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Enhancing the EVI-X National Framework to Address Emerging Questions on Charging Infrastructure Deployment

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National Renewable Energy Laboratory

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Project ID # VAN052

Overview

Timeline

- Project start: Nov 2022
- Project end: Sept 2025
- Percent complete: 15%

Budget

- Total project funding: $1.2M
  - DOE share: 100%
- Funding for FY22: zero
- Funding for FY23: $0.4M

Barriers

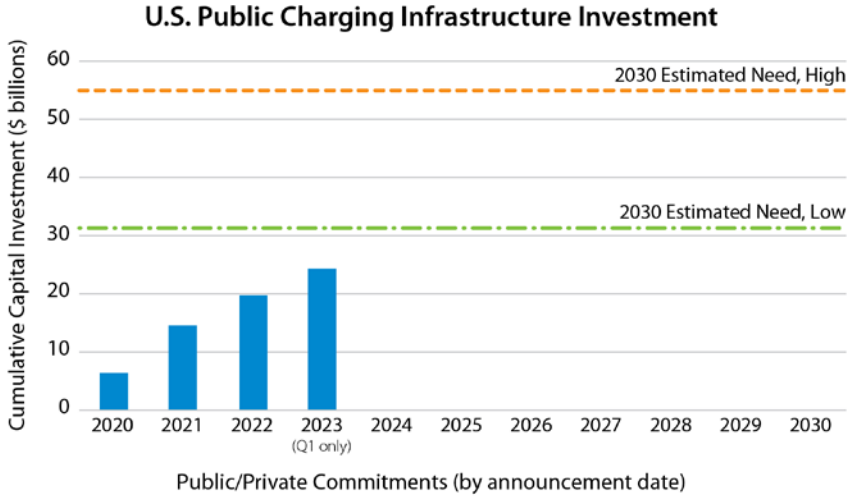
- Availability of EV charging infrastructure
- Financial viability of charging infrastructure owners/operators
- Grid planning to enable efficient infrastructure deployment

Partners

- California Energy Commission
- Electric Power Research Institute
- U.S. Environmental Protection Agency
- U.S. Joint Office of Energy and Transportation
- And others (see collaboration slide)

Significant Public/Private Investments Being Made in EVs & Charging Infrastructure

- An estimated $900B has been invested in transportation electrification globally
  - $220B in the U.S.
- Domestic investment in public charging infrastructure exceeds $24B (and counting)
  - $7.5B from Bipartisan Infrastructure Law
  - $3.0B in additional public funding
  - $11.2B in private investment
  - $2.7B in approved utility filings
- Capital raised by charging network companies and incentives from Inflation Reduction Act and Low Carbon Fuel Standards are expected to stimulate additional investment



*Estimates derived from tracking shared by Atlas Public Policy

**Estimated need from NREL 50x30 Report

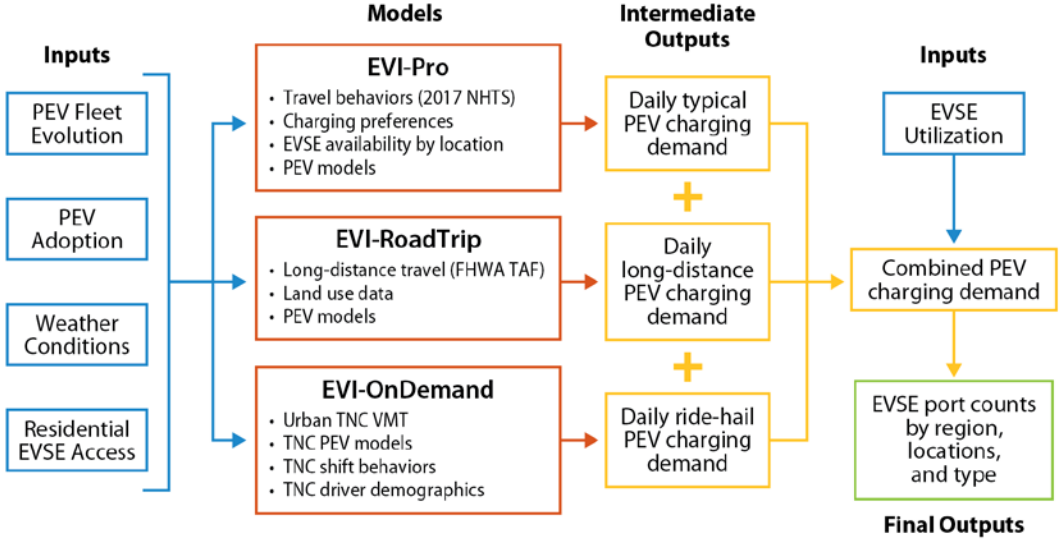
Deliverables Aim to Inform Decision Makers

