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Evaluation Report for 2023

Standard Review Projects & AB 1082/1083 Pilots

September 20, 2024

ZM ASSOCIATES Environmental Consultants

DAVENERGY solutions DEDICATION ALIGNMENT VALUE

NREL NATIONAL RENEWABLE ENERGY LABORATORY

ITS UCDAVIS INSTITUTE OF TRANSPORTATION STUDIES

Agenda

- Introduction
- Medium-Duty and Heavy-Duty Fleets
- Schools, Parks and Beaches, and EV Fast Charge
- Vehicle-to-Grid
- Q&A

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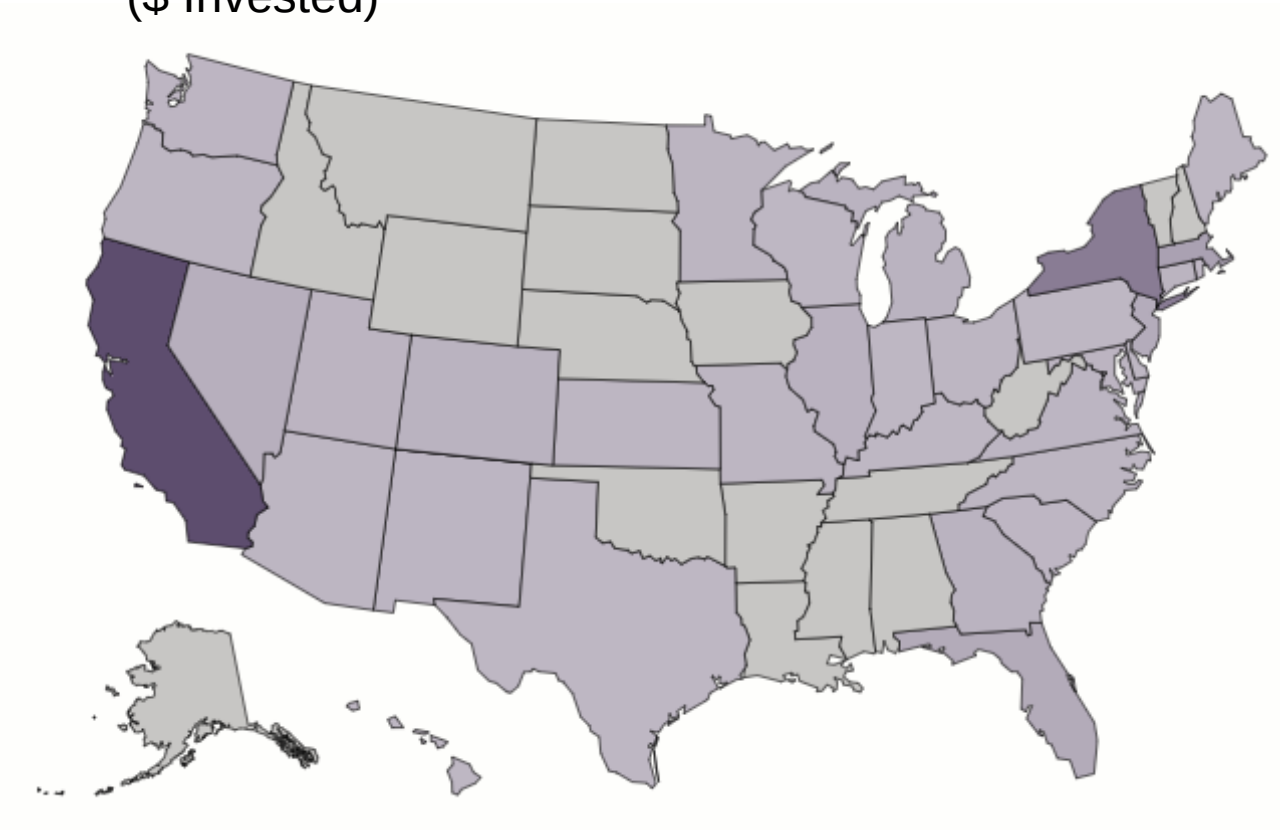
Introduction | Programs and Budgets

Total Utility investment: **$765M over four to six years**

	Program	Budget ($Millions)
Liberty	EV Bus Infrastructure Program	$0.2
	Schools Pilot	$3.9
	Parks Pilot	$0.8
Pacific Gas & Electric (PG&E)	EV Fleet (Fleet) Program	$236.3
	EV Fast Charge Program	$22.4
	Schools Pilot	$5.8
	Parks Pilot	$5.5
Southern California Edison (SCE)	Charge Ready Transport (CRT) Program	$342.6
	Schools Pilot	$9.9
	Parks Pilot	$9.9
San Diego Gas & Electric (SDG&E)	Power Your Drive for Fleets (PYDFF) Program	$107.4
	Vehicle-to-Grid (V2G) Pilot	$1.7
	Schools Pilot	$9.9
	Parks Pilot	$8.8
	Total	**$765**

Approved EV Make-Ready Filings
($ Invested)



Source: Atlas Public Policy, EV Hub
www.atlasevhub.com/materials/electric-utility-filings/

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Introduction | Team Partnership

Tasks across evaluation

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- Surveys
- Program Performance
- ME&O
- Interviews
- Total Cost of Ownership
- Health Impacts
- Delphi Panels
- NTG
- Truck Choice Model
- LDV Regression Model
- V2G

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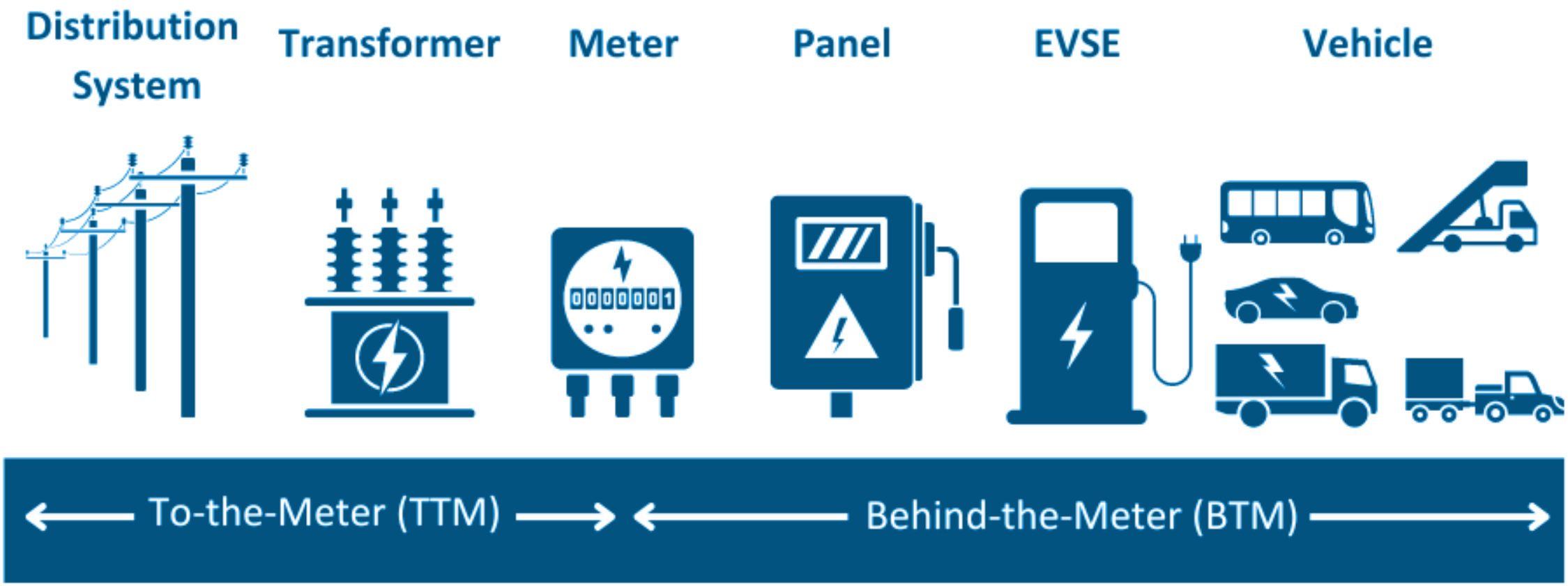
- Site Visits
- Grid Impacts:
  - AMI Synthesis & Annualization
  - EVSP Analysis
  - Billing Data
- Deep Dives
- GHG, Criteria Pollutant
- Petroleum
- LDV Counterfactual
- MDHD Counterfactual

Introduction | Infrastructure



- 14 programs support both To-the-Meter (TTM) and Behind-the-meter (BTM) infrastructure upgrades
- Utilities pay 100% for TTM infrastructure costs and some or all of the BTM
- Similar CA programs are Rule 29, Rule 45, CALeVIP, EnergIIZE

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Introduction | Unique Contributions

Large volume of **real-world data** in a clean, consistent format (e.g., ~25% of electric MDHD in dataset)

Diversity of vehicle categories, fleet participants, tariffs, etc.

Site cost, Meter data, charger data and billing data

Interactive dashboards on site performance (not public)

Medium-Duty and Heavy-Duty Fleets

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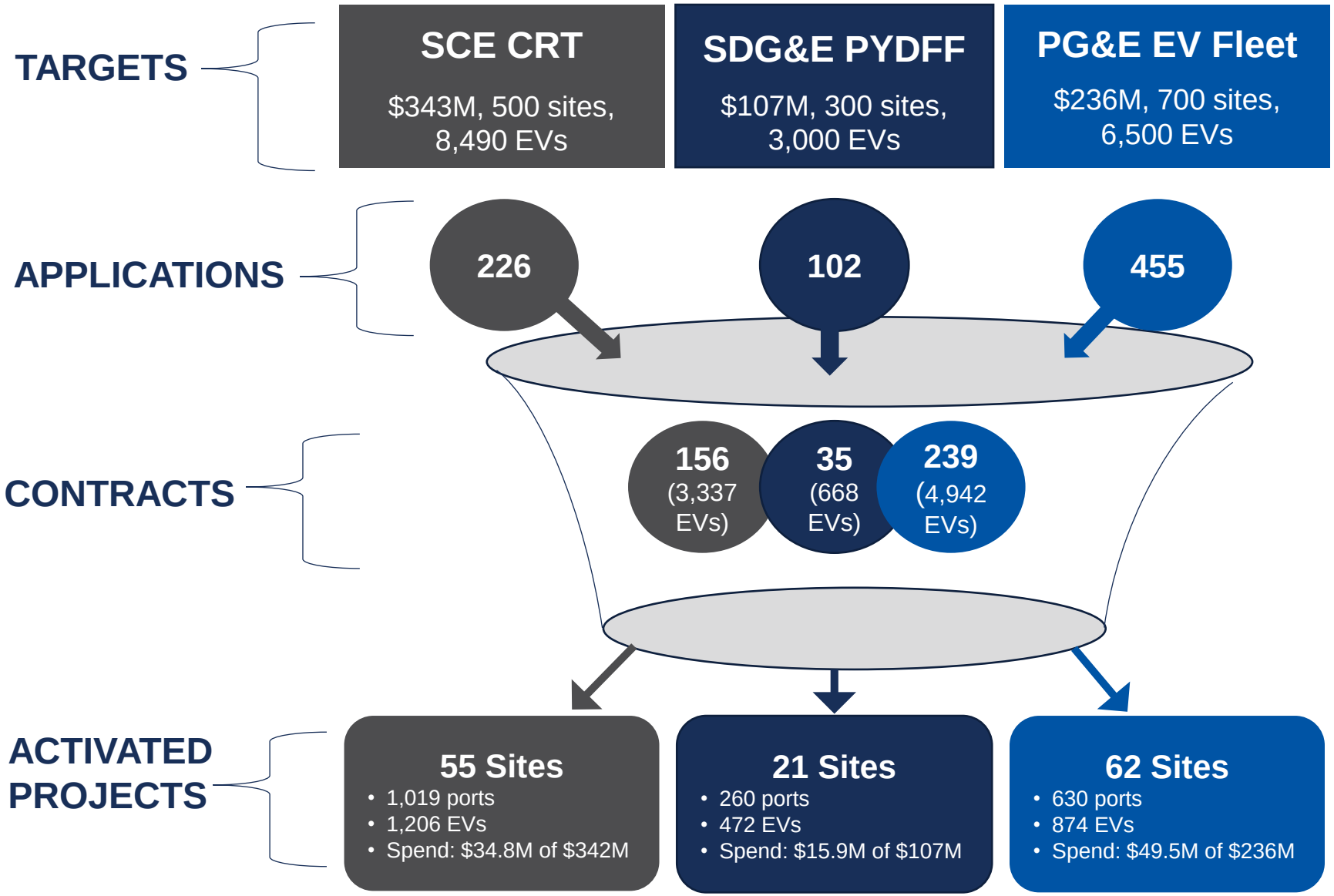
Progress Toward Program Targets

