NREL Electric Vehicle Infrastructure Projection Modeling in Bogotá Colombia

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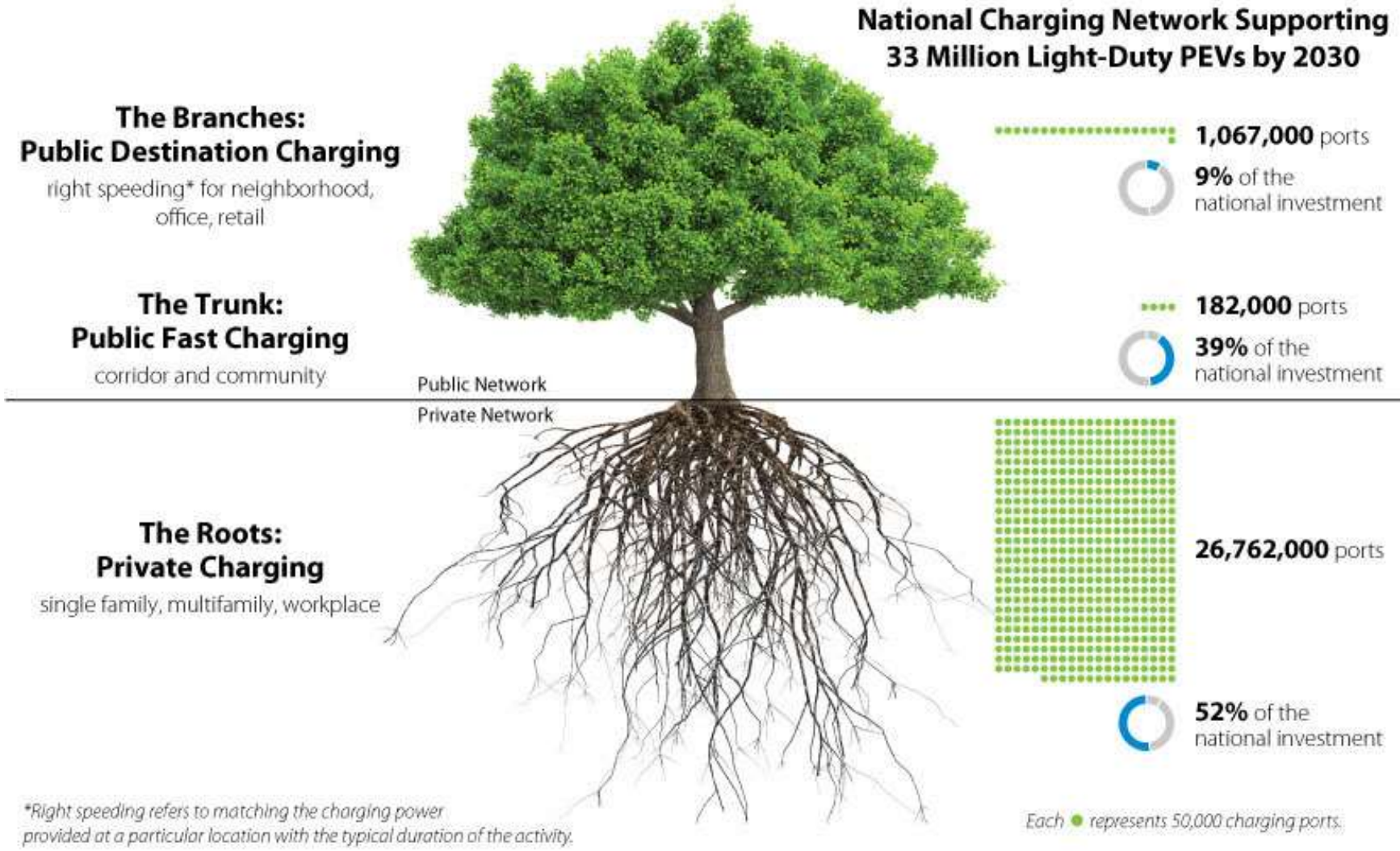
8/31/23

EVI-Pro Model Overview

EVI-Pro

- Uses **daily travel data** to estimate EV charging demand
- Designs a **charging station network** that meets the needs of the region's travel behavior
- Estimates the resulting **impact on the electrical grid** over the modeled travel day
- EVI-Pro has been used for **studies across the United States** and is now expanding to international applications

The 2030 National Charging Network: Estimating U.S. Light-Duty Demand for Electric Vehicle Charging Infrastructure



