Advanced Smart Charging Infrastructure Planning Tool - ASCRIPT

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U.S. Department of ENERGY | Office of Electricity

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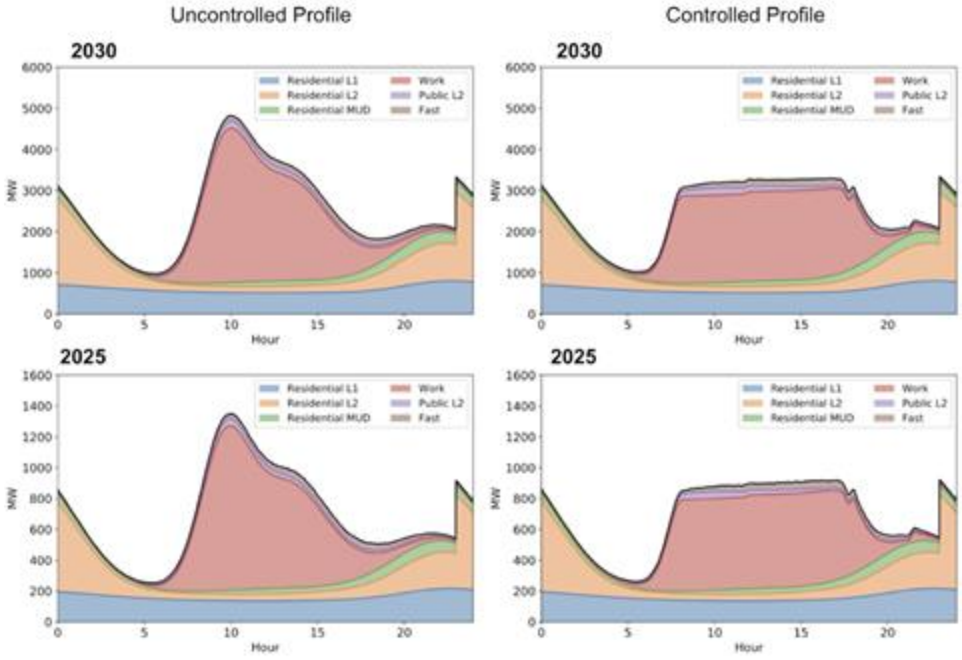
Background

- Load growth for EV charging is challenging utilities ability to meet demand
- Energy supply and peak power require additional assets
- Controlled charging can mitigate peak power impacts on system assets
- System planning requires tools that can locate system impacts
- Allows trade-off of investments in controls with investments in assets



