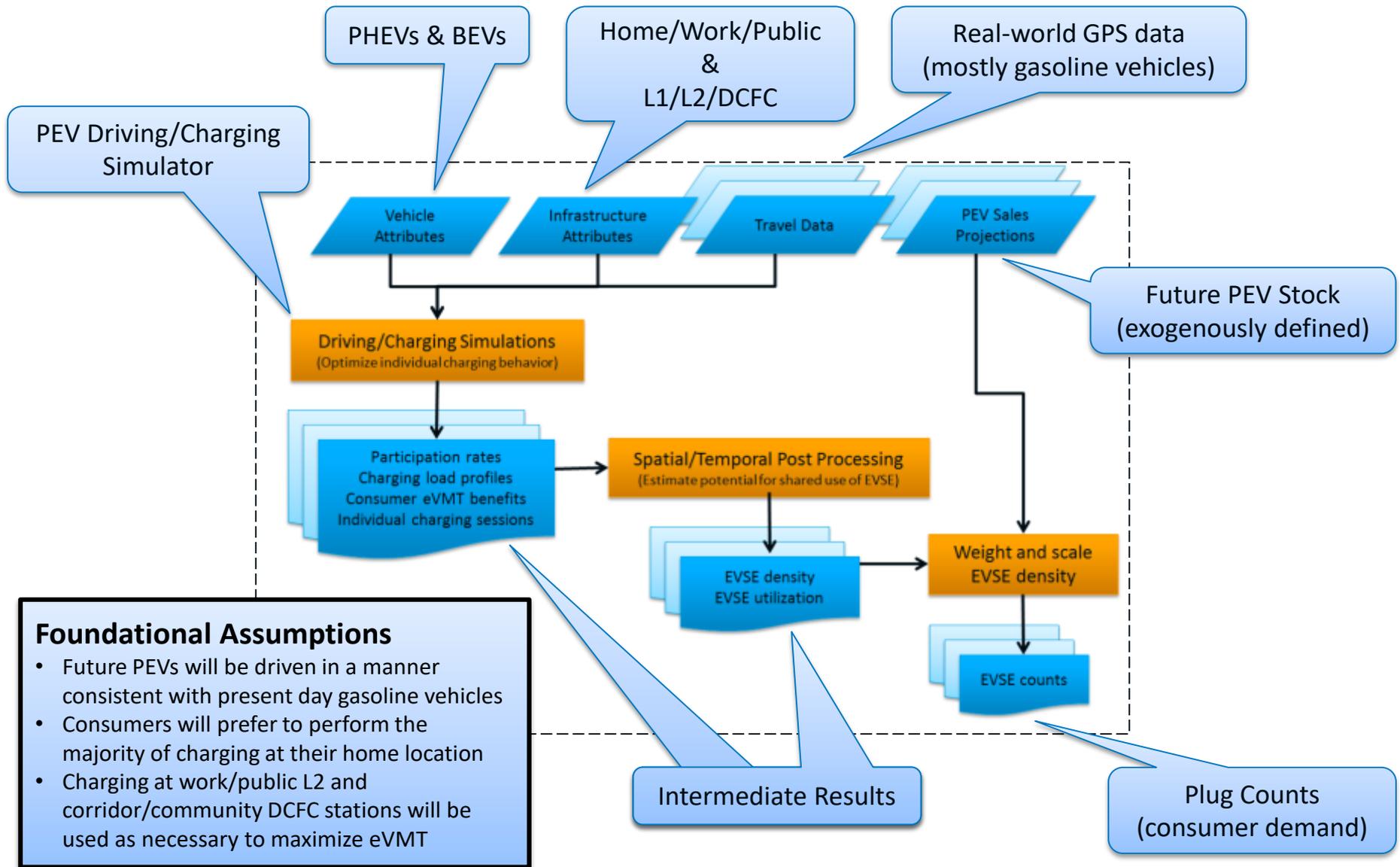


**A “utilization gap” persists in a low vehicle density environment making it difficult to justify investment in new stations when existing stations are poorly utilized (see: chicken & egg)**