Milestone	Date	Status
Financial case studies will be presented, leveraging discounted cash flow analysis to identify conditions where futureproofing NEVI sites (designing stations above minimum standards) ultimately provides net benefits, particularly to the station owner/operator and applicable public funding agencies.	March 2023	Complete
The team will present analysis findings on options for enabling affordable charging prices paid by DACs at federally funded public charging stations. This could include programs to subsidize the cost of installations, utility tariffs designed to improve public charging affordability, and innovative business models employed by site hosts.	Sept 2023	On-track

Leverage and Enhance Existing Resources

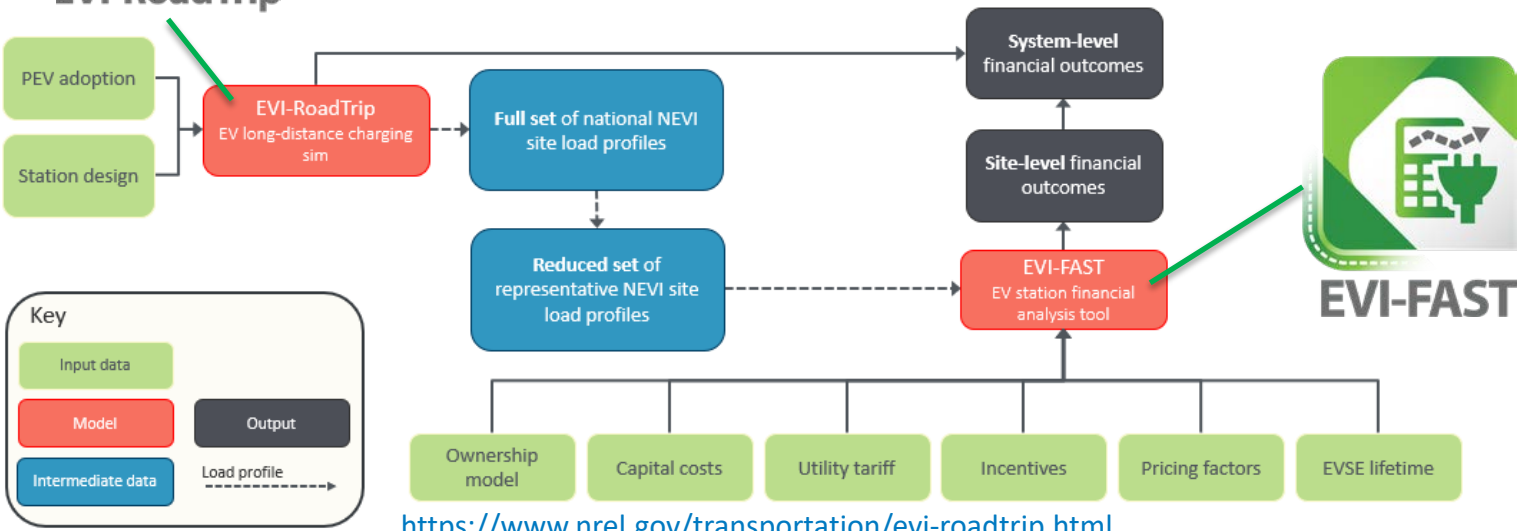
Approach 1

This project leverages the EVI-X national light-duty infrastructure framework (below) developed in the 50x30 report (right) to estimate charging needs of those without residential access, long-distance travel, and ride-hailing electrification



Leverage and Enhance Existing Resources

This project enhances the EVI-X national framework by coupling EVI-RoadTrip and EVI-FAST to evaluate the potential levelized cost of charging at rural, fast charging, corridor sites designed to support long-distance travel