Program Targets (Sites & EVs) / Received Applications / Signed Contracts / Completed Sites



MDHD | Program Findings to Date

Population of Activated Sites in EY2023 (#)

138

Ports Installed in Analyzed Sites (#)

1,889

EVs Supported (#)

2,552*

*Derived EVs supported value from vehicle acquisition plans (VAPs). Represents max number of vehicles expected, not number on the road today.

Electric Energy Consumption (MWh)

32,881

Petroleum Displacement (diesel gal equiv.)

3,112,739

GHG Emission Reduction (MT GHG)

19,464*

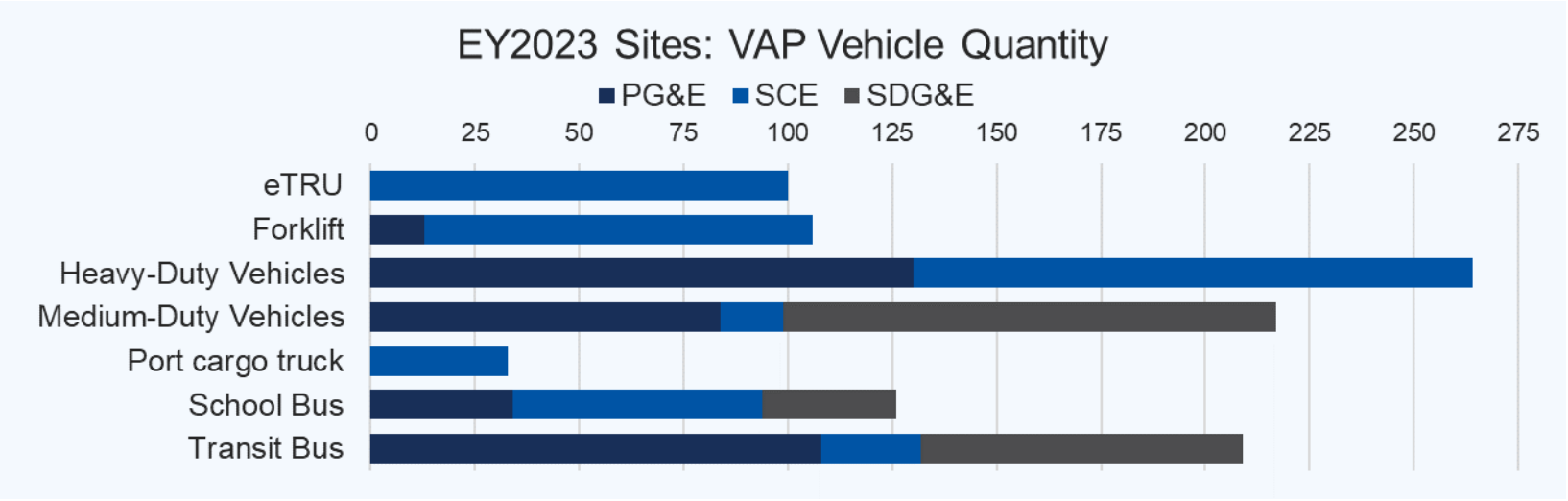
GHGs include CO_2, CH_4, N_2O multiplied by respective GWP as defined by IPCC. Calculated using CAISO real-time generation data

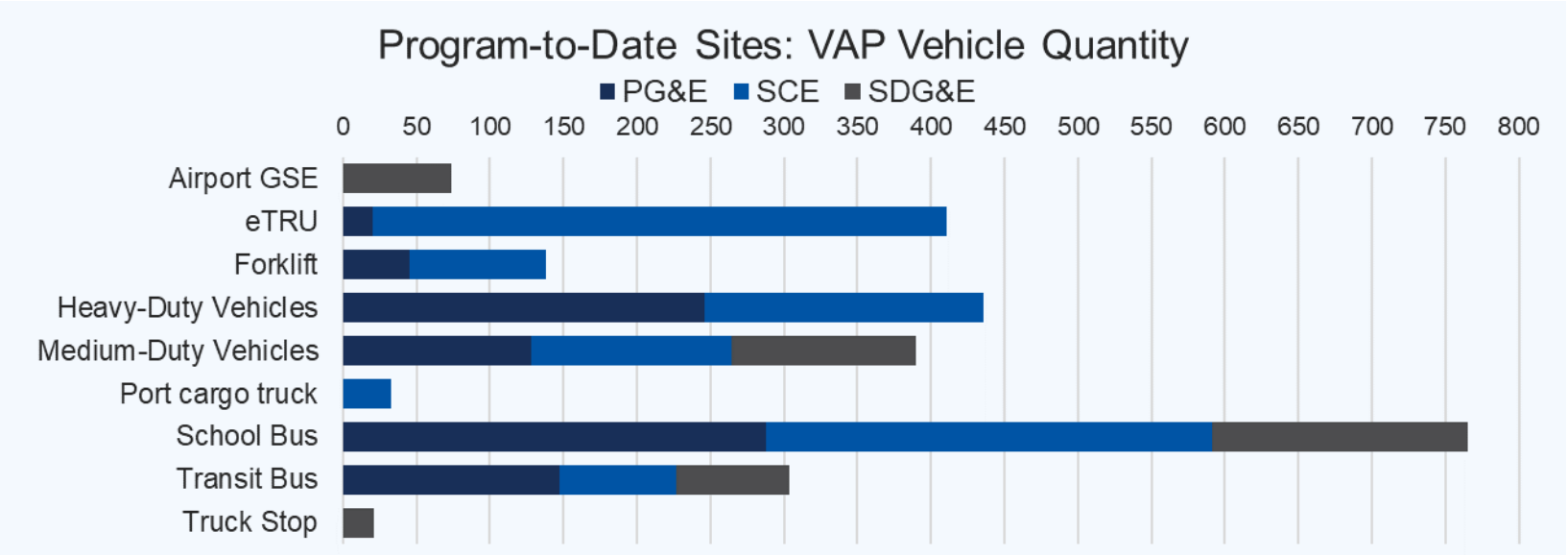
Tailpipe Pollutant Reductions

	Reduction (kg)
Oxides of Nitrogen (NO_x)	15,042
Particulate Matter (PM_{10})	980
Particulate Matter ($PM_{2.5}$)	197
Reactive Organic Gases (ROG)	2,937
Carbon Monoxide (CO)	172,814

MDHD | Market Sector Mix

Market Sector Diversity Continues





EY2023 Takeaways

- **Medium- and Heavy-Duty Vehicles** have increasing presence
  - ➢ Large fleet adoption
- The **Transit Bus sector** had significant growth
  - ➢ CARB ICT regulation
- The **School Bus sector** continues to grow
  - ➢ EPA and CEC grants
- **Port Cargo Trucks** are a new market sector

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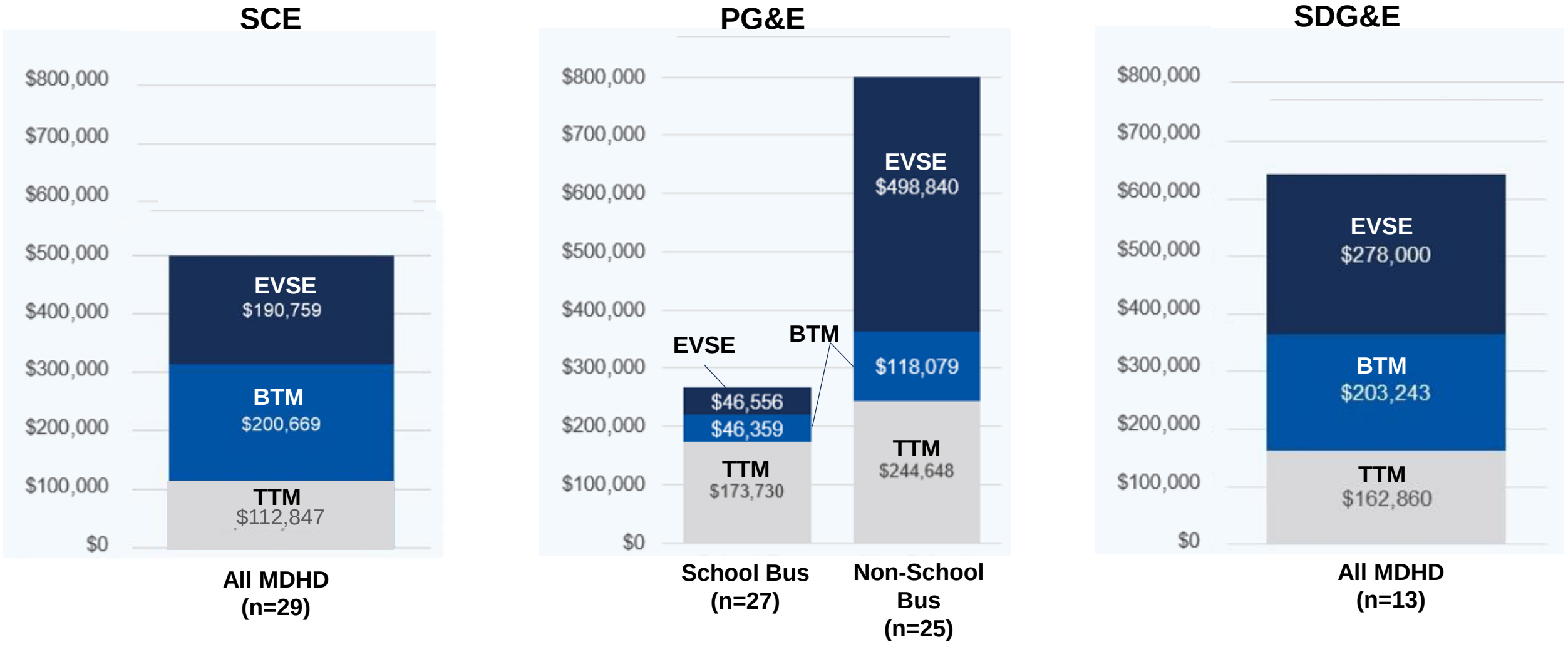
MDHD | Average Estimated All-In Costs