EV Driving / Charging Simulations

Travel Data | **Simulated Charge Events**

Departure	Arrival	Destination	Driver A	Driver B	Driver C
7:00 AM	7:45 AM	Public	None	None	Public DCFC
9:30 AM	10:30 AM	Public	None	Public L2	None
12:45 PM	3:00 PM	Public	None	None	None
4:00 PM	5:00 PM	Home	Home L2	Home L2	None

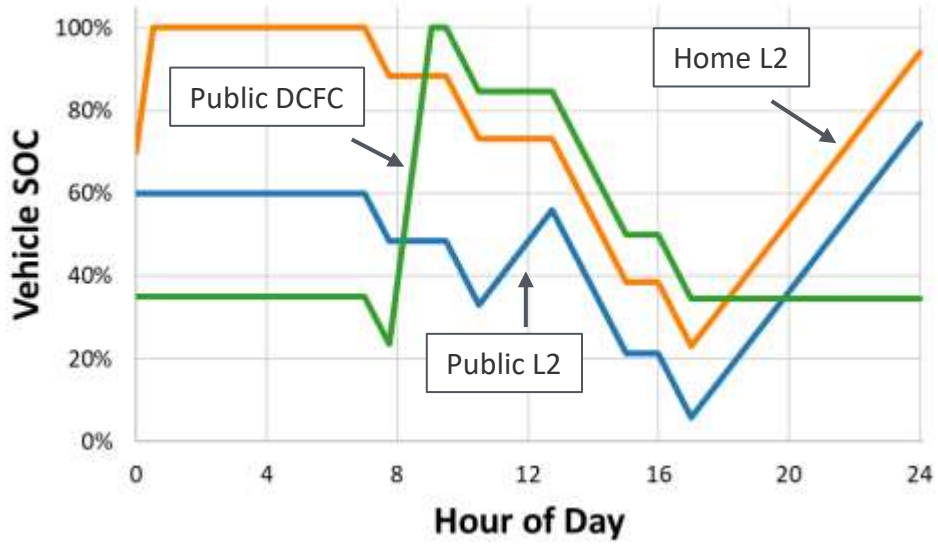
Charging demand to satisfy travel

Sample Vehicle / Infra Assumptions:
- 250-mile BEV
- DCFC = 150kW
- L2 = 7.2kW

Sample Choice / Access Assumptions:
- Charge every night, home dominant
- Plug-in only if needed, even at home
- No home-charging, reliant on public infrastructure