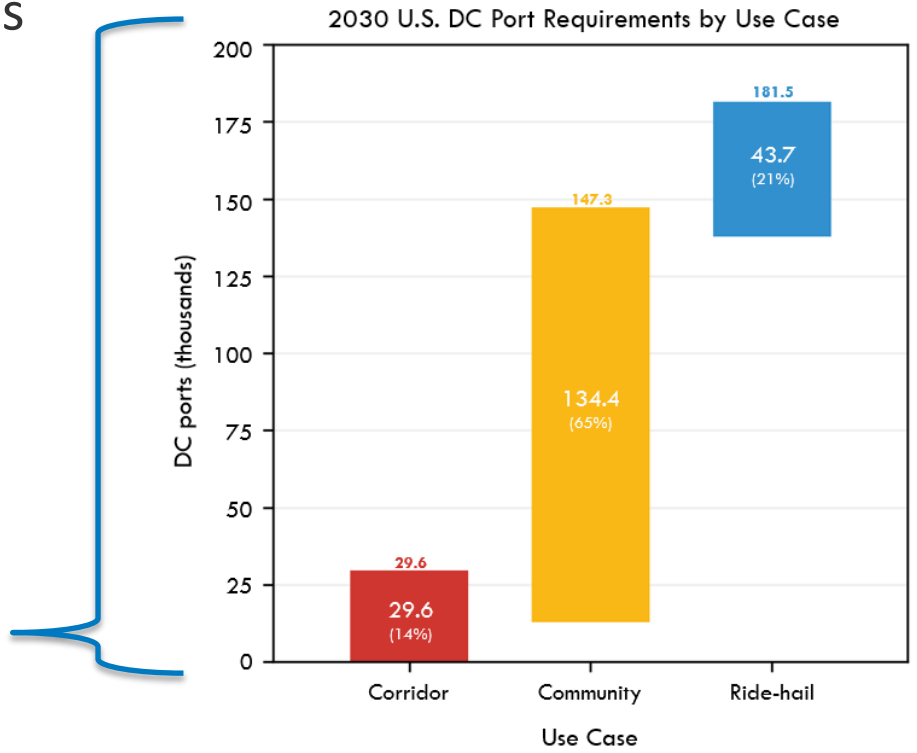


https://www.nrel.gov/transportation/evi-roadtrip.html
https://www.nrel.gov/transportation/evi-fast.html

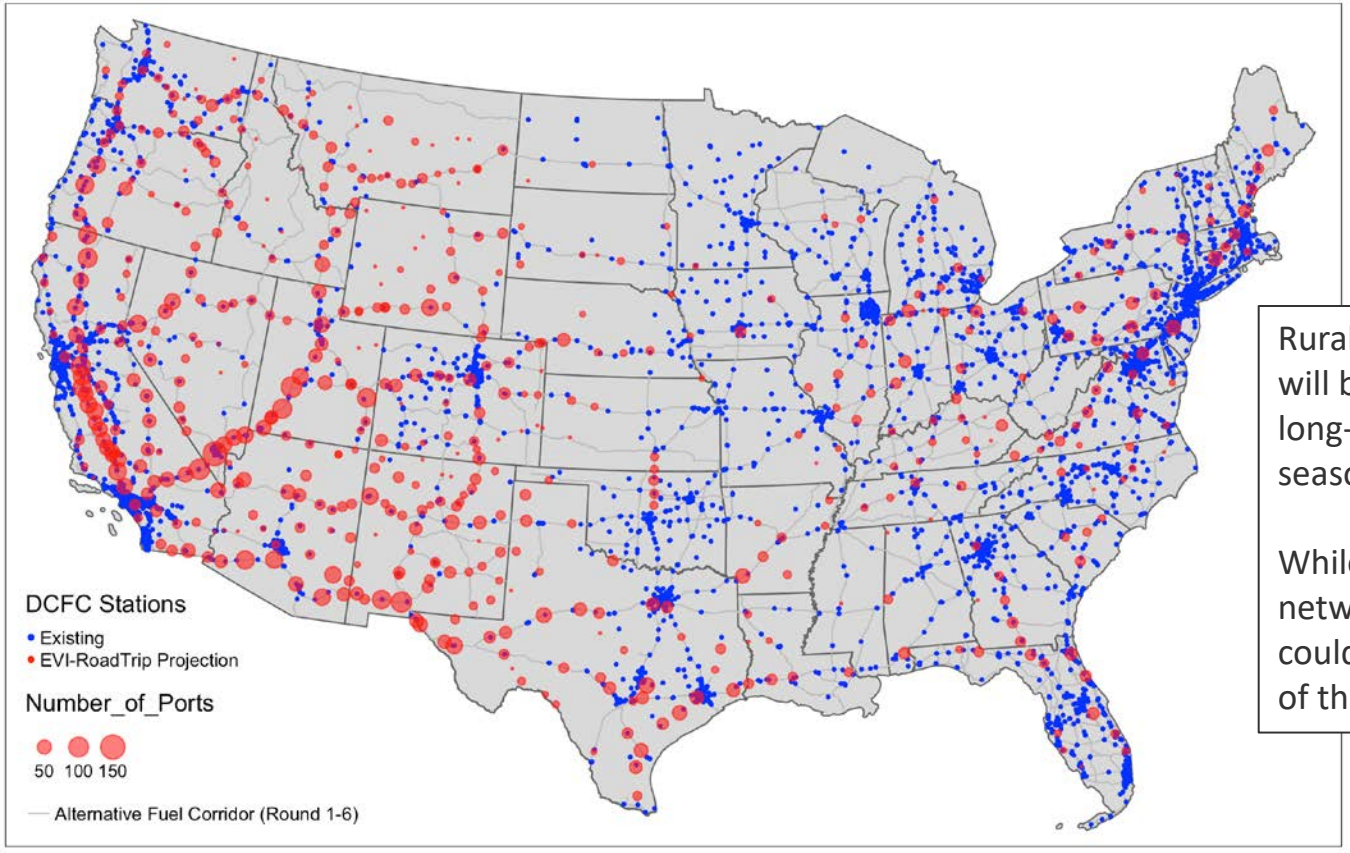
Rural Corridors Estimated as 10% of 2030 National Fast Charging Demand

