Electric Vehicle Charging Demand

SCE Intern Expo 2023

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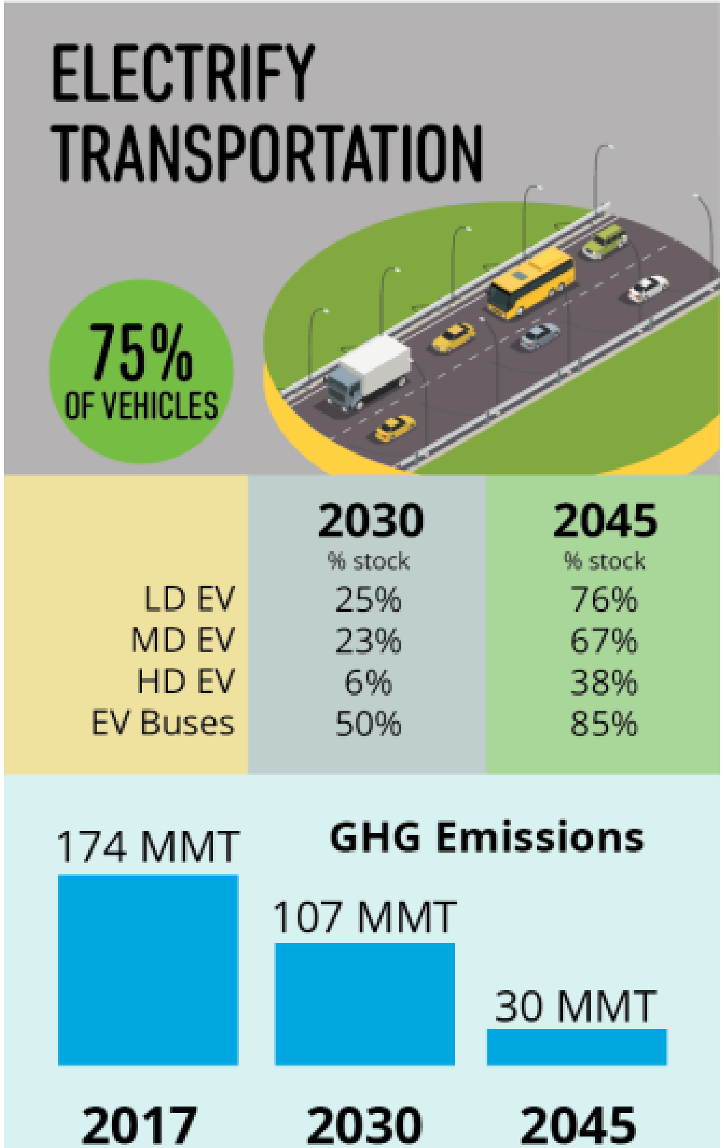
Project Overview



- Reach EV adoption goals from Pathway 2045
- Electrify transportation
- Observe charging patterns and characteristics of EV adopters (Phase I)
- Understand EV demand and energy loads
- Identify potential EV adoption across cities in CA (Phase II)