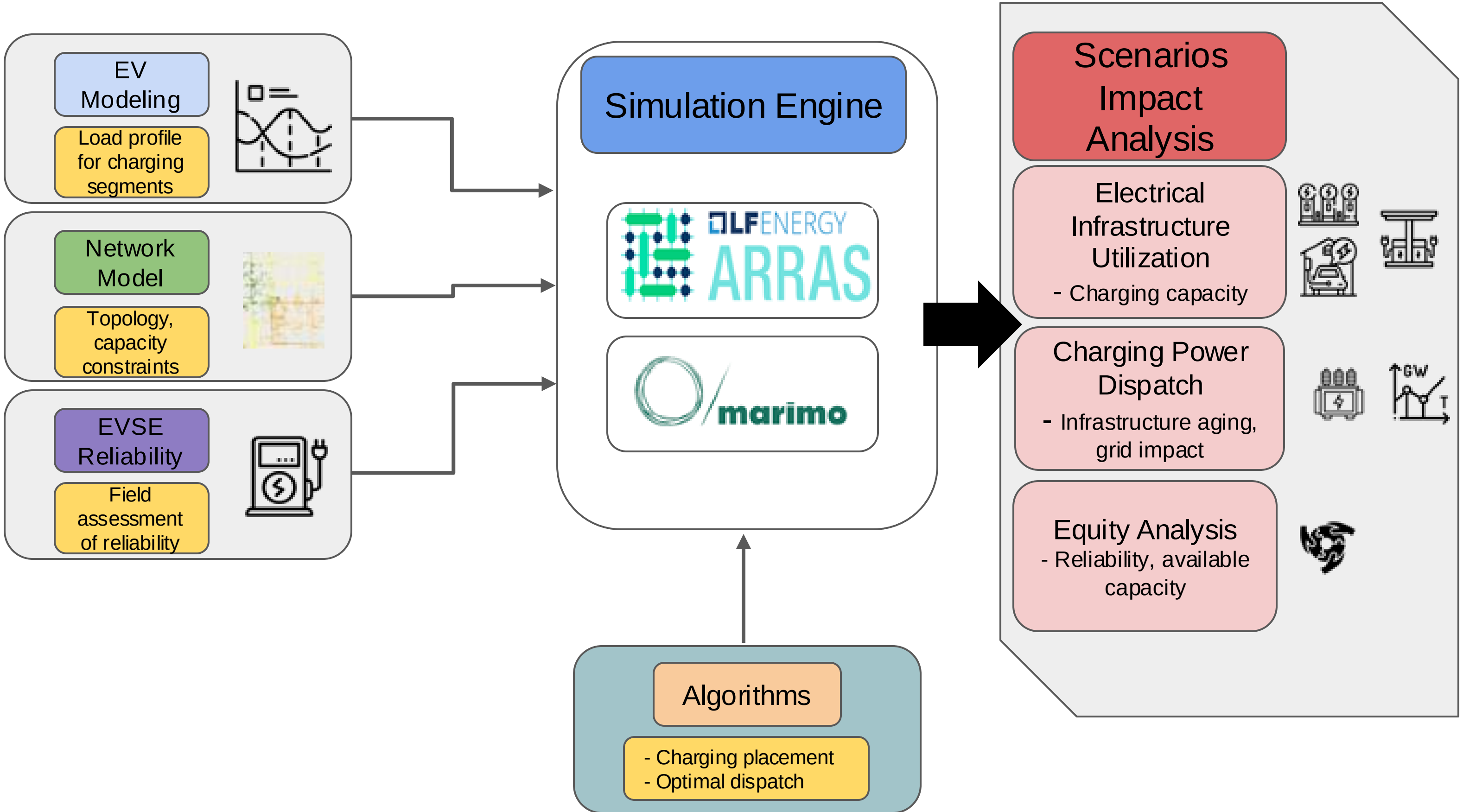
Objective

SLAC

Scenario-based impact analysis tool:

- Build a data-driven understanding of EV demand (both location and size)
- Identify impacts of significantly expanded charging infrastructure
- Provide easy-to-use user interface to SPEECH model, including
  - National-scale, high-resolution, detailed break-down of existing and planned charging assets
  - Integration with distribution network simulations to identify "hot-spots"
  - Integration of charging control strategies to mitigate load growth impacts on networks
- Support outreach to utilities and researchers