EVI-X national simulation results suggest 18,000 DC ports could be necessary outside urban areas by 2030

Port (thousands)			
Public	1,248		
	Level 2	**1,067**	
	Neighborhood	305	
	Office	206	
	Retail	178	
	Healthcare	100	
	Recreational	84	
	Transport Hub	75	
	School	62	
	Com. Center	56	
	DC Fast	**182**	
	DC150	63	
	DC250	55	
	DC350+	64	



Half of Rural Corridor Stations Estimated to Experience Low Utilization in 2030



EVI-RoadTrip

Rural corridor fast charging stations will be necessary to support national long-distance trips during peak travel seasons

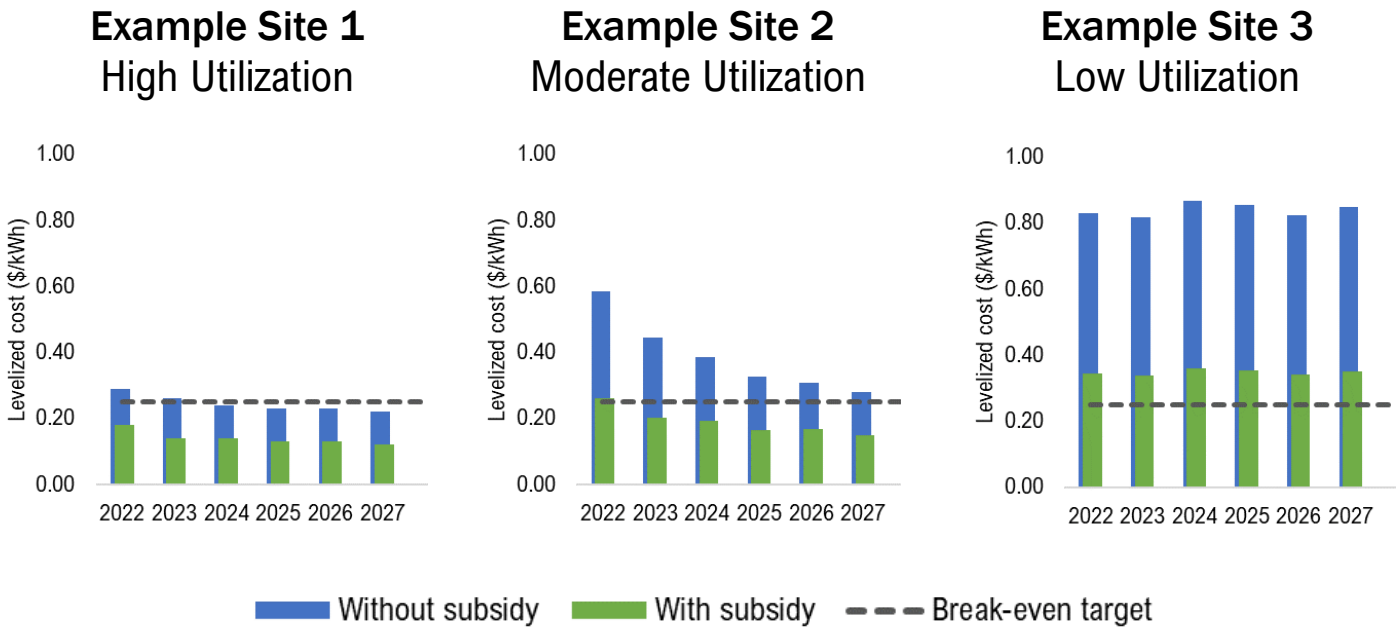
While critical to the national network, up to half of these stations could experience low utilization most of the year

Cost of Low Utilization Stations Could be Offset by High Utilization Locations

EVI-FAST

EVI-FAST was used to calculate the levelized cost of charging over a six-year period for three example demand profiles

Results are included with and without capital and operating subsidies to highlight the impact of financial incentives