Executive Summary

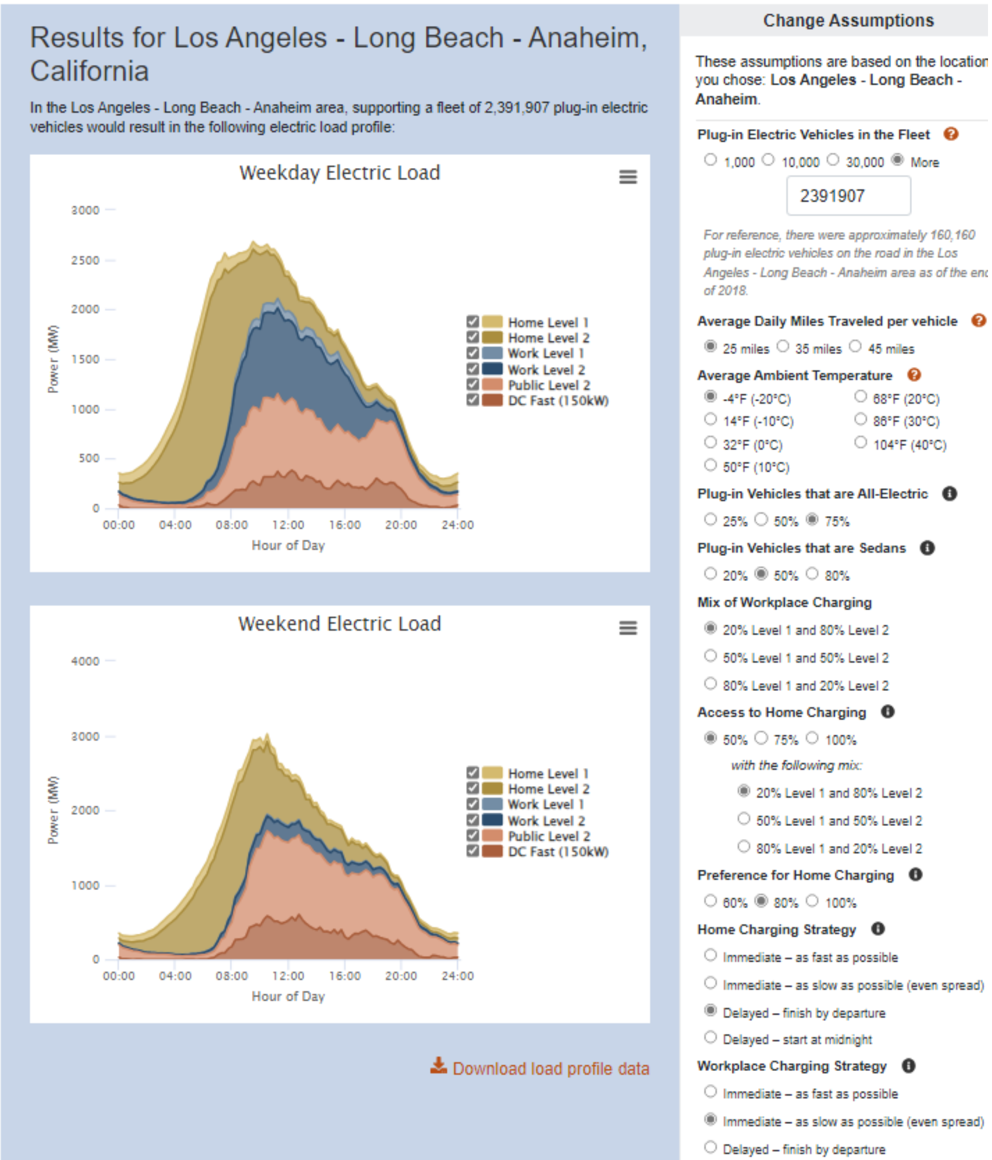
- EVI-Pro tool predicts energy load shapes based on a customer's specific charging strategy
- Building scenarios show how diverse each customer's charging patterns impact the overall energy load
- EVI-Pro helps to identify key drivers that can change the demand
- Identifying charging behaviors by observing energy usage before and after EV adoption
- Analyzing differences in energy loads to show the charging strategy and in the long-run, build a model to identify EV adopters

PHASE I: Exploring EVI-Pro

Energy for What's Ahead®

SOUTHERN CALIFORNIA EDISON®

EV Infrastructure Projection Tool (EVI-Pro LITE Version)



https://afdc.energy.gov/evi-pro-lite

What is it?

The NREL tool estimates how much electric charging one might need and how it affects customer demand.