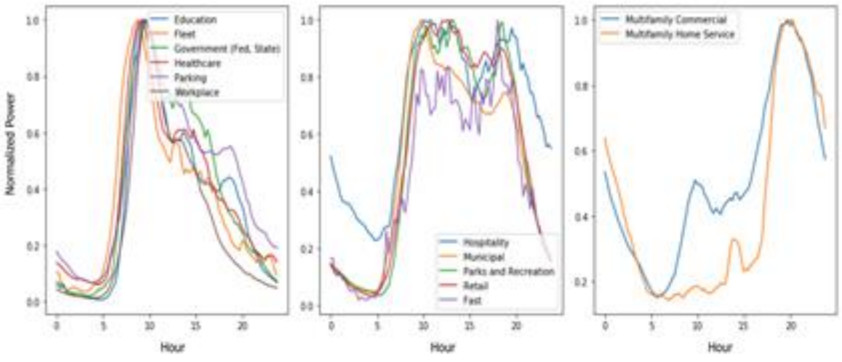
Approach



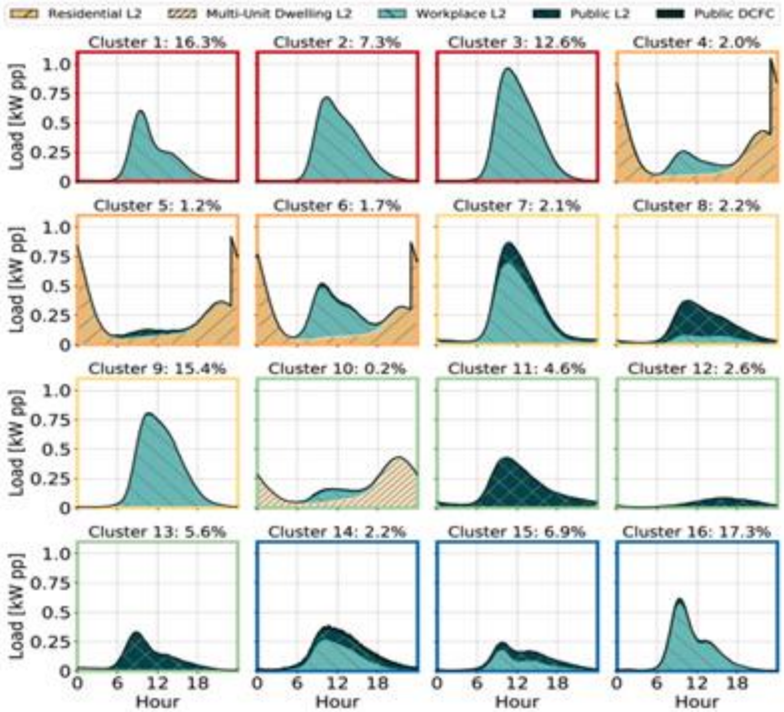
EV Modeling
Load profile for charging segments
Network Model
Topology, capacity constraints
EVSE Reliability
Field assessment of reliability
Simulation Engine
LF ENERGY
ARRAS
marimo
Algorithms
- Charging placement
- Optimal dispatch
Scenarios Impact Analysis
Electrical Infrastructure Utilization
- Charging capacity
Charging Power Dispatch
- Infrastructure aging, grid impact
GW
T
Equity Analysis
- Reliability, available capacity

EV Modeling (1)

- General Statistics
  - 6.09mn sessions: 4.2mn from workplace, 521k residential single family, 148k multifamily, remaining from retail and public
  - 119k unique drivers in 9 counties

