Demonstration of Vehicle-Grid Integration in Non-Residential Scenarios

Sept 30, 2020

PowerFlex Systems - Overview

3,000+
EV CHARGING STATIONS DEPLOYED

10,000,000+
ELECTRIC MILES DELIVERED SAFELY

100+
CHARGING SITES

- PROJECT DEVELOPMENT
- FINANCING
- TURN KEY EPC
- PROJECT COMMISSIONING
- ASSET MANAGEMENT/O&M

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Large-scale EV deployments at Offices, Schools, and Universities

Campbell Union HSD

(248 total: 38 deployed, 210 under construction)


Caltech

(138 total deployed)


Los Altos SD

(180 total: 52 deployed, 128 under construction)


Mountain View Los Altos UHSD

(52 total deployed)


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Sample PowerFlex Clients

Municipal

PASADENA CALIFORNIA · WWW.CITYOFPASADENA.NET
County of Los Angeles California
County of Santa Barbara California
City and County of San Francisco
City of San Jose Capital of Silicon Valley

Real Estate

Cushman & Wakefield
UDR
Hines
MGR Real Estate
SummerHill Apartment Communities

Universities

Caltech
UCSF
UC San Diego

Non-Profit

Children's Hospital Los Angeles
Natural History Museum Los Angeles County
Getty
LACMA
Los Angeles LGBT Center

Research

NREL National Renewable Energy Laboratory
JPL Jet Propulsion Laboratory California Institute of Technology
SLAC National Accelerator Laboratory