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

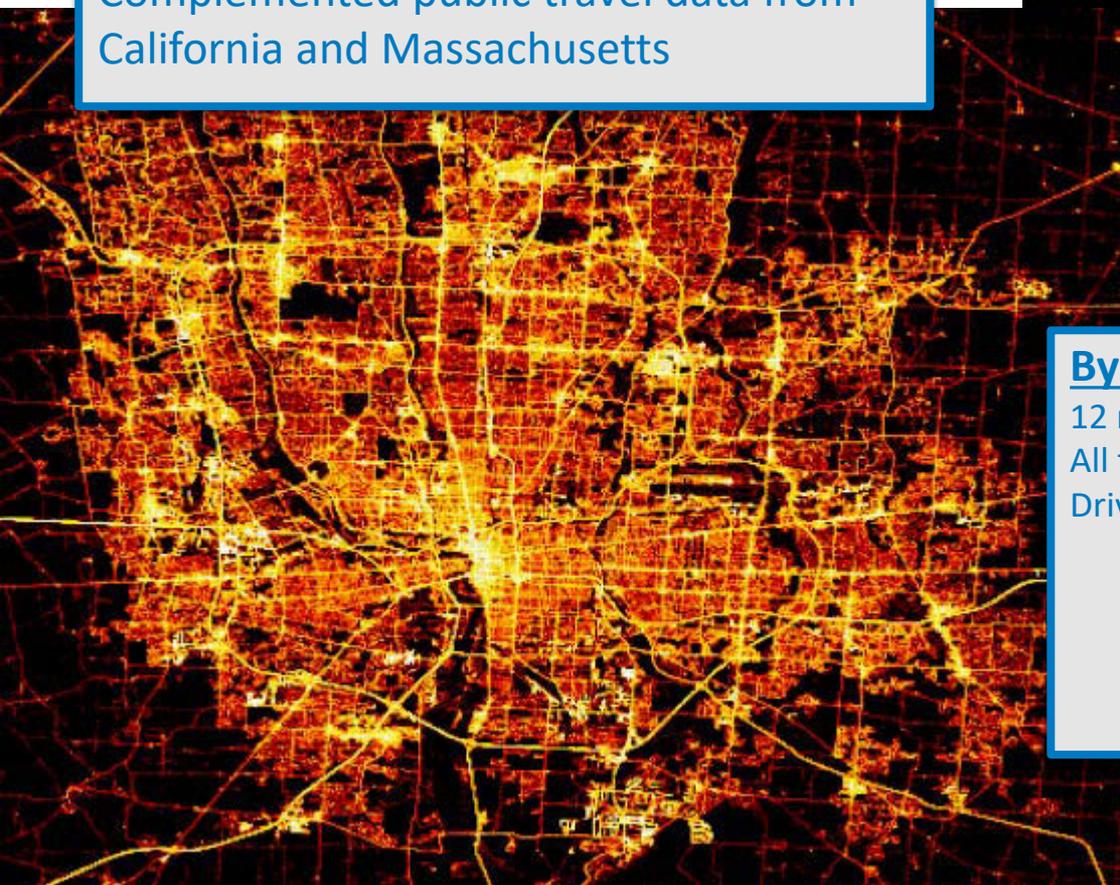
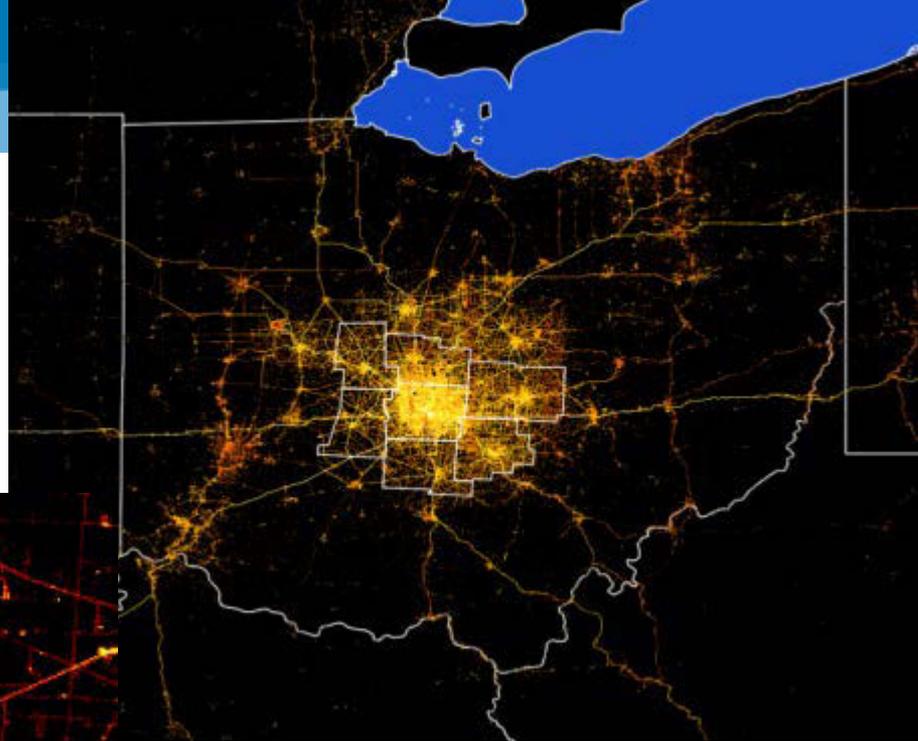
# Electric Vehicle Infrastructure Projection Tool (EVI-Pro)