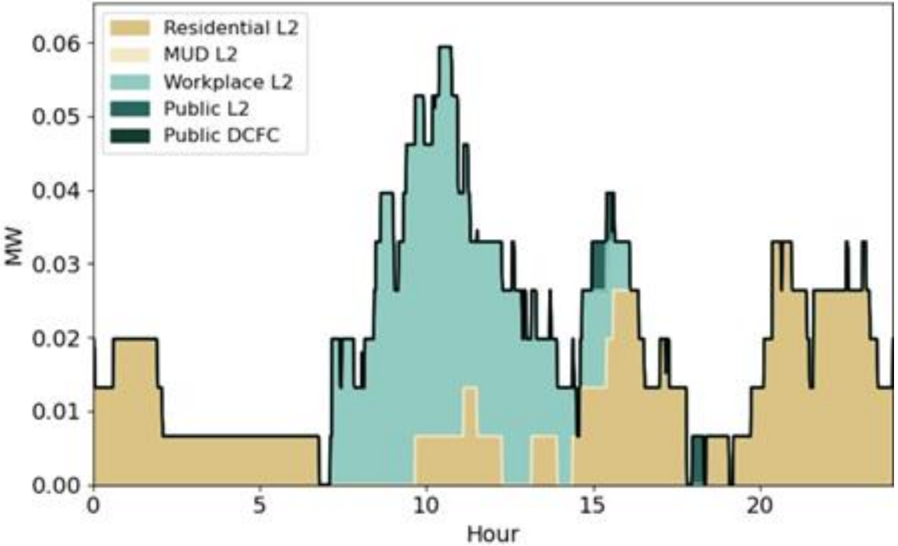


Clustered Segments

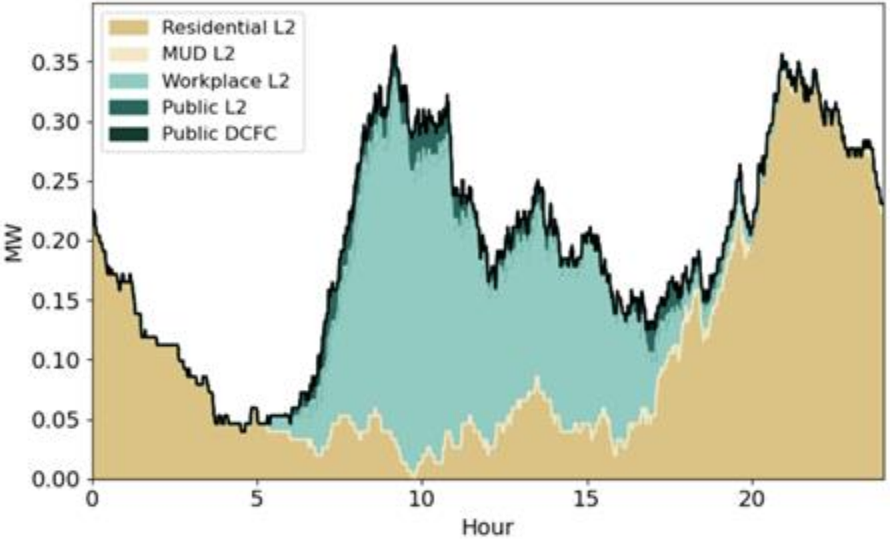


**"Scalable probabilistic estimates of electric vehicle charging given observed driver behavior"; Powell, Cezar and Rajagopal; Applied Energy, 2022*

EV Modeling (2)



Total EVs: 100
50% sessions happening exclusively in workplace, 50% happening residential+public



Total EVs: 1000
50% sessions happening exclusively in workplace, 50% happening residential+public