Workplace

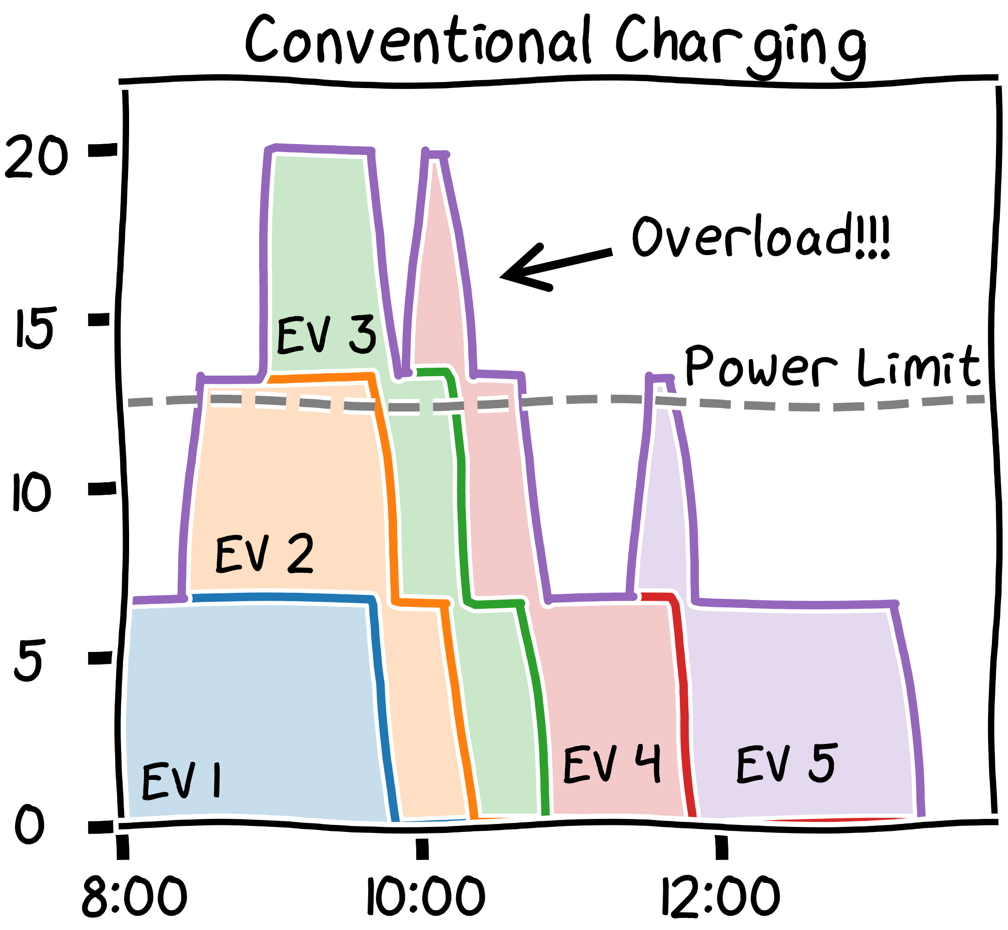
intuit
Adobe
SAP
OSIsoft

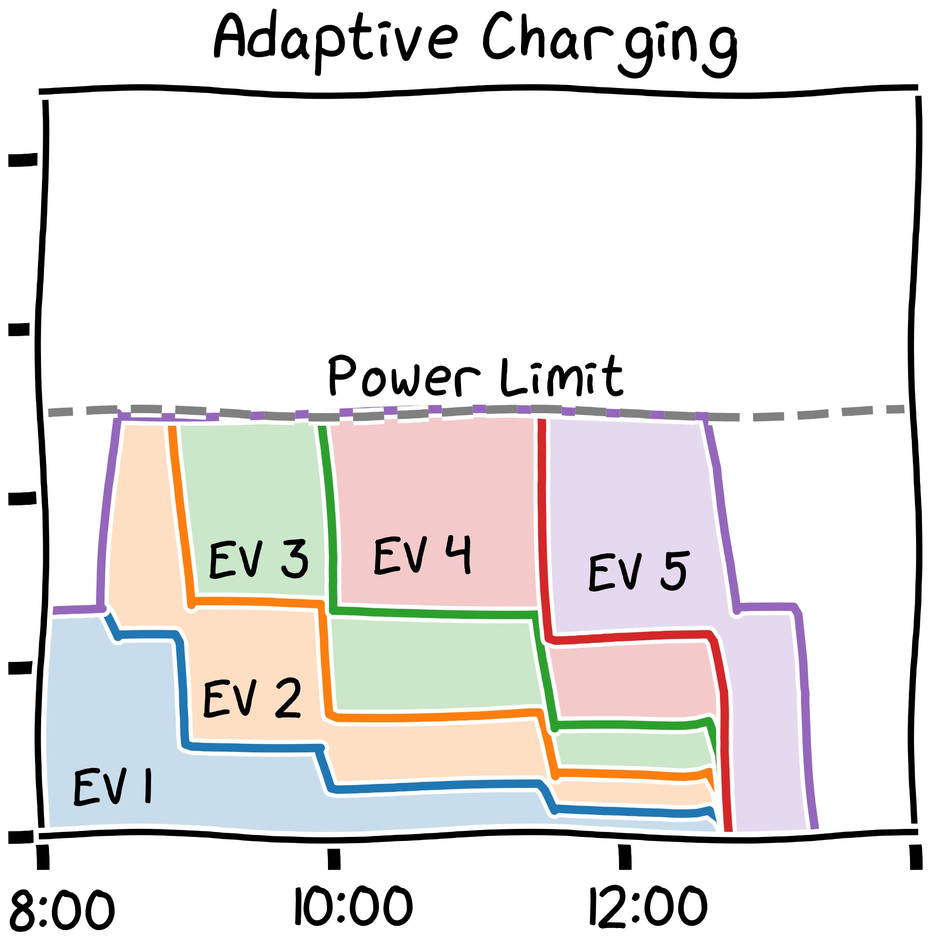
Medium Duty Fleet

DHL
OTG Off the Grid

PowerFlex AN EDF RENEWABLES COMPANY

Driver flexibility allows us to do more with less…





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Infrastructure Options: 100 EVs per day