- LITE version is a public web version

Purpose:

- Learn how this tool operates
- Build scenarios of load shapes with different assumptions according to 2030 and 2045
- Identify parameters that significantly shift load shapes
- Understand peaks forming at certain times

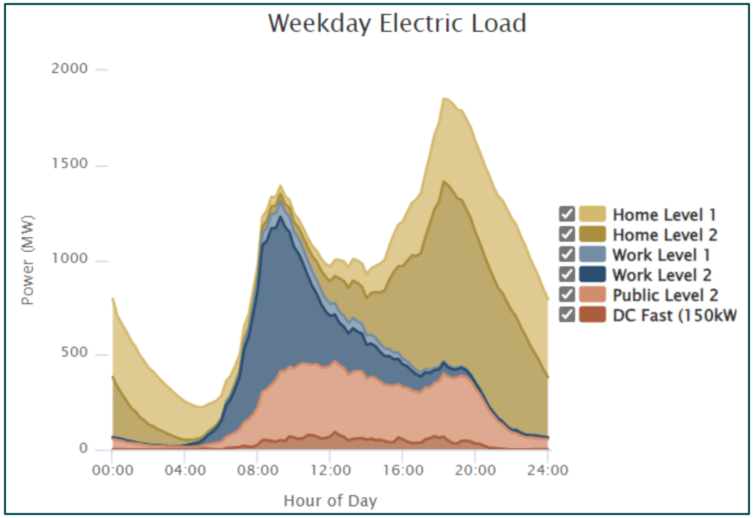
Can this tool be helpful in forecasting demand in the future?

Specific Conditions and Charging Preferences Shift Load Shapes

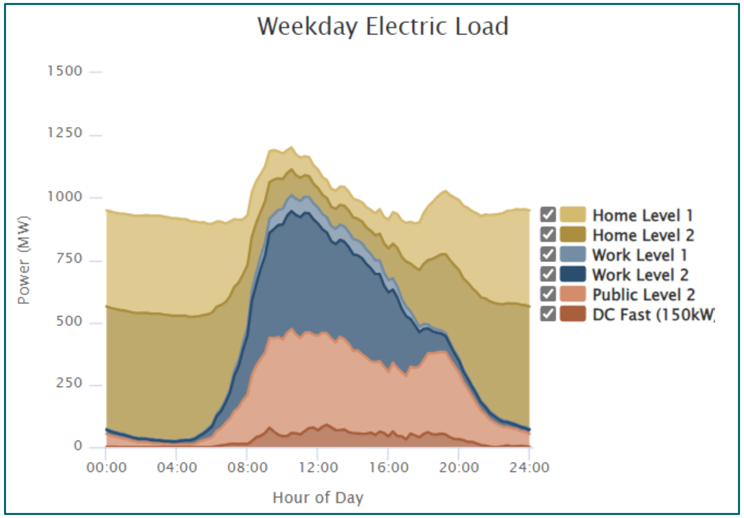
Scenarios	Customer Type	Charging Behavior
Scenario 1	On the move	• Constantly on the move • Needs to charge often to travel • Short on time • Frequent charging
Scenario 2	Nontraveler	• Do not need to charge as much • Does not travel often • Do not need a full charge • Plugs in if necessary
Scenario 3	Optimal Night Charging	• Prioritize charging at midnight • Charges at work sometimes • Travels long distances
Scenario 4	Optimal Charging	• Likes to strategically charge to a specific time • How fast or slow is not a factor

