



Electric Vehicle Grid Integration (EVGI)

Addressing EVGI Challenges: Modeling, Analysis, and Hardware Development

John Kisacikoglu, EVGI Team Lead
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CERV

EVGI Research Scope



Analysis

Charging behavior modeling, impact analysis



Equipment

Testing and Evaluation of DC EVSE and EVs.



Vehicle to X

Smart charging (V1G), Vehicle to grid (V2G) and Vehicle to building (V2B)



Storage

Integration of storage systems for High Power Charging



Charging Site

High-power charging site design and operation for LD, MD, and HD vehicles

EVs@Scale Lab Consortium

Smart Charge Management

Develop SCM and VGI strategies and tools suitable across transportation vocations

High Power Charging

Expand understanding of HPC characteristics and develop technologies to meet concentrated EV HPC demands and improve grid connectivity

Wireless Power Transfer

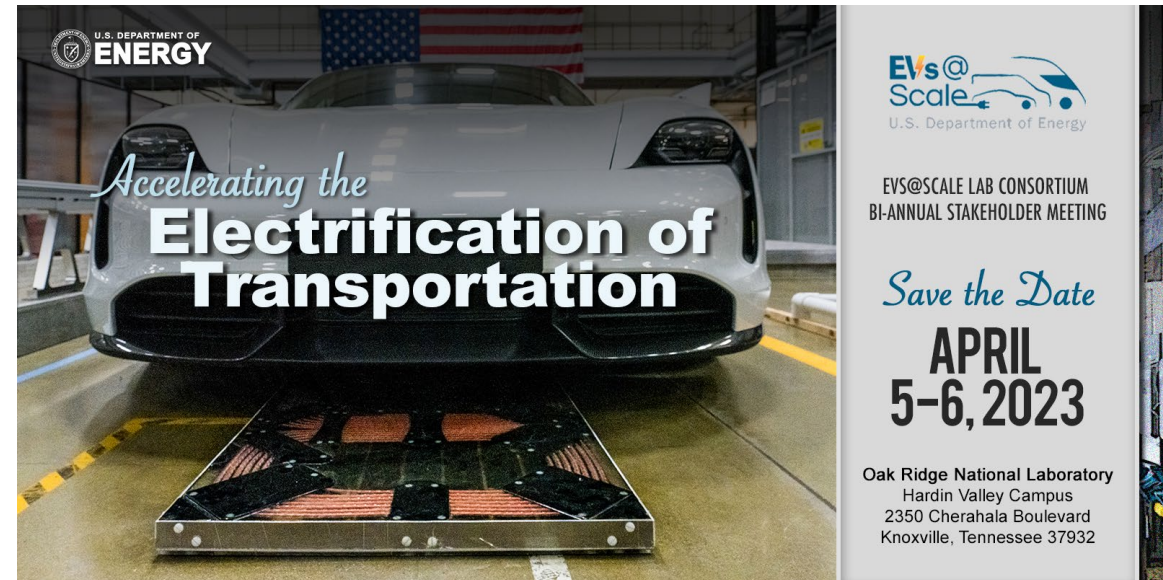
Develop and validate high-power dWPT from proof-of-concept to a practical roadway-integrated system

Cyber-Physical Security

Identify and address challenges to high-power charging security, safety, infrastructure and grid operations reliability, and consumer confidence

Codes and Standards

Address standards challenges for high-power EV charging, grid impacts, interoperability, and safety



EVs@Scale Consortium website:

<https://www.energy.gov/eere/vehicles/electric-vehicles-scale-consortium>

Charging Modeling Approach

- EV charging demand simulation to understand energy/power requirements and smart charge management opportunities
- Developing models/approaches for synthesizing spatially resolved EV travel and charging data for new regions and higher adoption levels (>50% EV penetration)

1. Trip Data Acquisition & Preprocessing

Representative LDV travel data for region(s) of study is joined with geographically determined locational characteristics obtained from multiple data sources.

2. EV Adoption Modeling

For a given analysis year (2040), assign PEVs to households by vehicle model (battery size, ECR, & max kW acceptance required for simulation).