Level 1 Charging

102 Ports
200 kVA Transformer

Demand Met: **75.4%**
Cost: $0.28 / kWh

Uncontrolled Level 2 Charging

102 Ports
680 kVA Transformer

Demand Met: 99.9%
Cost: **$0.35 / kWh**

30 Ports w/ Swapping
200 kVA Transformer

Demand Met: 99.6%
Cost: $0.256 / kWh
Swaps: **1,103 / month**

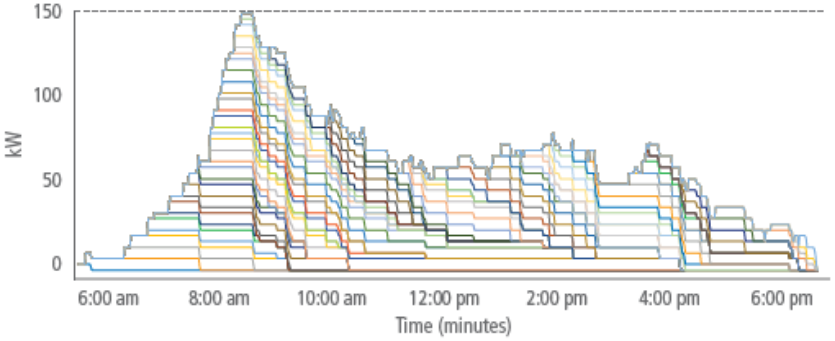
Adaptive Level 2 Charging

102 Ports
200 kVA Transformer

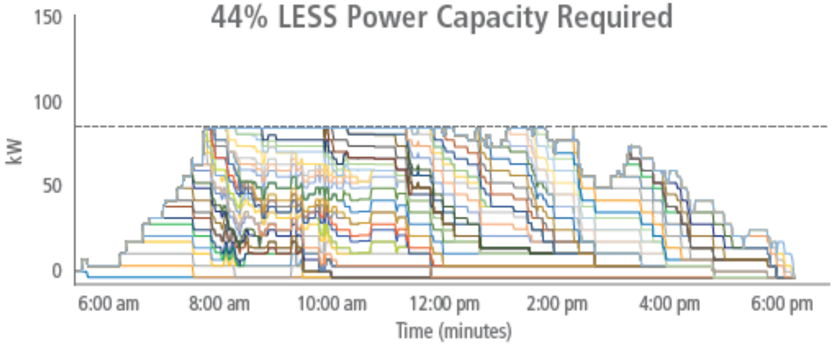
Demand Met: **99.8%**
Cost: **$0.23 / kWh**

