



# EVI-Pro Lite Updates Webinar

Eric Wood | Lauren Spath Luhring | Matt Rahill  
December 9, 2020

# Presenters



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**Matt Rahill**

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# Agenda

- 1 AFDC Introduction**

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- 2 EVI-Pro Model & Load Profile Scenarios**

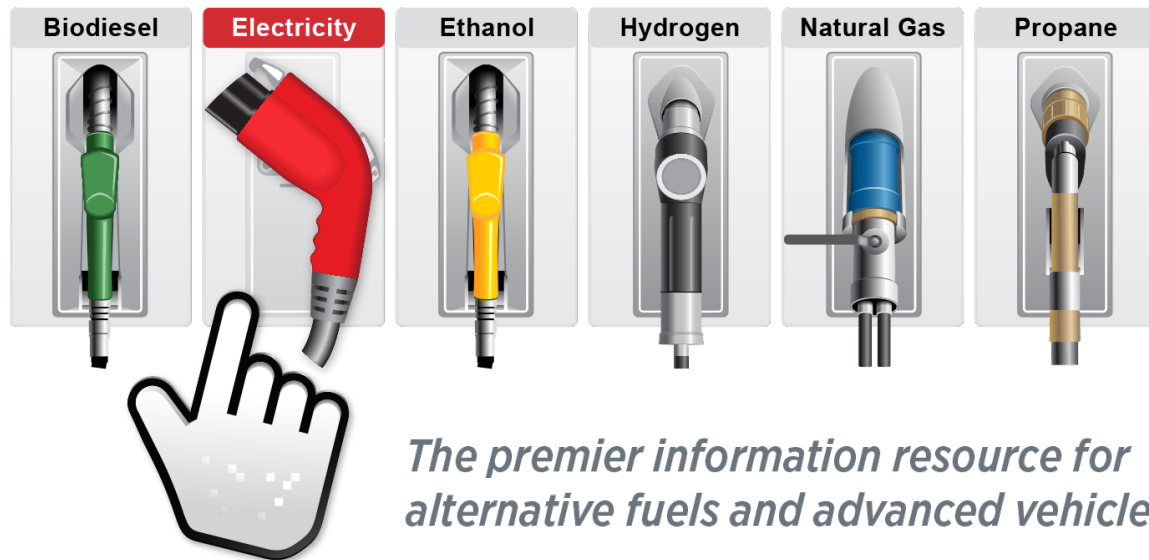
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- 3 Demo of the Tool and API**

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- 4 Local Opportunities**

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- 5 Q&A**

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# Alternative Fuels Data Center



*The premier information resource for  
alternative fuels and advanced vehicles*

*[afdc.energy.gov](https://afdc.energy.gov)*

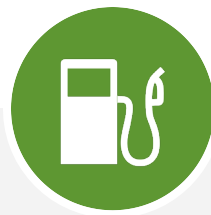
# Who uses the AFDC?



Fleet  
managers



Transportation  
planners



Fuel  
providers



Utilities



Clean Cities  
coalitions

**3 million**  
users annually

**12 million**  
pageviews annually

**25 million**  
station searches annually


# EVI-Pro Lite

## Charging Need

**Alternative Fuels Data Center** Search the AFDC



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 **Electric Vehicle Infrastructure Projection Tool (EVI-Pro) Lite**  
This tool provides a simple way to estimate how much electric vehicle charging you might need and how it affects your charging load profile.

[Charging Need](#) [Load Profile](#)

How Much Electric Vehicle Charging Do I Need in My Area?




## Load Profile

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 **Electric Vehicle Infrastructure Projection Tool (EVI-Pro) Lite**  
This tool provides a simple way to estimate how much electric vehicle charging you might need and how it affects your charging load profile.




[Charging Need](#) [Load Profile](#)

How Does Vehicle Charging Affect My Charging Load Profile?

Choose from the options that best fit your scenario.

Where does your fleet operate?

How many plug-in electric vehicles are in your fleet?



*[afdc.energy.gov/evi-pro-lite](https://afdc.energy.gov/evi-pro-lite)*

# Home Page

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### Fuels & Vehicles >

Biodiesel


Electricity

Ethanol

Hydrogen

Natural Gas


Propane



#### How does electric vehicle charging affect the grid?

Explore the impact on your electric load profile with EVI-Pro Lite.

### Information by State >



select a state

### Information by Fleet Application >

Delivery Services

Refuse Collection


Public Transit

School Transportation

### Maps & Data >

- U.S. Alternative Fueling Stations by Fuel Type
- U.S. Hybrid Electric Vehicle Sales by Model
- Light-Duty Alternative Fuel Vehicle Registrations


#### Fuel Prices



### Tools >

- Laws & Incentives
- Electricity Sources & Emissions
- Vehicle Cost Calculator

#### Station Locator



Download

iPhone app

or

Android app

# Tools Page

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### Tools

The Alternative Fuels Data Center offers a large collection of helpful tools. These calculators, interactive maps, and data searches can assist fleets, fuel providers, and other transportation decision makers in their efforts to advance alternative fuels and energy-efficient vehicle technologies.

#### Calculators

**Vehicle Cost Calculator**  
Compare cost of ownership and emissions for most vehicle models.

**CNG VICE Model 2.0**  
Evaluate ROI and payback period for natural gas vehicles and infrastructure.

**AFLEET Tool**  
Calculate a fleet's petroleum use, cost of ownership, and emissions.

**JOBS Model**  
Estimate economic impacts of natural gas, hydrogen, or fuel cell infrastructure.

**Heavy-Duty Vehicle Emissions**  
Calculate the emissions of alternative fuel medium- and heavy-duty vehicles.

**Evolution: E-Drive Vehicle Education**  
Understand the costs and benefits of electric vehicles based on location.

**EVI-Pro Lite**  
Estimate a city or state's need for vehicle charging and the effect on electric load.

#### Interactive Maps

**Alternative Fueling Station Locator**  
Locate alternative fueling stations and get maps and driving directions.

**Alternative Fuel Corridors**  
Find maps and station data to help with nominating alternative fuel corridors.

**TransAtlas**  
Analyze vehicle densities and locations of fueling stations and production facilities.

**Biofuels Atlas**  
Compare feedstocks and analyze biofuel production by location.

**Coalition Locations**  
Find Clean Cities coalitions and contact information for coordinators.

#### Data Searches

**Vehicle Search**  
Compare all classes of alternative fuel vehicles, electric vehicles, and hybrids.

**Laws and Incentives Search**  
Search for laws and incentives related to alternative fuels and advanced vehicles.

**Fuel Properties Comparison**  
Compare alternative fuel properties and characteristics.

**Find a Car**  
Compare fuel efficiency, costs, carbon footprints, and emissions.

**State Information**  
Find state information about alternative fuels and advanced vehicles.

NREL | 7

# EVI-Pro Model & Load Profile Scenarios

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# The EV Infrastructure Projection Tool