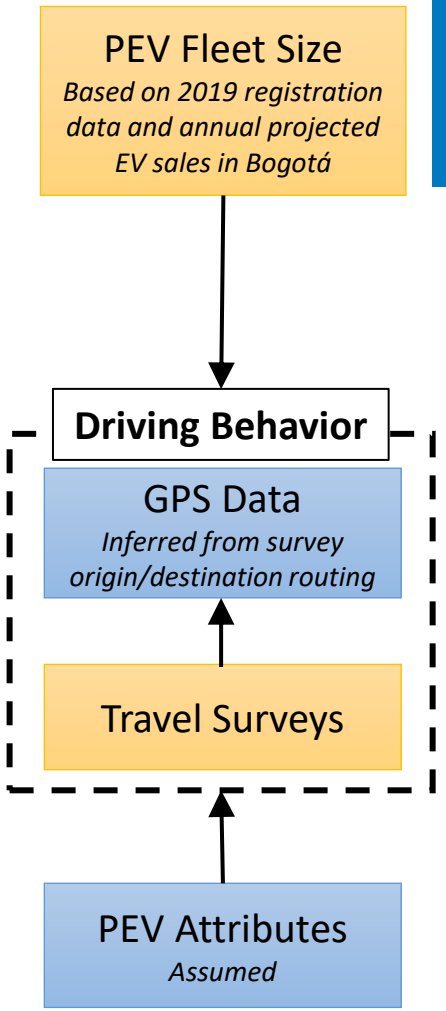
EVI-Pro

Driving, Charging Simulations



Model Inputs and Ouptuts

Orange boxes indicate data inputs provided by Bogotá



Cost of Charging
Assumed

Residential Access
Based on parking data from survey

→ 3rd Party Data/Simulations

EVI-Pro

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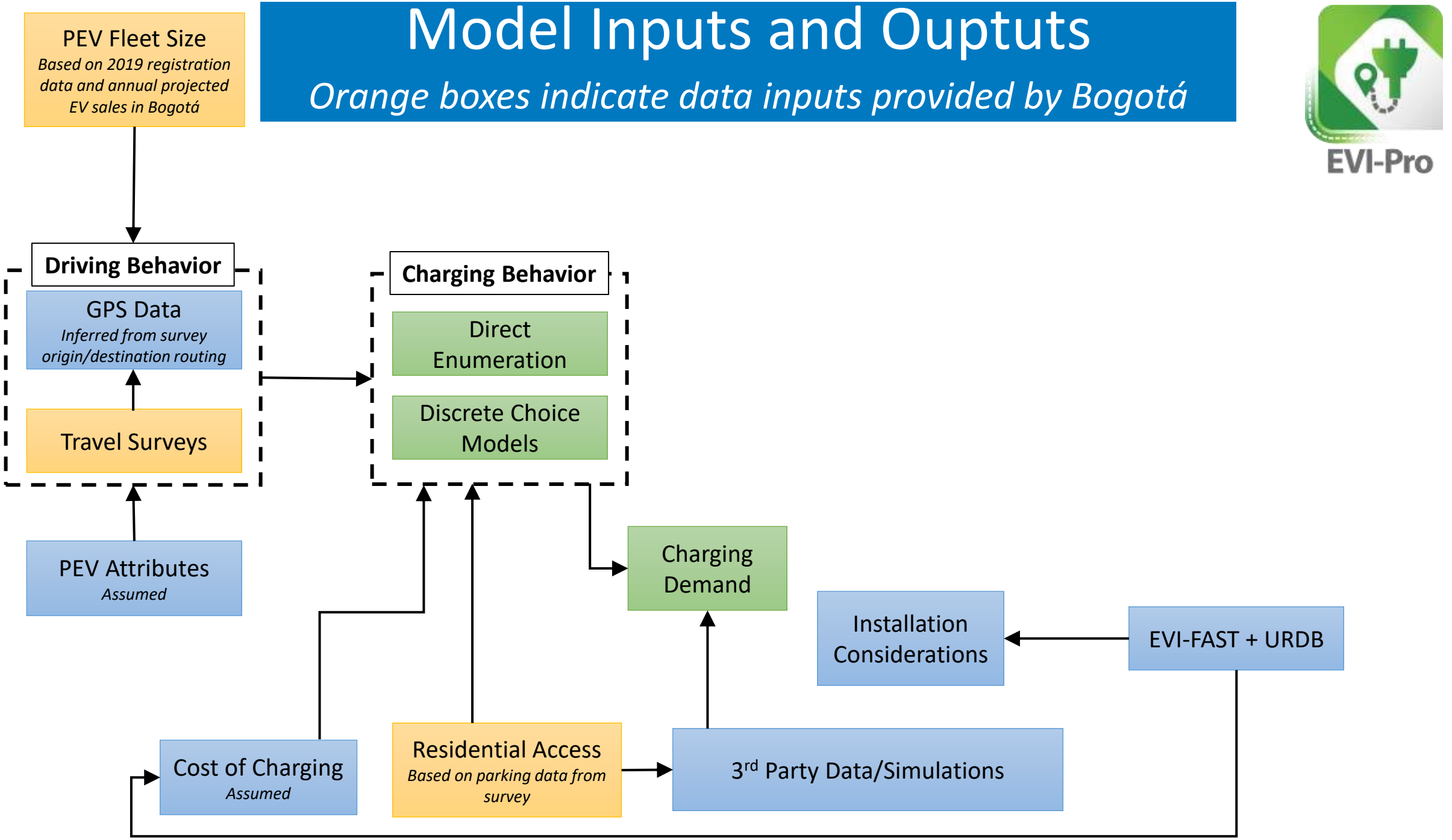