# 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**

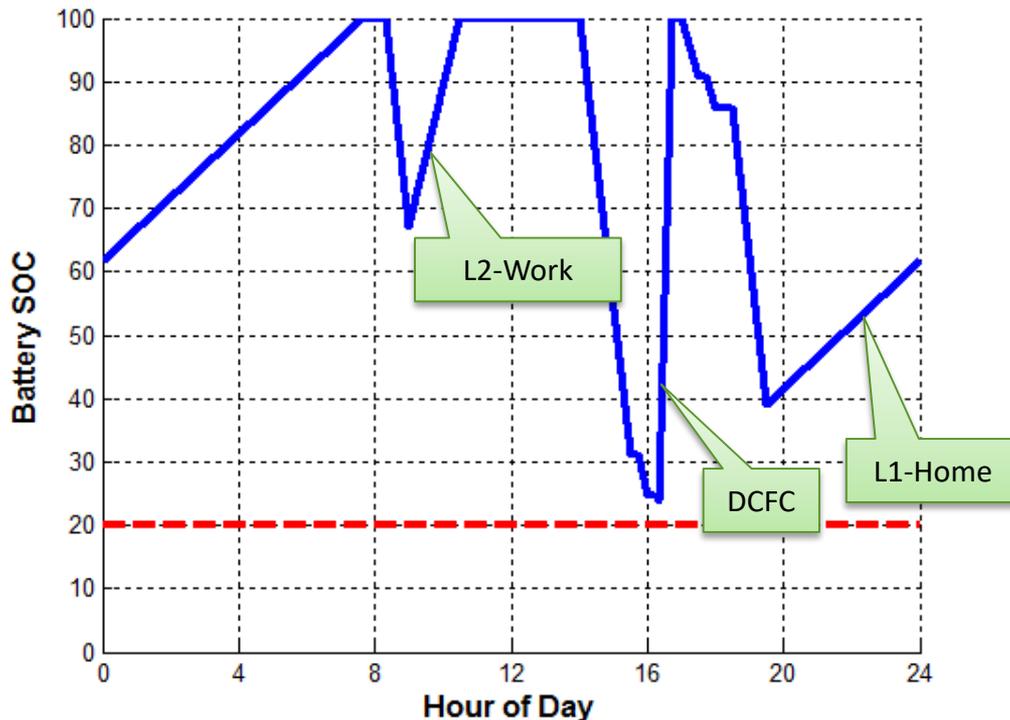
**1.04B miles**

**2.58B waypoints**

# Driving/Charging Simulations

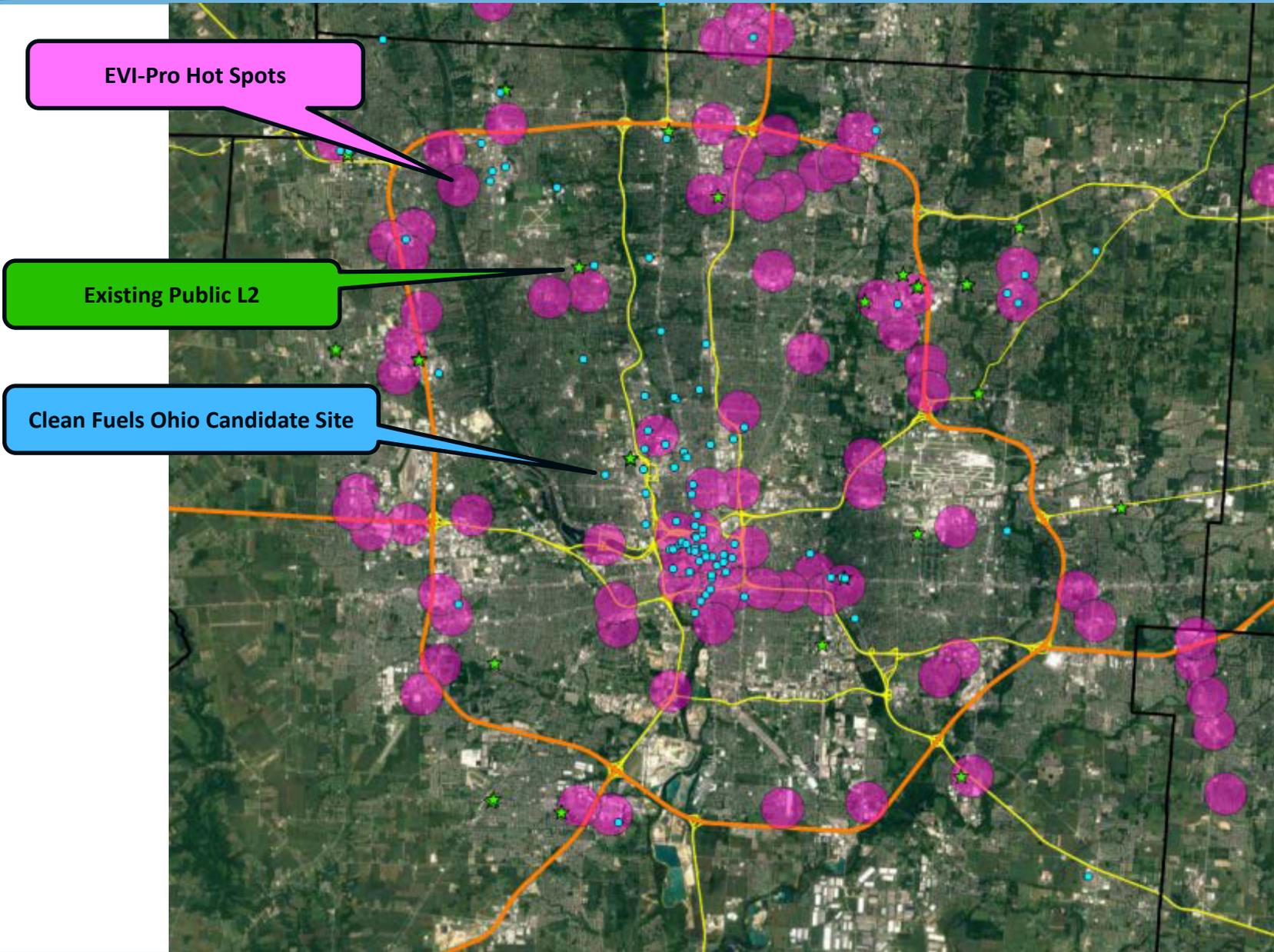
Destination	Departure	Arrival	Drive Miles	Dwell Hours	Simulated Charging
Work	8:20 AM	9:00 AM	32.8	5.00	L2
Non-Res	2:00 PM	3:30 PM	68.9	0.25	---
Non-Res	3:45 PM	4:00 PM	6.3	0.25	---
Non-Res	4:15 PM	4:20 PM	0.9	0.67	DCFC
Non-Res	5:00 PM	5:30 PM	9.2	0.25	---
Non-Res	5:45 PM	6:00 PM	5.0	0.50	---
Home	6:30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