- Average site-level costs including what the Utility pays and the site host pays to install the chargers.
- EVSE is the largest estimated cost across both PG&E and SDG&E sites, followed by estimated BTM, then TTM.
- Mix of charging power drives results, as illustrated in the two PG&E bars (i.e., school buses rely on L2 much more)

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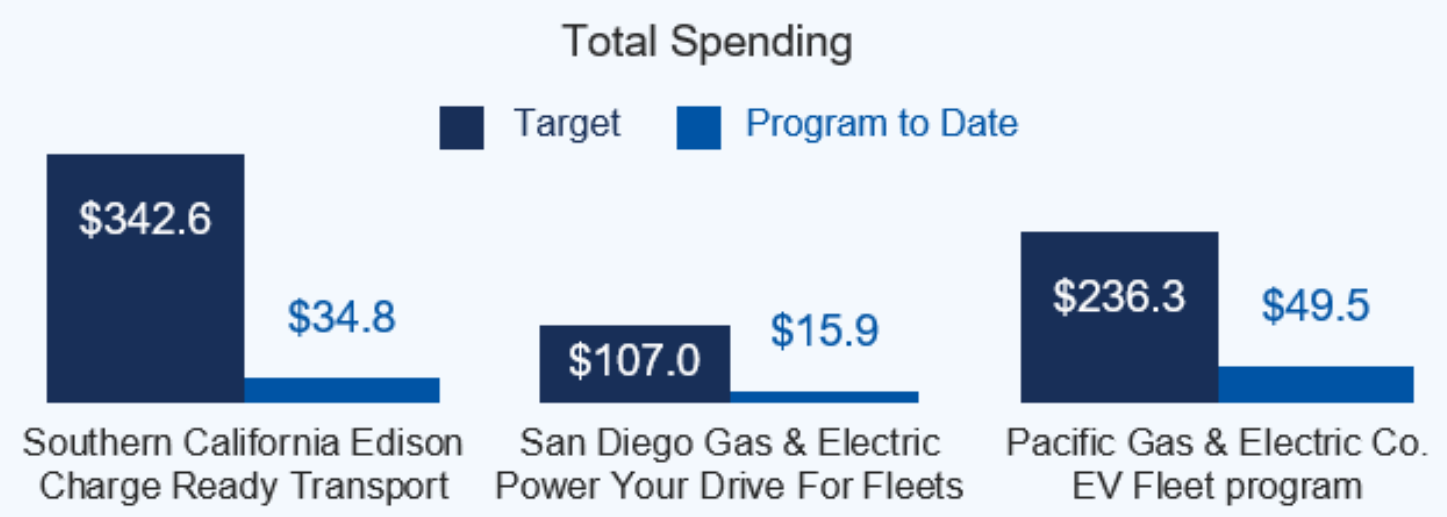
MDHD | Infrastructure Costs

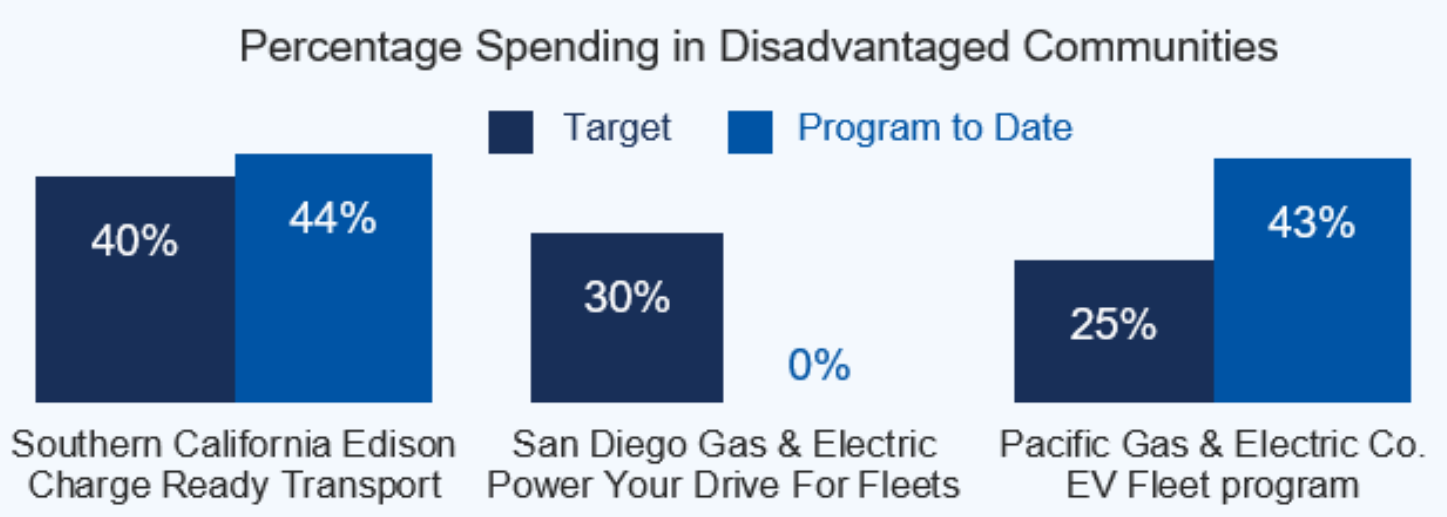
TTM and BTM Cost versus Installed Site Capacity (kW)

TTM = To the meter, BTM = Behind the meter

- Curves show relationship between infrastructure costs and installed capacity (kW)
- Smaller sites are more expensive per kW
- Around 500 kW curves for TTM and BTM flatten

Program spending is ramping up slowly; however, spending in disadvantaged communities exceeds targets in most programs.





Costs for installing infrastructure vary across market sectors and are corelated with the installed charging capacity (kW).

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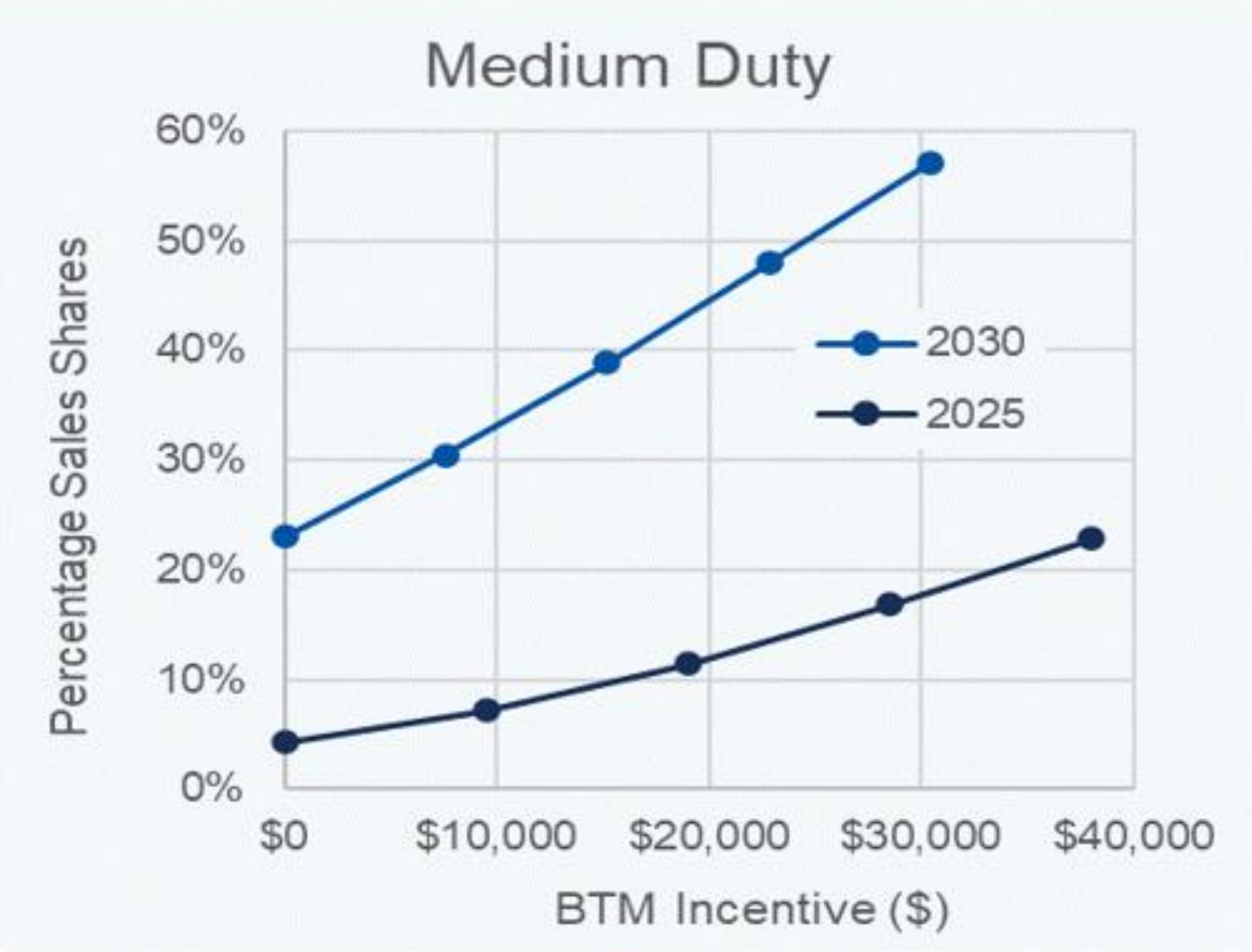
MDHD | Truck Choice Model

Results

The Truck Choice Model **estimates new vehicle purchase decisions for electric vs. ICE**, accounting costs and human preferences.