sg2t 0.1.1

```
pip install sg2t
```

Algorithms

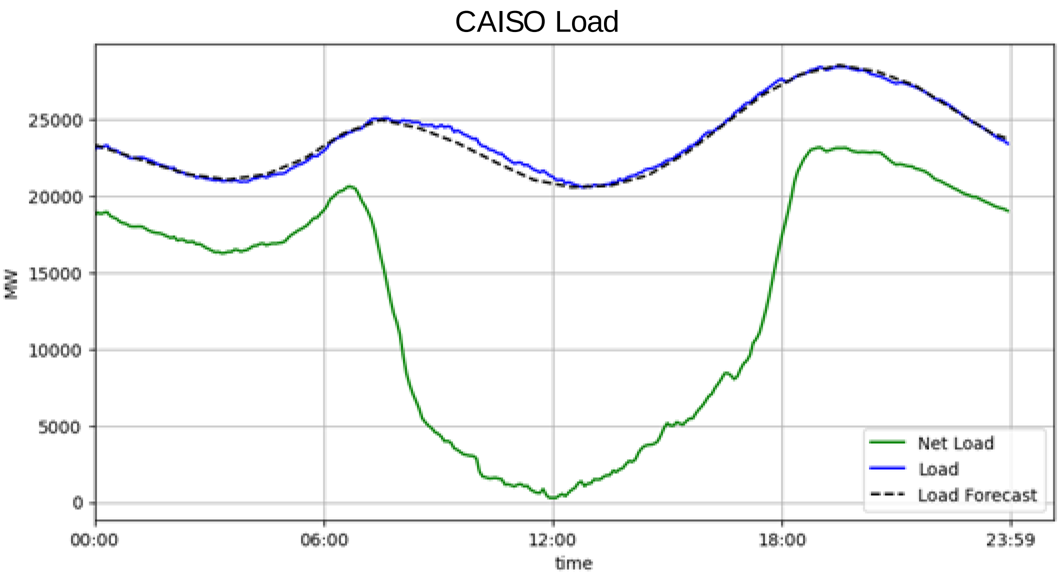
Two problems

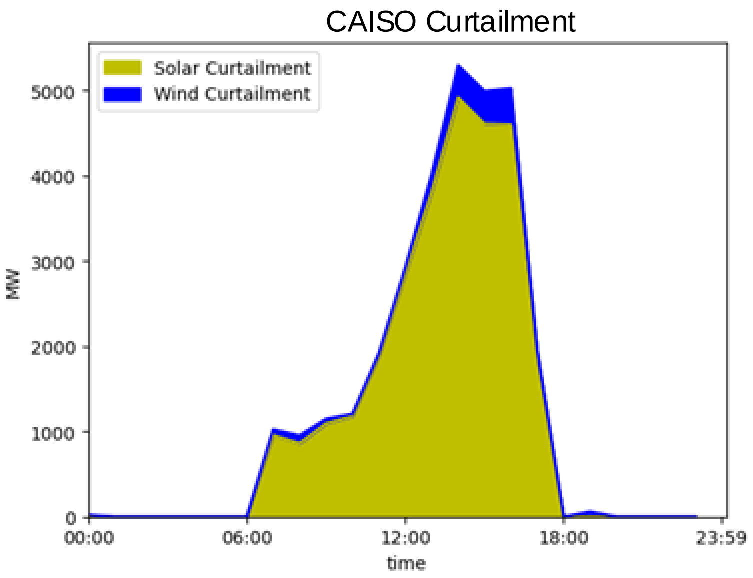
1. Charging placement problem (long term infrastructure investment problem)
   What is the total charging capacity at each node that maximizes utilization of the existing electrical infrastructure?
2. Optimal dispatch (near term infrastructure utilization problem)
   What is the dispatch of charging power that minimizes degradation of the existing electrical infrastructure?

Algorithms (2)

Charging placement problem (long term infrastructure investment problem)

Charging placement heuristics implemented in Arras Energy as a function of available grid capacity and location.

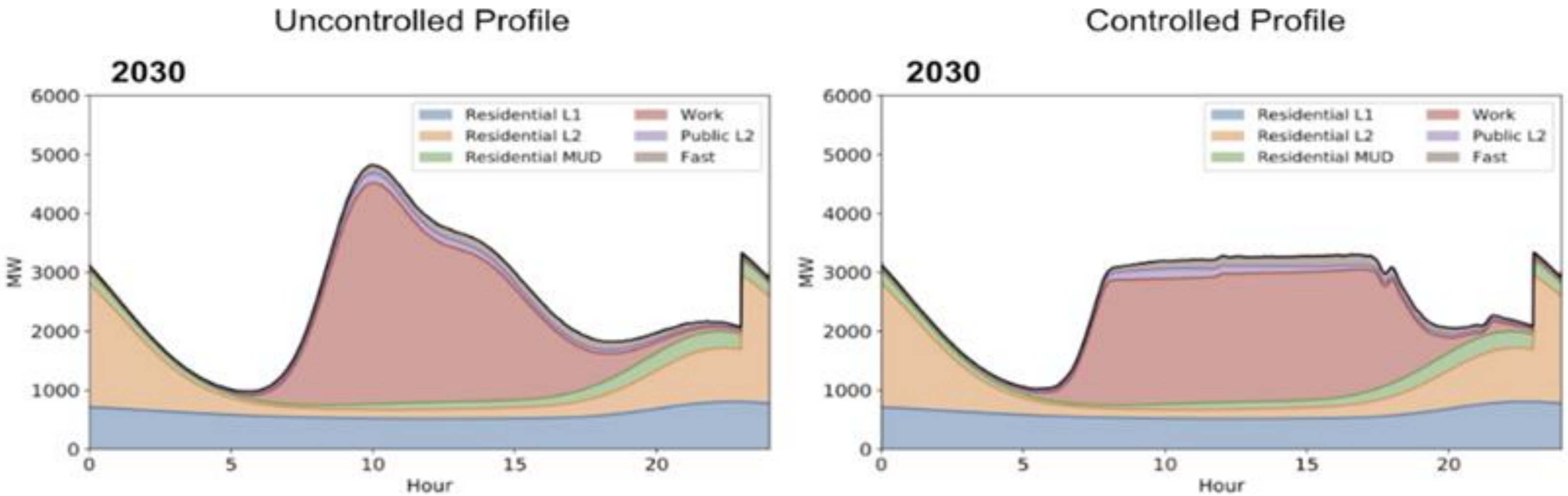




Algorithms (3)

Optimal dispatch (near term infrastructure utilization problem)

What is the dispatch of charging power that minimizes degradation of the existing electrical infrastructure?