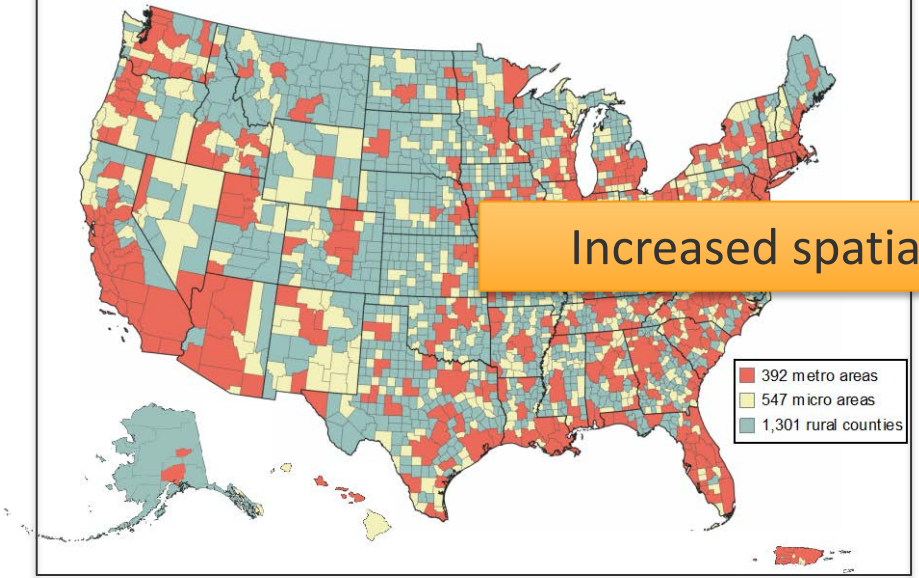


Break-even target is for illustrative purposes only.

Leverage and Enhance Existing Resources

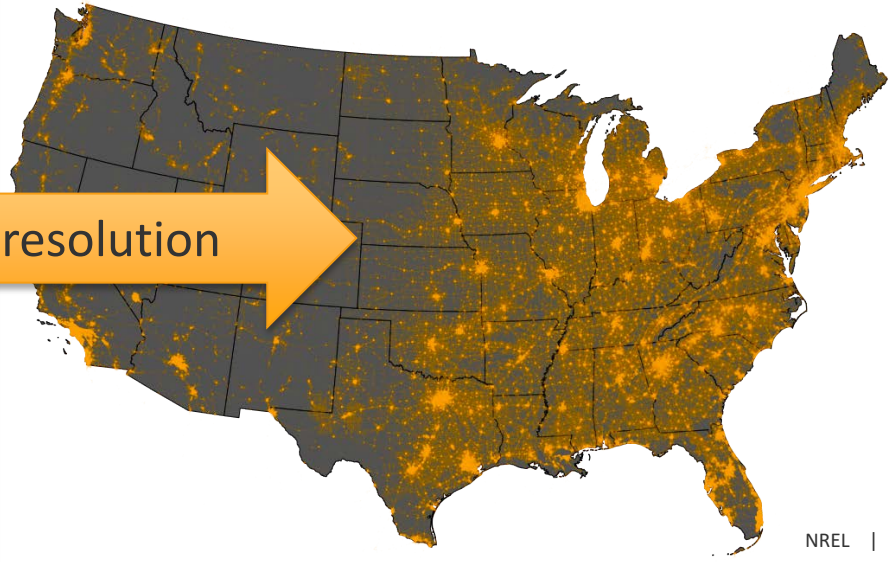
Approach 3

The EVI-X national framework provides infrastructure estimates at the resolution of core-based statistical areas (CBSAs) or counties



EVI-X is being enhanced using high resolution telematics data to disaggregate infrastructure demand within each CBSA/county