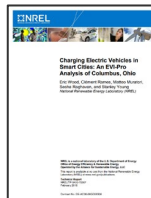
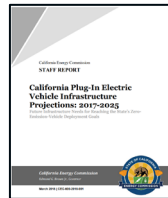
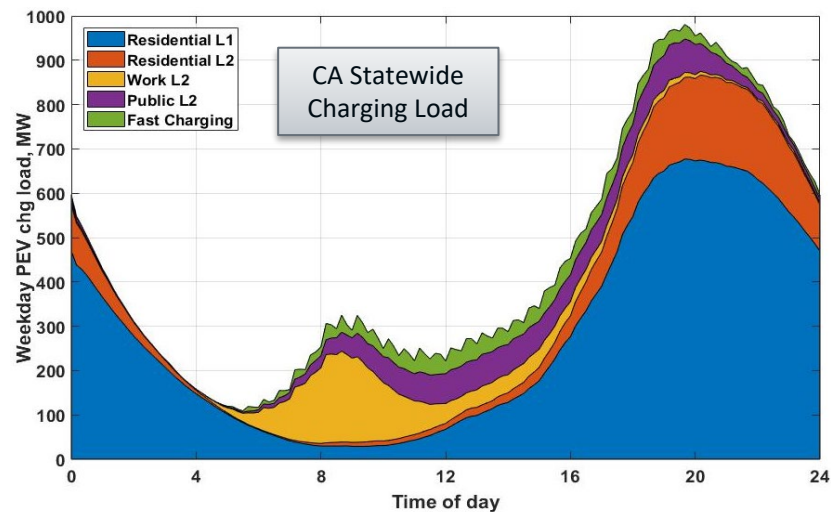
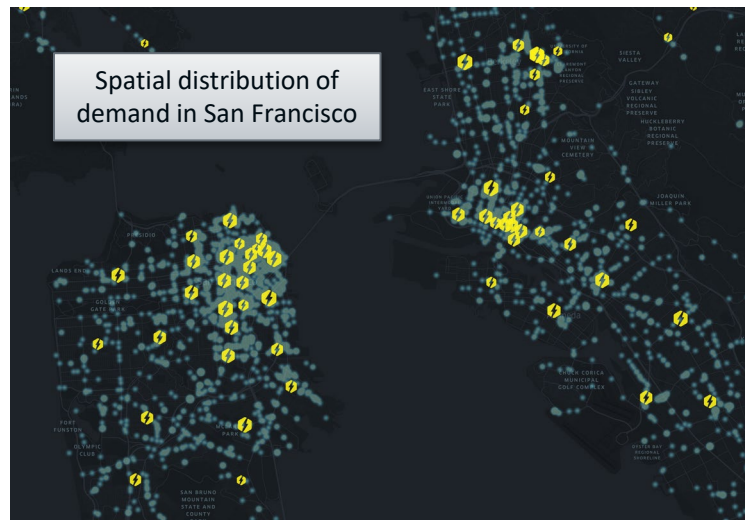


Simulation model to:

- Estimate charging **demand** from EVs
- Design **supply** of infrastructure

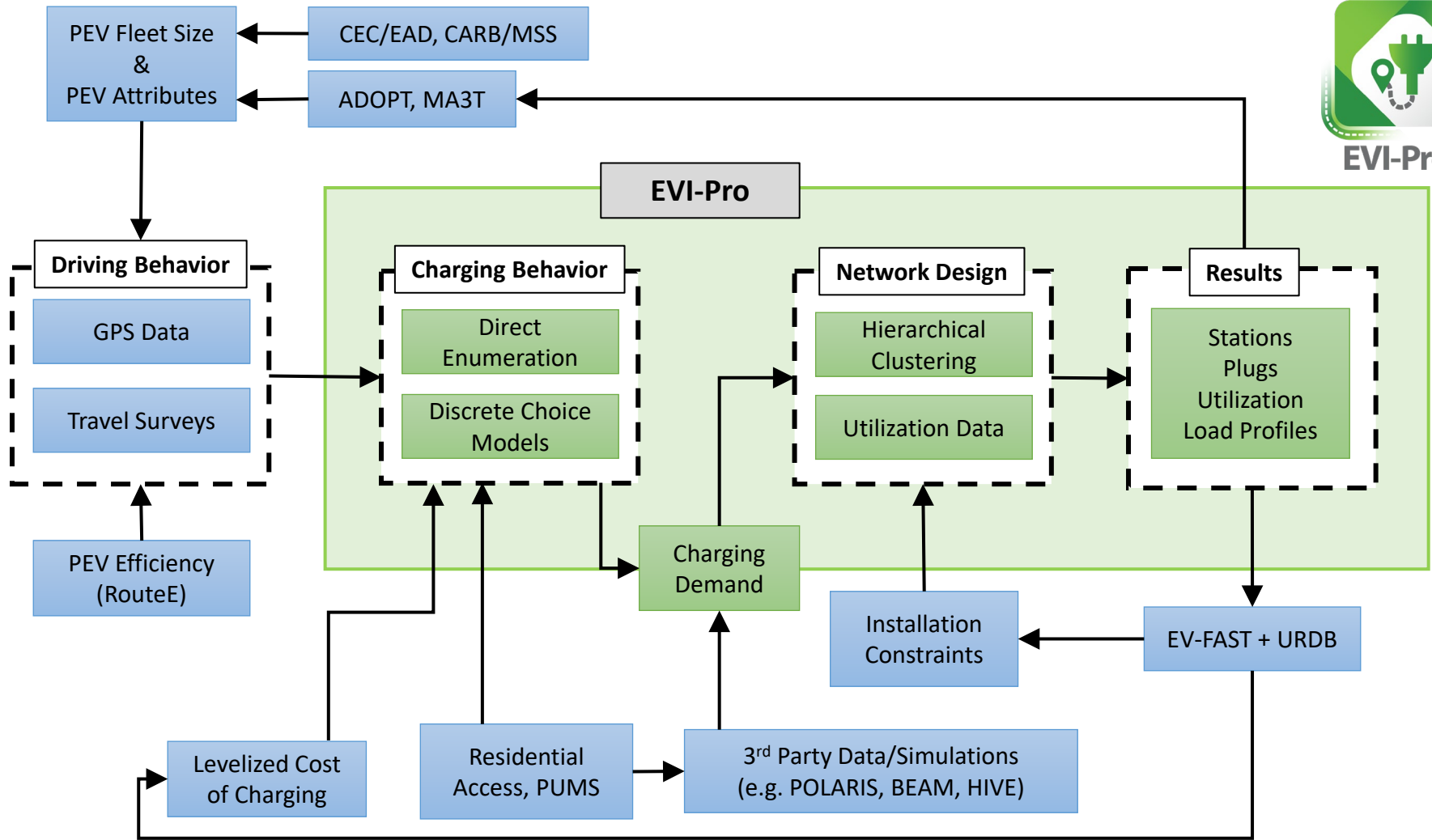
Informed by real-world data and integrated with models of vehicle adoption, mobility, station economics, and the grid

Originally developed through collaboration with the California Energy Commission and since applied at the city-, state-, and national-level





**EVI-Pro**



# Bottom Up EVI-Pro Driving / Charging Simulations



## Travel Data

Departure	Arrival	Miles	Destination
7:00 AM	7:45 AM	30	Public
9:30 AM	10:30 AM	30	Public
12:45 PM	3:00 PM	100	Public
4:00 PM	5:00 PM	40	Home

# Bottom Up EVI-Pro Driving / Charging Simulations



## Travel Data

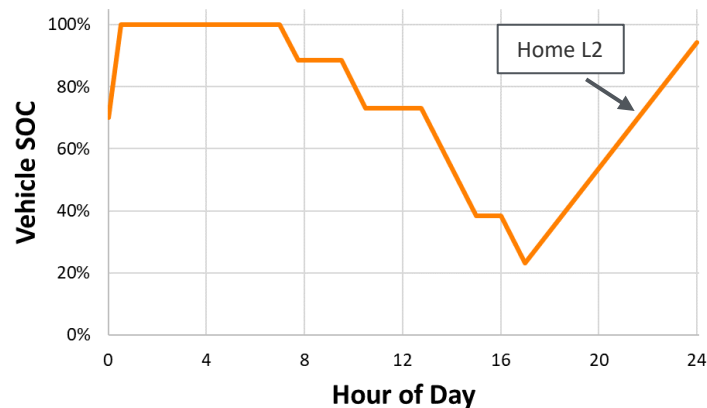
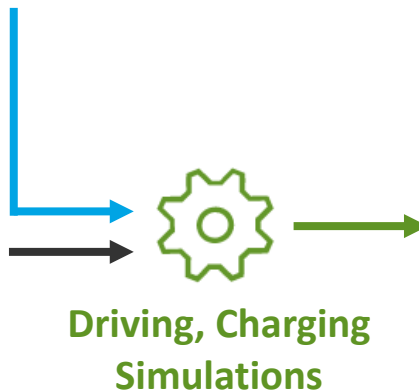
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7:00 AM	7:45 AM	30	Public
9:30 AM	10:30 AM	30	Public
12:45 PM	3:00 PM	100	Public
4:00 PM	5:00 PM	40	Home