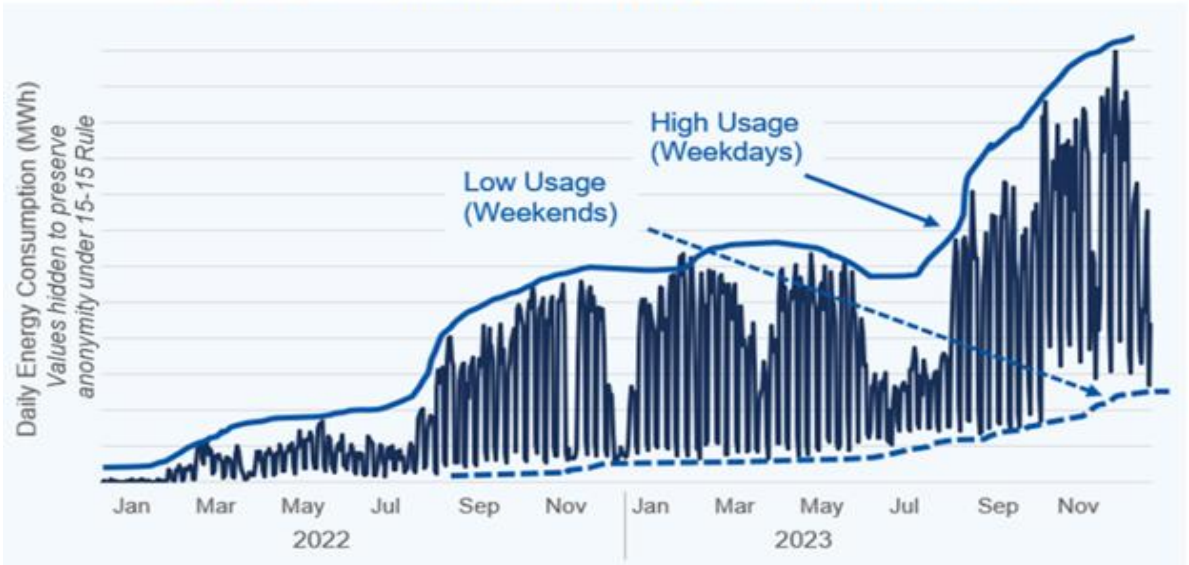


- When the **Utility fully funds the TTM** and **BTM is shared** between the Utility and customer, the model results suggest a **positive correlation between Utility BTM incentive and EV adoption**.
- Factors that are not easily captured in the model (such as ACF regulation, switchgear wait times, and vehicle availability) could change the trajectories.

MDHD | Grid Impacts – Energy Use Trends

Program Daily Consumption

Figure 197. SDG&E PYDFF Program Daily Energy Consumption for PTD Sites



- **Daily energy consumption and demand** across all sites has continued to **increase**.
- There are wide variations in daily energy consumed, as well as in consumption between weekdays and weekends.
- **20% of activated sites** (28 of 138) have exhibited the use of **load management** to date.

Figure 61. SCE Charge Ready Transport Program Daily Energy Consumption for PTD Sites

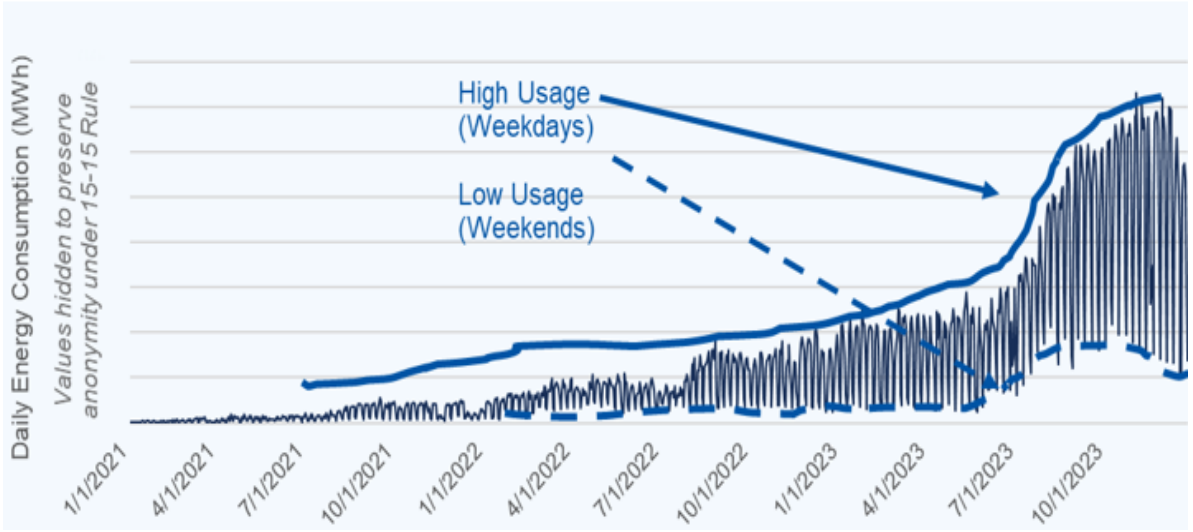
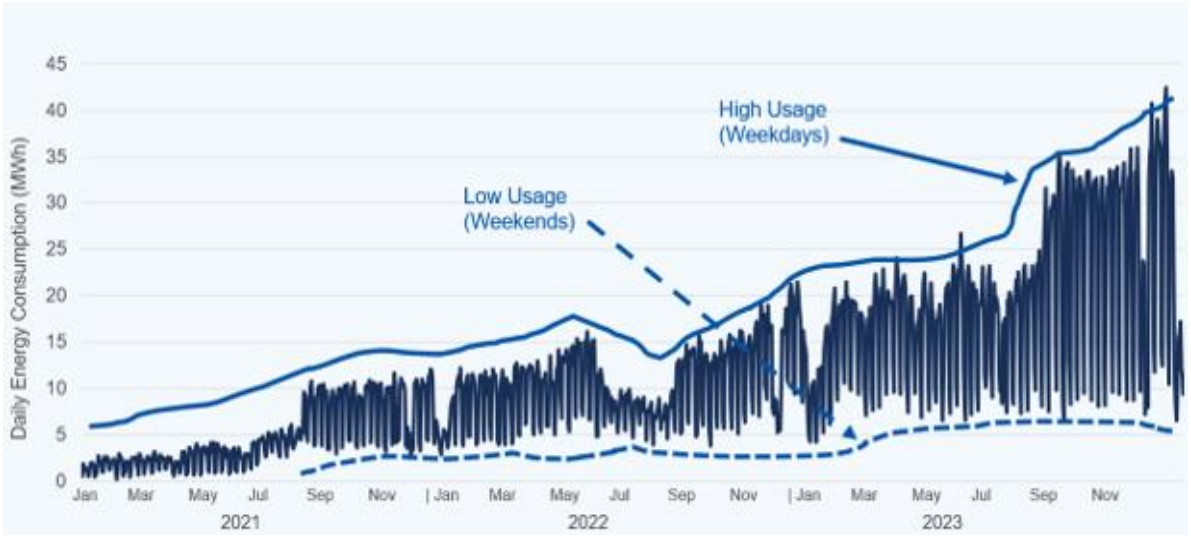


Figure 129. PG&E EV Fleet Program Daily Energy Consumption for PTD Sites



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MDHD | Grid Impacts – Load Management

Figure 134. PG&E EV Fleet Program Weekday and Weekend Daily Average Loads for PTD Sites from September 2023 through November 2023

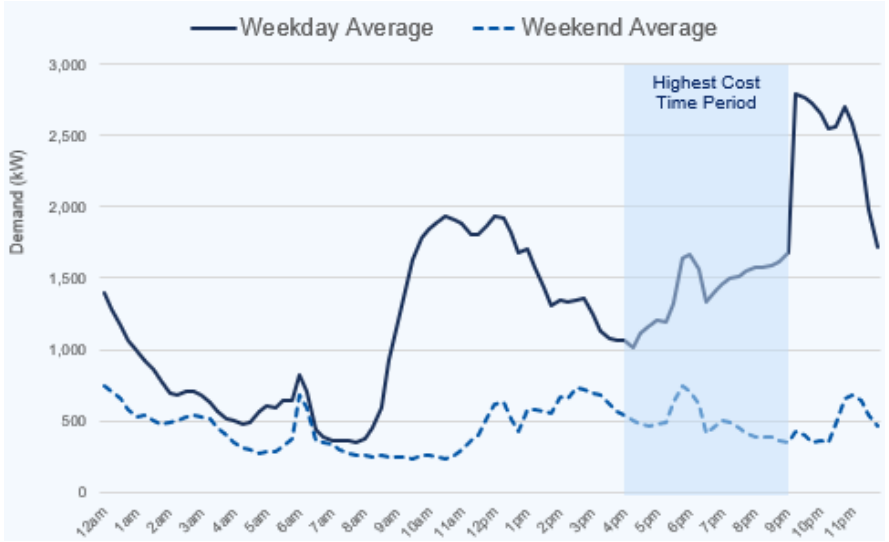


Figure 203. SDG&E PYDFF Program Weekday and Weekend Daily Average Loads for PTD Sites from September 2023 through November 2023

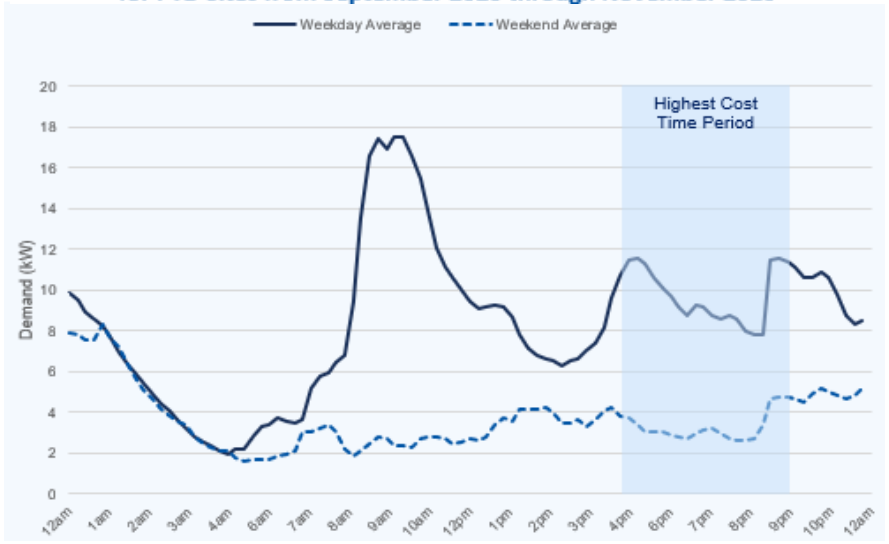
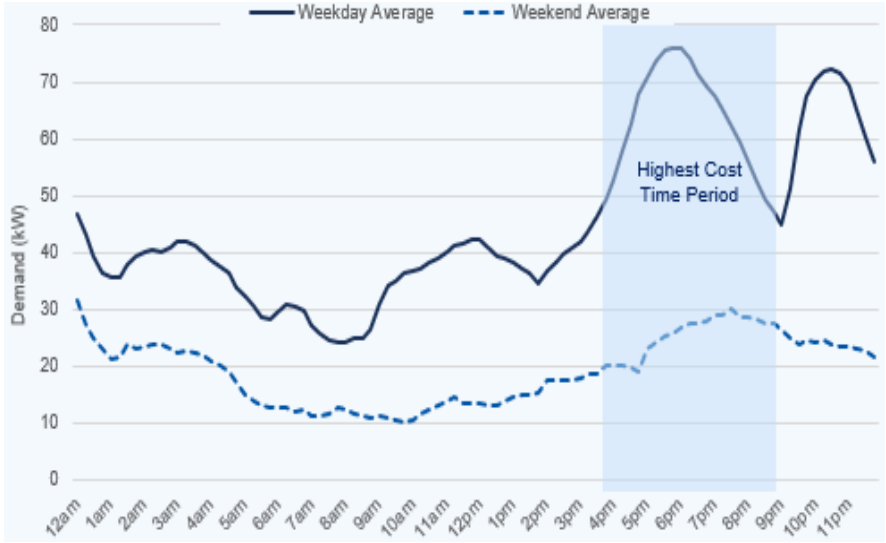


