NREL
NATIONAL RENEWABLE ENERGY LABORATORY

New EVSE Analytical Tools/Models:

Electric Vehicle Infrastructure Projection Tool (EVI-Pro) Lite

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NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

Significant Public/Private Investments Being Made in EV Charging Infrastructure

Disparate group of stakeholders* requires consistent approach for intelligently informing infrastructure investments to grow the PEV market and improve domestic energy security

*Automotive manufacturers, electric utilities, charging networks, transportation network companies, state/local governments

Volkswagen Plans to 'Electrify America' with $2 Billion Investment in the Largest U.S. EV Charging Network

Maryland's utilities propose spending $104 million on statewide electric-vehicle charging network

PG&E Launches Country's Largest Utility-Sponsored EV Charging Program

The pilot program will introduce 7,500 electric car chargers in California. More utility electrification initiatives to come.

EMMA FOEHRINGER MERCHANT | JANUARY 17, 2018

Senator Skinner Introduces "E-CAr" (SB 1014) to Shift Ride-Hailing to Zero-Emission Vehicles

State to Spend $14M on Electric Car Charging Stations

Virginia is looking for a developer to build a statewide charging network for electric vehicles.

California aims to have 5 million electric cars on the road and 250k charging stations by 2030

Fred Lambert - Jan. 29th 2018 10:40 am ET @FredericLambert

BP becomes latest oil giant to invest in electric vehicle charging

Fred Lambert - Jan. 30th 2018 8:02 am ET @FredericLambert

Washington state to spend $1M on electric-vehicle charging stations

Originally published September 7, 2017 at 10:19 am | *Updated September 7, 2017 at 2:21 pm*

Volkswagen, Walmart partner to bring EV charging to more than 100 Walmart stores in 34 states

Western governors set sights on electric vehicle charging network spanning seven states

Deal signed to ease EV range anxiety with fast-charge network along 11 Interstate highways

Via: Electrek, Greentech Media, Baltimore Sun, Future Car, US News and World Report, Seattle Times, Denver Post, CNET, CA-Senate, NY Daily News

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?

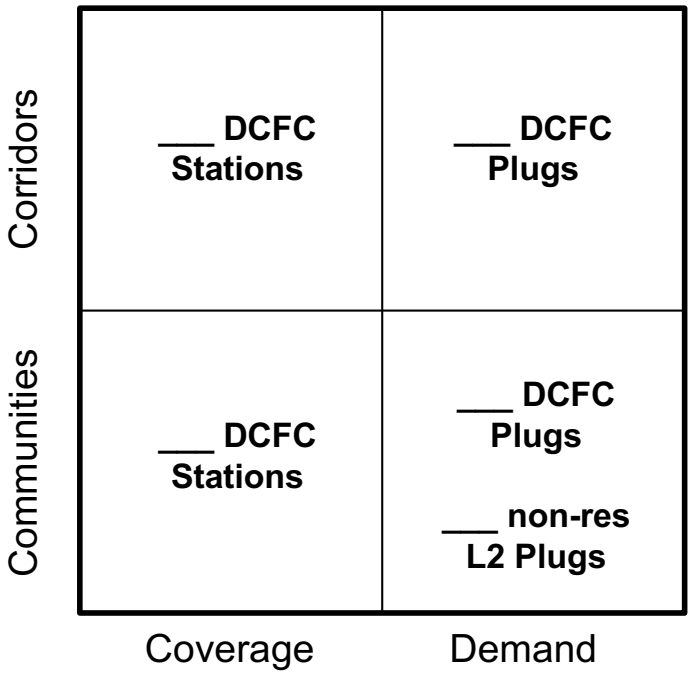
Recent Studies

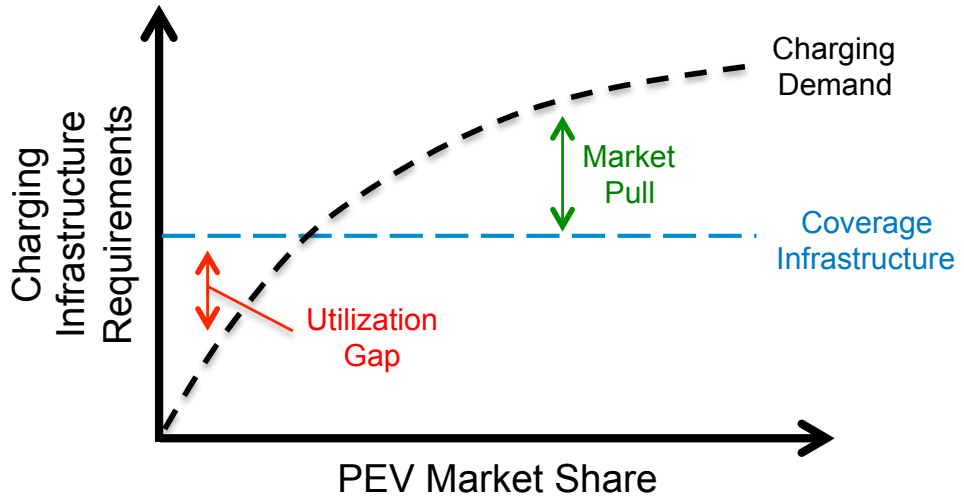
California (2014)
Seattle, WA (2015)
Massachusetts (2017)
Colorado (2017)
National Analysis (2017)
Columbus, OH (2018)
California (2018)
Maryland (forthcoming)