Adaptive Load Management at Scale

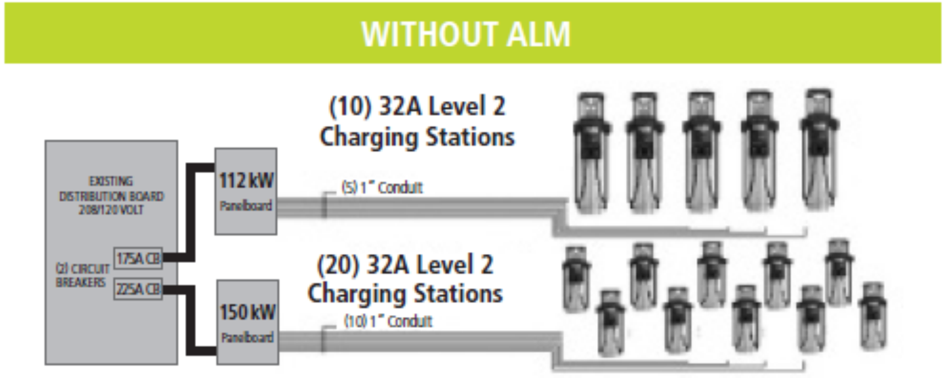
71 EVs without Adaptive Charging

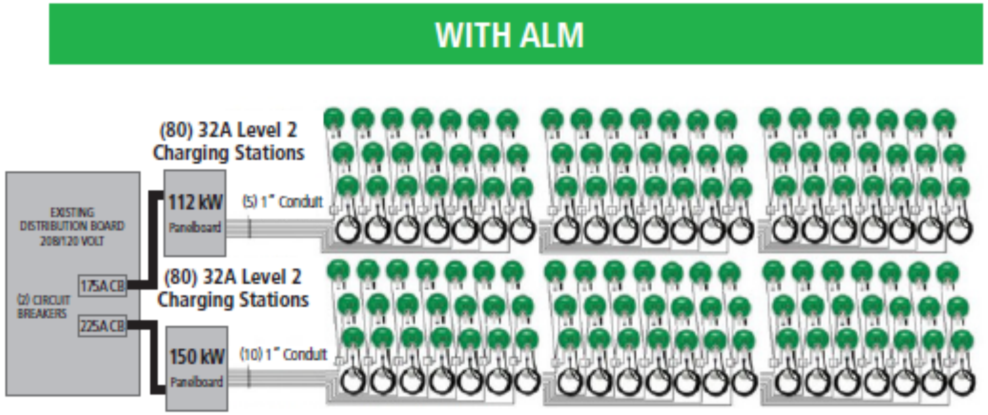


71 EVs with Adaptive Charging:
44% LESS Power Capacity Required



Not a single car had to stay later to receive the same amount of energy as the chart above.





(160) 32A Charging Stations on 262 kW total capacity using UL916 Adaptive Load Management