### Sample Vehicle / Infra Assumptions:

- 250 mile BEV
- DCFC = 50kW
- L2 = 7.2kW

### Sample Choice / Access Assumptions:

- Charge every night, home dominant



# Bottom Up EVI-Pro Driving / Charging Simulations



## Travel Data

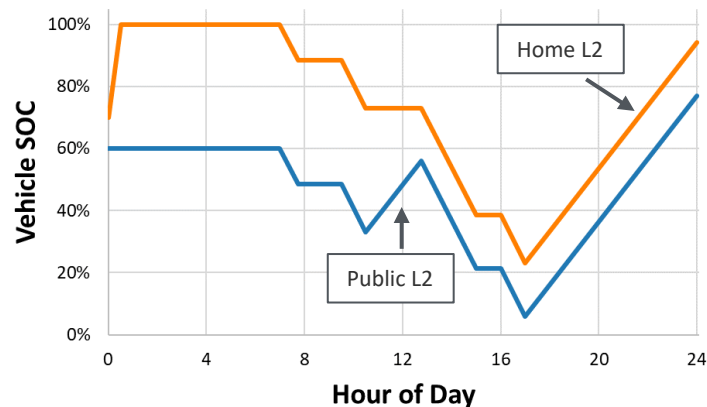
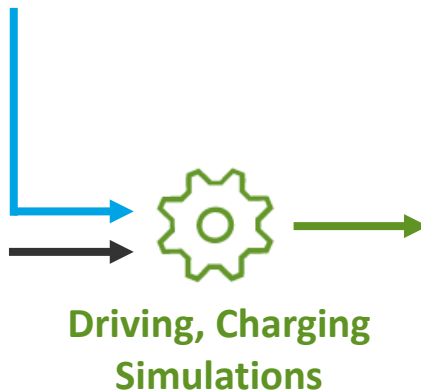
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### Sample Vehicle / Infra Assumptions:

- 250 mile BEV
- DCFC = 50kW
- L2 = 7.2kW

### Sample Choice / Access Assumptions:

- Charge every night, home dominant
- Plug-in only if needed, even at home



# Bottom Up EVI-Pro Driving / Charging Simulations



## Travel Data

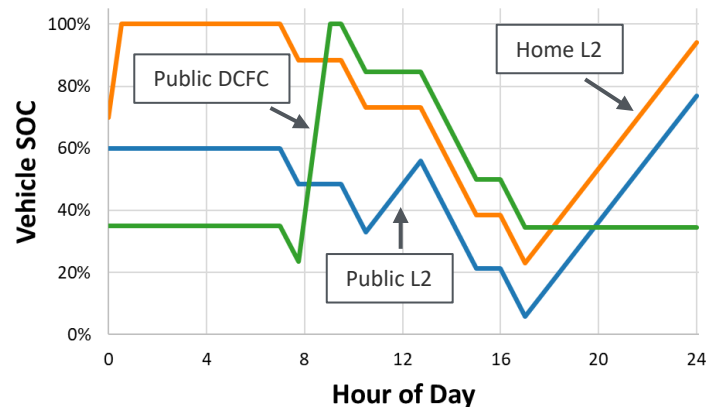
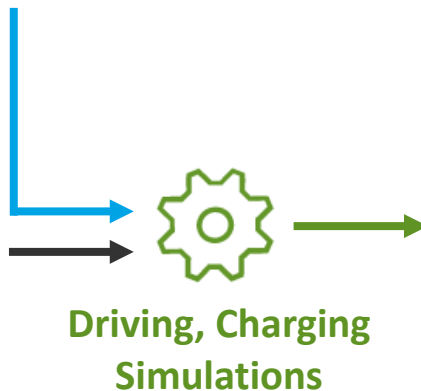
Departure	Arrival	Miles	Destination
7:00 AM	7:45 AM	30	Public
9:30 AM	10:30 AM	30	Public
12:45 PM	3:00 PM	100	Public
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### Sample Vehicle / Infra Assumptions:

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### Sample Choice / Access Assumptions:

- Charge every night, home dominant
- Plug-in only if needed, even at home
- No home-charging, reliant on public infrastructure



# Bottom Up EVI-Pro Driving / Charging Simulations



## Travel Data

## Discovered, Simulated Charge Events

Departure	Arrival	Miles	Destination	Driver A	Driver B	Driver C
7:00 AM	7:45 AM	30	Public	None	None	Public DCFC
9:30 AM	10:30 AM	30	Public	None	Public L2	None
12:45 PM	3:00 PM	100	Public	None	None	None
4:00 PM	5:00 PM	40	Home	Home L2	Home L2	None

**Charging demand  
to satisfy travel**

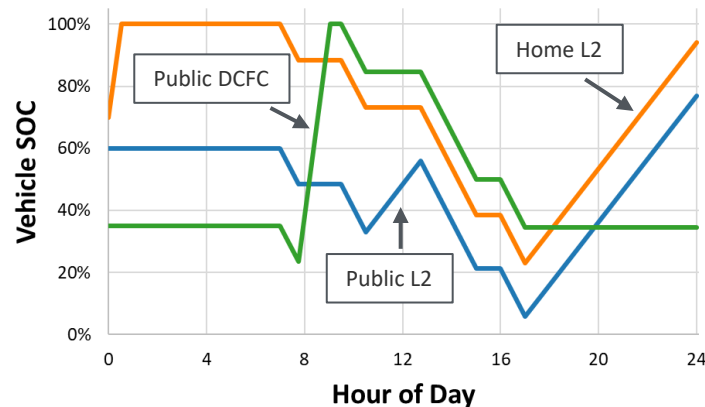
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### Sample Choice / Access Assumptions:

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**Driving, Charging  
Simulations**



# Online PEV Infrastructure Tool: EVI-Pro Lite

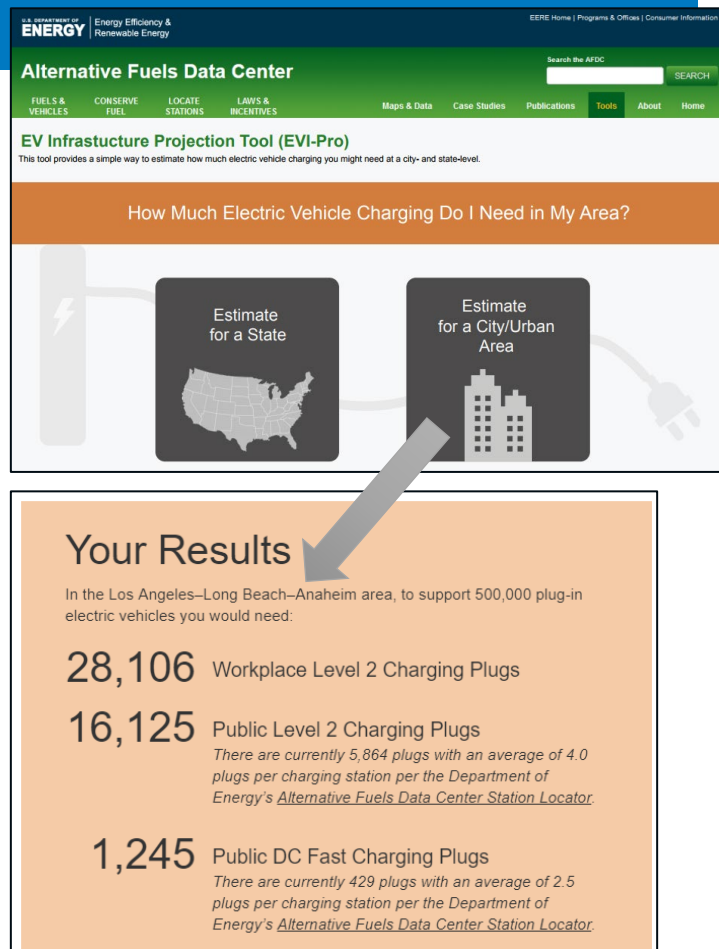
**Objective:** Make analytic capabilities of EVI-Pro model accessible to broad group of stakeholders for EVSE investment decisions.