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"



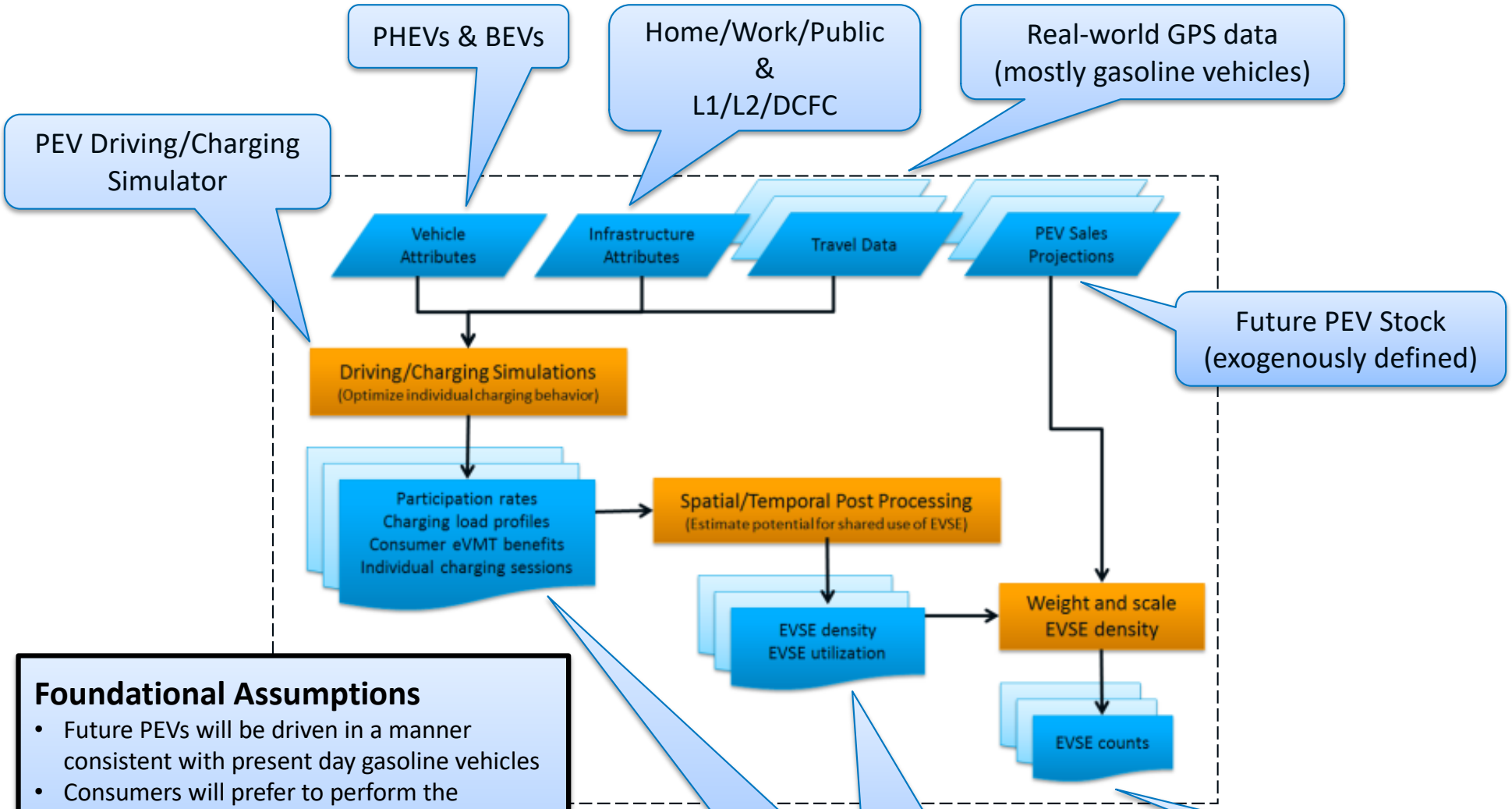


A "utilization gap" persists in a low vehicle density environment making it difficult to justify investment in new stations when existing stations are poorly utilized (see: chicken & egg)

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)