Increased spatial resolution

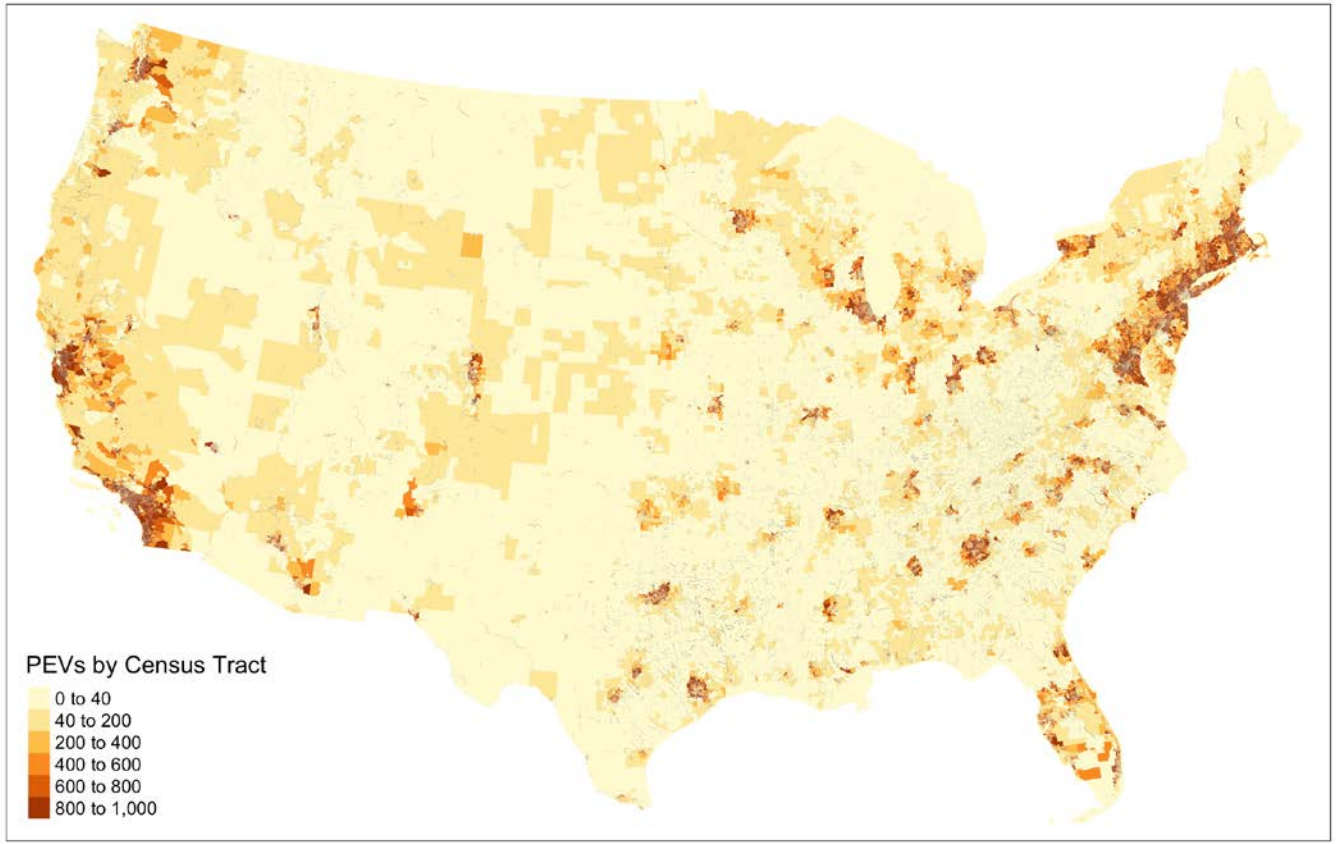


Increased Spatial Resolution Supports Utility Planning in Residential Neighborhoods

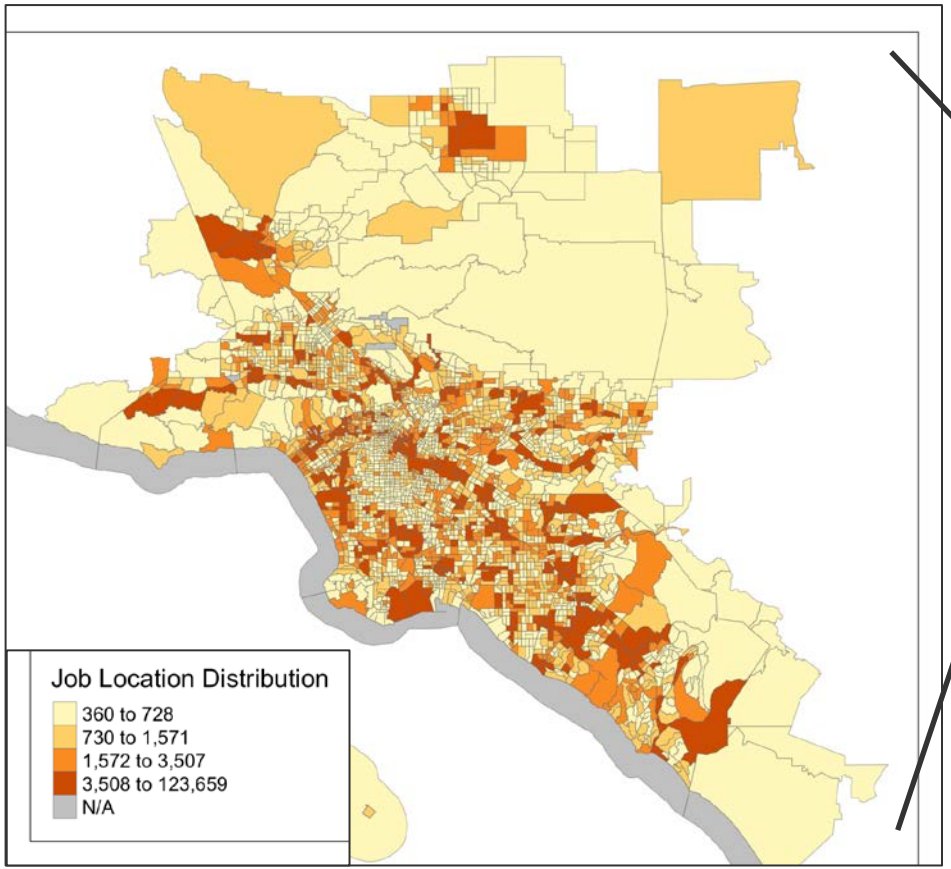
A likely adopter model is applied to each zone within the national framework to dissolve EV home locations at the tract-level