Figure 67. SCE Charge Ready Transport Program Weekday and Weekend Daily Average Loads for PTD Sites from September 2023 to November 2023



Significant unnecessary consumption from 4 PM to 9 PM

- **Significant increase in demand start at 9 p.m.** for **weekday** operations, indicating that a portion of program sites are employing load management.
- At the same time, the **lack of a demand peak after 9 p.m. on weekends** suggests that most weekend operators are not currently using load management

- Most fleet operators had a disconnect between what they expected the electricity to cost versus their actual costs, but they were aware of time-of-use pricing, regardless of knowing usage trends and costs

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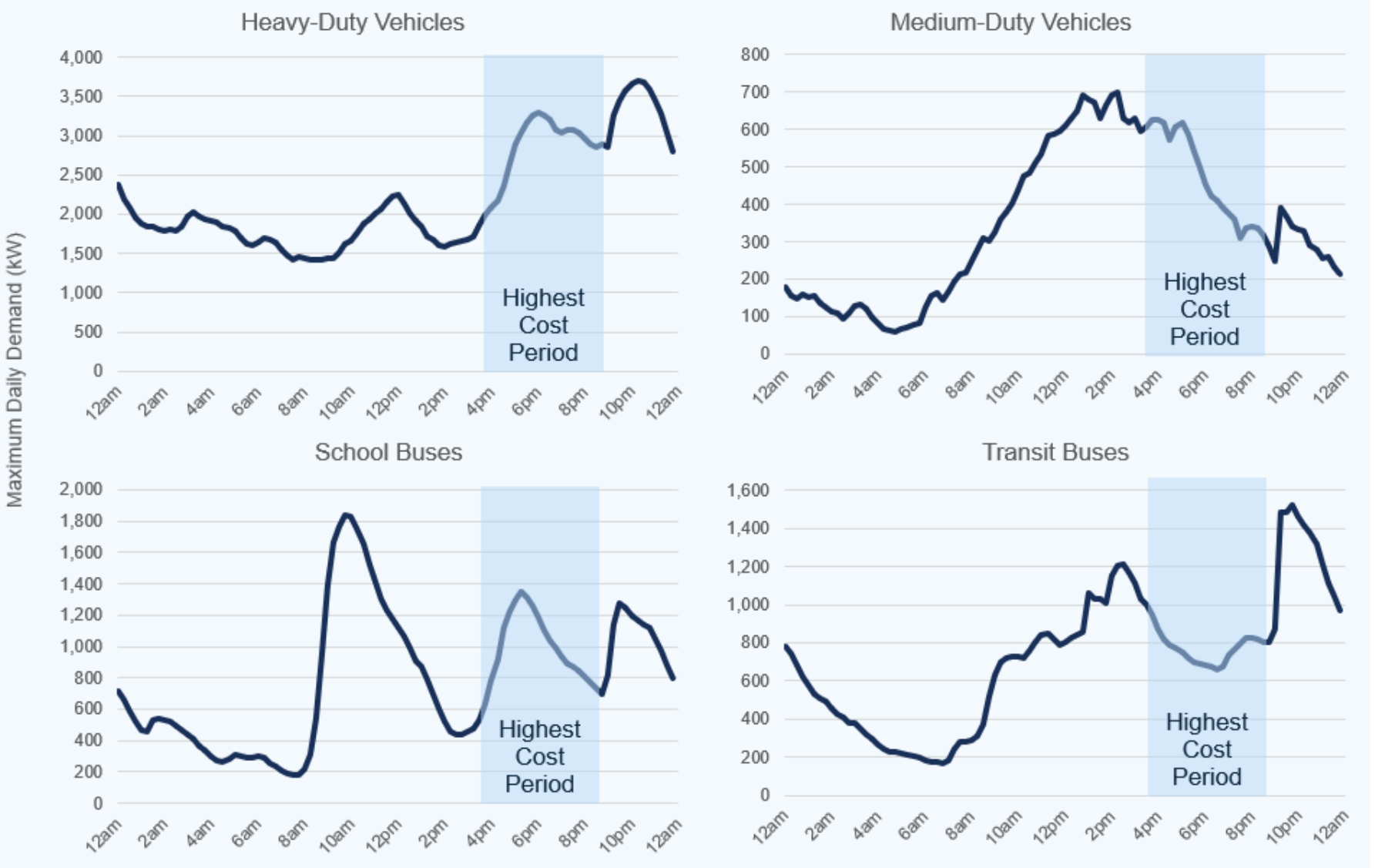
MDHD | Grid Impacts – Statewide Daily Load Curves

Average Daily Load Curve for Four Market Segments - October 2023 through December 2023

- All four market segments shows a spike in demand at 9 p.m.
  - Indicating sites are implementing load management to avoid the highest cost period.
- This is most pronounced in the Transit Bus segment
  - Showing a **drop in demand of nearly 50% between 2-6 p.m.,** followed by an **increase of almost 50% at 9 p.m**.
- Heavy-Duty vehicle market segment has the highest demand between 4-9 p.m.
- Medium-Duty vehicle market segment has the most consistent load profile
- School Bus segment exhibits charging peaks after morning routes and again in the late afternoon during the highest cost period
  - Significant opportunity to reduce costs through load management



MDHD | Grid Impacts – Load Management

Figure 68. SCE Charge Ready Transport Program Flexible Charging Availability for PTD Sites in Sessions Overlapping the Time Period Between 4 p.m. and 9 p.m.

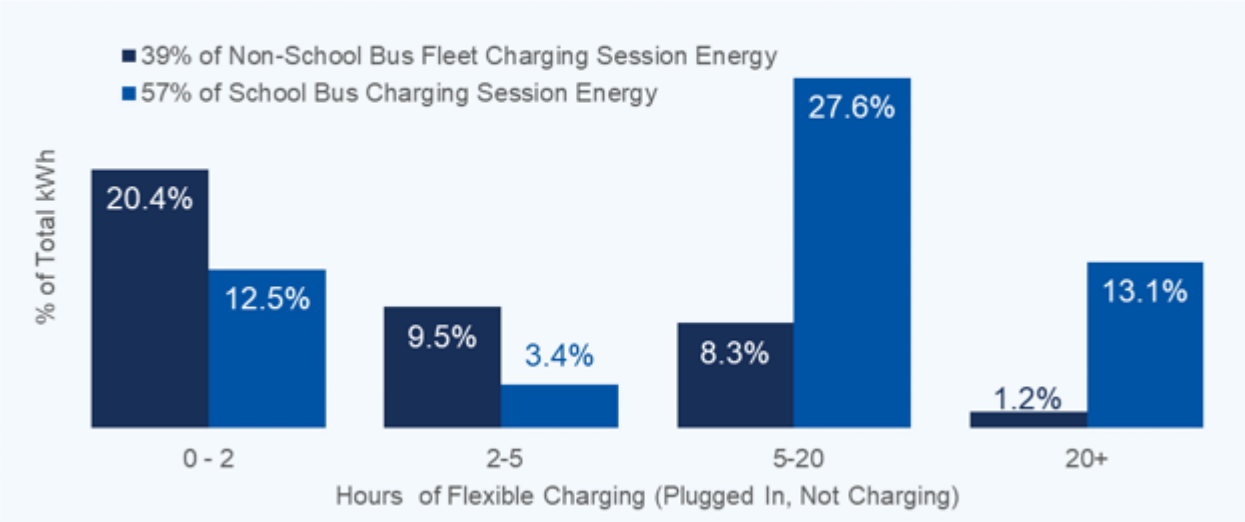


Figure 135. PG&E EV Fleet Program Flexible Charging Availability for PTD Sites in Sessions Overlapping the Time Period Between 4 p.m. and 9 p.m.

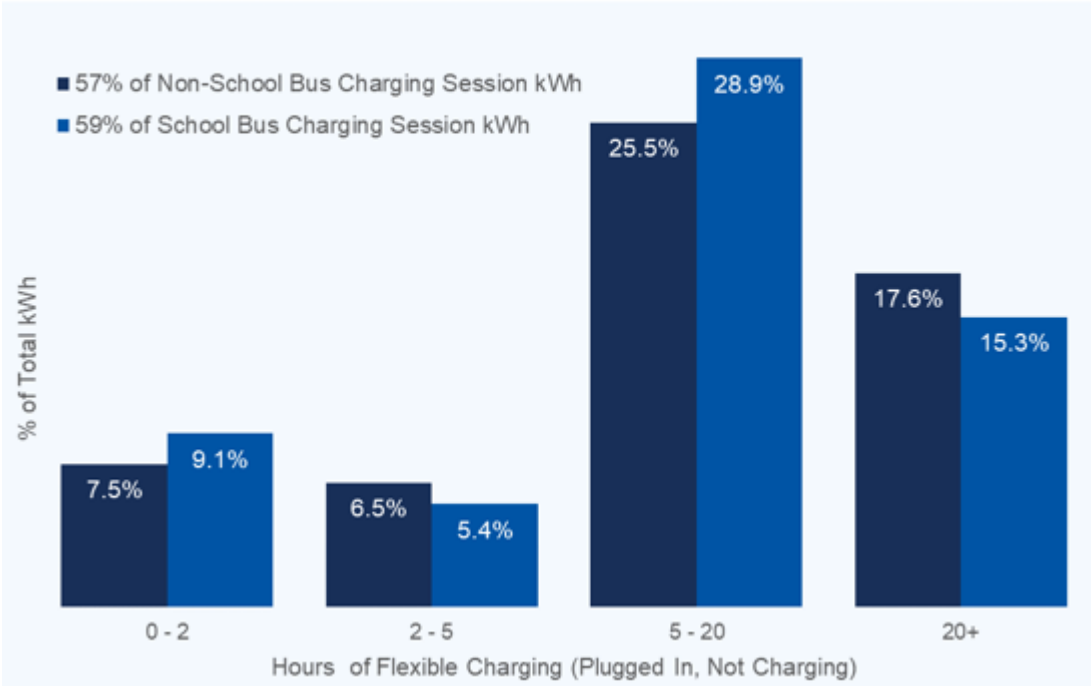
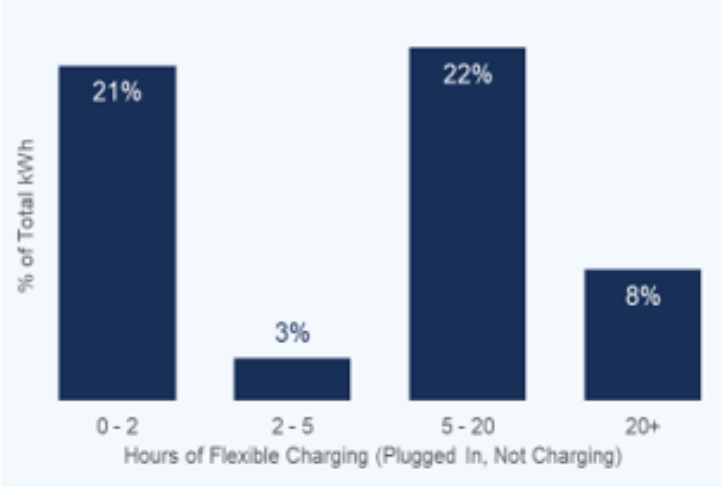