**Approach:** Develop a simplified, web-based interface for EVI-Pro that gives users access to a limited number of critical input variables.

## Significance & Impact

- EVI-Pro “unlocks” an unlimited number of scenarios for planners to explore regarding EV charging infrastructure requirements.
- Ability to rapidly develop scenarios and explore sensitivities will help users understand the key drivers for investment.

[afdc.energy.gov/evi-pro-lite](https://afdc.energy.gov/evi-pro-lite)





# EVI-Pro Lite: Providing complex modeling to a broad audience

EVI-Pro Lite simplifies demand modeling, enabling partners to create tailored scenarios for state or city charging infrastructure.

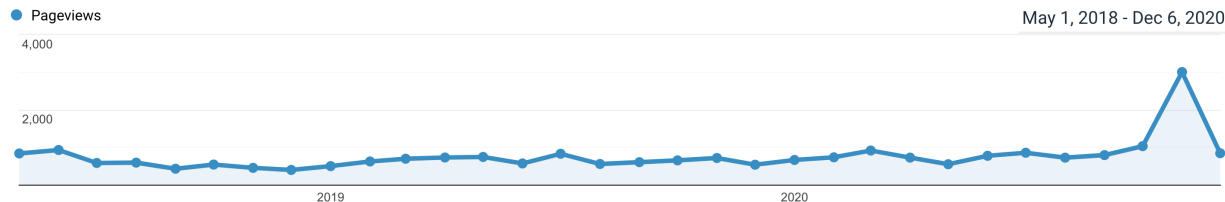
## Building Partnerships

What are partners doing with the EVI-Pro Lite?

- FHWA has highlighted the tool during state convenings on nominating electric alternative fuel corridors
- Hawaiian Electric Company built a case for infrastructure investment for the public utilities commission
- Broward County, Florida directs consultants to use the tool for electric vehicle infrastructure strategies
- Tesla uses the tool in discussions with cities around public infrastructure investments
- NYSERDA planned infrastructure investment and has developed an ongoing partnership with NREL

## Measuring Success

Since its launch, 10,000 users have viewed 24,000 pages on the tool, spending almost 3.5 minutes per visit.

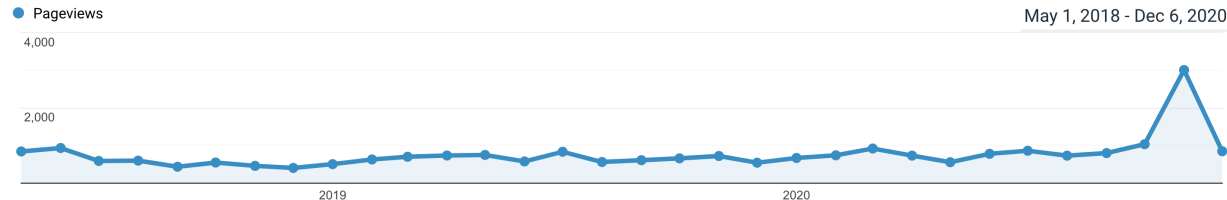


# EVI-Pro Lite: Providing complex modeling to a broad audience

EVI-Pro Lite simplifies demand modeling, enabling partners to create tailored scenarios for state or city charging infrastructure.

*“Municipal and regional governments typically do not have the resources to understand their charging infrastructure needs. Having a quick online tool that gives a ballpark estimate of charging needs is a deeply helpful service. I’ve witnessed first-hand the amazement when city level sustainability staff first use EVI-Pro Lite.”*

**-DOE 2019 Annual Merit Reviewer**



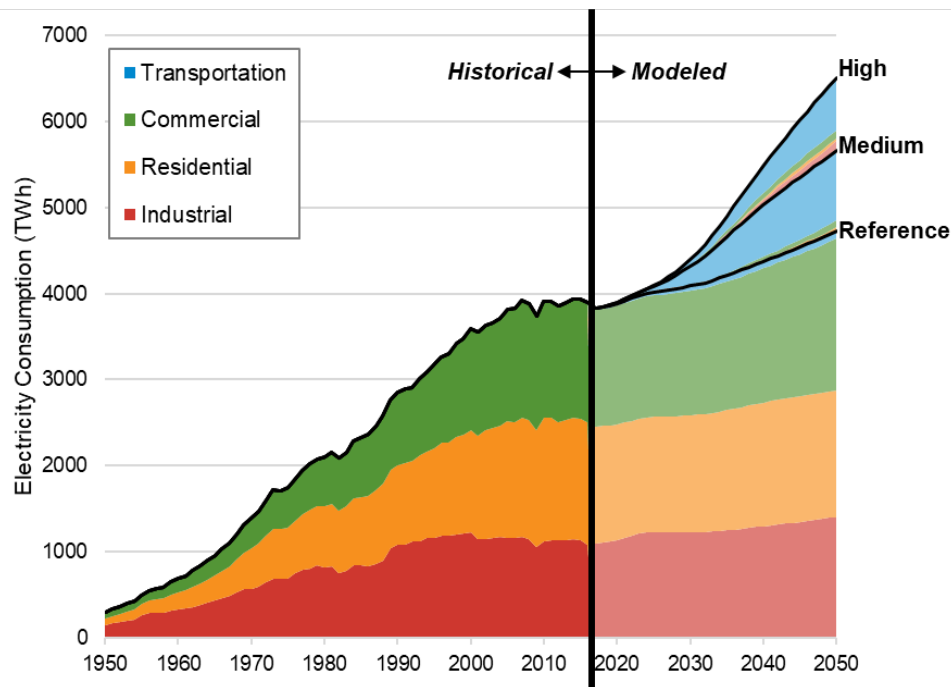
# US Electricity Demand Scenarios



NREL Electrification Futures Study scenarios project great degree of transportation electrification, in line with several energy system transformation scenarios

## EFS High scenario, 2050

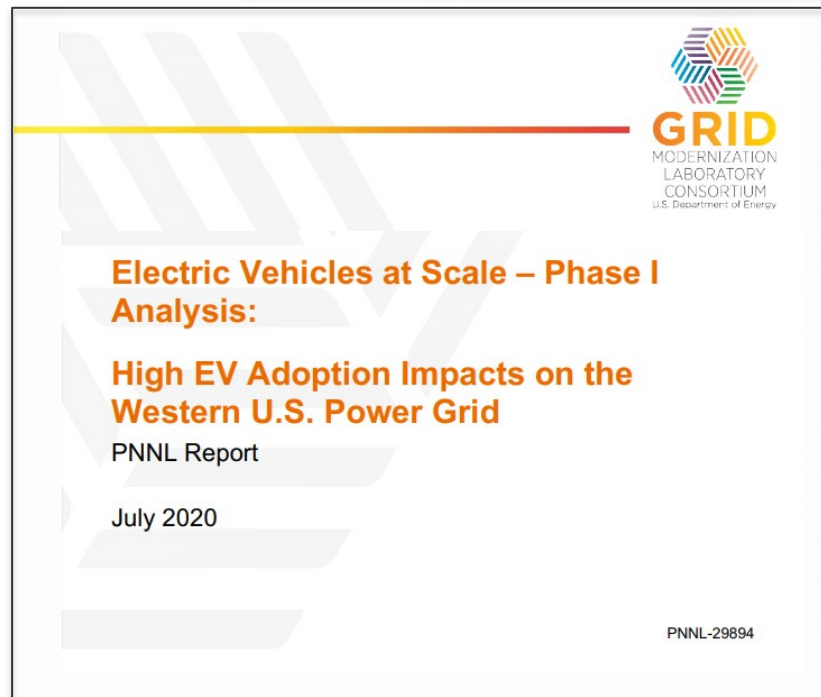
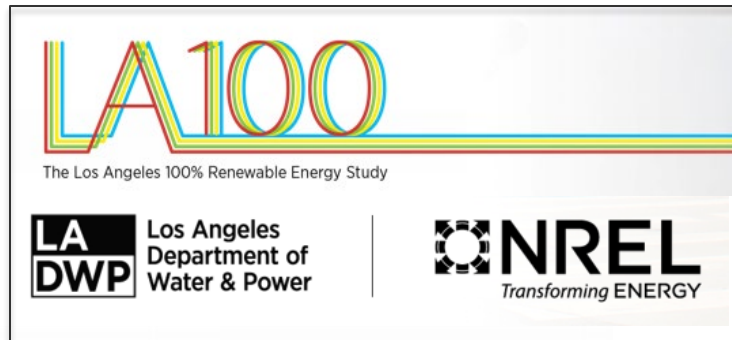
- Transportation share of electricity use increases from 0.2% in 2018 to 23% of electricity consumption in 2050.
- 1,424 TWh increase in transportation-related electricity consumption relative to the 2050 Reference scenario.