Simulated charging behavior for a BEV100 under an example travel day



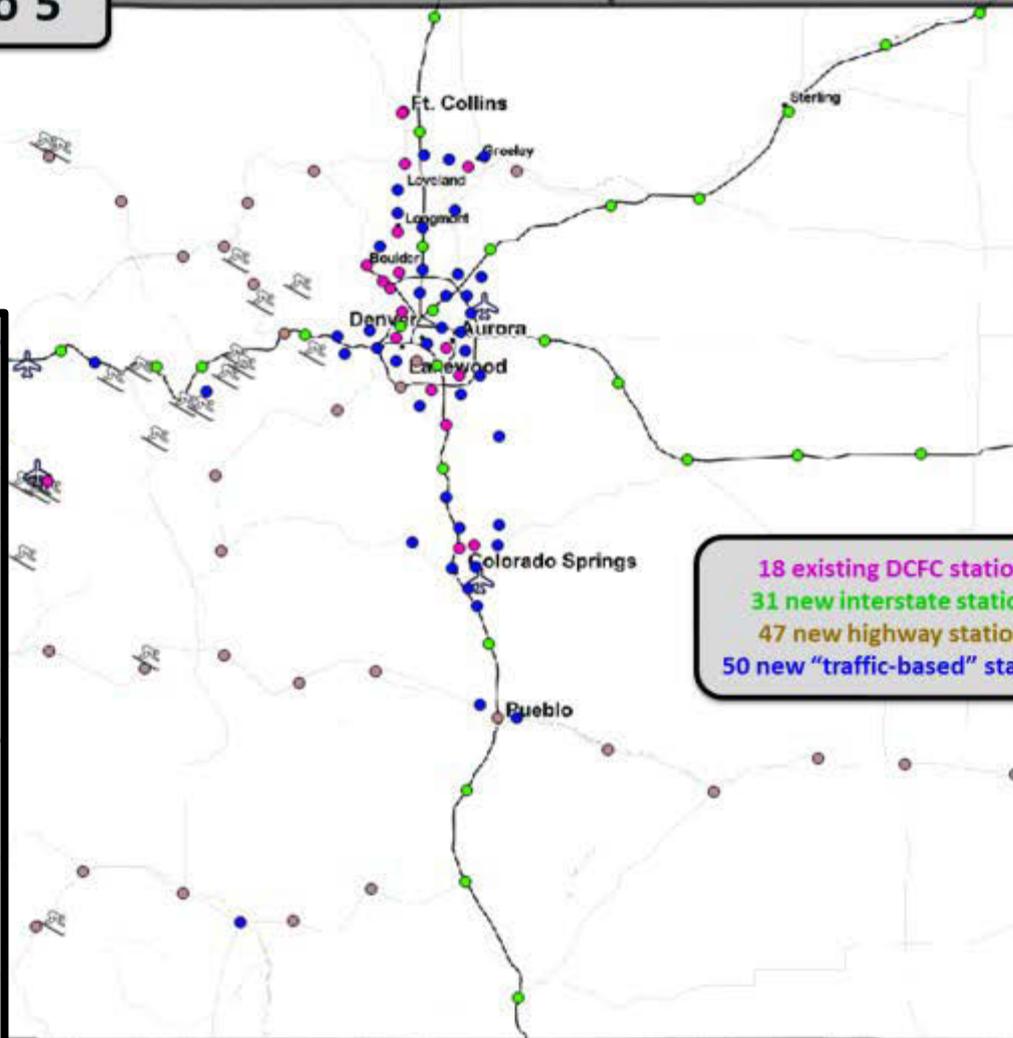
**Bottom-up simulations** are used to estimate percent of vehicles participating in non-residential charging, derive aggregate load profiles, and investigate spatial distribution of demand