Figure 204. SDG&E PYDFF Program Flexible Charging Availability for PTD Sites in Sessions Overlapping the Time Period Between 4 p.m. and 9 p.m. (54% of all sessions)



Many charging sessions have enough **flexibility to avoid charging during peak periods**:

- SCE Charge Ready Transport school bus: **40%**
- SCE Charge Ready Transport non-school bus: **10%**
- PG&E EV Fleet: **over 40%**

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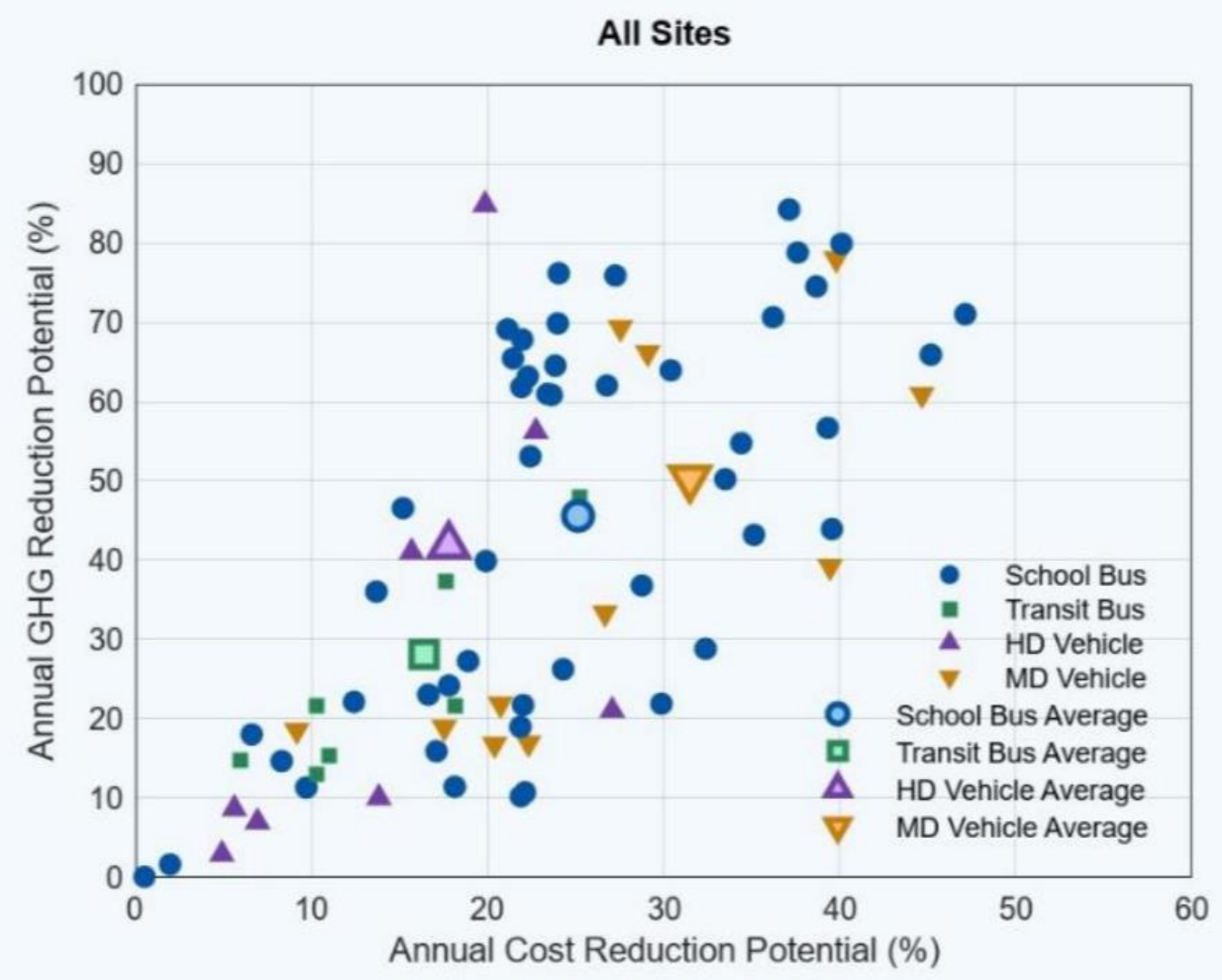
MDHD | NREL Optimization

Potential Cost and Attributed GHG Emissions Reductions



Total Count of 2023 Operating Days	Cost Reduction Potential (%)
• SCE: 8,598 • PG&E: 8, 210 • SDG&E: 3,342	• SCE: 27.1% • PG&E: 19.3% • SDG&E: 23.1%

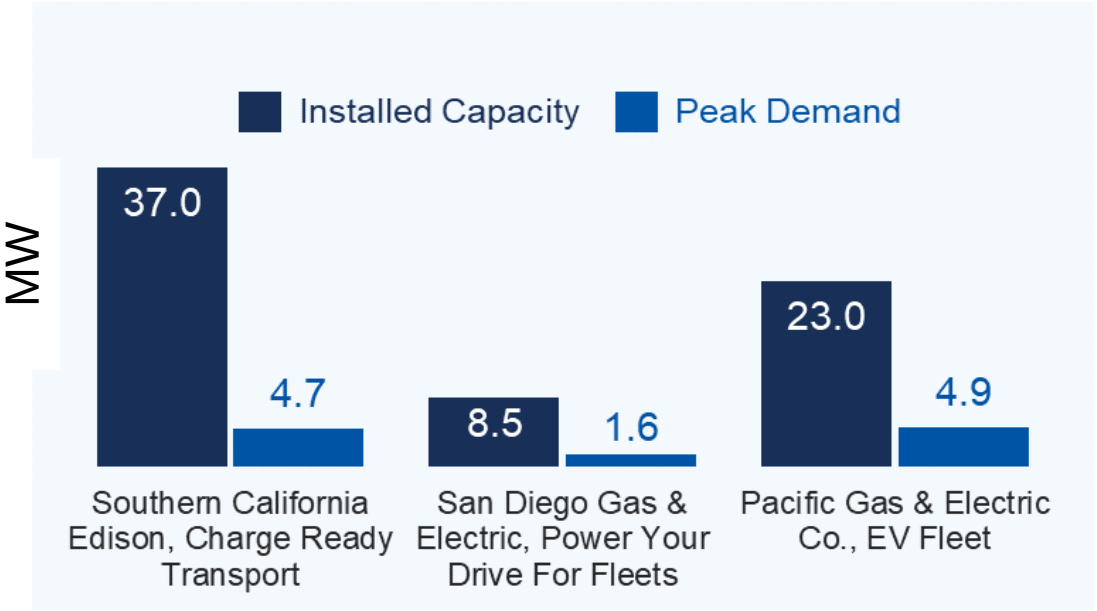
Total Number of Fleets	GHG Reduction Potential (%)
• SCE: 33 • PG&E: 30 • SDG&E: 13	• SCE: 39.7% • PG&E: 50.3% • SDG&E: 20.5%

Estimated cost and GHG emissions reductions for each site **resulting from a cost-minimizing load management strategy** *considering carbon intensity only as a tiebreaking factor when there is sufficient charging flexibility

Shifting charging load to reduce costs shows the potential to **reduce GHG emissions** by an even greater percentage than costs

Medium-Duty / Heavy-Duty | Lessons Learned

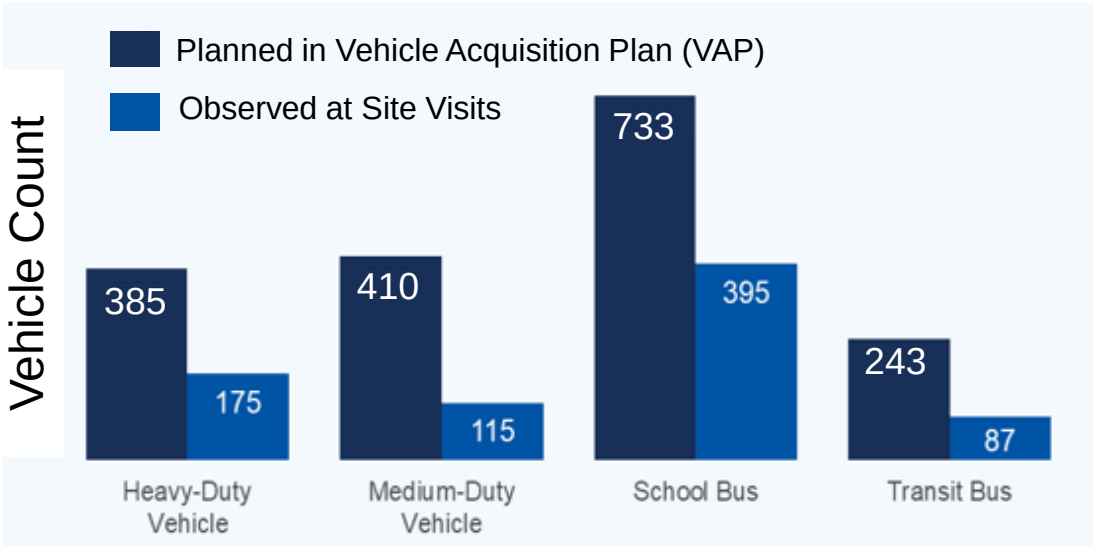
Installed Capacity vs. Peak Demand (MW)



Only **28 of the 138** activated sites exhibited the use of **load management**

Though overall demand for electric vehicle charging increased substantially in EY2023, customers are only using a small percentage of installed charging capacity, and the majority of fleet operators are not implementing load management.

Planned vs. Observed Vehicles



Utilization is expected to increase as fleet operators receive additional planned vehicles

Vehicle deliveries are not running on schedule; therefore, most fleets have not yet acquired the vehicles per their agreement with all Utilities.

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MDHD | Liberty Utilities EV Transit Bus Project

Scope: From two 60 kW DCFC, added two 450 kW overhead fast chargers (pantographs) and associated infrastructure to support <1 MW of new load to operate three transit buses in 2022.

Budget: $876k for line extension, new transformer, and 3,000-amp switchgear.

Timeline: TTD started regularly charging buses in July 2022. There have been no additional milestones in 2023.

In June of 2023, Tahoe Transit District started using load management for Proterra electric bus charging at the LTCC site.

- Site has not used the chargers to their fullest extent, due to ongoing electric bus issues and delays in manufacturer's response
- Navigating these program challenges helped Liberty staff better understand how to serve customers with dynamic needs for complex EV infrastructure projects.

Usage	
94,108 Miles	222,063 kWh

Petroleum Displaced
23,524 gallons

GHG Reduction
168 MT

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Medium-Duty / Heavy-Duty | Lessons Learned

Despite Utility staff being focused on improving activation timelines, the timelines have been increasing each of the last three years due to program and non-program challenges.