Scenarios show Distinct Charging Patterns

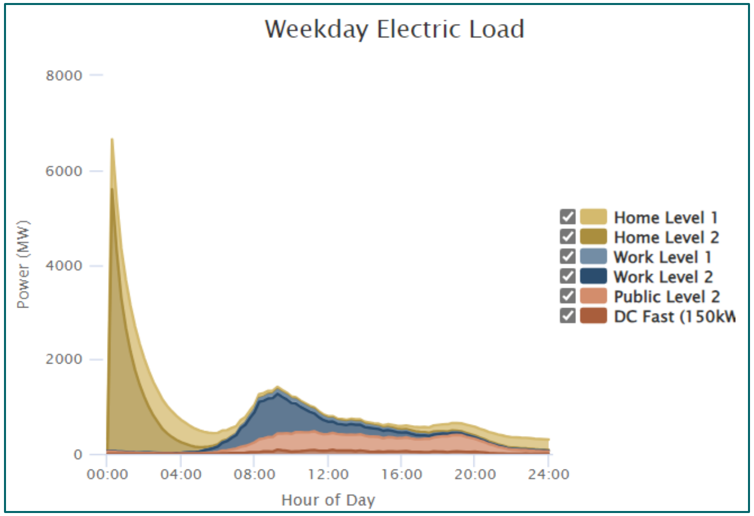
Scenario 1: On the move



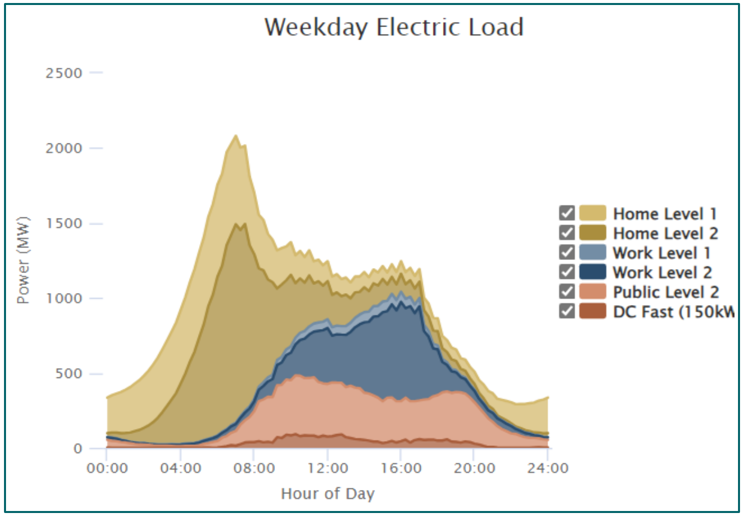
Scenario 2: Nontraveler



Scenario 3: Optimal night charging

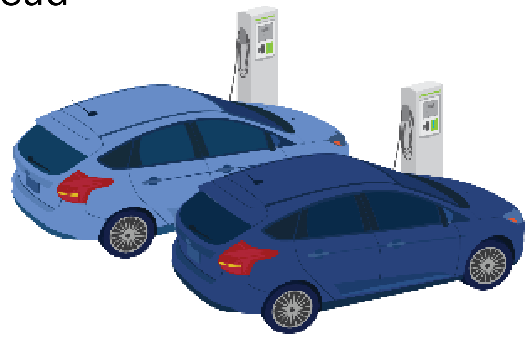


Scenario 4: Optimal charging



Specific Parameters Drive Significant Demand Changes within EVI-Pro

- **Working Hours**
  - Energy peaks commonly occur before and after working hours (6:00-9:00am and 16:00-20:00pm)
  - Other off-peak hours are due to specific charging incentives of customers
- **Home/Workplace Charging** (assumptions)
  - Access to home charging = shifts total load
  - Mix of L1 and L2 chargers(%) = shifts total load
  - Preference for home charging(%) = does not affect load
  - Home/Workplace Charging Strategy:
    - Immediate - as fast as possible
    - Immediate - as slow as possible
    - Delayed - finish by departure
    - Delayed – start at midnight (only home charging)



Certain Conditions Prove No Effect on Demand

- Temperature
  - No significant effect on the load shape
- Public charging
  - Similar load shapes in all scenarios
  - Not a reliable factor due to limited options in comparison to Home/Workplace

Tool Limitations Hinder Significant Change to Demand

- Pricing is not a factor in this tool, which would significantly affect charging decisions for customers
- Public charging strategy is not a factor
  - Not as weighted compared to Home/Workplace Charging Strategy
- Limited range of options for certain parameters