Actual data from Caltech

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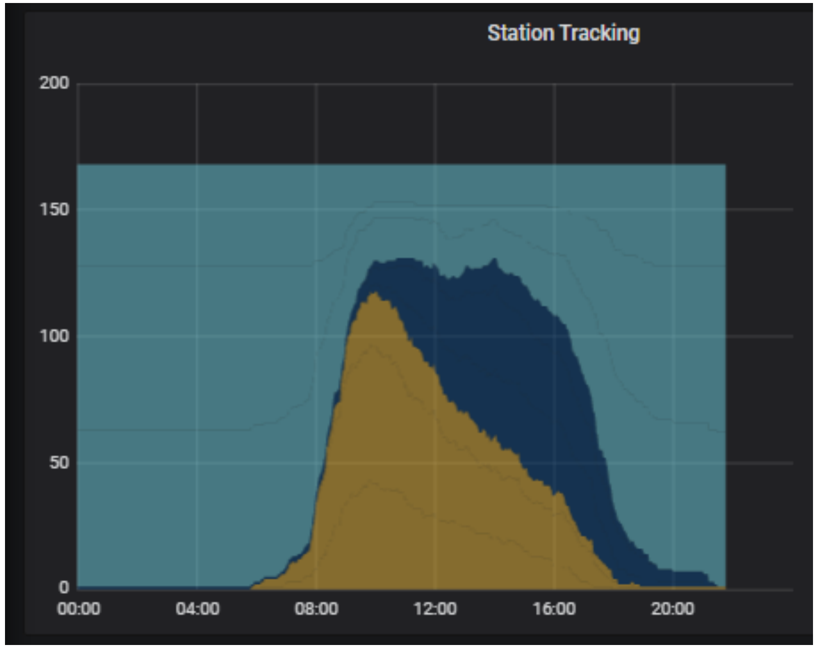
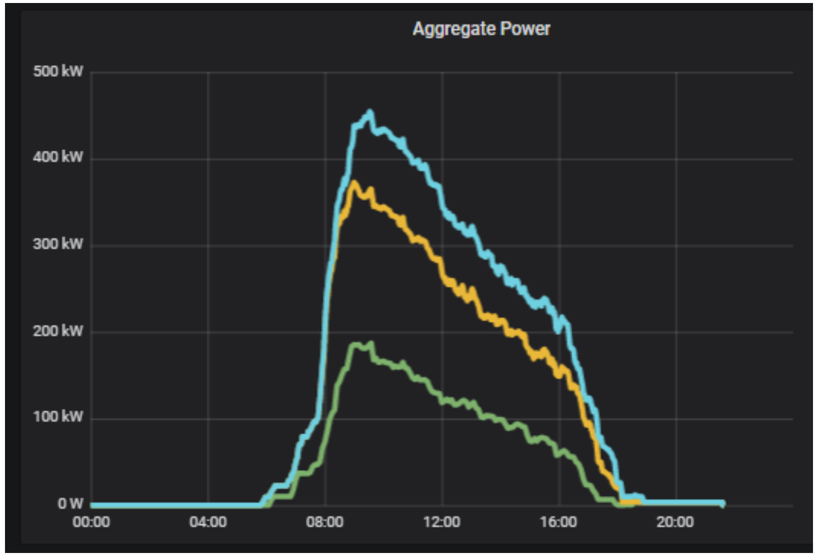
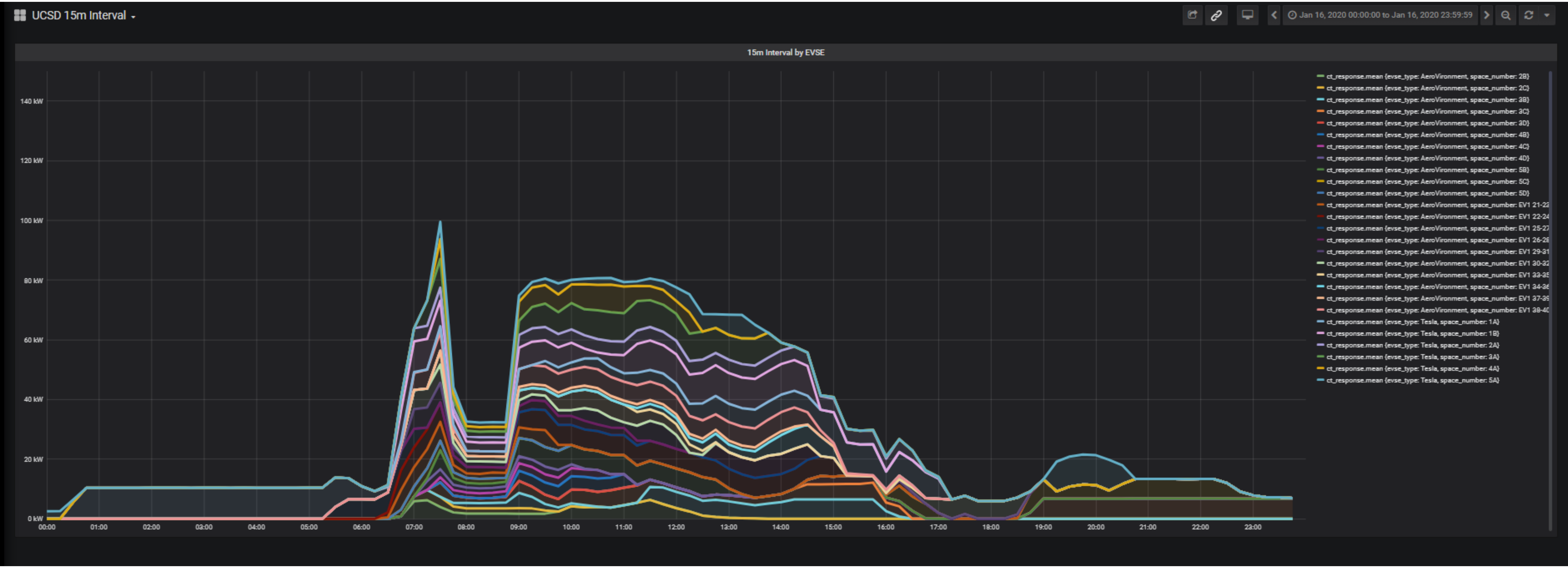
Case Study: 168 Chargers