Start-to-finish median calendar days:

EY2021: **600 days**

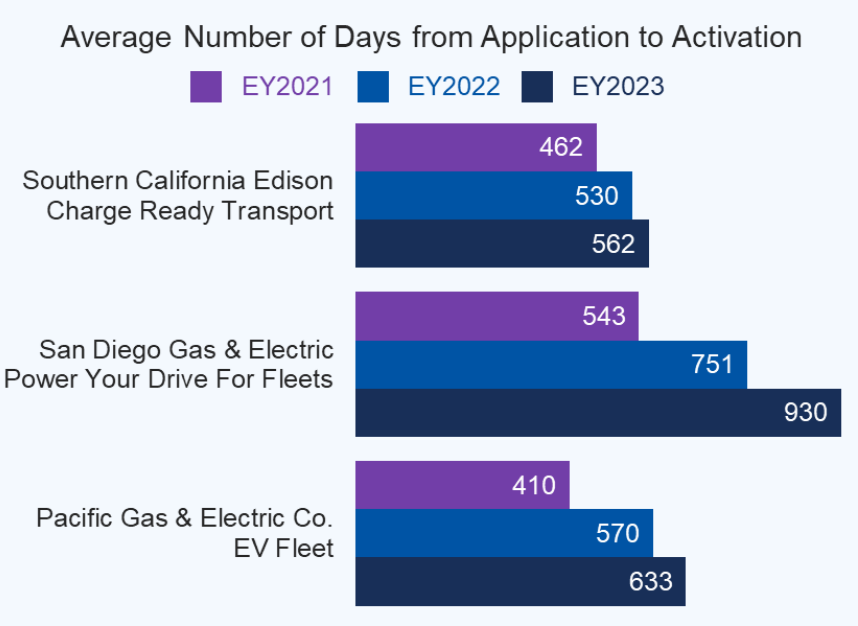
EY2022: **723 days**

EY2023: **862 days**

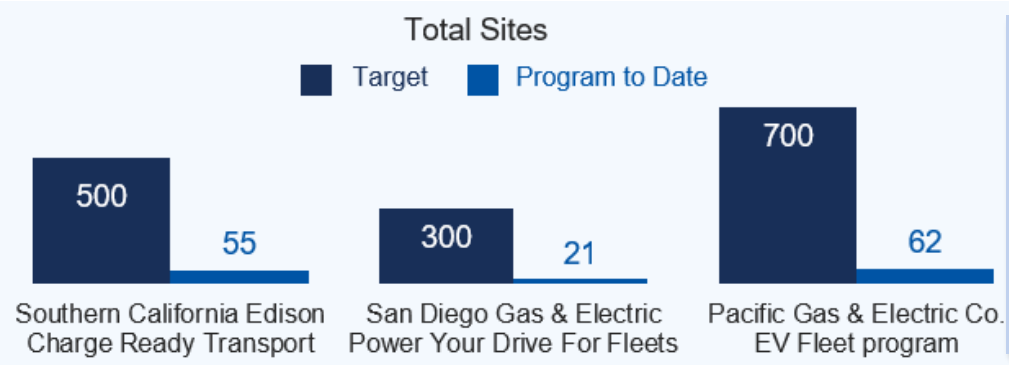
The **Design and Permitting phase** has been the **longest in duration** across programs each year

Prominent 2023 factors:

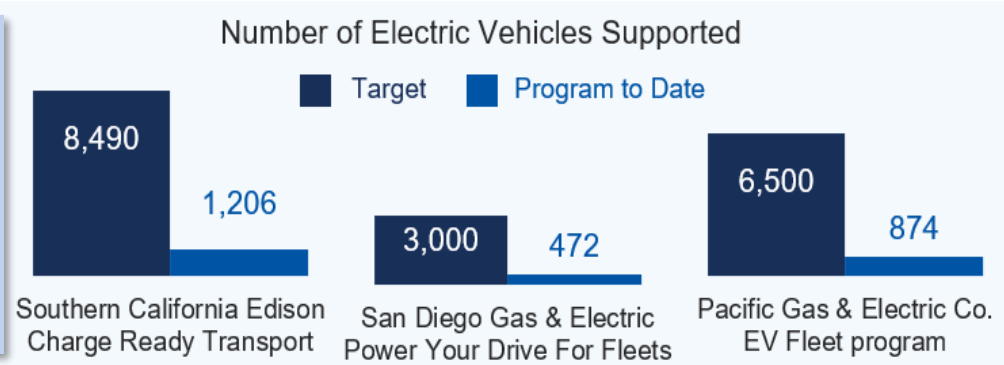
- **Supply chain delays**
- Activation of **larger, more complex projects**



Medium-Duty/Heavy-Duty programs are having a meaningful impact on electric vehicle and charger deployments, but the number of total sites continues to lag program goals.



At the current trajectory, the programs are **not expected to meet the original goal** for number of sites



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Medium-Duty / Heavy-Duty | Lessons Learned

The electric regional and long-haul truck market share is projected to increase to above 30% by 2030 (according to an expert Delphi panel) but lags behind the Advanced Clean Trucks sales requirements.

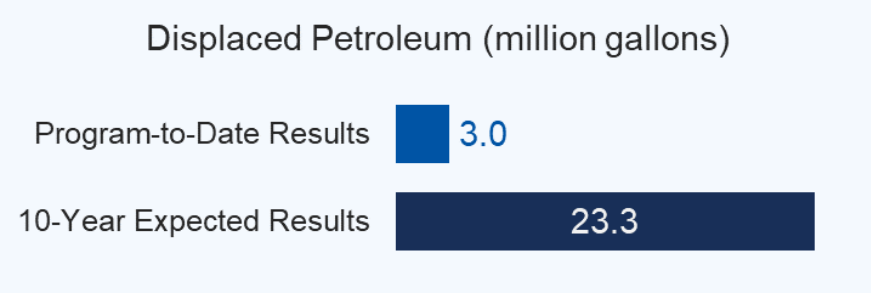
Several reasons were noted as to why this market sector could **struggle to meet the sales requirements**:

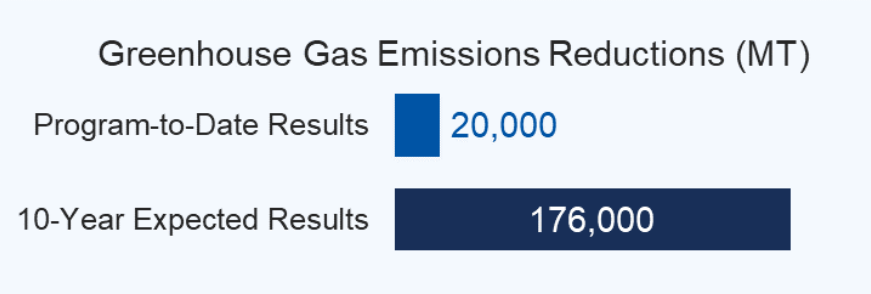
- Costs
- Constraints of batteries
- Lack of charging infrastructure

Areas of concern:

- **Uncertainty in how vehicle manufacturers will price future electric and diesel trucks** given the Advanced Clean Trucks regulation could have follow-on **impacts on fleet decision-making**.
- Other experts cited the **weak business case for deploying public charging infrastructure for electric trucks** and said that government funding will be needed.

Utility Medium-Duty/Heavy-Duty programs are resulting in displaced petroleum and reduced greenhouse gas and local emissions and are achieving health benefits overall and within disadvantaged communities.





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MDHD | Recommendations

Continue to contact customers on an annual basis following site activation.

Utilities should continue to contact customers on an annual basis (at minimum) following site activation to ensure that sites are proactively identifying load management opportunities. The Evaluation Team recommends focusing on school bus sites—which typically do not manage load—and large sites such as those with greater than 1 MW installed capacity—which have the greatest opportunity to manage load. By identifying and documenting reasons why customers are not actively managing load, program staff and the Evaluation Team can build more-targeted recommendations for addressing load management barriers

Incorporate ongoing lessons learned into programs. Continue to communicate recommendations for updates to program design and metrics to regulators and other stakeholders.

Utilities are significantly lagging in their progress toward site goals and are spending their allocated budgets slower than expected. Ongoing lessons learned by Utility staff and from evaluation findings should be incorporated into programs to promote improvements. To ensure changes can be implemented in a timely manner, Utilities should continue to communicate recommendations for updates to program design and metrics to regulators and other stakeholders. For many changes, regulatory support will be needed to implement these recommendations. For example, the cost threshold metrics designed by the Utilities—which are based on CPUC decisions—can create barriers to greater and more-diverse site participation. Program changes are needed to meet the overarching goals to advance transportation electrification.

Take a proactive approach to track progress toward the Vehicle Acquisition Plans.

The vehicle counts observed during site visits tend to be significantly lower than customers' Vehicle Acquisition Plans (even when compared with the expected annual procurement). Taking a proactive approach to tracking progress toward the Vehicle Acquisition Plans (with an annual customer contact about vehicle procurement, for example) would allow the Utilities to ensure that customers are following their Plan, which could contribute to improved program performance with respect to energy consumption, petroleum displacement, emissions reductions, and health impacts.

Public Charging

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Public Charging | Program Findings to Date

Population of total Activated Sites (#)

74

Ports Installed in Analyzed Sites (#)

515

Electric Energy Consumption (MWh)*

2,060

Petroleum Displacement (diesel gal equiv.)

178,854

GHG Emission Reduction (MT GHG)

1,317

GHGs include CO_2, CH_4, N_2O multiplied by respective GWP as defined by IPCC. Calculated using CAISO real-time generation data

Tailpipe Pollutant Reductions

	Reduction (kg)
Particulate Matter (PM_{10})	7
Particulate Matter ($PM_{2.5}$)	6
Reactive Organic Gases (ROG)	116
Carbon Monoxide (CO)	2,597