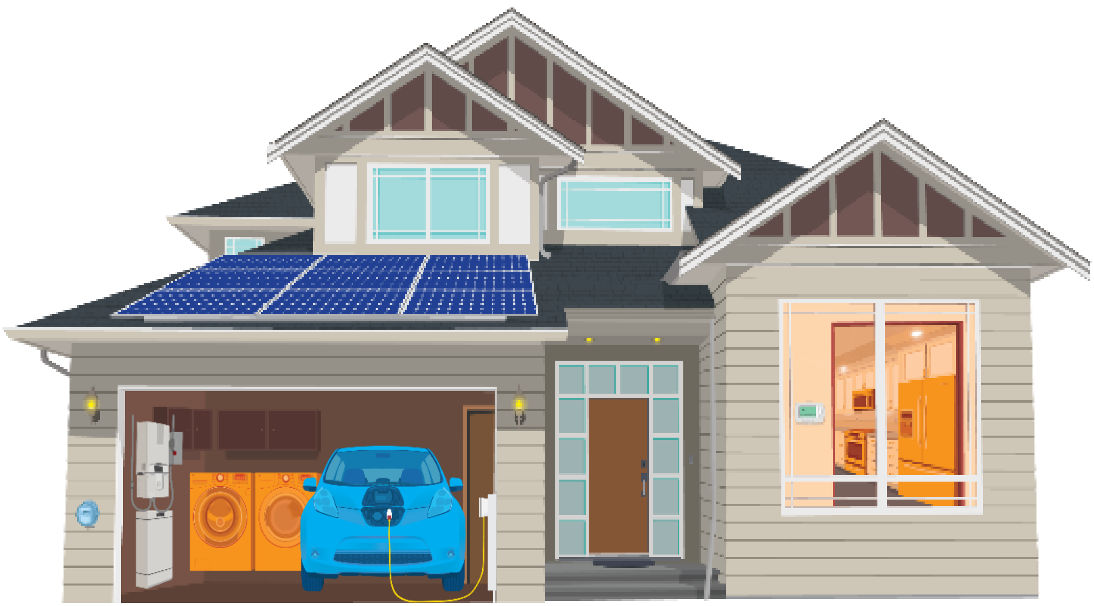
PHASE II: Comparing Pre-EV and Post-EV Average Load Shapes

Analyzing Pre-EV vs Post-EV of Customers to Identify Charging Behavior

Compare energy usage before and after EV purchase for each customer → Identify EV charging and customer's charging patterns → Automate process to perform on a larger scale → Identify potential EV adopters

Walnut- 91789

- 12%- EV Adoption
- 76% - Single family households
- 90%- Homeowners

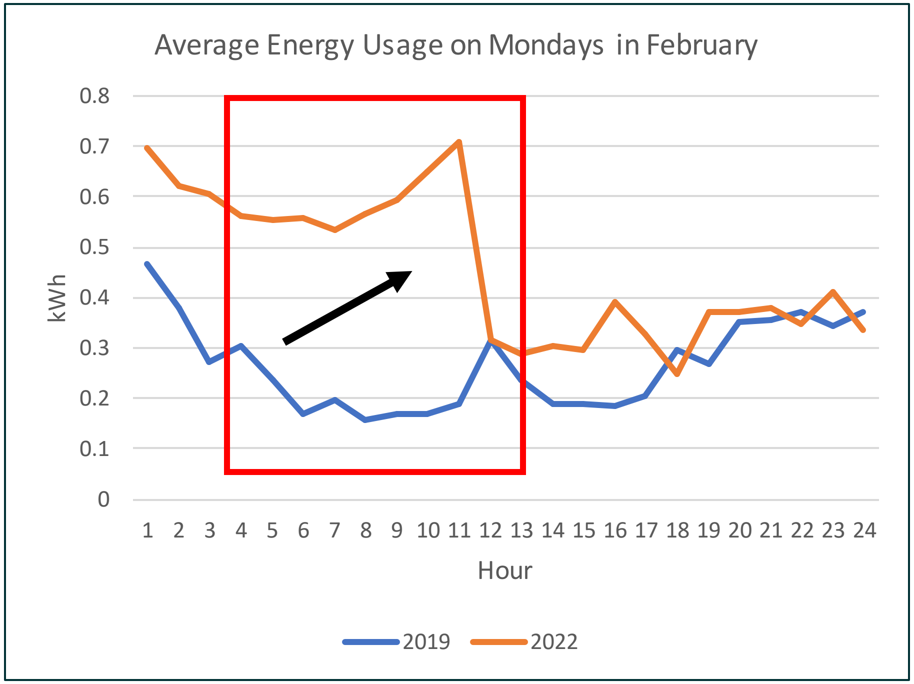


Customer Segments:

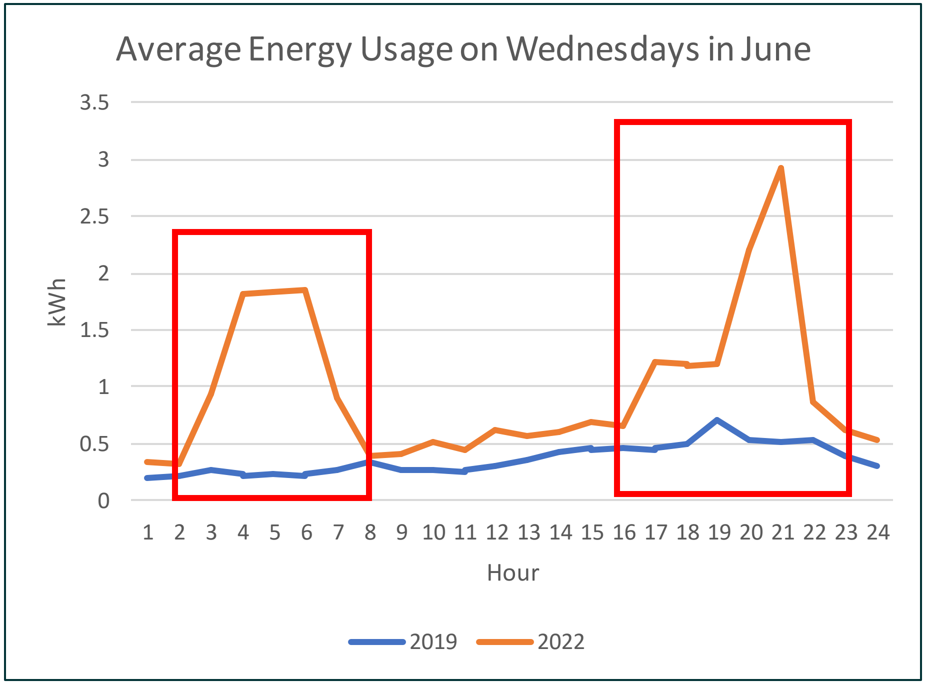
- Young Hopefuls
  - Young, Single, Low-Income
- Affluent Modern Families
  - Large families, High-Income, High-Education
- Clean Energy Engagers
  - Moderate-Income, Clean Energy fans
- Settled Seniors
  - Retired Singles/Couples, Lowest Household Income