- **168 chargers**
  - 118x Universal (J1772) x 6.6kW
  - 50x Tesla x 16kW
- 1.578MW nameplate
  - Connected to 800A/480V panel (max load @80% = 532kW)
  - 3x capacity
  - No Interconnection Upgrade
- Cost: **<$3,000/station**

Demand Response Example



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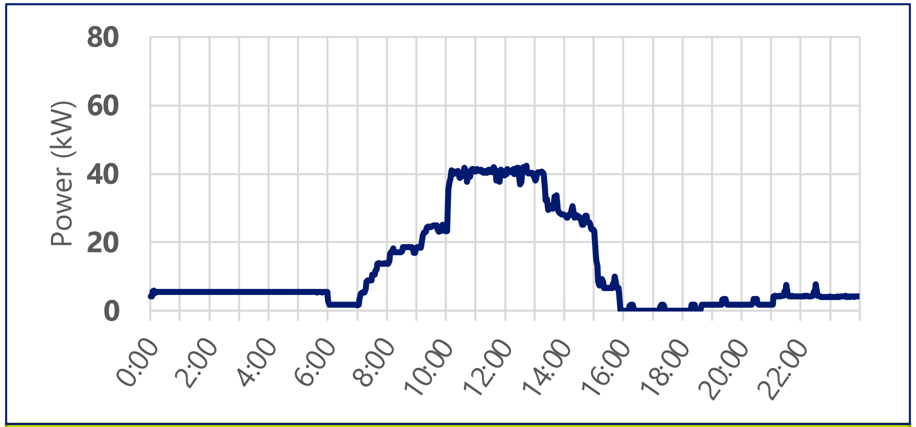
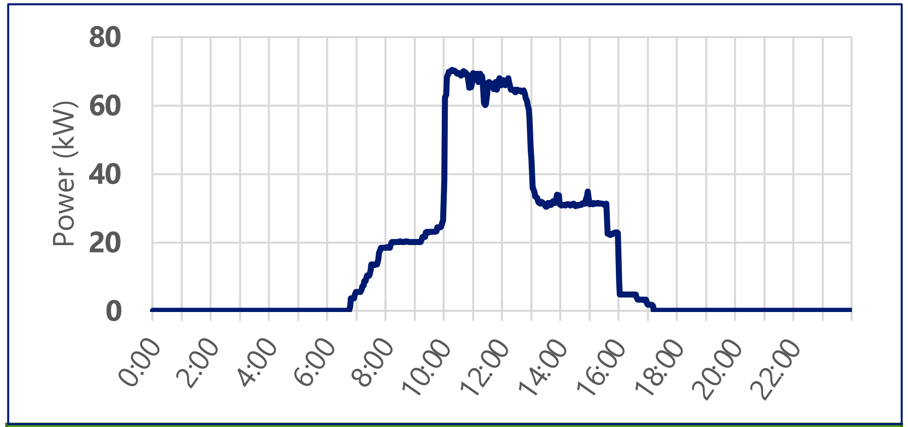
Longer Dwell time = Max Smart Charging