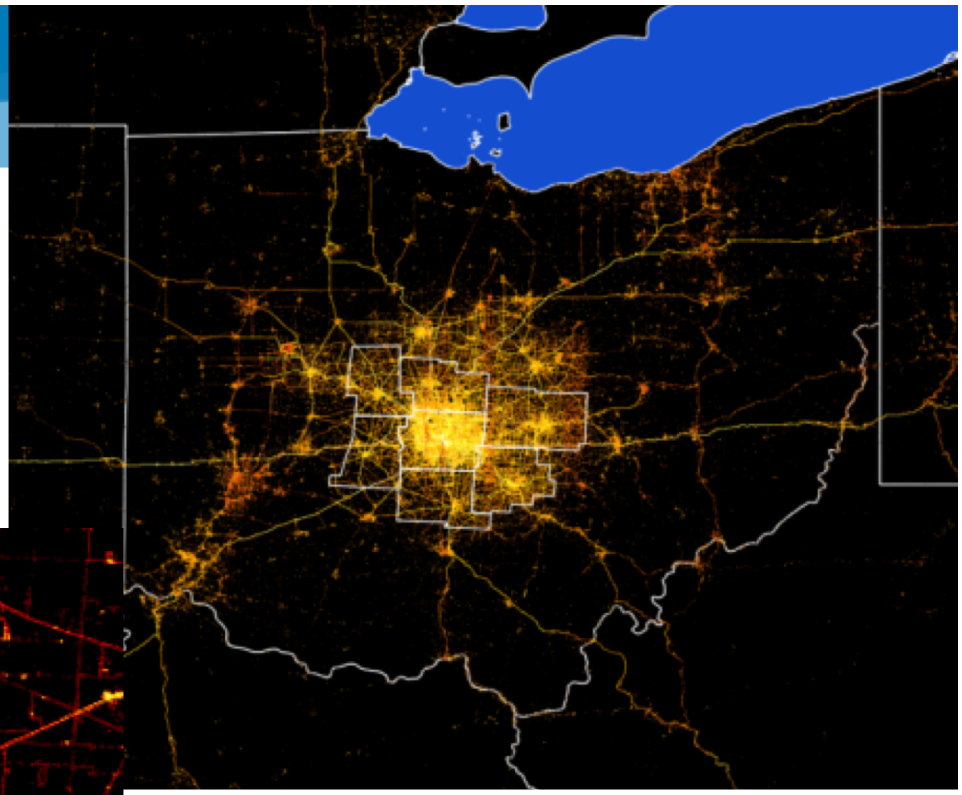
Foundational Assumptions

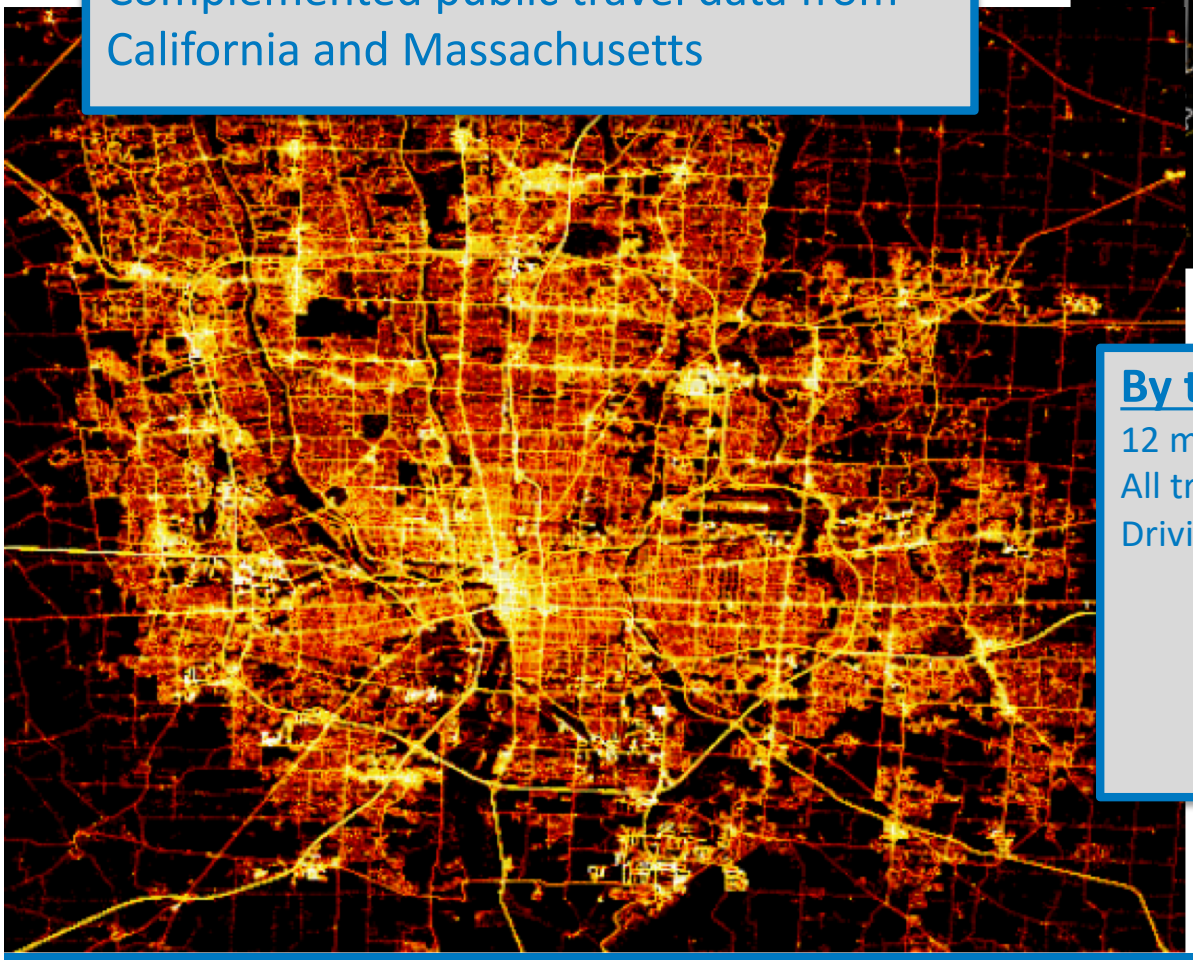
- Future PEVs will be driven in a manner consistent with present day gasoline vehicles
- Consumers will prefer to perform the majority of charging at their home location
- Charging at work/public L2 and corridor/community DCFC stations will be used as necessary to maximize eVMT

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:

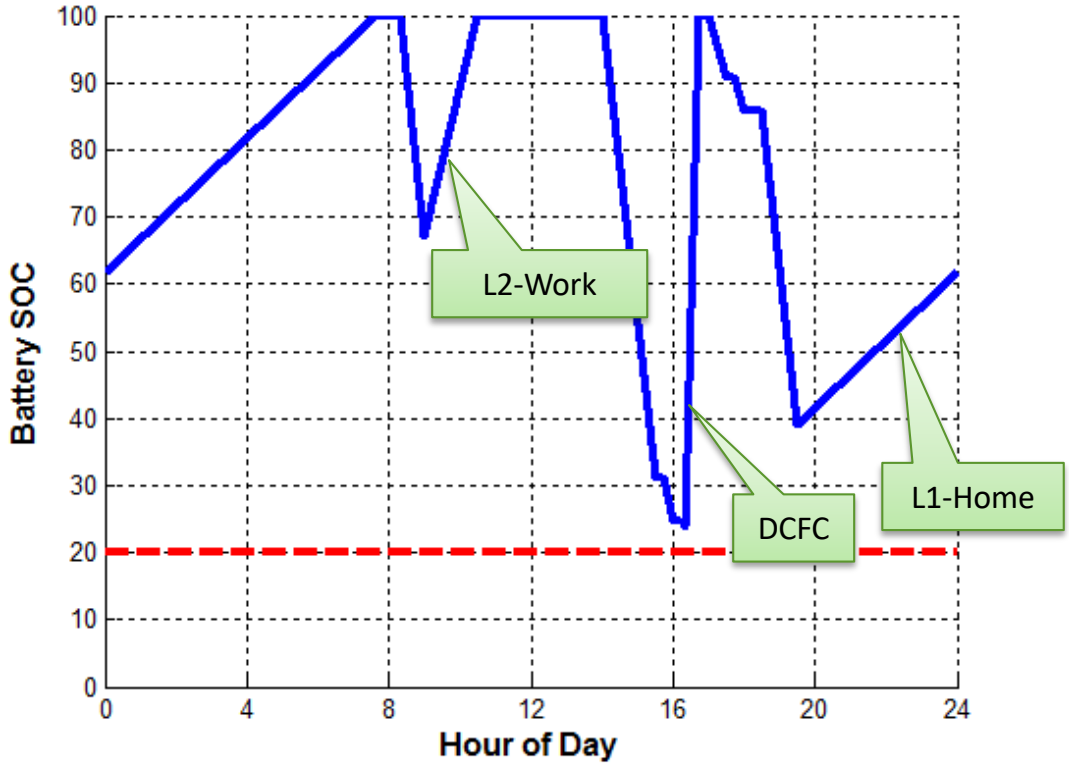
12 months of trips (all of 2016)
All trips intersecting Columbus region
Driving mode imputed by INRIX trip engine

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

Driving/Charging Simulations

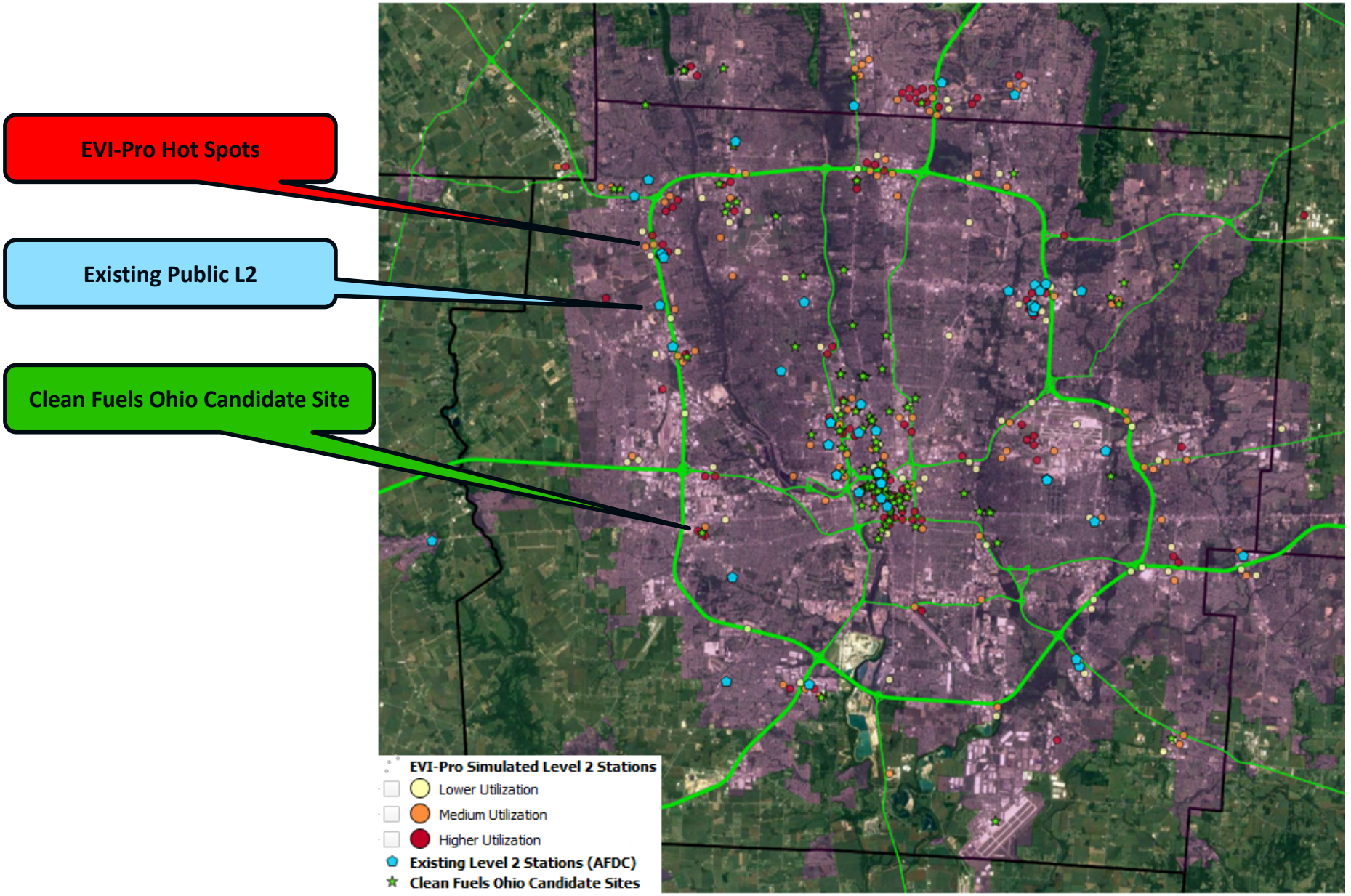
Destination	Departure	Arrival	Drive Miles	Dwell Hours	Simulated Charging
Work	8:20 AM	9:00 AM	32.8	5.00	L2
Non-Res	2:00 PM	3:30 PM	68.9	0.25	---
Non-Res	3:45 PM	4:00 PM	6.3	0.25	---
Non-Res	4:15 PM	4:20 PM	0.9	0.67	DCFC
Non-Res	5:00 PM	5:30 PM	9.2	0.25	---
Non-Res	5:45 PM	6:00 PM	5.0	0.50	---
Home	6:30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