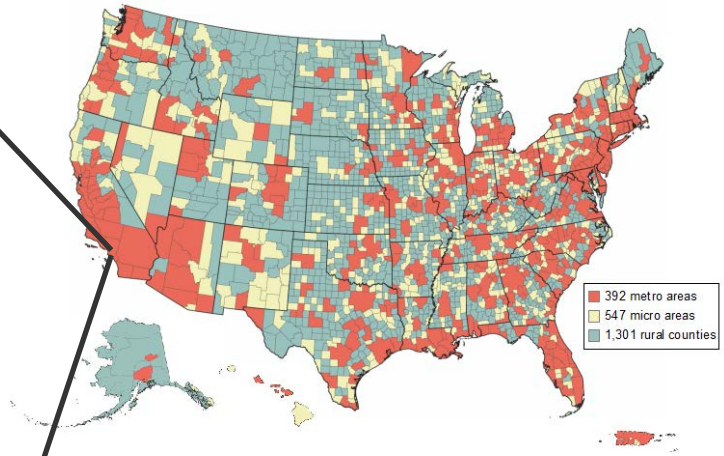
Spatial disaggregation includes estimates of those with and without access to residential charging

These estimates can be used by utilities to anticipate demand on distribution networks and make proactive investments to ensure reliable service to customers



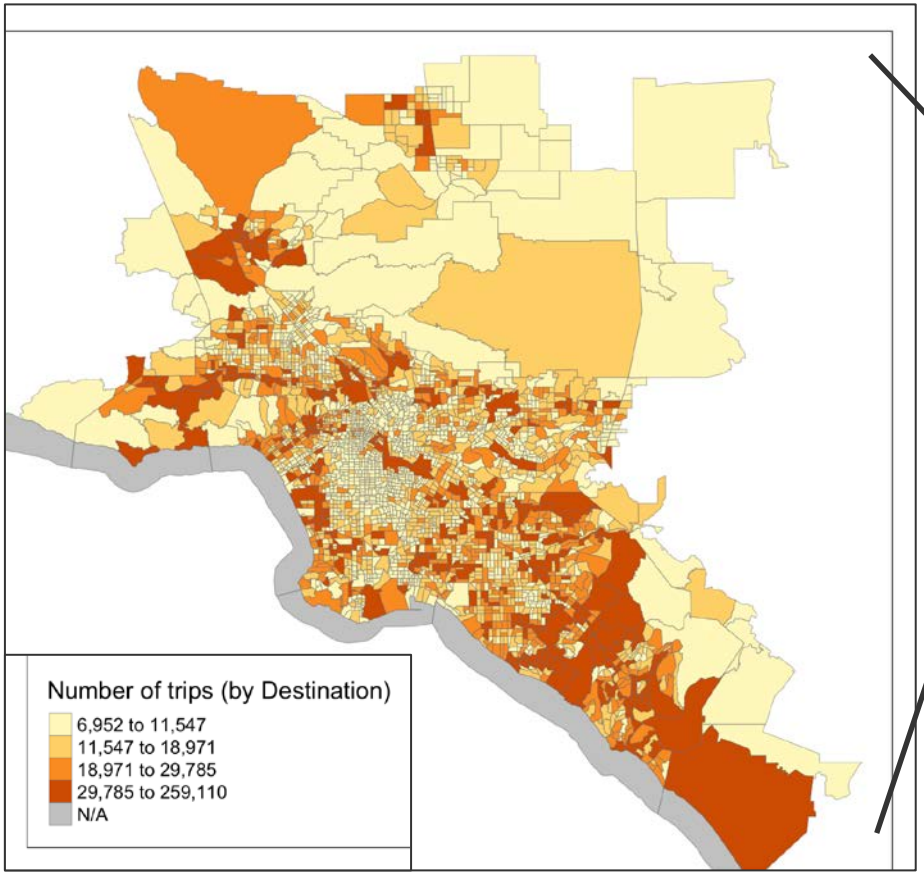
Census Data Used to Disaggregate Workplace Charging Demand