3. Travel Itinerary Synthesis

Vehicle trips from data aggregators typically do not contain persistent vehicle identifiers enabling analysis of multi-trip travel itineraries. Thus, an approach for generating synthetic travel itineraries is leveraged.

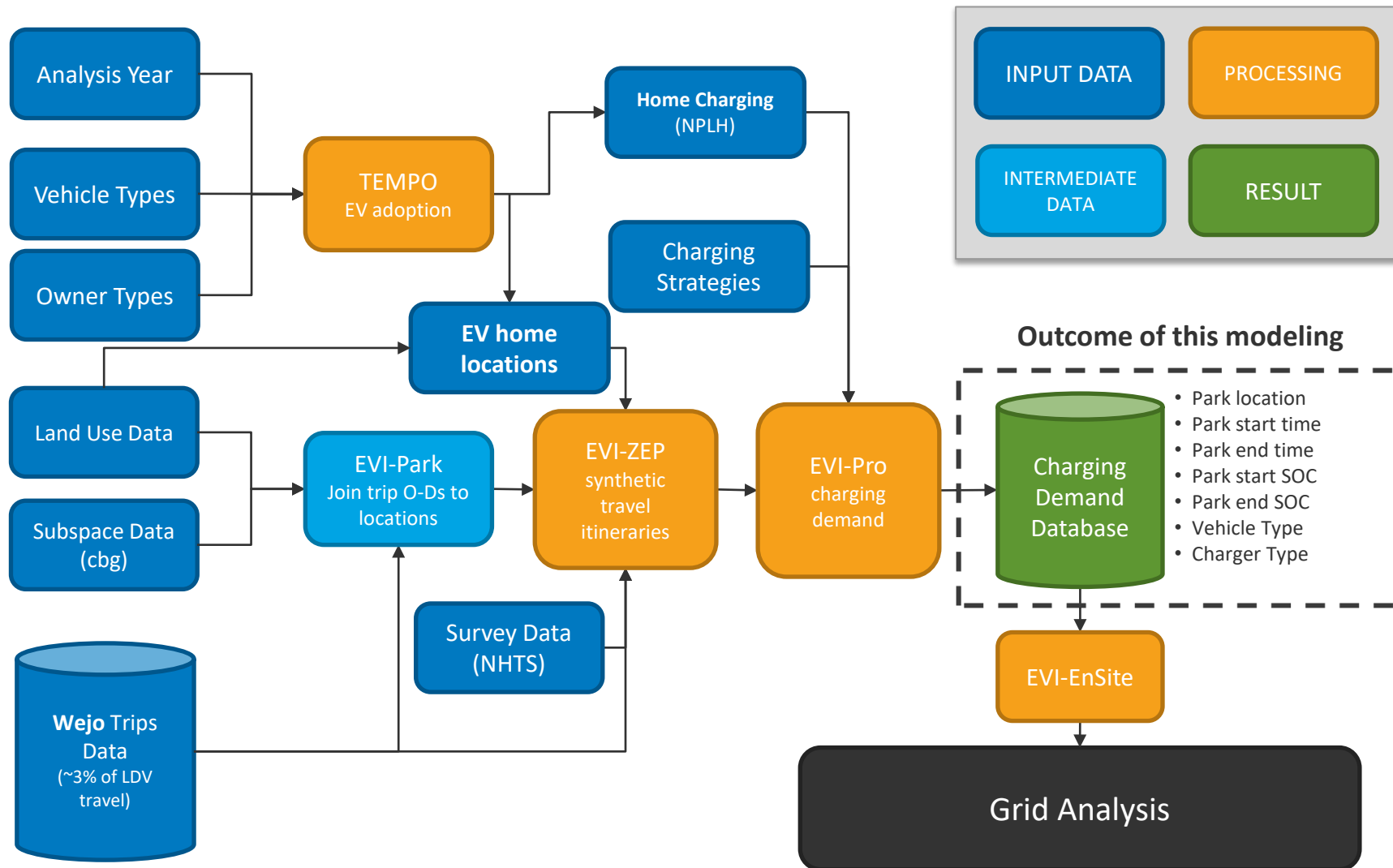
4. EV Charging Demand Simulation

EV charging is simulated for synthetic travel itineraries considering: 1) EV adoption assumptions; 2) charging behaviors and location-specific EVSE availability; 3) home charging access assumptions.