# EVI-Pro Hot Spots, Existing Stations, CFO Candidates



# Hypothetical DCFC Network

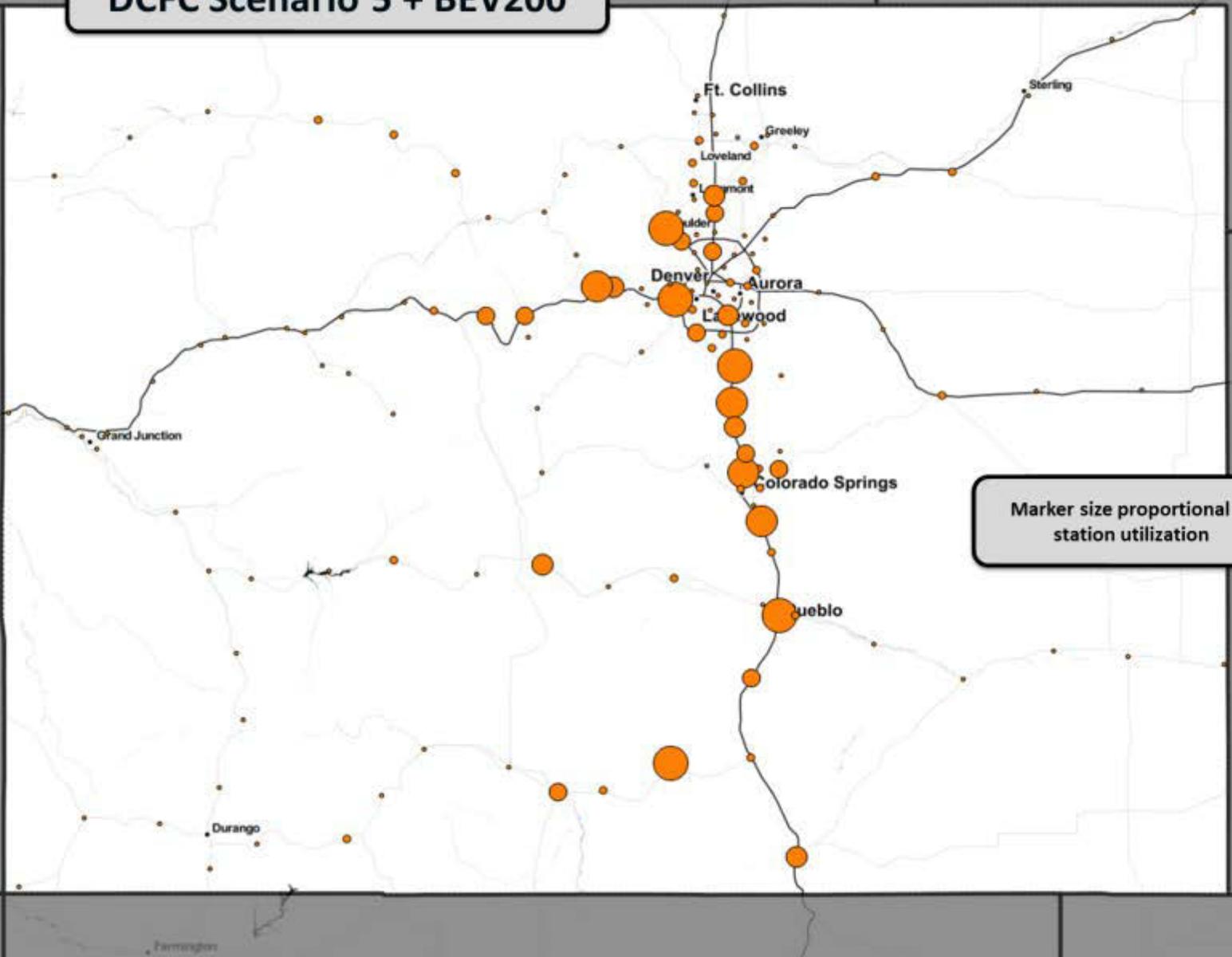
## DCFC Scenario 5



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

# Simulated Station Utilization

DCFC Scenario 5 + BEV200