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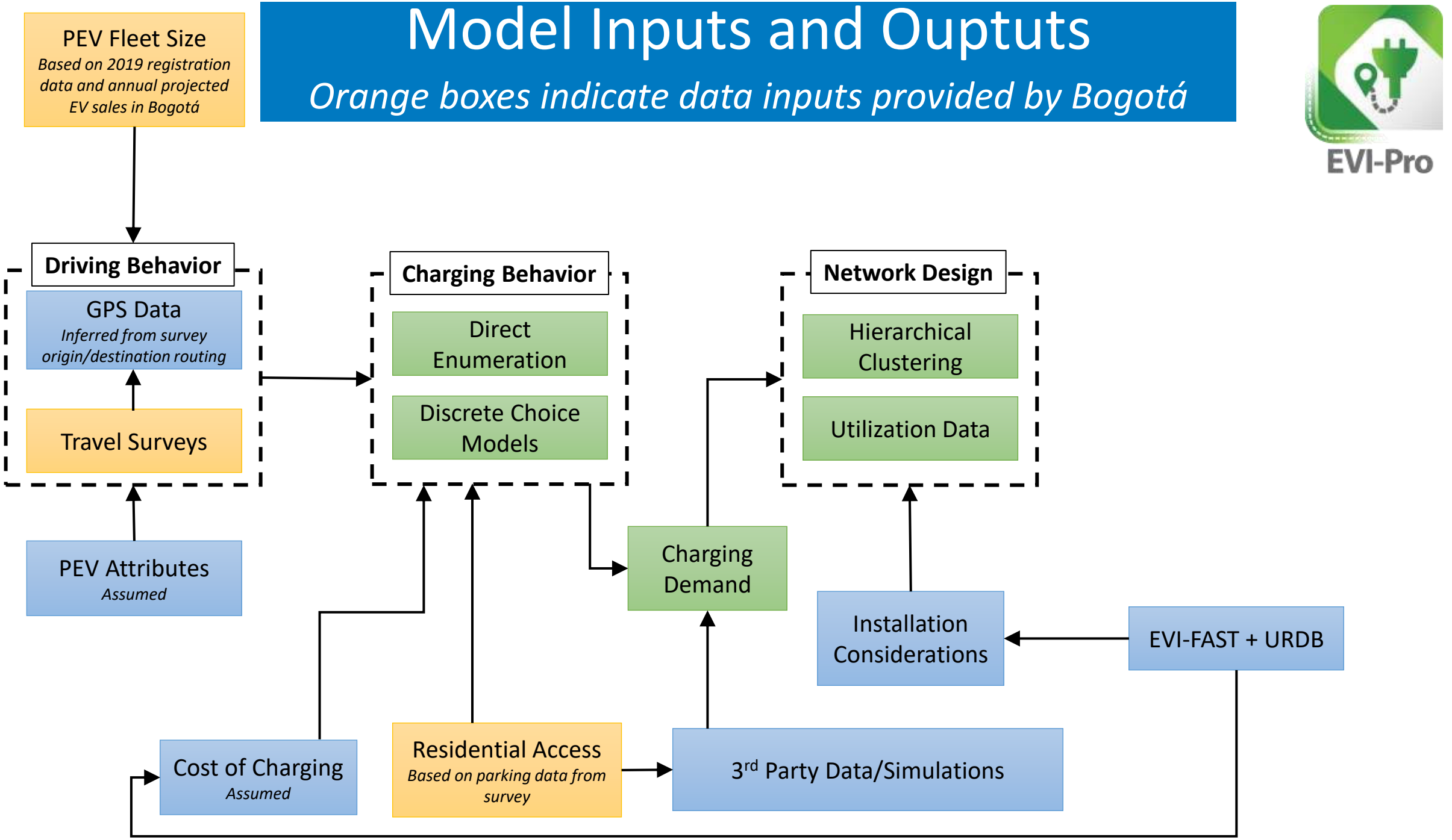

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PEV Fleet Size
Based on 2019 registration data and annual projected EV sales in Bogotá

EVI-Pro

Driving Behavior

GPS Data
Inferred from survey origin/destination routing

Trip Data

PEV Attributes
Assumed

Charging Behavior

Direct Enumeration

Discrete Choice Models

Charging Demand

Network Design

Hierarchical Clustering

Utilization Data

Results

Stations
Plugs
Utilization
Load Profiles

Installation Considerations

EVI-FAST + URDB

Cost of Charging
Assumed

Residential Access
Based on parking data from survey

3rd Party Data/Simulations

EVI-Pro and EVSE Analysis for Bogotá Colombia

Applying EVI-Pro to the Bogotá context was made possible by the extensive 2019 travel survey which includes several key inputs for the model:

- **Urban socioeconomic data**: Household, person, and vehicle datasets
  - Household income, house ownership, vehicle registration, parking
- **Travel data**: 17,000 trips split by vehicle type
  - Origins and destinations (at the transportation analysis zone level)
  - Trip start and end times
  - Expansion factor estimated per trip to expand data to 16 million trips