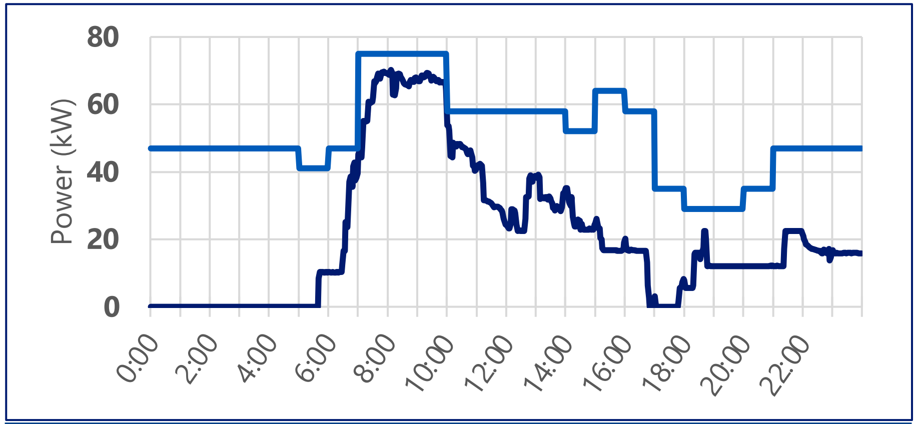
Max Delivery: Load management delivered as much power as desired within the 75kW constraint



Peak Reduction: Reduced Peak by 40% (72kW to 42kW) while still delivering same amount of energy



10am Floodgates: Charging maximized to transformer limits during 10am-2pm to optimize for incentives for consuming surplus solar energy



LCFS Curve Following: Charging optimized under LCFS Time-of-Use Value curve

Education is still the biggest challenge…

- Managing user expectations
  - Charging slower does **not mean there is a problem**
  - Trust the algorithm
  - Managed charging means **more ports** and **lower costs**

- Engaging with local permitting officials
  - Load management is **safe**
  - Within electrical codes

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What information is needed to evaluate EV management systems as non-wires alternatives?

- The key is high **temporal and spatial resolution**:
  - Ideal
    - Detailed feeder models
    - High resolution load data
    - Real-time measurements
  - Alternatively
    - Safe load envelopes to operate within
    - Fine-grained signals to follow
- **Charging workload information**
  - Real or statistical

Our Mission

Delivering renewable solutions to lead the transition to a sustainable energy future.

Connect

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Software Engineer - Algorithms
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Ongoing Research Projects with Caltech

Non-wires Alternatives

Working with Pasadena Water and Power on optimal placement and control of stationary battery storage to defer feeder upgrades.

Open-Source Data + Simulator

Adaptive Charging Network Research Portal provides real data from large-scale charging sites and a simulator to try our new control algorithms.