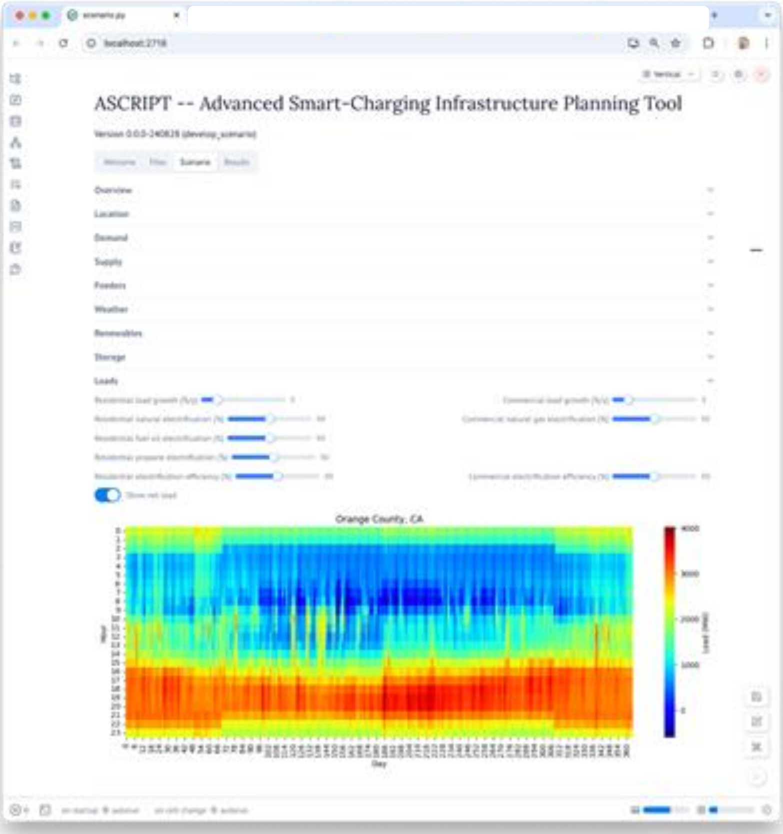


- Integrating CVX power flow solver in Arras Energy
  - This capability enables GridLAB-D to run optimal power flow solvers, to include various objectives (cost, emissions, etc), and constraints (limits on transformer, feeders etc).

Assess Impacts of Scenarios on Networks

Implement charging placement and dispatch solution in GridLAB-D

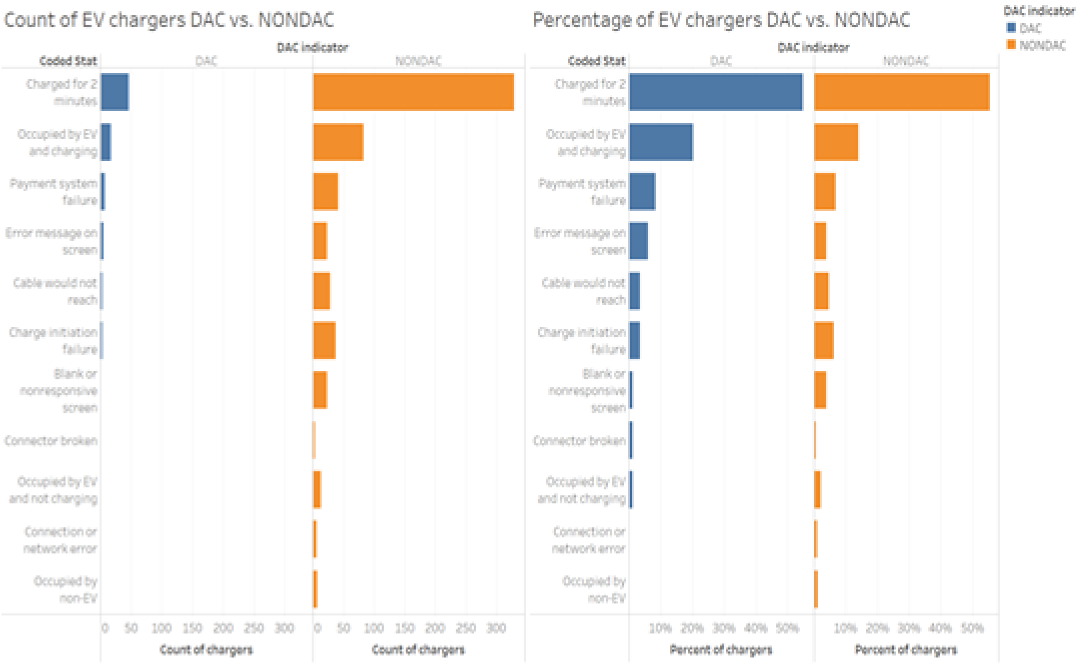
- Placement solution used to create GLM files of networks with EV chargers
- Dispatch solution run by GridLAB-D to study scenarios