Drop in Energy Usage Shows Shift to Home Charging and Charging Pattern

Midnight to 12PM



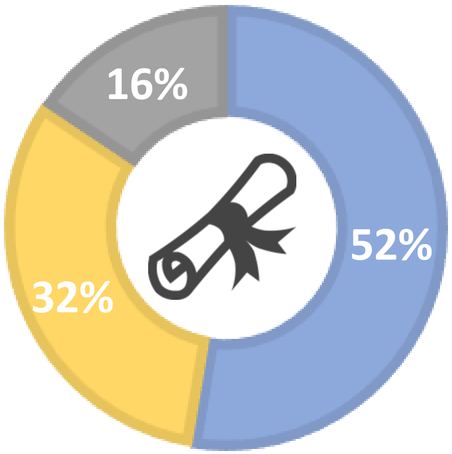
Midnight to Morning and Afternoon



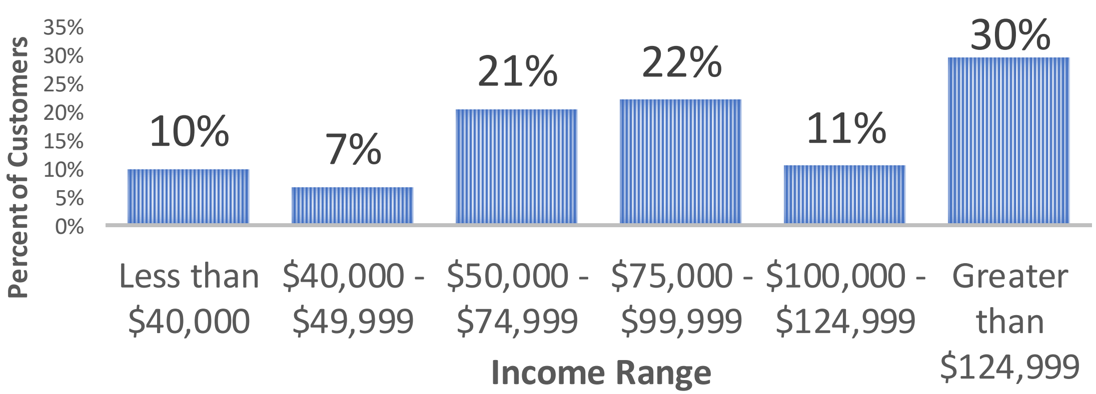
Observing the energy usage of a resident in Walnut that displays two different years before and after EV purchase. 2020 year excluded due to COVID-19.

Walnut Population

Majority of EV Owners Attained their High School Degree as Highest Level of Education