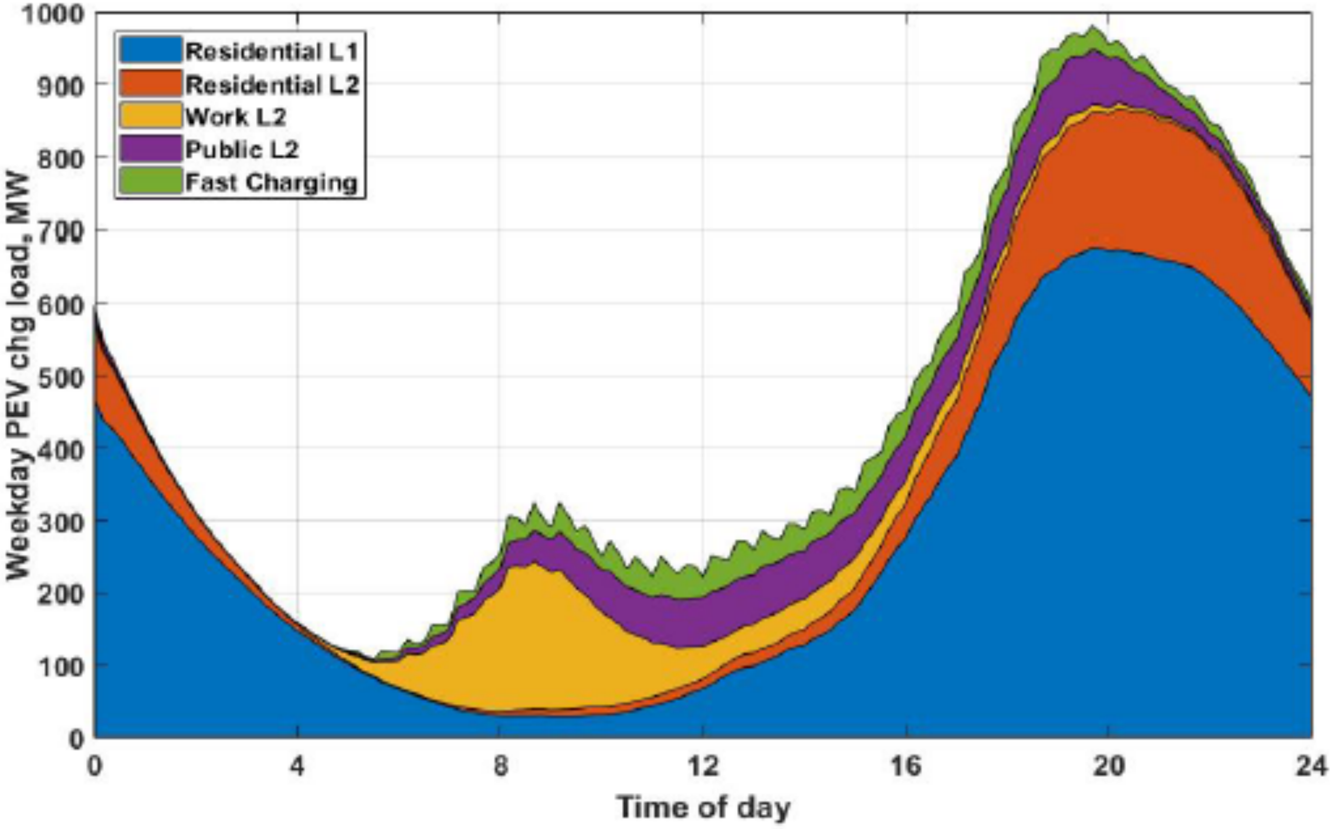
ev.caltech.edu

Distribution Impacts

Investigating impacts of large-scale EV charging on distribution feeders including thermal and voltage issues.

1.3M CA PEVs need 13GWh of electricity and 10x more plugs

Figure 4.3: The Statewide Aggregated Electricity Load for a Typical Weekday



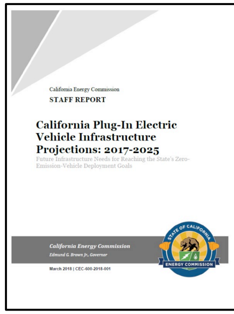
Source: California Energy Commission and NREL

Table ES.1: Projections for Statewide PEV Charger Demand

Demand for L2 Destination (Workplace and Public) Chargers (The Default Scenario)			
	Total PEVs	Lower Estimate (Chargers)	Higher Estimate (Chargers)
As of 2017	239,328	21,502	28,701
By 2020	645,093	53,173	70,368
By 2025	1,321,371	99,333	133,270

100,000 Chargers @$15k/ea = $1.5B

$15k/charger is unsustainable



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http://docketpublic.energy.ca.gov/PublicDocuments/17-ALT-01/TN222986_20180316T143039_Staff_Report__California_PlugIn_Electric_Vehicle_Infrastructure.pdf

The Case for Full-Shift EV Parking

The True Cost of "Re-Parking"

10m to walk to car, re-park, and walk back for both the first and second drive

Lost productivity per "Re-parking": 20m x 255 working days = 85hrs/yr

Across 100 EV chargers this translates to **8,500hrs**

At $50/hr > that's **$425,000/yr of lost productivity**

Disruptive to operations

"Sorry, I'm going to have to step out of surgery – I need to charge my car"

"Can we reschedule this meeting, I have to move my car"

"FULL-SHIFT" PARKING ALLEVIATES THIS ISSUE

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Alleviating the duck curve with smarter charging