***"Are EVs going to break the grid?"***



# Broad use of EVI-Pro for grid impacts analysis...





# “Unlock” EVI-Pro Load Profiles

## **With support from...**

The US Department of Energy

## **In collaboration with...**

Lawrence Berkeley National Laboratory

Schatz Energy Research Center at Humboldt State University

## **With feedback from...**

Electric utilities

Automotive manufacturers

Charging network companies

Local governments

Research institutes

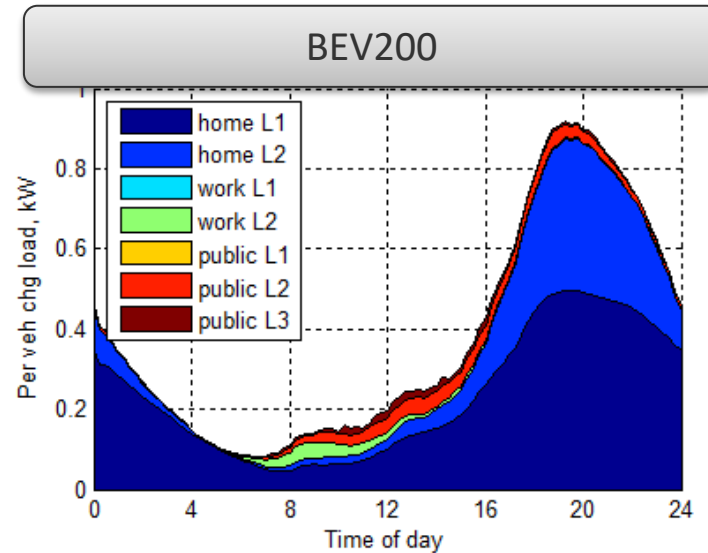
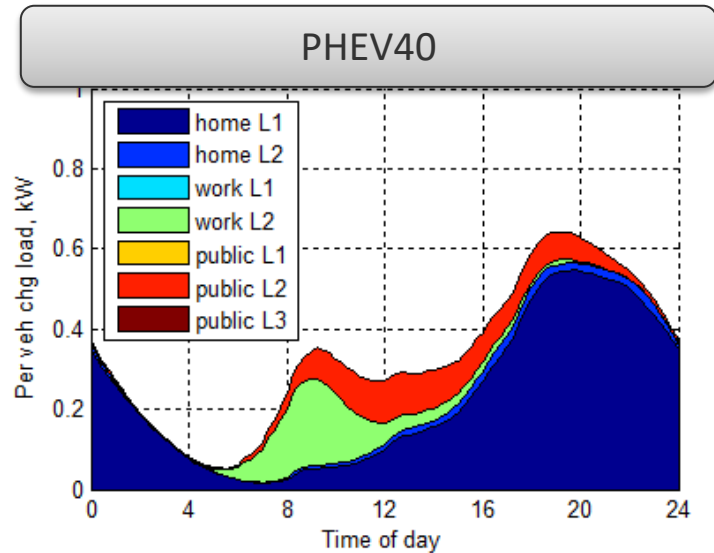
### **Expose users to projections in:**

A Simplified Interface for Accessibility

A Programmatic Interface for Analysts

# “Unlock” EVI-Pro Load Profiles

Emphasize significance of...  
**Vehicle Technology**

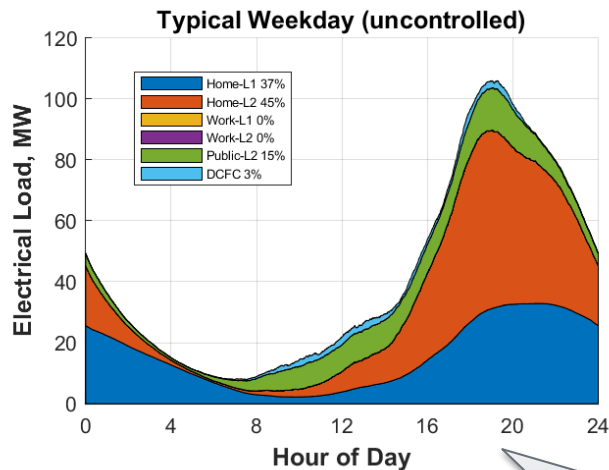


Simulated load from 300,000 EVs in Massachusetts

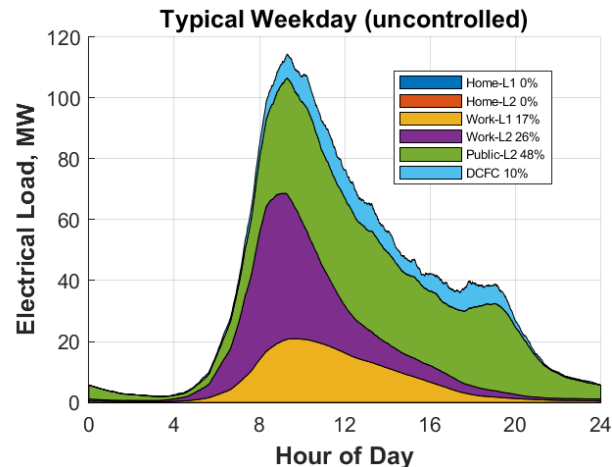
# “Unlock” EVI-Pro Load Profiles

Emphasize significance of...  
**Residential Access**

Home-Dominant Charging



No Home Charging

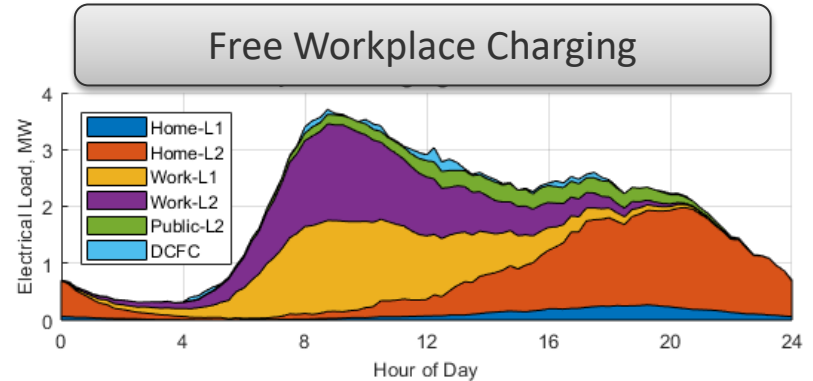
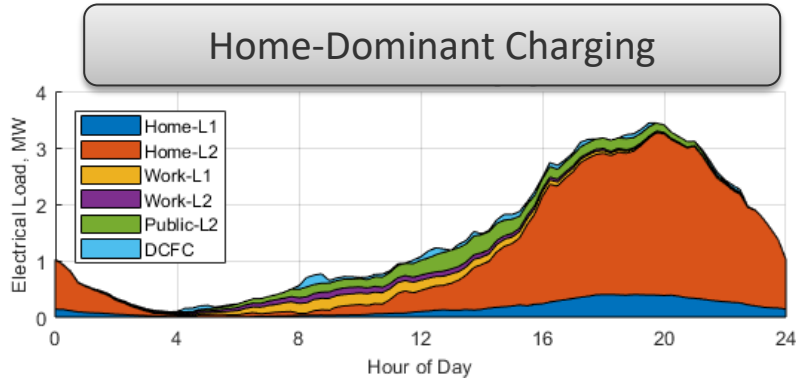