Statewide Assessments in Massachusetts, Maryland, California, Colorado

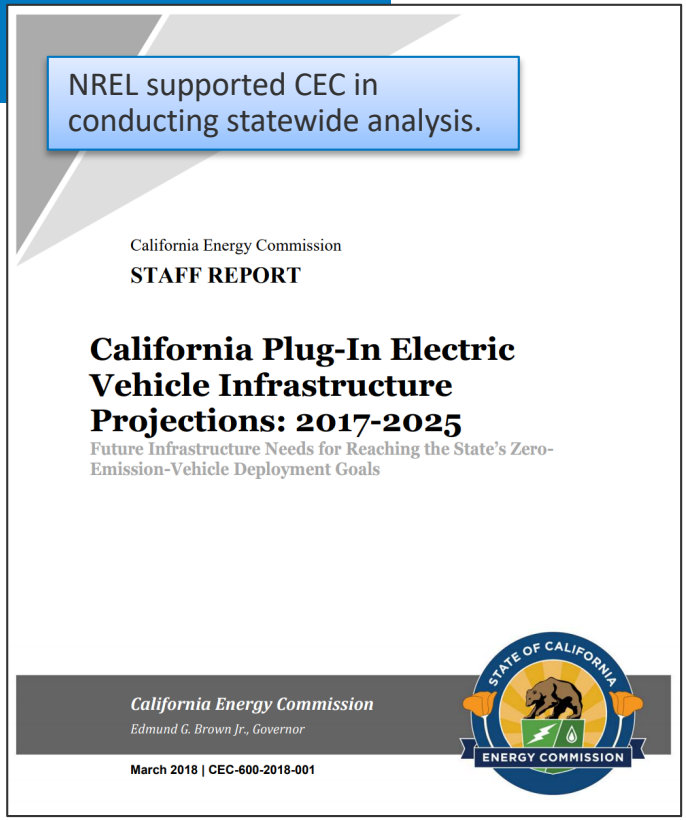
Objective: To provide guidance on PEV charging infrastructure requirements to regional stakeholders.

Approach: Superimpose existing regional driving data with simulated PEVs and identify work/public EVSE requirements that meet anticipated consumer demand.