EVI-Pro Model: Charging Station Analysis for Bogotá Colombia

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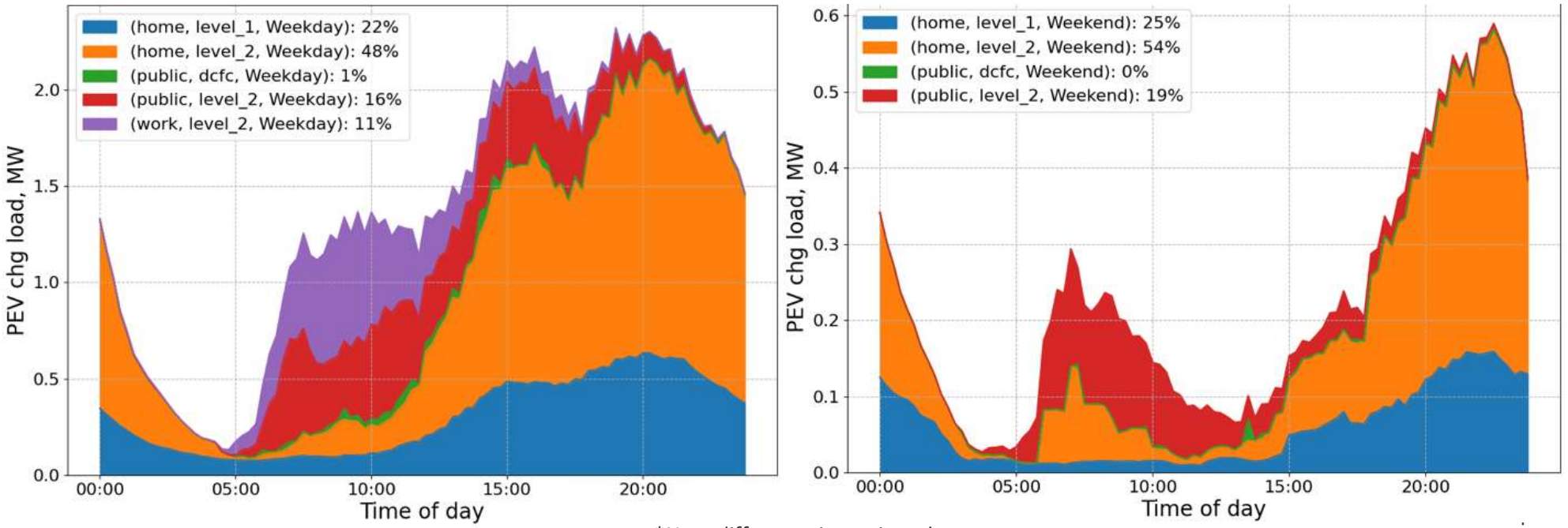
Primary model outputs include:

- Electricity **load profile** from EV charging
- **Number** and **type** of charger for each region
- Average **charger utilization** for each region

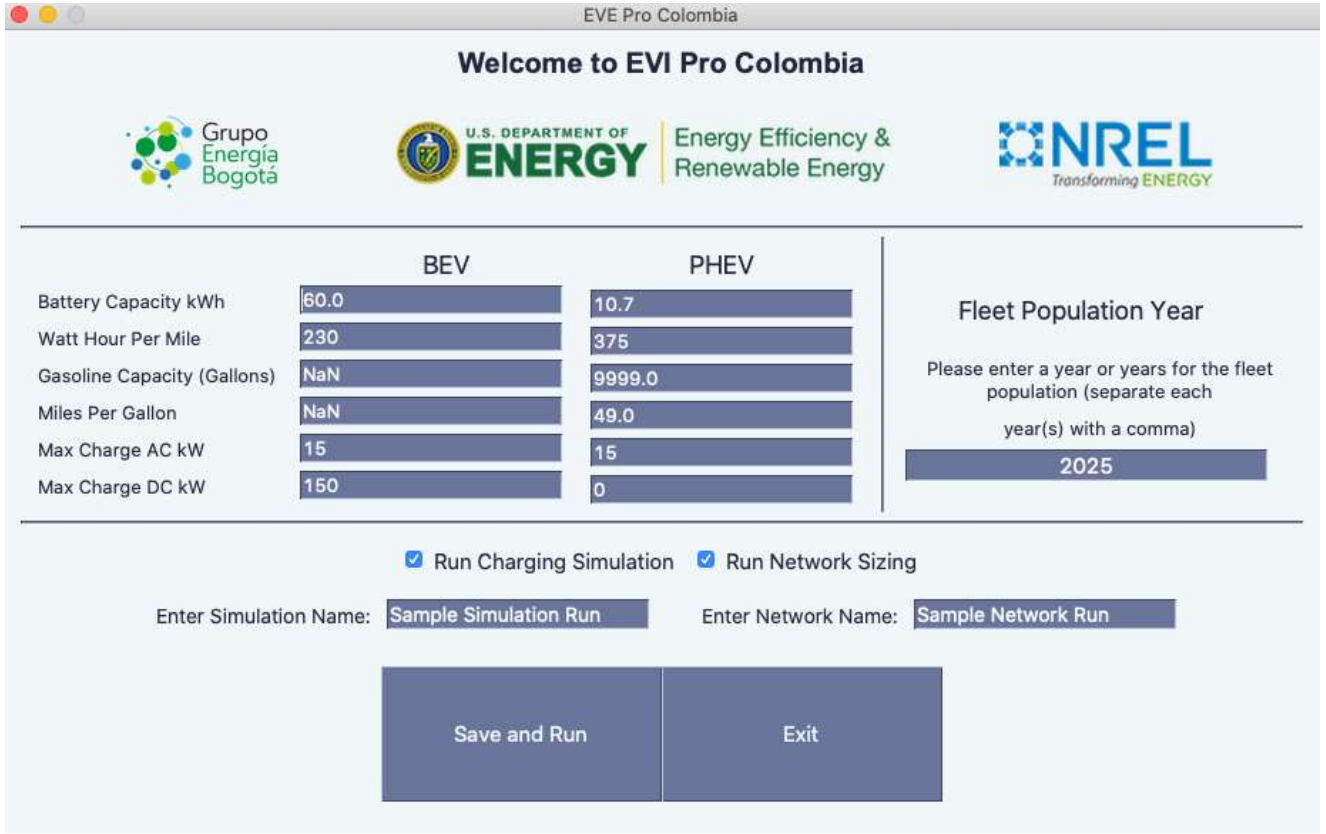
Sample Weekday and Weekend EV Charging Load Profile Outputs