Simulated load from 120,000 EVs in Atlanta, GA



# “Unlock” EVI-Pro Load Profiles

Emphasize significance of...  
**Charging Behavior**

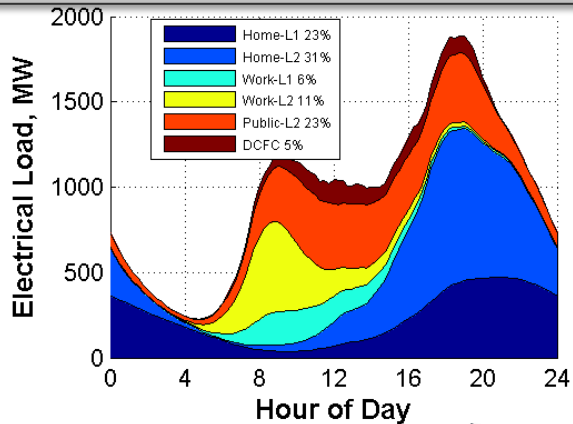


Simulated load from 4,000 EVs in Denver, CO

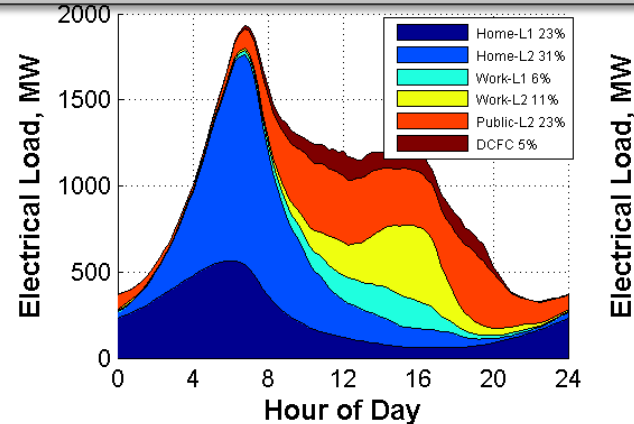
# “Unlock” EVI-Pro Load Profiles

Emphasize significance of...  
**Load Flexibility**

Charge as soon as possible



Charge as late as possible

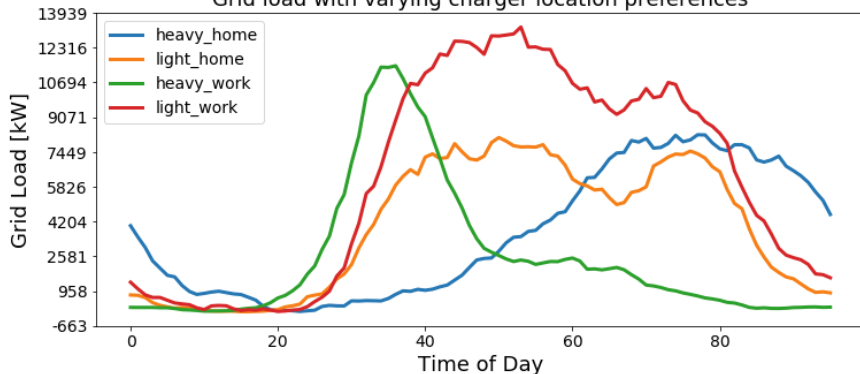


Simulated load from 2M EVs in Los Angeles

# Preview scenarios

## Example Load Scenarios (from NREL API)

Grid load with varying charger location preferences



15-min steps; midnight at 0 and 96; noon at 48

# of variable permutations: 13,122  
# of files: 7 (for each temperature: -20, -10, 0, 10, 20, 30, 40)  
# Total permutations: 30,618

- Fleet size (3)
  - 1,000, 10,000, 50,000
- Average Fleet DVTMT (3)
  - 25, 35, 45
- Temperature (7)
  - -20, -10, 0, 10, 20, 30, 40
- PEV Distribution (3) (Numbers correlate to % of vehicle type: PHEV20, PHEV50, BEV100, BEV250)
  - BEV Dominant = 10/15/25/50
  - PHEV Dominant = 25/50/10/15
  - PHEV/BEV Equal Shares = 15/35/15/35
- Vehicle Class (3)
  - Sedan dominant = 80/20
  - Equal distribution = 50/50
  - SUV dominant = 20/80
- Day of Week (2): weekday, weekend
- Home Access and Power (9)
  - 100% have access to home power (reflects region with high fraction of single family homes<sup>1</sup>). Three additional options for home power
    - Most L1 (80% L1, 20% L2)
    - Most L2 (20% L1, 80% L2)
    - Even L2 (50% L1, 50% L2)
  - 75% have access to home power. Three additional options for home power
    - Most L1 (80% L1, 20% L2)
    - Most L2 (20% L1, 80% L2)
    - Even L2 (50% L1, 50% L2)
  - 50% have access to home power. Three additional options for home power
    - Most L1 (80% L1, 20% L2)
    - Most L2 (20% L1, 80% L2)
    - Even L2 (50% L1, 50% L2)
- Work Power (3):
  - **Most L2 (20% L1, 80% L2)**
  - **Even L2 (50% L1, 50% L2)**
  - **Most L1 (80% L1, 20% L2)**
- Home/Work Preference (3):
  - 100% prefer home
  - 80% prefer home
  - 60% prefer home

## Exhaustive list of API input parameters

# Demo of the Tool and API

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- [afdc.energy.gov/evi-pro-lite/load-profile](https://afdc.energy.gov/evi-pro-lite/load-profile)
- [developer.nrel.gov/docs/transportation/evi-pro-lite-v1](https://developer.nrel.gov/docs/transportation/evi-pro-lite-v1)

# EVI-Pro Lite – Load Profile

<https://afdc.energy.gov/evi-pro-lite/load-profile>

The screenshot shows the 'Alternative Fuels Data Center' website. The main navigation bar includes 'FUELS & VEHICLES', 'CONSERVE FUEL', 'LOCATE STATIONS', 'LAWS & INCENTIVES', 'Maps & Data', 'Case Studies', 'Publications', 'Tools', 'About', and 'Home'. The 'Tools' section is active, showing 'EERE + AFDC + Tools' and a 'Portable Version' link. The title is 'Electric Vehicle Infrastructure Projection Tool (EVI-Pro) Lite'. A description states: 'This tool provides a simple way to estimate how much electric vehicle charging you might need and how it affects your energy load profile.' Below this are two tabs: 'Charging Need' and 'Load Profile', with 'Load Profile' selected. The main heading is 'How Does Vehicle Charging Affect My Charging Load Profile?'. The form asks to 'Choose from the options that best fit your scenario.' It has two dropdowns: 'Where does your fleet operate?' with 'select a state' and 'select a city/urban area'. Below this is 'How many plug-in electric vehicles are in your fleet?' with a slider from 1,000 to 30,000 and a 'More' option. A 'Calculate' button is at the bottom. At the very bottom, there are links for 'Developer API' and 'Assumptions'.

<https://developer.nrel.gov/docs/transportation/evi-pro-lite-v1/>

The screenshot shows the 'Developer Network' page for NREL. The navigation bar includes 'HOME', 'DOCUMENTATION', and 'COMMUNITY'. The 'Documentation' section is active, showing 'Transportation' > 'EVI-Pro Lite'. The title is 'EVI-Pro Lite API' with a base URL of '/api/evi-pro/v1'. A description states: 'APIs providing output from NREL's EVI-Pro model. Used to power the EVI-Pro Lite tool at <https://afdc.energy.gov/evi-pro-lite>. These endpoints provide daily (24 hour) fleet-level charging load profiles for a variety of customizable scenarios.' Below this is a paragraph explaining that EVI-Pro Lite is a simplified version of the Electric Vehicle Infrastructure Projection Tool (EVI-Pro) and provides real-world travel data from mass market consumers. It also mentions that for more information, users should see the 'methodology and assumptions page'. On the right, there is an 'API Key' field with 'DEMO\_KEY' and a note: 'For higher rate limits, [sign up for your own API key](#). See [API key usage](#) for more information.' Below this are two API endpoints: 1. 'GET /daily-load-profile' with a description: 'Loads (kW) are returned in 15-min step intervals for 24 hours where the 15-min data point is the average of instantaneous load over that interval. The first element of the load profile covers 12:00 AM - 12:15 AM, the second 12:15 AM - 12:30 AM, and so on.' 2. 'GET /daily-load-profile/breakdown' with a description: 'Loads (kW) are returned in 15-min step intervals for 24 hours but broken down by pev\_type (one of PHEV20, PHEV50, BEV100, BEV250) and class\_type (Sedan or SUV)'. At the bottom right, there is a 'VALID' button and a 'Help Improve this Content' link. At the bottom, there is a footer with the NREL logo and text: '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.' and links for 'Need Help?', 'Security & Privacy', 'Disclaimer', and 'NREL Home'.