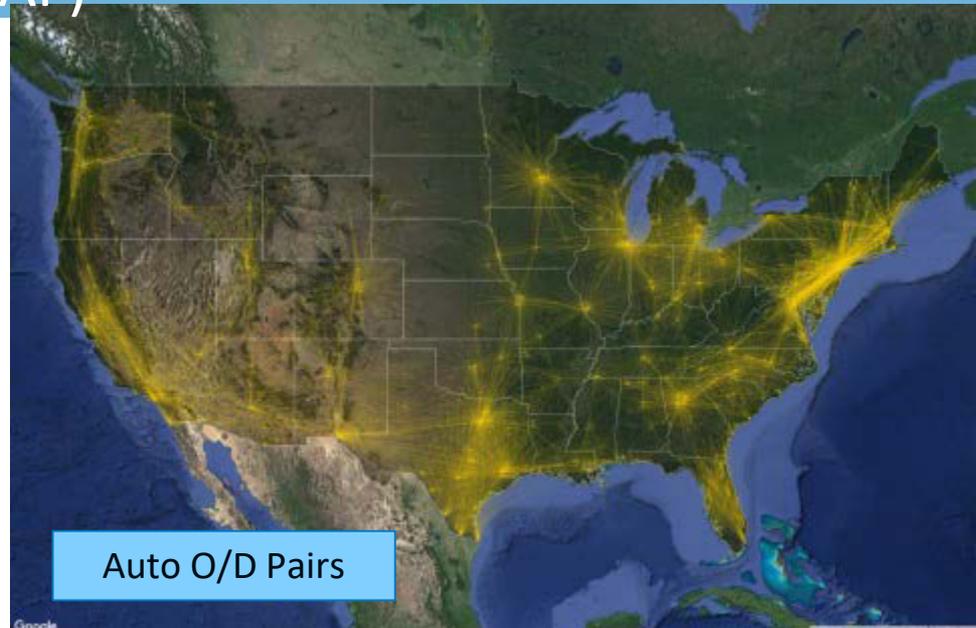
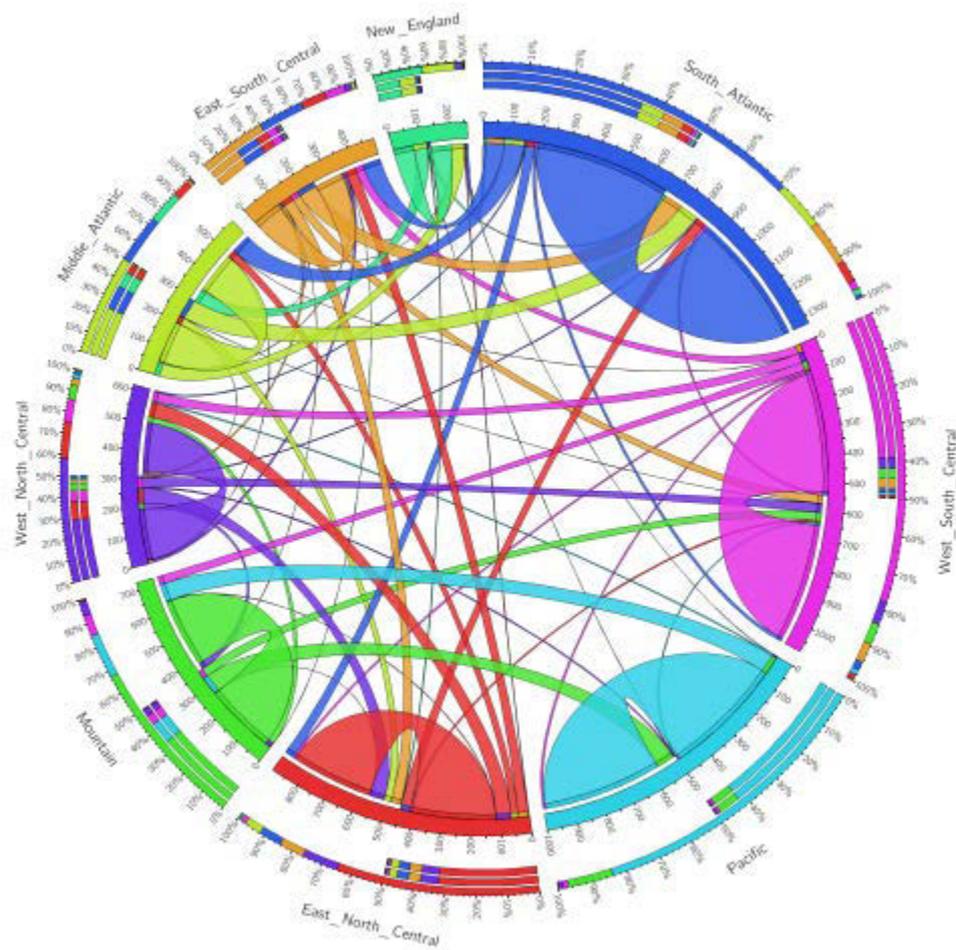


Marker size proportional to station utilization

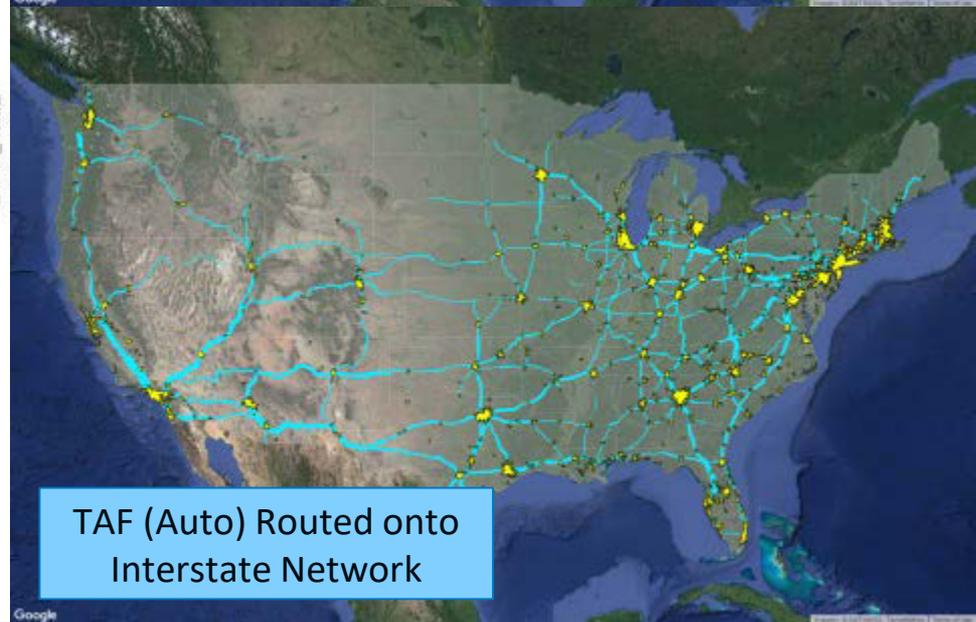
# Long Distance Travel Data From FHWA Traveler Analysis Framework (TAF)