*Note difference in y axis scales

EVI-Pro Interface

- Created a user-friendly interface for running EVI-Pro with a simplified set of useful inputs
- The NREL team worked with stakeholders in Bogotá to train them in the use of the EVI-Pro model and interpretation of results
- Next steps are for Colombia to run scenarios of interest with NREL as an advisory resource to provide input as needed
- Scenarios can vary any inputs to the model such as home charging availability, future EV adoption estimates, electricity prices, battery size, and daily driving patterns

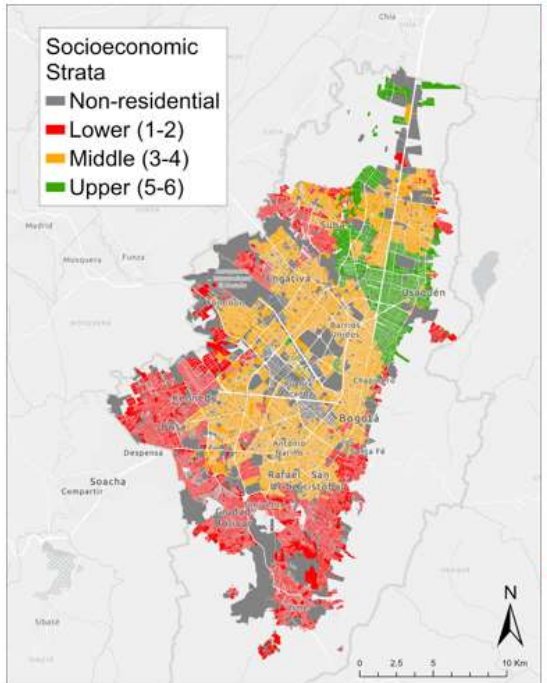


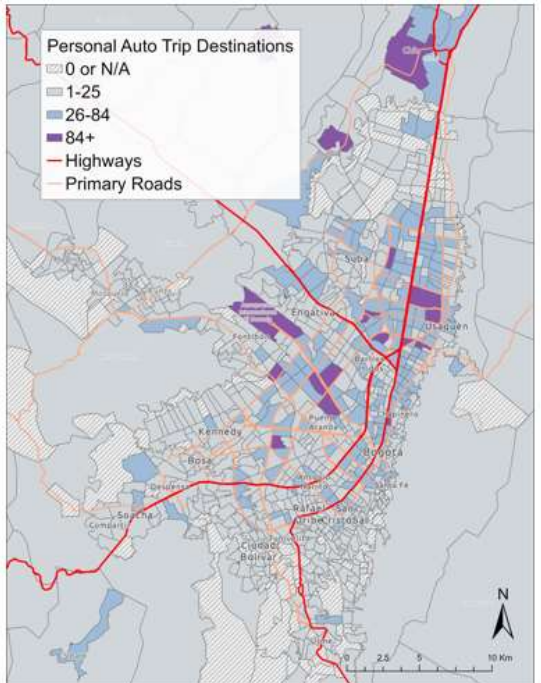