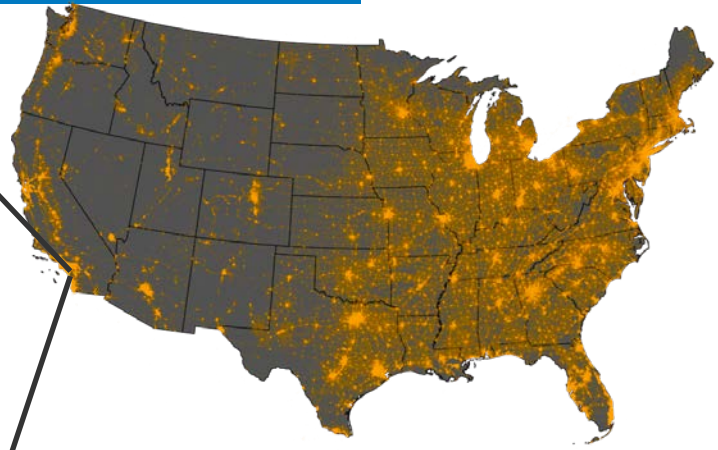




- Charging while at work (public and private access) is expected to be the dominant non-residential use case for Level 2 charging
- Longitudinal origin-destination data from the Census is being used to disaggregate simulated demand to the tract-level for all U.S. CBSAs
- Los Angeles example shown at left for illustration

National Telematics Data Used to Disaggregate Public Charging Demand





- 90% of the 2030-simulated fast charging demand is estimated within urban areas
- National telematics data from millions of devices is being used to disaggregate public charging demand (including community-based fast charging)
- Los Angeles example shown at left for illustration

Responses to Previous Year Reviewer Comments

- This project was not reviewed in FY22.

Collaboration and Coordination with Other Institutions

- This project has benefited from engagement with the following organizations:
  - California Energy Commission
  - Edison Electric Institute
  - Electric Power Research Institute
  - Environmental Resources Management
  - EVgo
  - General Motors
  - National Grid
  - New York State Department of Public Services
  - New York State Energy Research and Development Authority
  - Shell Recharge Solutions
  - Toyota Research Institute
  - Trillium
  - U.S. Department of Transportation
  - U.S. Environmental Protection Agency
  - U.S. Joint Office of Energy and Transportation

Remaining Challenges and Barriers

- **Intuitively communicating uncertainty:**
  - While there is inherit value in increased modeling resolution, it must be tempered by an understanding of uncertainty and communicated to stakeholders in an intuitive manner.

- **Quantifying interplay between LDV and M/HDV infrastructure:**
  - EV charging infrastructure can be a significant capital investment that could benefit from dual utilization across LDV and M/HDV segments. Vehicle needs and interoperability of charging infrastructure for these segments remain uncertain.

- **Vehicle-grid integration:**
  - Efficient deployment of charging infrastructure requires proactive utility planning to enable timely service requests. As the scale of charging deployments accelerate, the team will need to identify avenues to disseminate results to all stakeholders (especially utilities) to support efficient planning/deployment.

Proposed Future Work

- Refine financial analysis
  - Explore additional scenarios for corridor charging demand in rural areas
  - Sweep EVI-FAST parameters beyond representative value presented (right)
- Increase spatial resolution
  - Validate results using present-day networks
  - Determine appropriate level of spatial resolution for balancing precision and uncertainty
- Continue to engage with industry stakeholders and adapt project plan accordingly

EVI-FAST Independent Variables:

EV adoption/EVSE utilization
Station design/sizing
Capital costs
EVSE ownership models
Utility tariffs
Distributed energy resources (DERs)
EVSE incentives
Profit margin
Maximum EV charging price
EVSE lifetime

Any proposed future work is subject to change based on funding levels

Summary

Relevance

- Significant investments are being made in U.S. EV charging infrastructure
  - >$5B private investment in 2023 Q1 alone
- Efficient deployment requires sophisticated planning

Approach

- Evaluate levelized cost of charging by integrating demand estimation and financial analysis
- Increase spatial resolution of national modeling using large, telematics datasets

Technical Accomplishments

- As many as 50% of rural fast charge stations are likely to experience low utilization through 2030
- Laid foundation for national utility planning tool with distribution-level resolution

Collaboration

- Multiple stakeholder groups have contributed to the overall research scope

Proposed Future Research

(subject to future funding)

- Refine financial analysis
- Increase spatial resolution
- Continue to engage with industry stakeholders and adapt project plan accordingly

Thanks! Questions?

www.nrel.gov

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