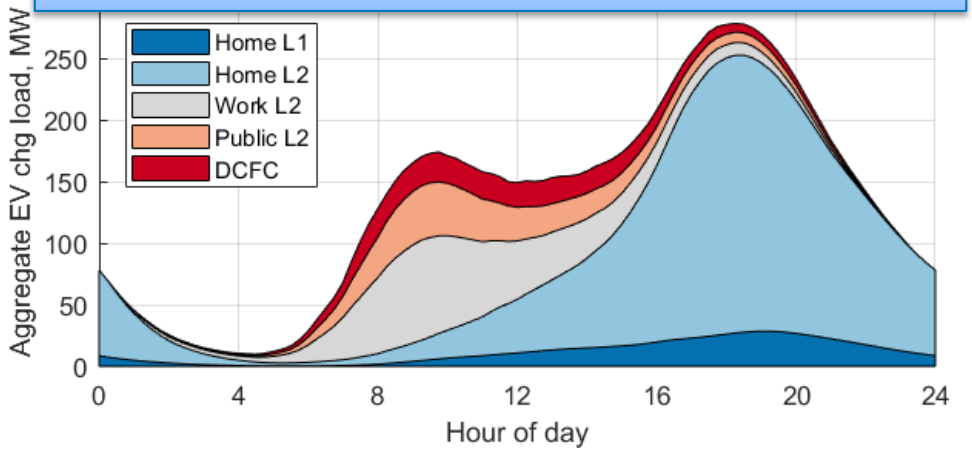
Significance & Impact

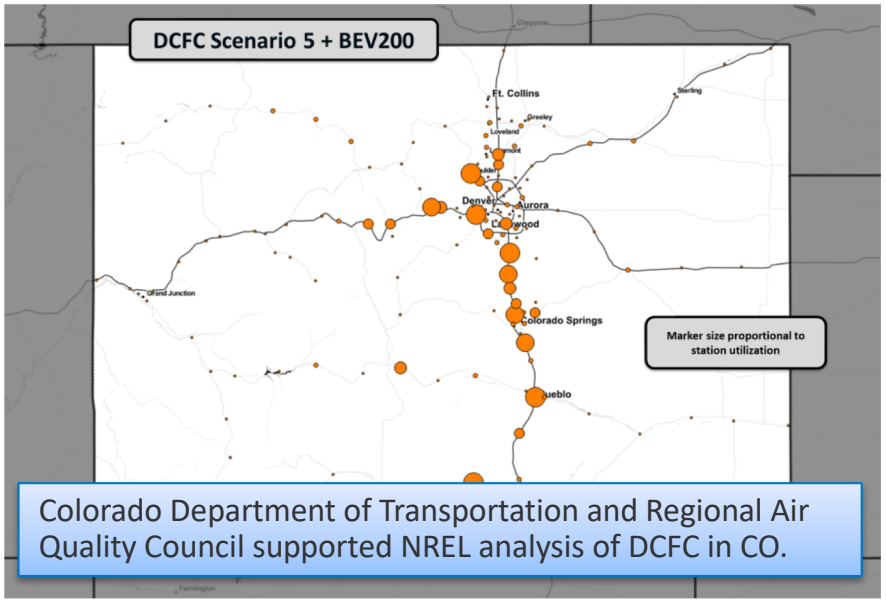
- State agencies in MA, MD, CA, and CO are using demand projections from EVI-Pro to assist in planning statewide EVSE growth supporting PEVs.
- Related organizations have inquired on the potential to run similar analysis in additional states.

NREL supported CEC in conducting statewide analysis.



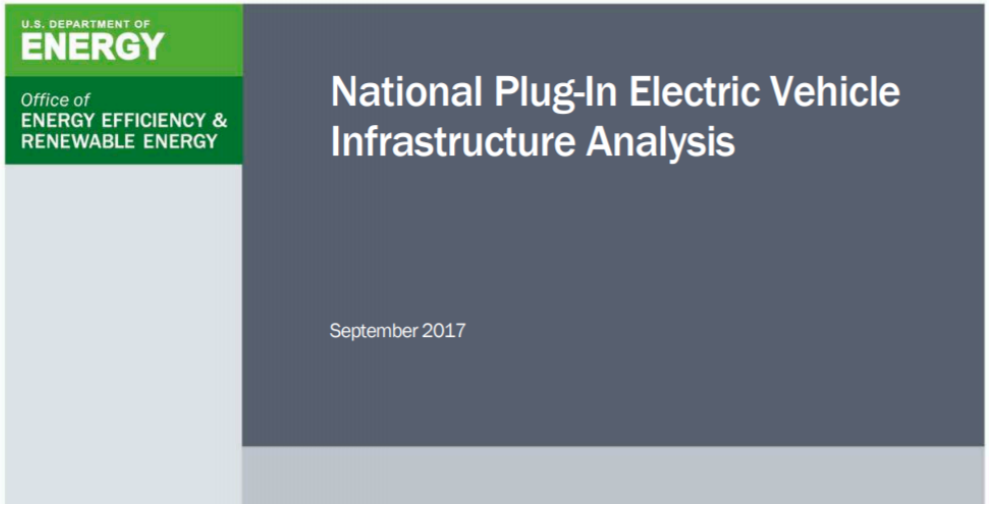
Potomac Electric and Maryland Public Service Commission supporting NREL analysis of EVSE requirements to meet ZEV goal.





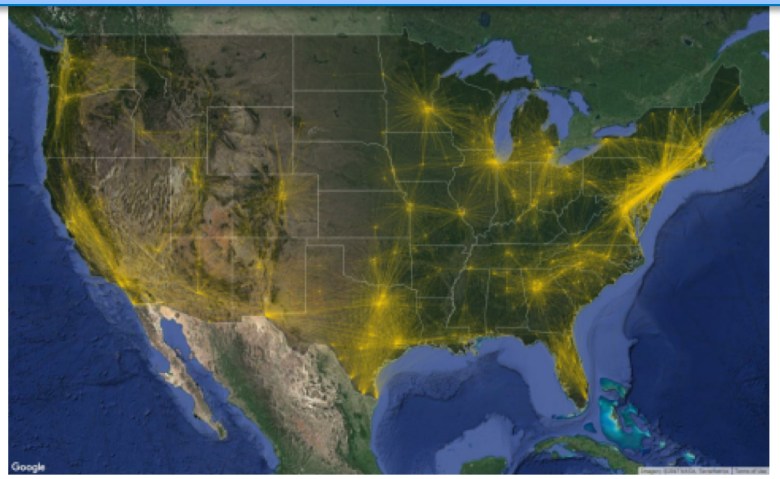
Colorado Department of Transportation and Regional Air Quality Council supported NREL analysis of DCFC in CO.