## TAF Auto Trips by Census Division

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



Auto O/D Pairs



TAF (Auto) Routed onto Interstate Network

# Coming soon... Online version of EVI-Pro

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

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### EV Infrastructure Projection Tool (EVI-Pro)

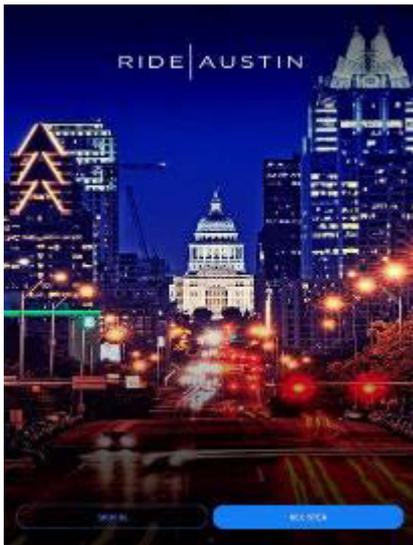
This tool provides a simple way to estimate how much electric vehicle charging you might need at a city- and state-level.

### How Much Electric Vehicle Charging Do I Need in My Area?

The diagram illustrates the tool's capabilities. On the left, a vertical grey bar contains a white lightning bolt icon. A grey line connects this bar to a dark grey rounded square box containing the text "Estimate for a State" and a map of the United States. A grey line then connects this box to another dark grey rounded square box containing the text "Estimate for a City/Urban Area" and an icon of two buildings. A final grey line connects this second box to a grey electrical plug icon on the right.

EVI-Pro is a tool developed by the National Renewable Energy Laboratory to estimate consumer demand for charging infrastructure. Developed with the support of the California Energy Commission and the U.S. Department of Energy's Vehicle Technologies Office, EVI-Pro uses detailed data on personal vehicle travel patterns, electric vehicle attributes, and charging station characteristics in bottom-up simulations to estimate the quantity and type of charging infrastructure necessary to support regional adoption of electric vehicles. EVI-Pro has been used for detailed planning studies in [Massachusetts](#), Columbus (forthcoming), California (forthcoming), and for a [National Analysis](#) of U.S. communities and corridors.

