Department of Engineering Management and Systems Engineering
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# Peak-Shaving and Cost Efficiency of BEV Smart Charging

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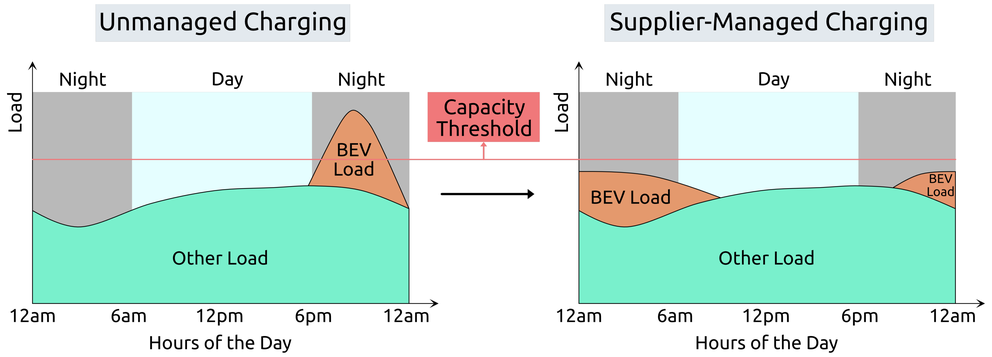
## Introduction

- **Unmanaged** BEV charging amplifies grid peaks, raising costs and emissions.
- Supplier-managed charging (**SMC**) shifts load to valleys, shaving peak and costs.
- We chose **CAISO** and **NYISO** as high-BEV-adoption regions with contrasting grids (solar *vs* hydro, warm *vs* cold).
- **Research Questions:**
  1. How much **peak** can be **shaved** across regions, seasons, and extreme days?
  2. How to maximize **cost efficiency** and avoid counter-productivity?




## Method

**1.Config**: 5 TOU windows, 11 enrollment levels, 4 seasons, 2 extreme days.
**2.Data**: NHTS trip records, grid net load, Census data, SMC survey results.

**Scenario Inputs**

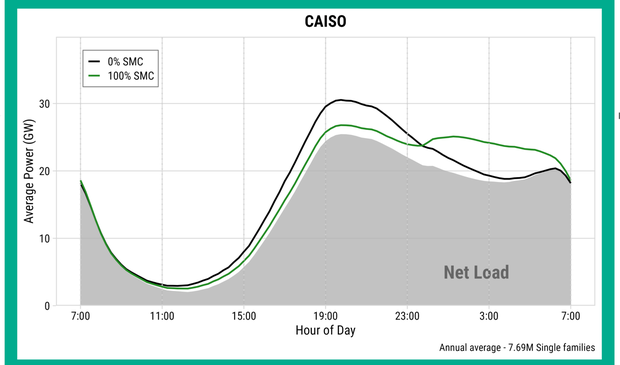
- **Regions**: CAISO, NYISO
- **Time Periods**: Annual average, Extreme days, Seasonal
- **EV:House**: 1:1, 1:2, 1:4
- **SMC Enrollment**: 0%, 10%, ..., 100%
- **Load Shifting Window**: 10AM-8PM -> 8PM-7AM; 10AM-9PM -> 9PM-7AM; 10AM-10PM -> 10PM-7AM; 10AM-11PM -> 11PM-7AM; 10AM-12AM -> 12AM-7AM

**Peak-Shaving Model**

Data Source

- Grid Net Load: 2025 CAISO & NYISO time-series data
- Household Count: 2025 U.S. Census; CAISO: 7.69M; NYISO: 3.16M
- Travel Patterns: 2022 NHTS Results

One Example Run



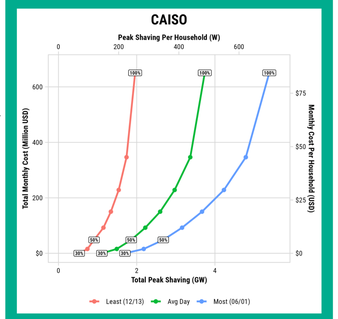

Run the peak-shaving model multiple times with varying scenario inputs.