# Initial form

- Users select state and city/urban area on initial screen
- May choose a larger fleet size, but max fleet size is restricted to 100% of current light duty fleet

### How Does Vehicle Charging Affect My Charging Load Profile?


Choose from the options that best fit your scenario.

Where does your fleet operate?

Minnesota


Grand Forks

How many plug-in electric vehicles are in your fleet?

  
1,000

10,000

30,000

  
More

Fleet size can't be greater than the total number of light-duty vehicles (56,080) for the area.

Fleet Size

Calculate

# Results page

- Results show user inputs plus other default values
- All values may be edited
- Question mark icon on results page indicates more information is available

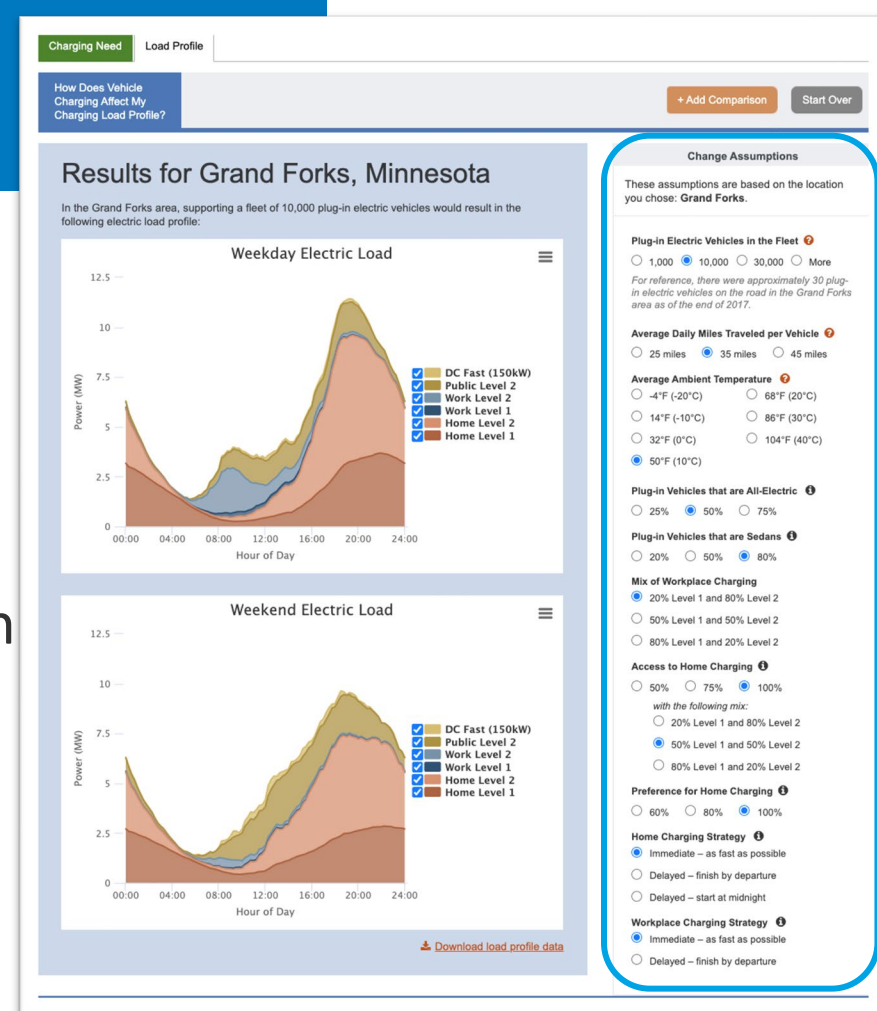
**Plug-in Electric Vehicles in the Fleet** ⓘ

☐ 1,000 ☐ 10,000 ☒ 30,000 ☐ More

Based on national electric vehicle stock projections from the US Energy Information Administration, the Grand Forks region could see 673 electric vehicles on the road by 2030 (see assumptions).

**Average Ambient Temperature** ⓘ

☐ -4°F (-20°C) ☐ 68°F (20°C)



# Results page

- Tooltips add context and clarification

**Plug-in Vehicles that are All-Electric** ⓘ

☐ 25% ☒ 50% ☐ 75%

**Plug-in Vehicles that are Sedans** ⓘ

☐ 20% ☐ 50% ☒ 80%

**Mix of All-Electric Vehicles** ✕

This filter has three options that let you choose a distribution of all-electric vehicles (EVs), also called battery electric vehicles (BEVs). Each distribution is based on assumptions for the percentage of EVs and plug-in hybrid electric vehicles (PHEVs) that have enough energy storage to drive a given distance.

**25% – PHEV Dominant**  
This fleet has more PHEVs than EVs with this breakdown:

- 25% PHEVs that can drive 20 electric miles
- 50% PHEVs that can drive 50 electric miles
- 10% EVs that can drive 100 miles
- 15% EVs that can drive 250 miles

**50% – Equal Shares of EVs and PHEVs**  
This fleet has about the same number of EVs as PHEVs with this breakdown:

- 15% PHEVs that can drive 20 electric miles
- 35% PHEVs that can drive 50 electric miles
- 15% EVs that can drive 100 miles
- 35% EVs that can drive 250 miles

**75% – EV Dominant**  
This fleet has more EVs than PHEVs with this breakdown:

- 10% PHEVs that can drive 20 electric miles
- 15% PHEVs that can drive 50 electric miles
- 25% EVs that can drive 100 miles
- 50% EVs that can drive 250 miles



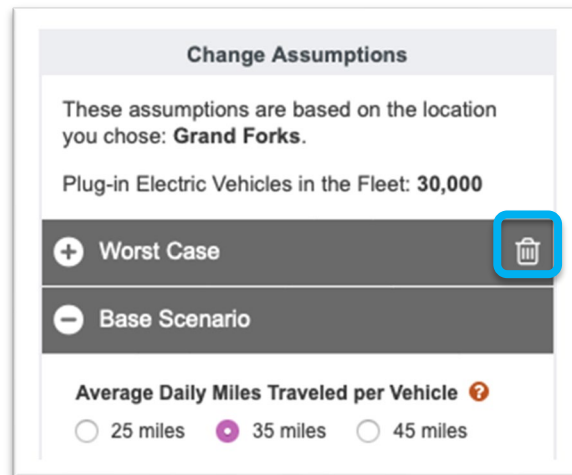
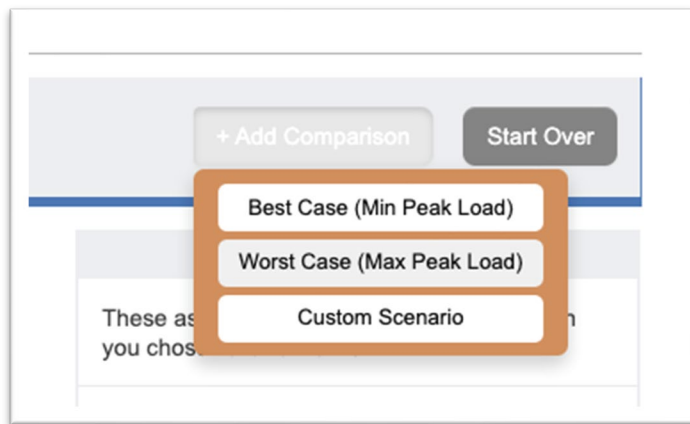
# Results page