5. EV Load Profile Generation

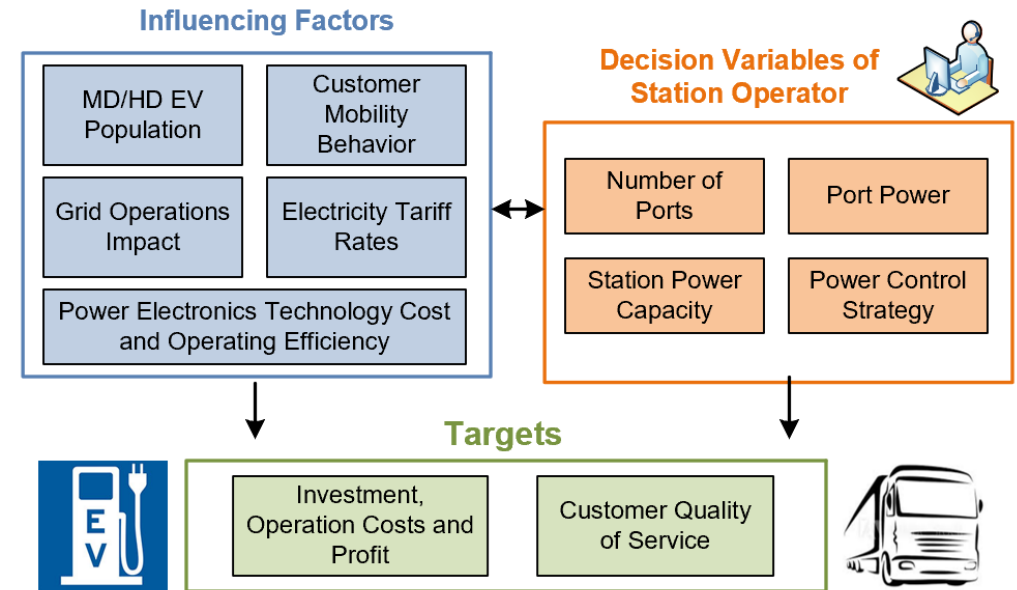
Charging demand for a given analysis year (2040) is assigned to specific locations (i.e., land parcels) by location type.

Modeling Framework



Optimization of Multi-port HPC Operation

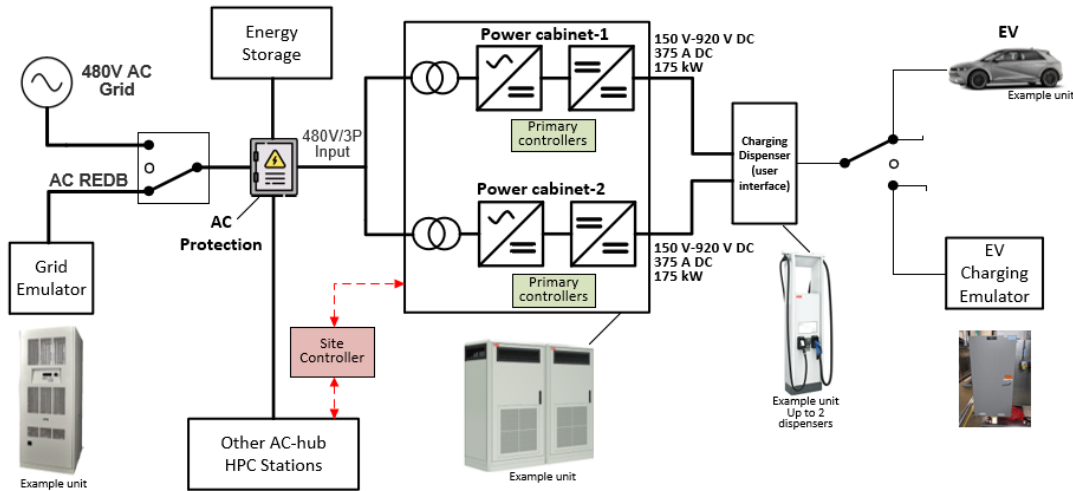
Electric Vehicle Infrastructure, Energy Estimation, and Site Optimization (EVI-EnSite) Tool