# Electrification of TNCs: A Case Study on RideAustin

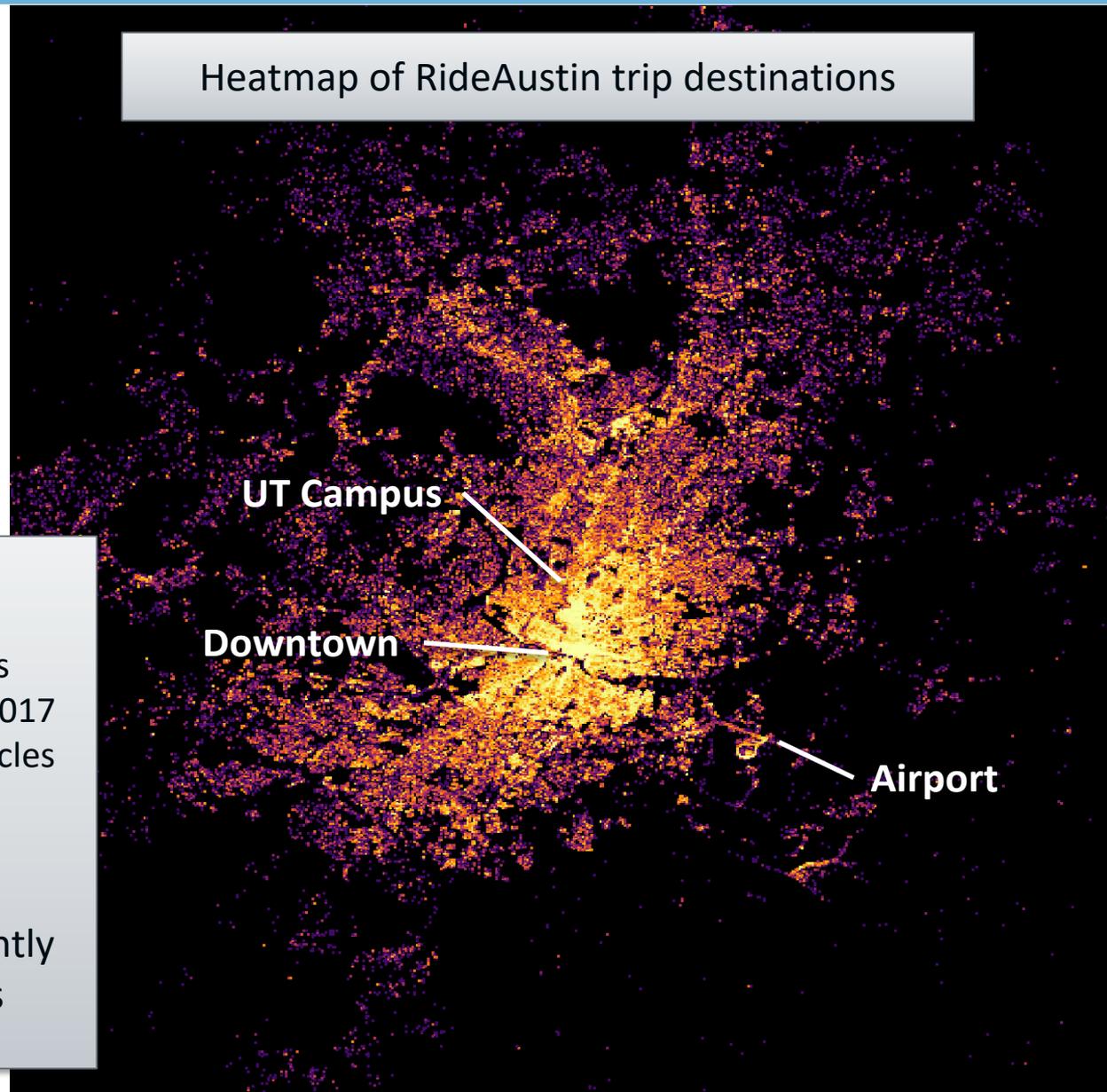


## By the numbers

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

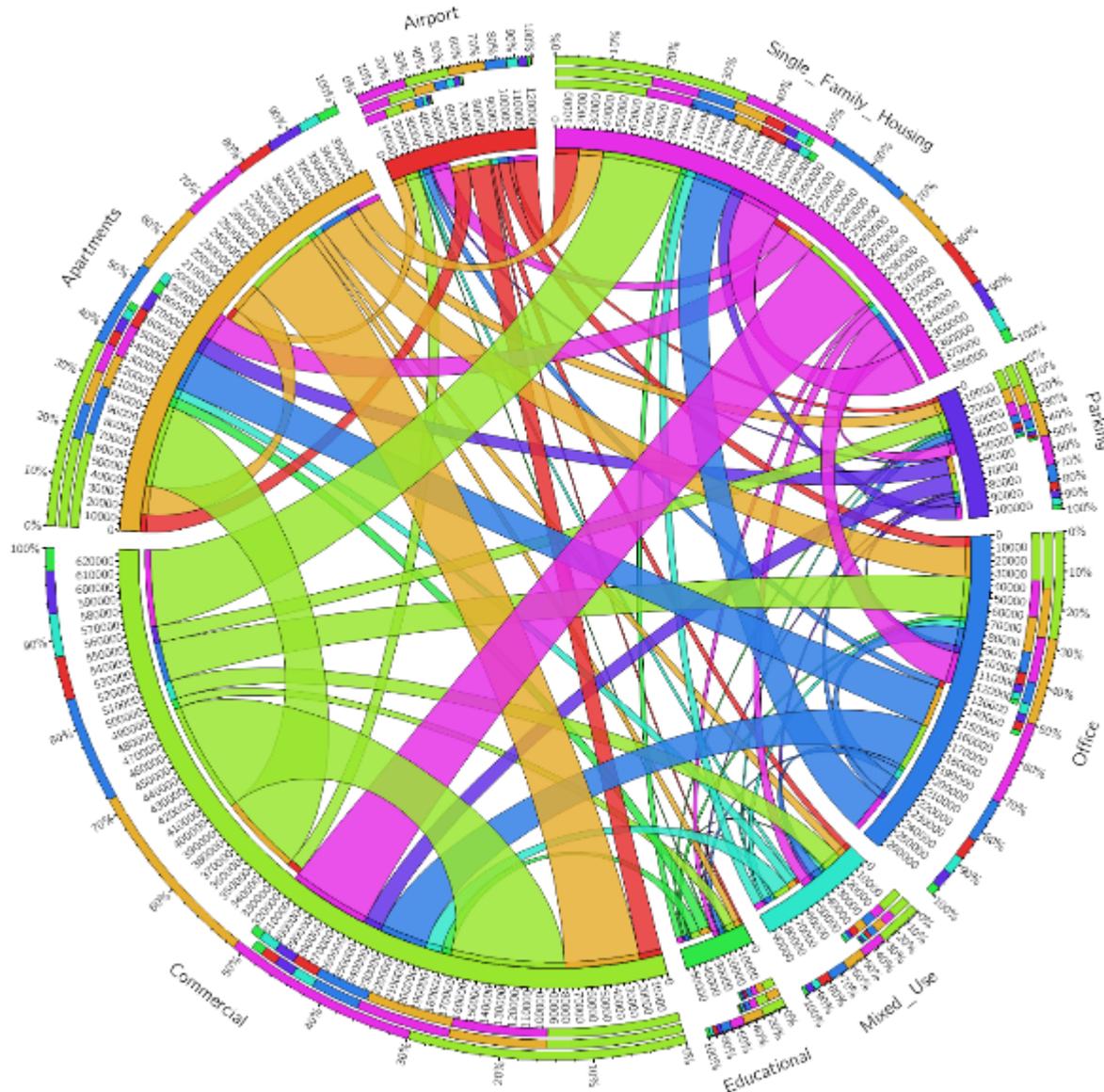
Largest TNC dataset currently available to researchers

Heatmap of RideAustin trip destinations



# 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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