- Load profile charts are greyed out and Recalculate button appears any time changes are made to inputs
- Load profile shapes adjust once the Recalculate button is clicked



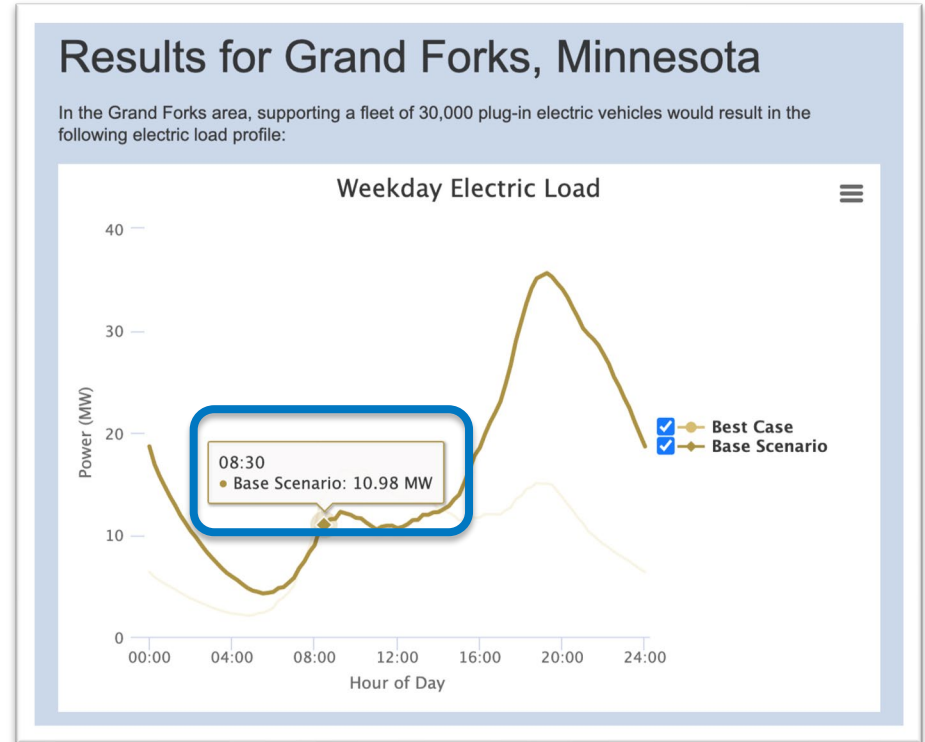
# Multiple scenarios allowed

- Users can add or remove up to 5 comparison scenarios
- Pre-defined “Best” and “Worst” case scenarios cannot be edited, show minimum and maximum peak scenarios

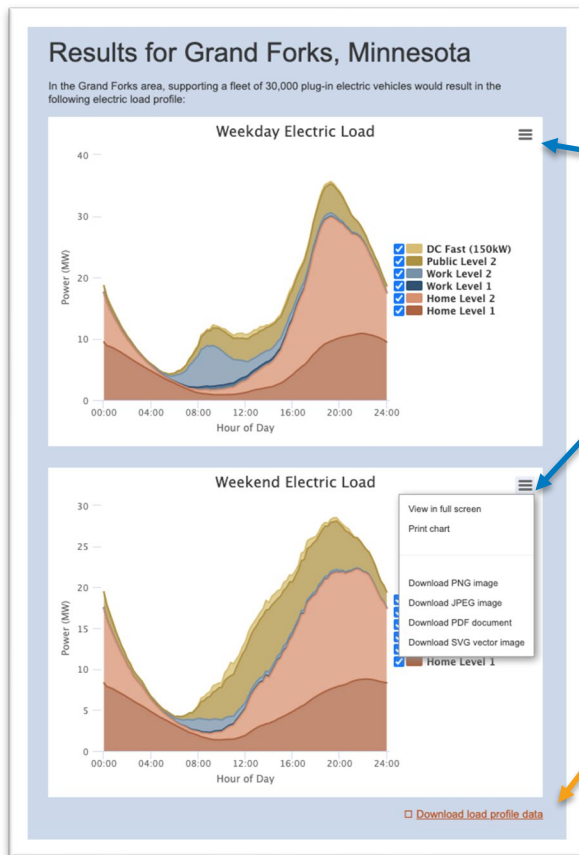


# Multiple scenarios

- When multiple scenarios are selected, charts change to a single line per scenario
- Hovering over chart shows time of day



# Chart and input downloads







- Two downloads available:
  - Chart images (PNG, JPEG, PDF, or SVG)
  - Scenario inputs (CSV)

# Load Flexibility

- Default scenario for EVI-Pro Lite is “minimum delay” – charging begins at full power/speed as soon as a user arrives at home or work and lasts until the vehicle is fully charged or unplugged
- Inputs to represent load flexibility demonstrate potential shifts in charging loads
- Tooltip defines charging strategies

### Home and Workplace Charging Strategy

This filter has four options for home charging and three options for workplace charging that let you explore load flexibility by adjusting the charging strategy:

-  **Immediate – as fast as possible**  
This option assumes vehicles begin charging as soon as possible upon arriving at a charging location and charge at full power/speed until fully charged or the vehicle departs.
-  **Immediate – as slow as possible (even spread)**  
This option assumes vehicles begin charging immediately upon arriving at a charging location, but the charging speed/power is controlled to be as slow/low as possible to spread the charge evenly over the time the vehicle is parked.
-  **Delayed – finish by departure**  
This option assumes vehicles wait as long as possible to begin charging so they can still receive a full charge. This strategy uses arrival and departure times from the travel data referenced in the assumptions to shift load during simulations.
-  **Delayed – start at midnight (only home charging)**  
This option assumes vehicles begin home charging at midnight because some vehicle owners elect to program their vehicles to start charging at a specific time overnight, which is often midnight.

### Change Assumptions

These assumptions are based on the location you chose: **Boulder**.

**Plug-In Electric Vehicles in the Fleet** ?  
☐ 1,000 ☒ 10,000 ☐ 30,000 ☐ More  
*For reference, there were approximately 1,860 plug-in electric vehicles on the road in the Boulder area as of the end of 2017.*

**Average Daily Miles Traveled per Vehicle** ?  
☐ 25 miles ☒ 35 miles ☐ 45 miles

**Average Ambient Temperature** ?  
☐ -4°F (-20°C) ☐ 68°F (20°C)  
☐ 14°F (-10°C) ☐ 86°F (30°C)  
☐ 32°F (0°C) ☐ 104°F (40°C)  
☒ 50°F (10°C)

**Plug-In Vehicles that are All-Electric** ?  
☐ 25% ☒ 50% ☐ 75%

**Plug-In Vehicles that are Sedans** ?  
☐ 20% ☐ 50% ☒ 80%

**Mix of Workplace Charging**  
☒ 20% Level 1 and 80% Level 2  
☐ 50% Level 1 and 50% Level 2  
☐ 80% Level 1 and 20% Level 2

**Access to Home Charging** ?  
☐ 50% ☐ 75% ☒ 100%  
*with the following mix:*  
☐ 20% Level 1 and 80% Level 2  
☒ 50% Level 1 and 50% Level 2  
☐ 80% Level 1 and 20% Level 2

**Preference for Home Charging** ?  
☐ 60% ☐ 80% ☒ 100%

**Home Charging Strategy** ?  
☐ Immediate – as fast as possible  
☒ Immediate – as slow as possible (even spread)  
☐ Delayed – finish by departure  
☐ Delayed – start at midnight

**Workplace Charging Strategy** ?  
☒ Immediate – as fast as possible  
☐ Immediate – as slow as possible (even spread)  
☐ Delayed – finish by departure

# API and Methodology

- Assumptions and Methodology content provided from page footer (<https://afdc.energy.gov/evi-pro-lite/load-profile/assumptions>)
- API documentation for underlying APIs also linked from page footer (<https://developer.nrel.gov/docs/transportation/evi-pro-lite-v1/>)

# Local Opportunities



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# Q&A

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