EVSE Mapping Analysis

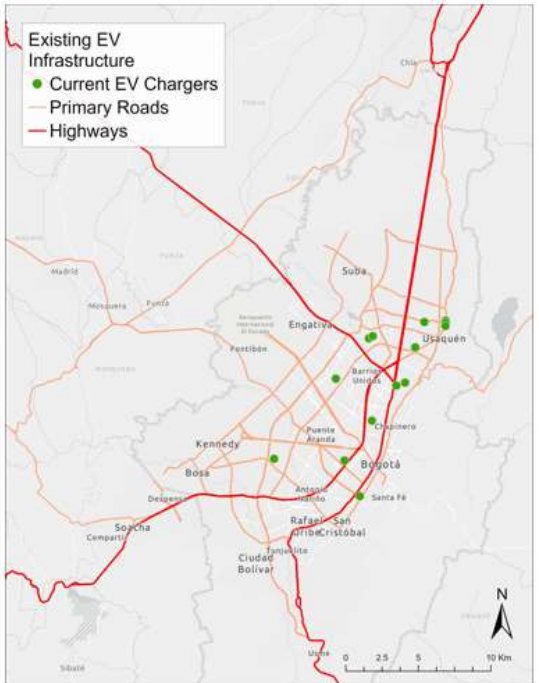
Scenario-based mapping analysis to identify locations for near-term buildout of charging stations based on travel data and likelihood of early EV adoption- complements EVI-Pro modeling analysis

Mapping Analysis Inputs:

- Car Origin/Destinations
- Household Income and Ownership
- Vehicle Registration
- Road Network
- Existing Chargers







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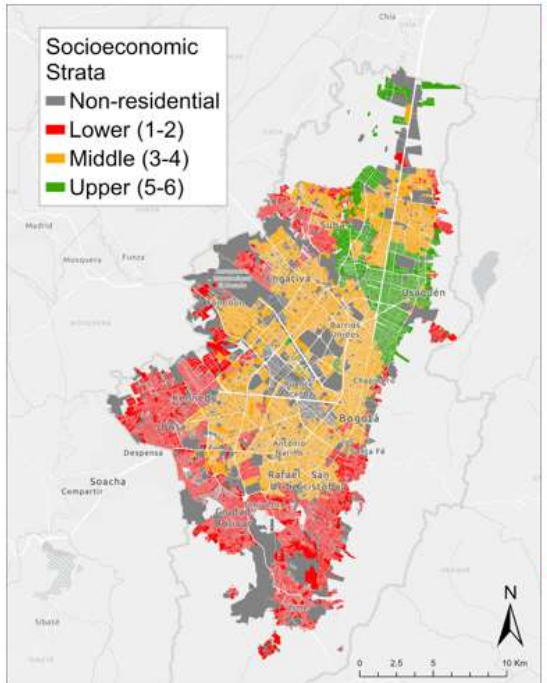
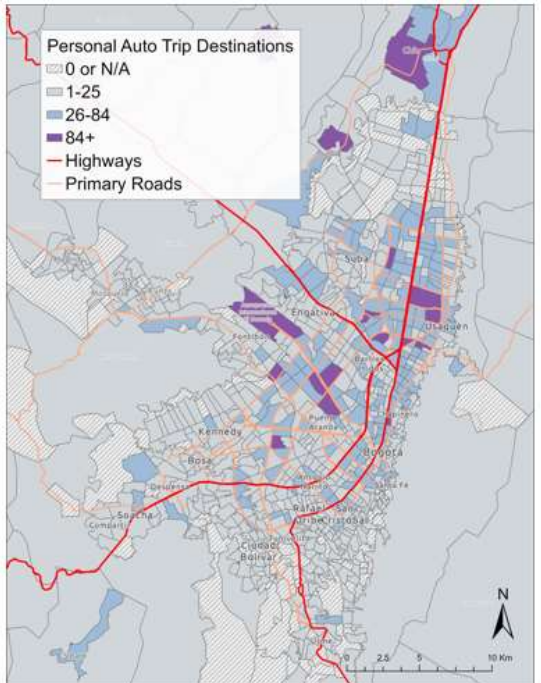
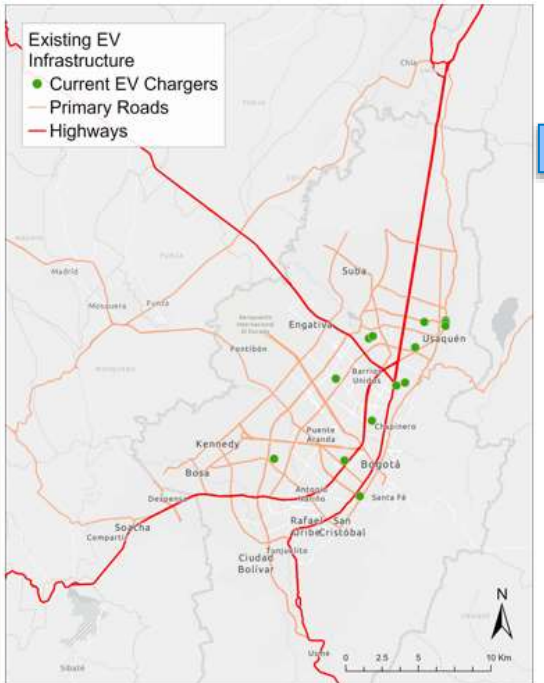
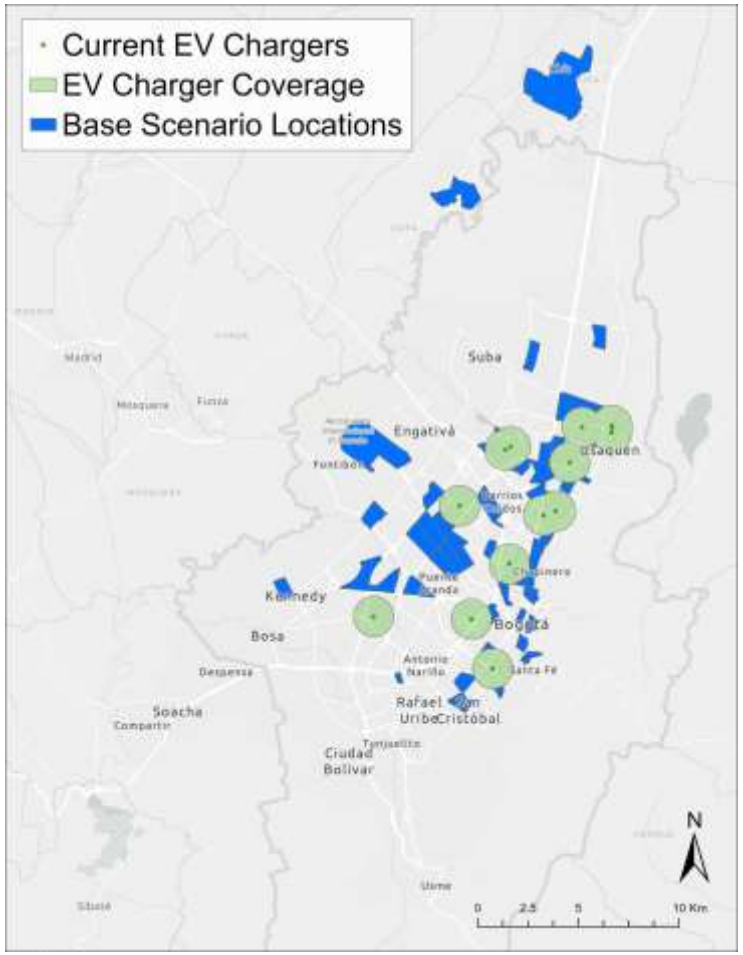