2017 National EVSE Analysis



National Long Distance Travel Data

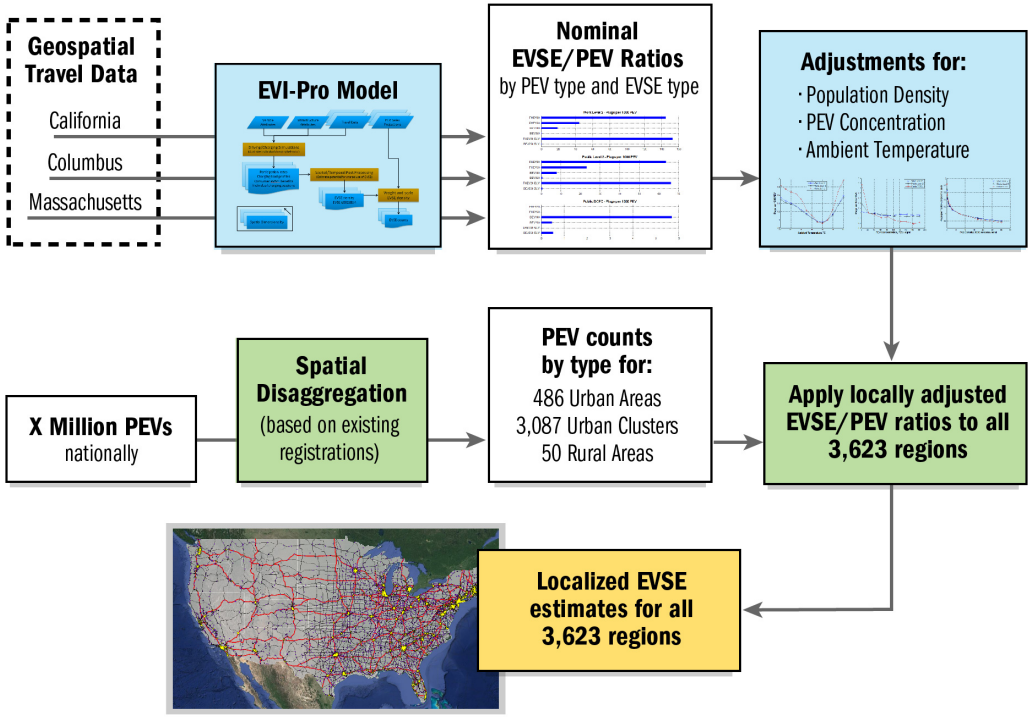
9M unique origin-destination (O/D) pairs from FHWA Traveler Analysis Framework



Regional analyses culminated in 2017 National PEV Infrastructure Analysis report.

Report methodology involved bottom-up EVSE estimates for 3,623 U.S. regions.

Estimates included non-residential L2 and DCFC plug counts by location type with sensitivity analysis conducted for a number of major input assumptions.



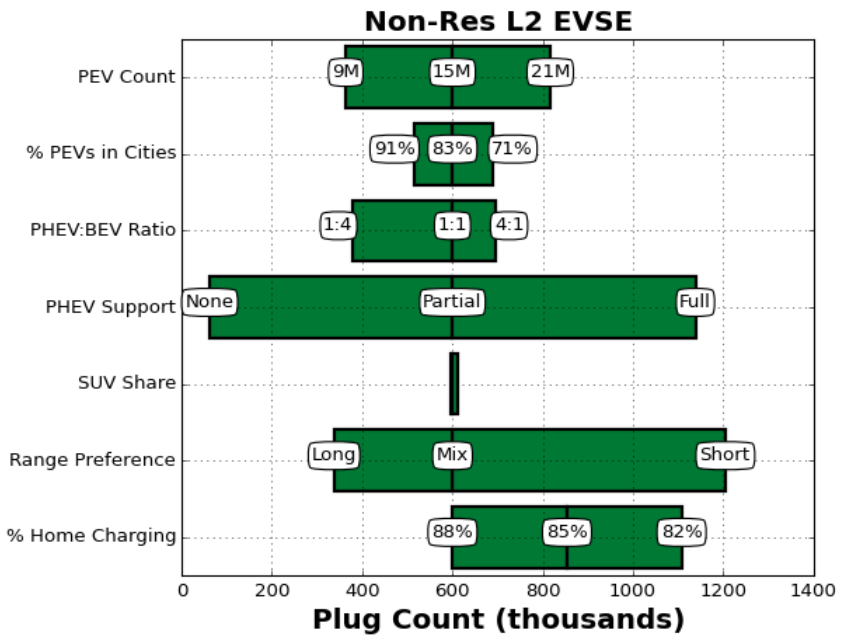
Results – Central Scenario & Sensitivity Analysis