Median Household Income Range is $50,000-$75,000 amongst EV Owners



189

customers with known EVs and household information

94%

reside in a single-family dwelling home

92%

are homeowners

TOYOTA 11%

TESLA **70%**

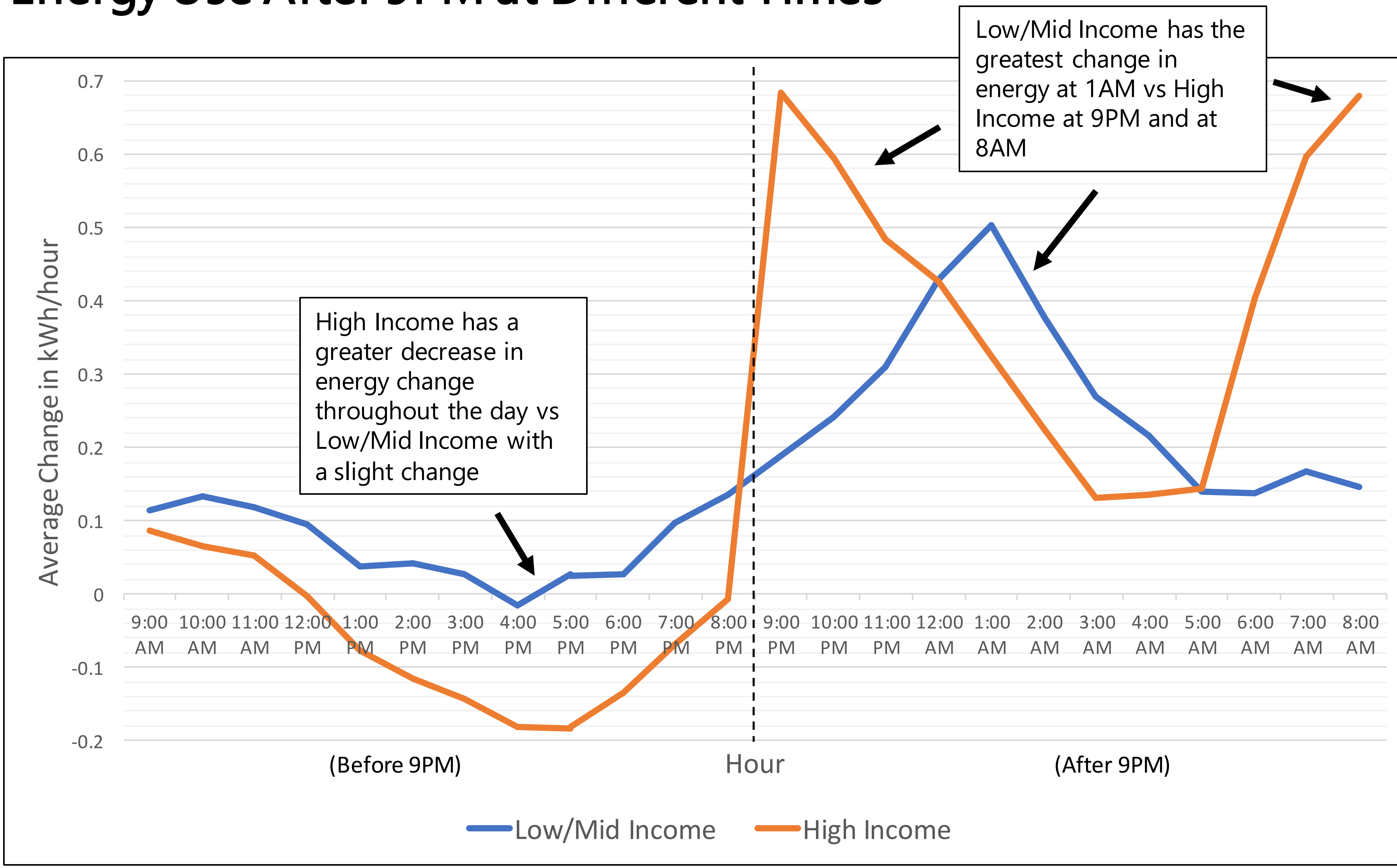
OTHER 19%

of EV adopters commonly own Tesla vehicles

Identify Charging Characteristics Based on Income Level

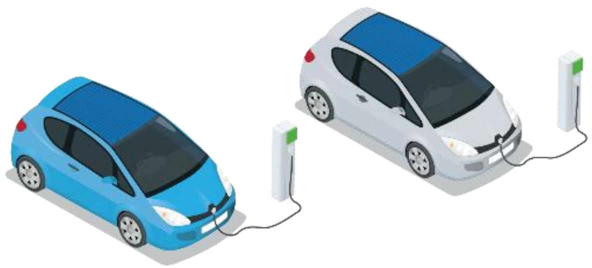
Group	Income	Energy Usage
Group 1: Low-Mid Income	<$75,000	Before 9pm
	<$75,000	After 9pm
Group 2: High Income	>$75,000	Before 9pm
	>$75,000	After 9pm

High Income and Low/Mid Income have Significant Changes in Energy Use After 9PM at Different Times

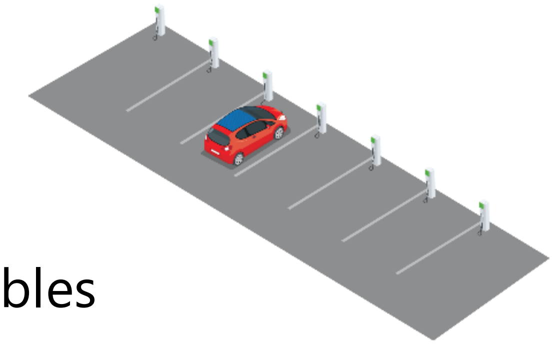


*Both lines are averages of all charging behaviors

Next Steps…



- Build a model that can identify potential EV adopters based on the characteristics and EV charging behavior of recent adopters
  - EV charging data/Meter data/Type of charger
- Build a model that can identify when the customer bought an EV based on Energy Usage (given no purchase date)



What I have learned

- Organize/digest data(energy) and its variables
- Project planning with a step-by-step process and meeting deadlines
- Improving my Excel and R language skills
- Methods to researching and learning information effectively
- Electric Vehicles and Charging Demand now vs in the future