Scenario Output



Adapting EVI-Pro: Data needs

Travel Data

a. Individual vehicle days (from trips) from travel survey or GPS data
b. Origin and destination locations
c. Start and end times of trips
d. Trip motive (destination type- home, work, public)

Consumer/Vehicle Data

a. Household ownership estimates
b. Vehicle ownership
c. Electricity/Charging costs (home and public at varying power levels)
d. Future EV sales projections

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The travel data is a critical input and must be representative of travel in the region. Datasets used for past analyses have had 10,000+ trips

NREL's OpenPATH can be used for data collection: https://www.nrel.gov/transportation/openpath.html

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Regional disaggregation for each data type is key to include location information for station buildout

EVI-X Suite of Tools

Tools to analyze different aspects of EV charging:

- Site design
- Finance
- Charging demand from heavy-duty vehicles, fleets, on-demand ride-hailing
- Long distance trips
- Equity considerations

Work with us

NREL is experienced in working with international stakeholders on a range of projects related to sustainable transportation and the energy transition

Reach Out- if you are interested in learning more about how the EVI-X suite could be applied in your region to aid in planning for vehicle electrification

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www.nrel.gov

Thank You

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Tools and Links

- **EVI-Pro:** https://www.nrel.gov/transportation/evi-pro.html
- **EVI-X Suite:** https://www.nrel.gov/transportation/evi-x.html
- **OpenPath:** https://www.nrel.gov/transportation/openpath.html
- **NREL International portfolio:** https://www.nrel.gov/international/
- **NREL-USAID Partnership:** https://www.nrel.gov/usaid-partnership/

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