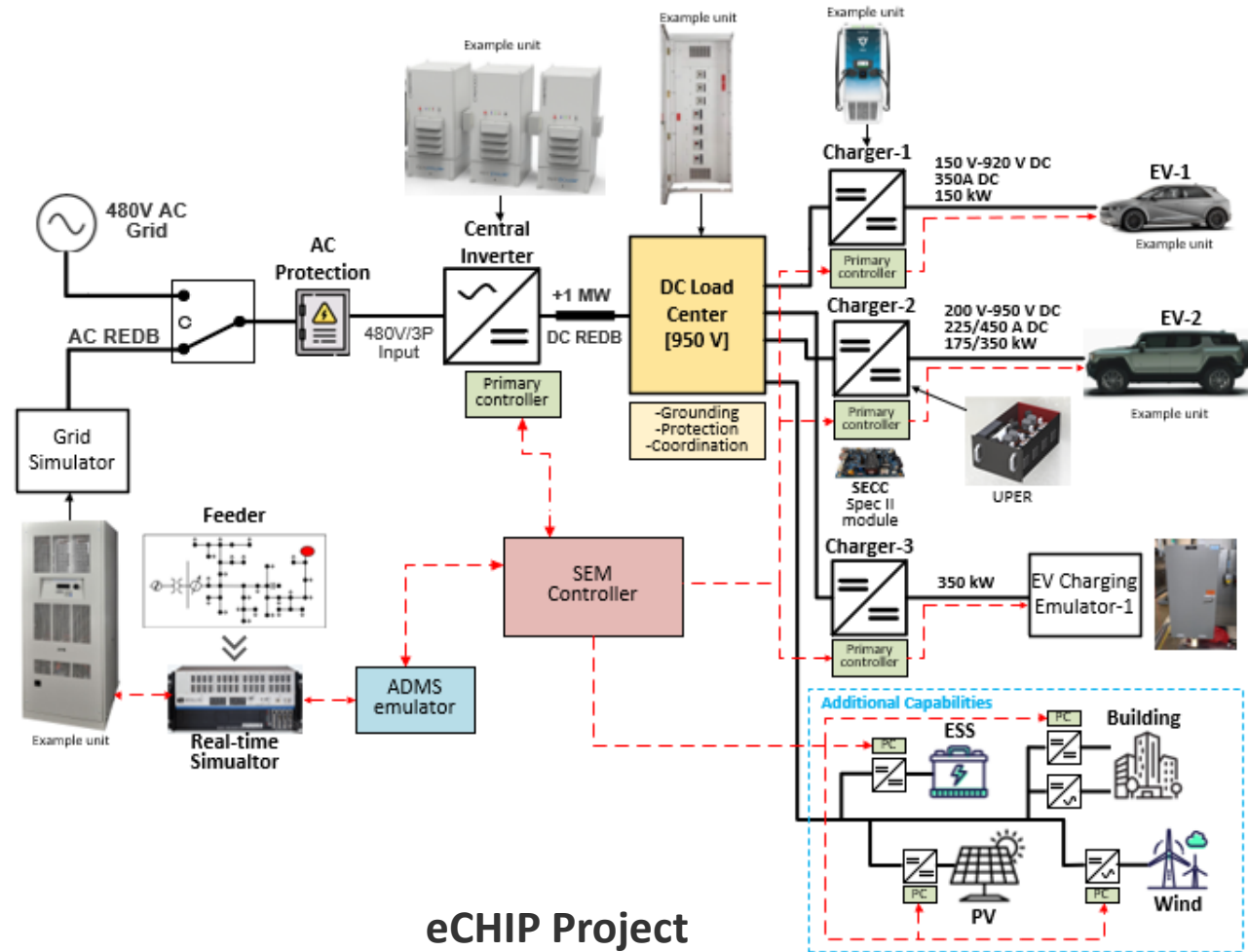
EVI-EnSite

<https://www.nrel.gov/transportation/evi-ensite.html>

Hardware Demonstration for High Power Charging

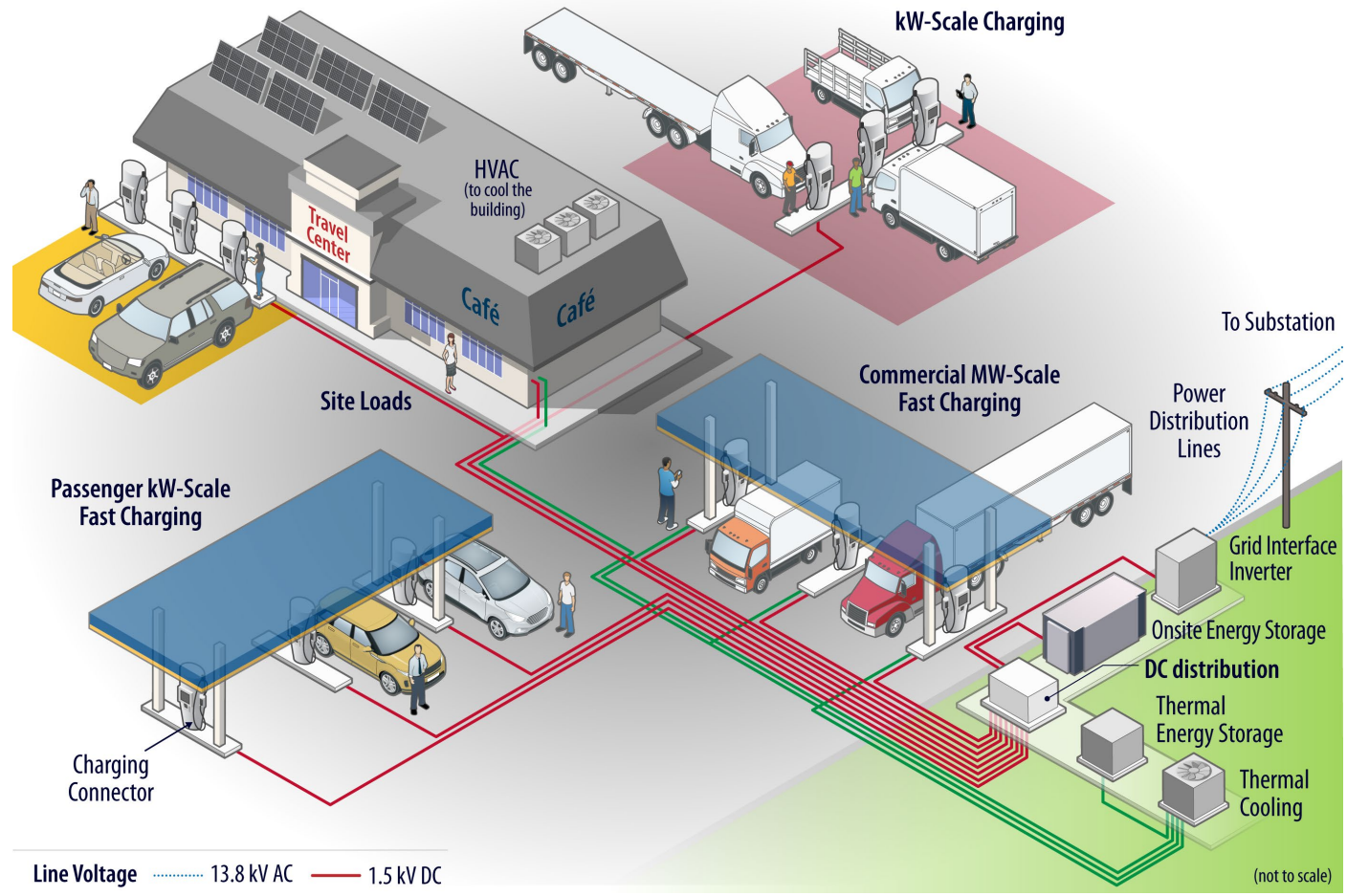


NextGen Profiles Project



eCHIP Project

Future High Power Charging Station: A Use Case



Thank you!

Photo Credit: Alfred Hicks, NREL

E-mail: john.kisacikoglu@nrel.gov

EVs@Scale Consortium website: <https://www.energy.gov/eere/vehicles/electric-vehicles-scale-consortium>