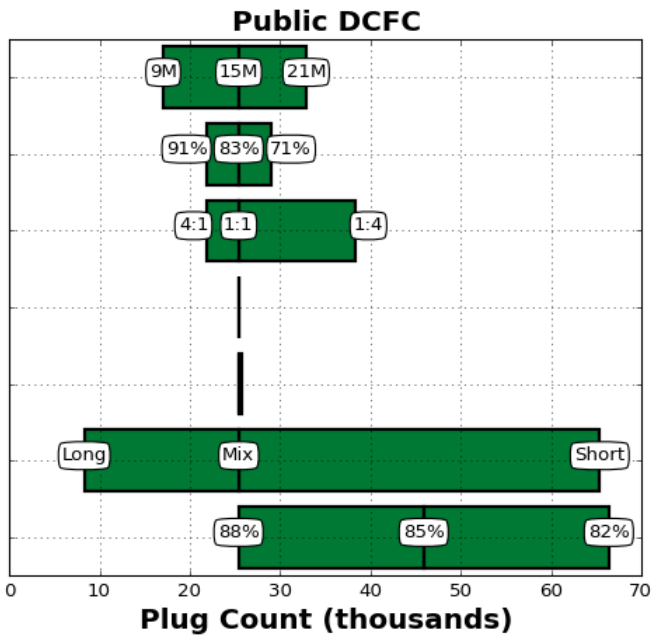
Central Scenario

		Cities	Towns	Rural Areas	Interstate Corridors
PEVs		12,411,000	1,848,000	642,000	---
DCFC	Stations (to provide coverage)	4,900	3,200	---	400
	Plugs (to meet demand)	19,000	4,000	2,000	2,500
	Plugs per station	3.9	1.3	---	6.3
	Plugs per 1,000 PEVs	1.5	2.2	3.1	---
Non-Res L2	Plugs (to meet demand)	451,000	99,000	51,000	---
	Plugs per 1,000 PEVs	36	54	79	---

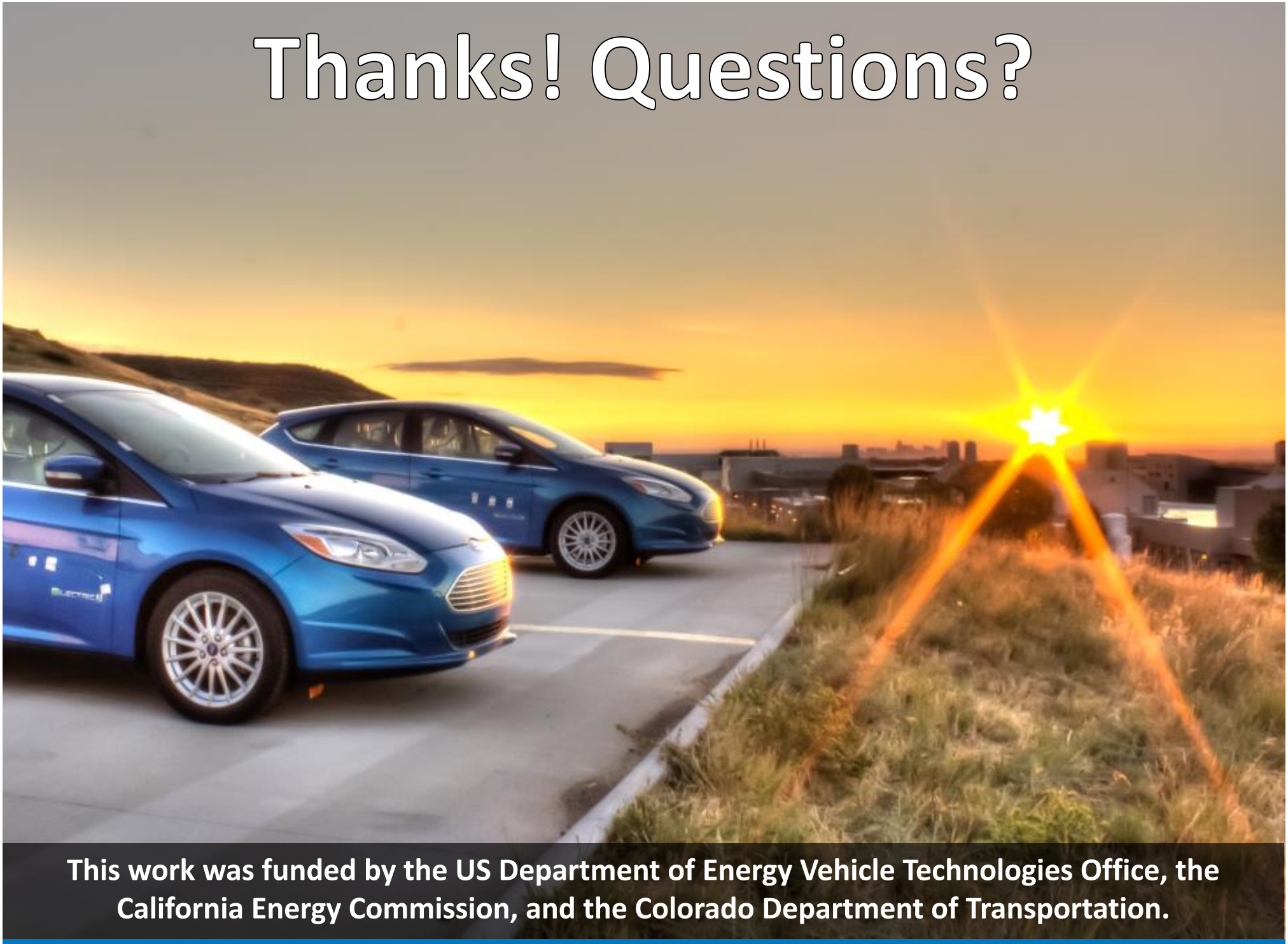
Estimated requirements for PEV charging infrastructure are heavily dependent on:
1) evolution of the PEV market, 2) consumer preferences, and 3) technology development

Sensitivity Analysis





Thanks! Questions?



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