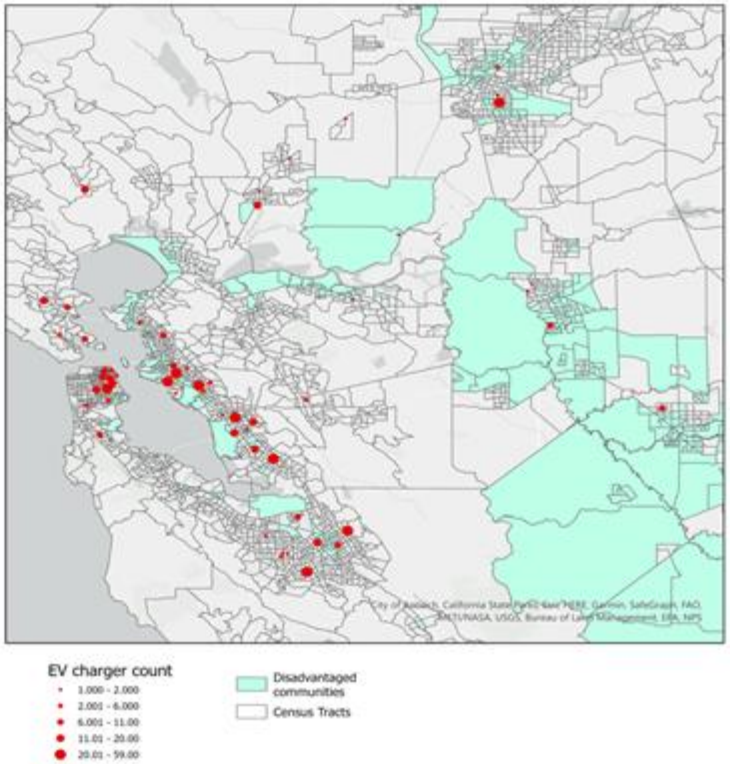


Equity Analysis

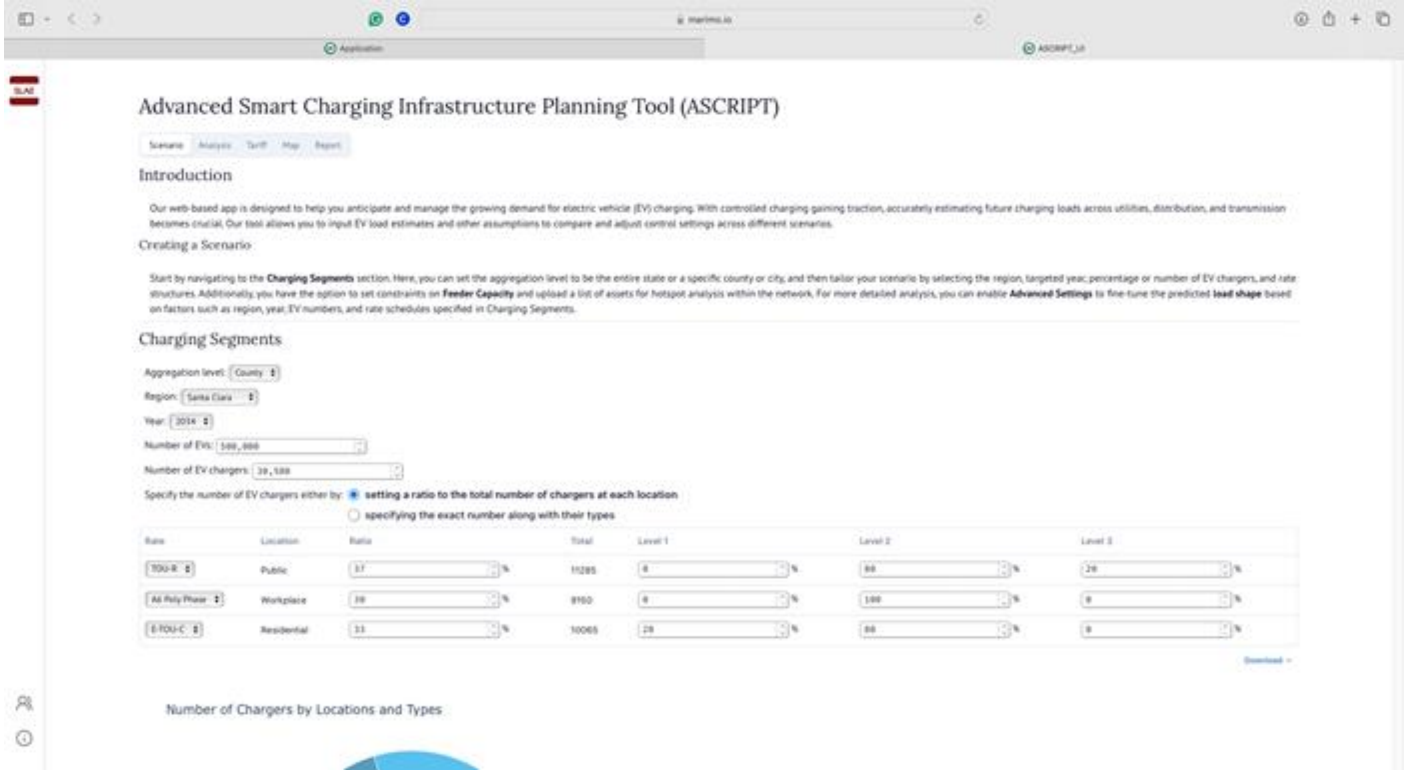
Protocol to answer questions about:

- Common causes of EVSE malfunction
- Distribution of EVSE

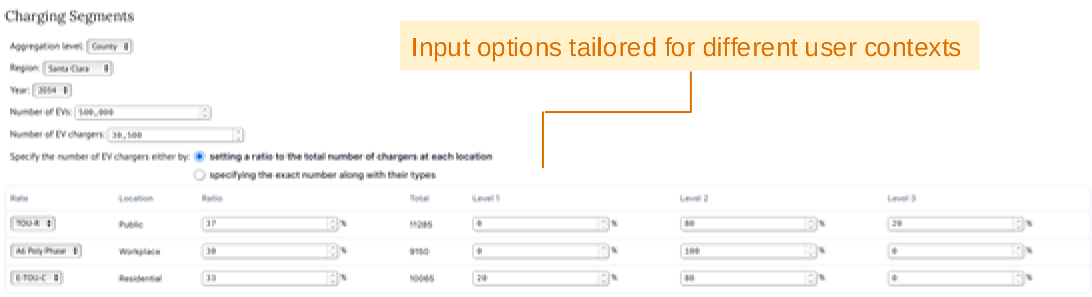




User Integration/Experience Design (1)



User Integration/Experience Design (2)



Input options tailored for different user contexts

Visualization of the number of EVs at different locations

User Integration/Experience Design (3)

Number of Chargers by Locations and Types

Feeder Capacity

Names (IDs):

Power constraint: 20 MW

Peak load: 110 %

Data Import: Upload Data (CSV/JSON) Reset

Distribution System | Meter

Feeder	Substation	Service transformer	Meter ID	Building ID	Building type	Charging infrastructure	Coordinates
object	object	object	object	object	object	object	object
unique: 1 nulls: 0	unique: 1 nulls: 0	unique: 1 nulls: 0	unique: 1 nulls: 0	unique: 1 nulls: 0	unique: 1 nulls: 0	unique: 1 nulls: 0	unique: 1 nulls: 0

Download

Thank you

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