**Cost Efficiency Simulation**

Data Source

- Enroll vs Cost Model: 2024 Discrete Choice Experiment (1,356 BEV owners)

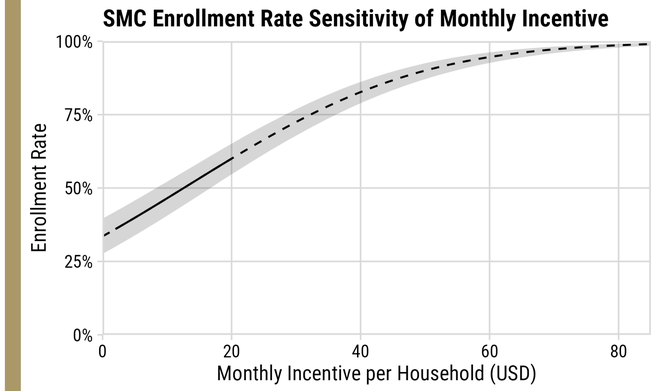
Extreme Days Example



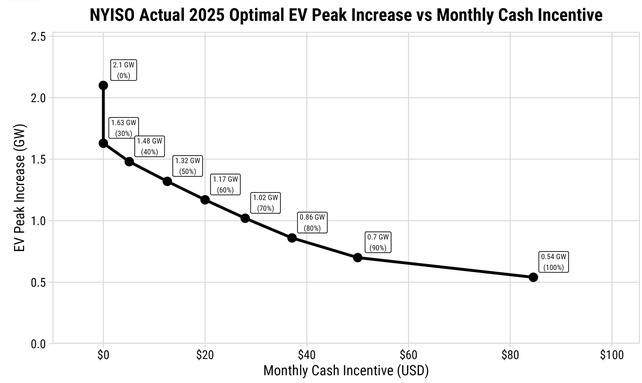

Contains annual average, extreme days, seasonal averages, and different EV-to-house ratios

## Modeling

### Enrollment Sensitivity

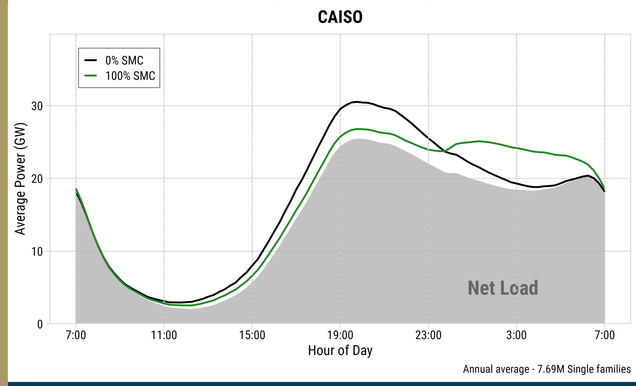



### EV Peak Reduction

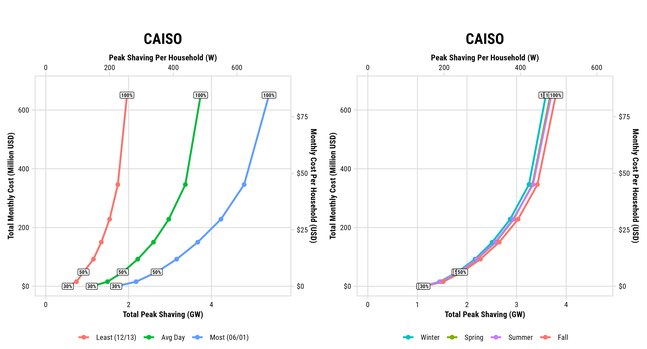



## CAISO Peak Shaving 2025

### Daily Average

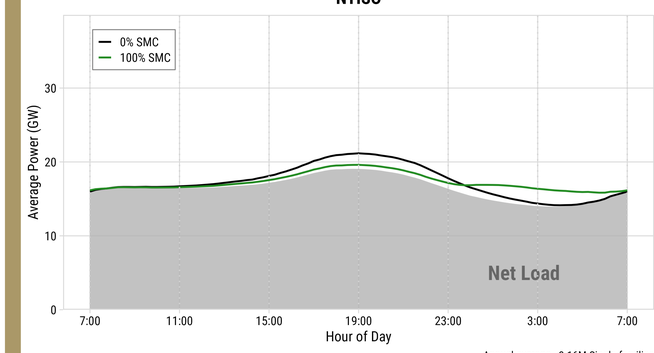



### Efficiencies

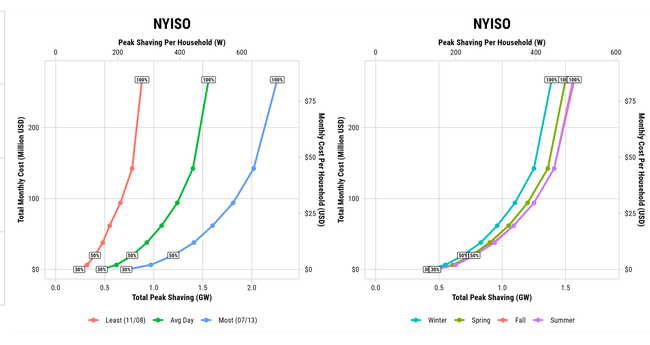



## NYISO Peak Shaving 2025

### Daily Average




### Efficiencies

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