*Excluding PG&E Schools and Parks data

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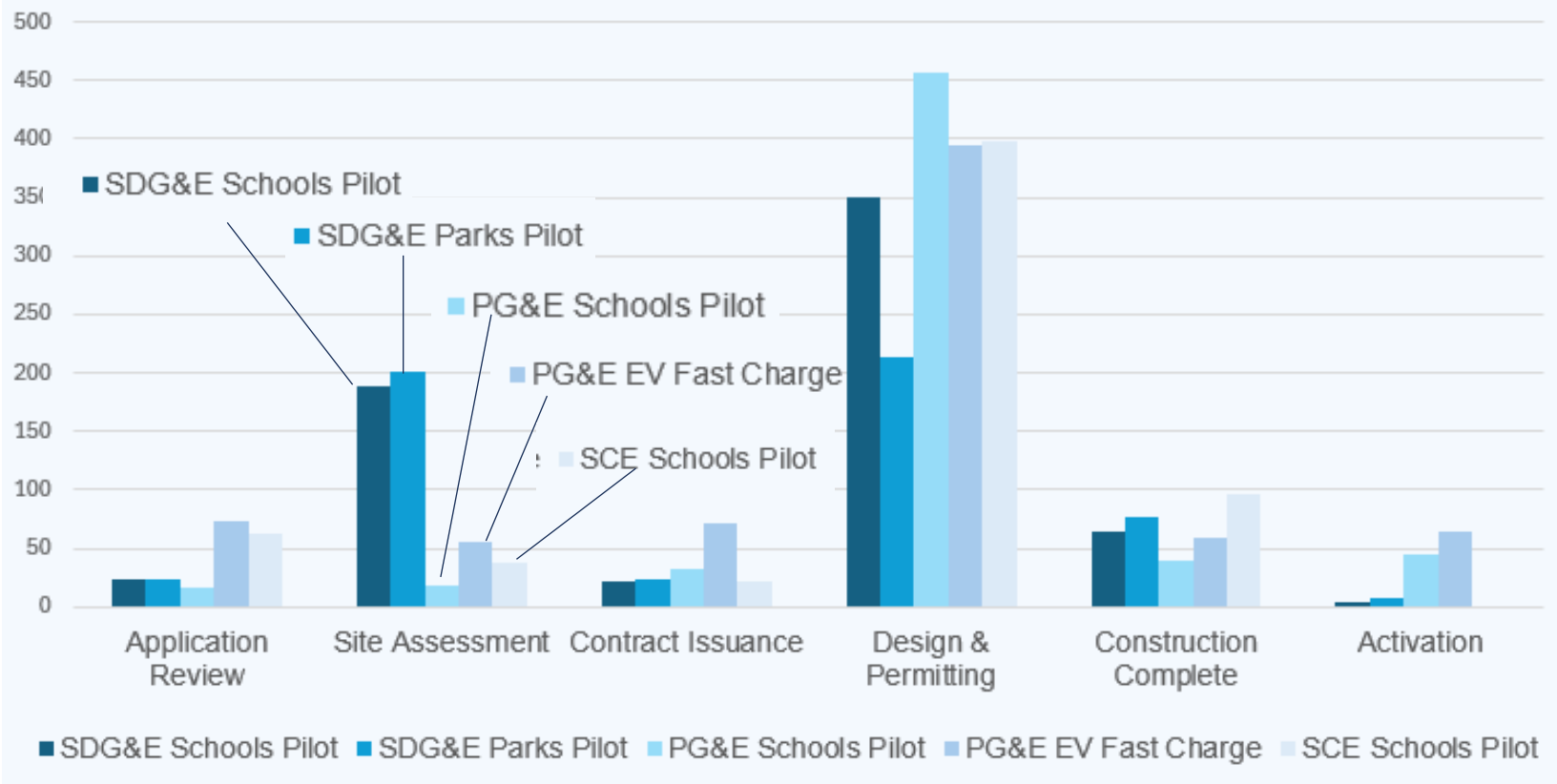
Public Charging | Site Program to Date Timelines

- PG&E Schools Pilot median durations in EY2023 were similar to those for the PTD.
- PG&E EV Fast Charge median durations in EY2023 were similar in magnitude to those for the PTD
  - The first 3 phases being slightly shorter
  - The last 3 being marginally longer
- SDG&E Schools & Parks Pilots median durations in EY2023 were similar to those for the PTD.
- SCE Schools Pilots median durations across the Application Review, Site Assessment, Contract Issuance, and Activation phases were similar to those for the Schools Pilot to date
  - **Design and Permitting and Construction** took noticeably longer compared to pilot-to-date median

Median Timelines by Phase Across Utilities – Program to Date



Public Charging | Energy Trends – AB1082 Schools

- Load curves reflect morning-weekday focused usage
  - Though aligned with low energy cost and high renewables, the influence of TOU rates is not obvious
- Some data shows after-hours public charging further benefitting local communities
- Given private-workplace charging trends, sites in these pilots leave many hours each day, weekend, and throughout the year with little demand
  - Enabling access outside of work hours (M-F / 9-5) is an opportunity to improve utilization and benefits to rate payers and local communities

Figure 93. SCE Schools Pilot Load Curves on Days of Maximum Demand and Consumption

Figure 154. PG&E Schools Pilot Load Curves on Day of Maximum Demand and Consumption

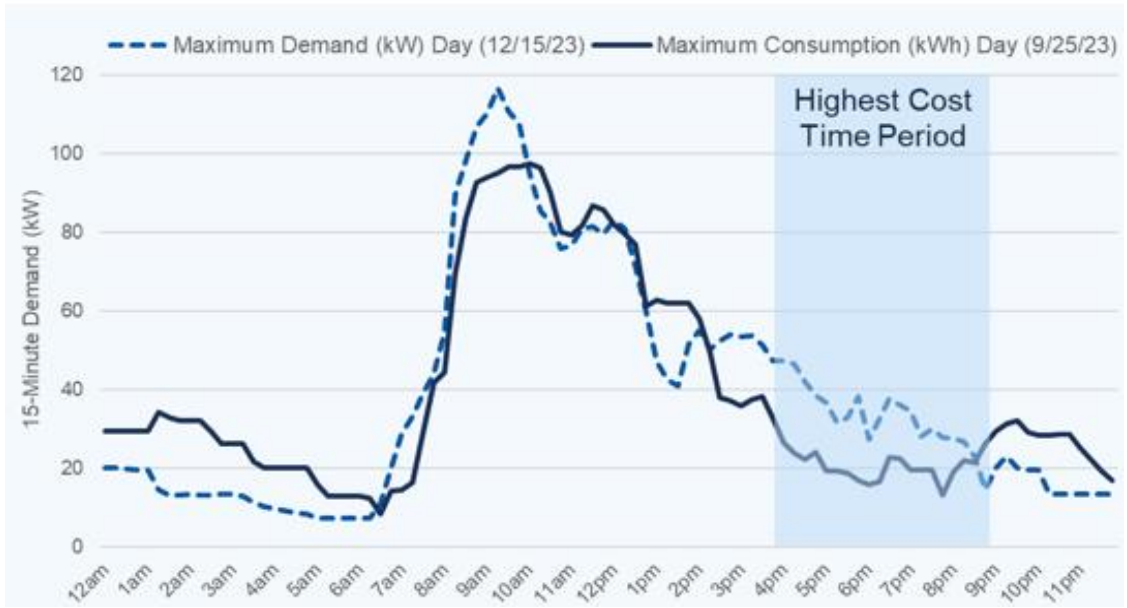
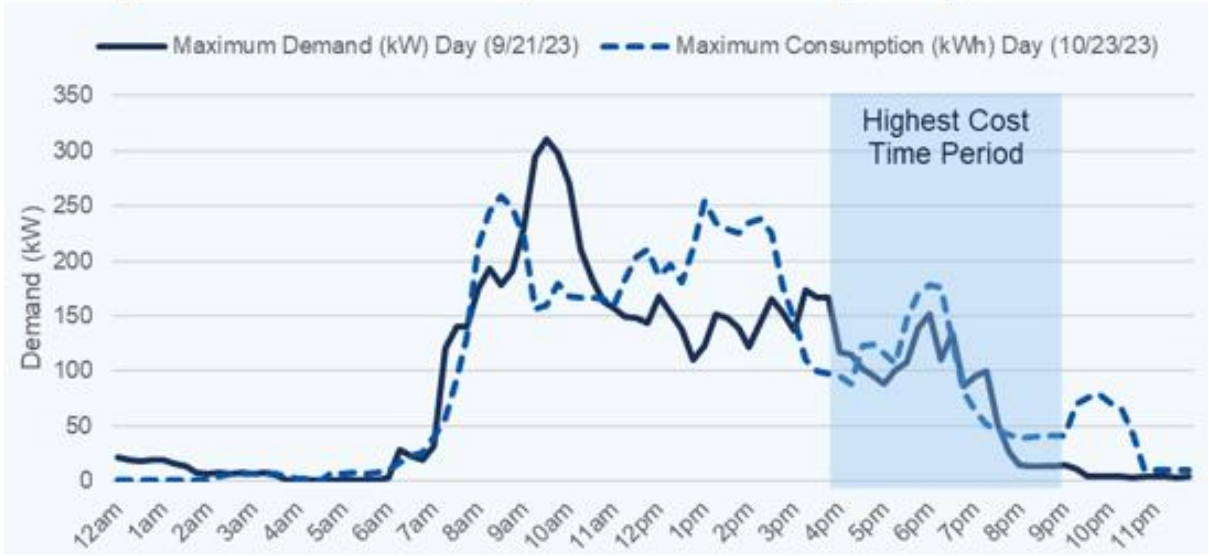


Figure 235. SDG&E Schools Pilot Highest Demand and Consumption Days Load Curve



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Public Charging | Energy Trends – Charging Sessions (kWh)

Figure 158. PG&E Schools Pilot Charging Session Count by Consumption Size

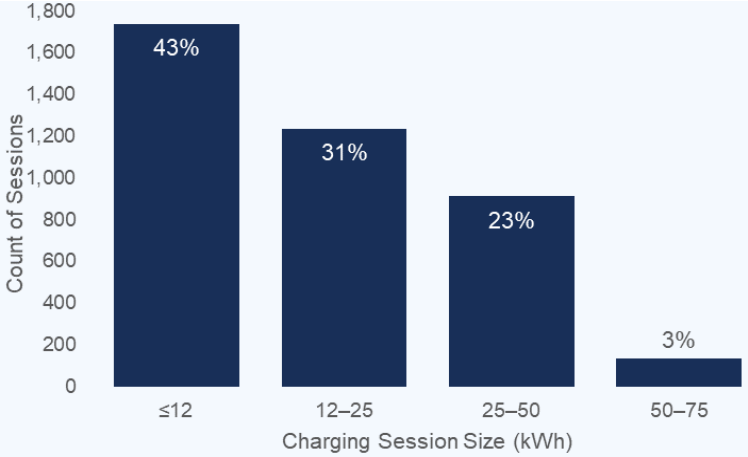
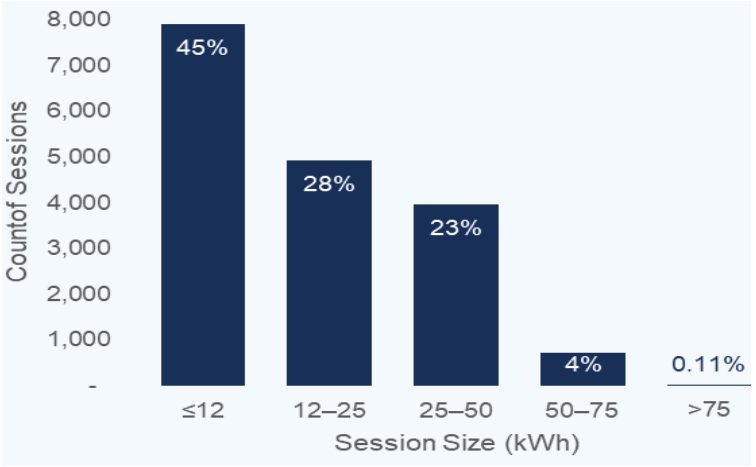


Figure 239. SDG&E Schools Pilot Charging Session Count by Consumption Size



- Charging session data can help indicate capacity needs for future planning
- High proportion under 25 kwh (level 2 and DCFC)
  - May change as the 'fleet' is weighted towards larger batteries
  - Suggest continued study

Figure 171. PG&E EV Fast Charge Program Count of Charging Sessions by Size

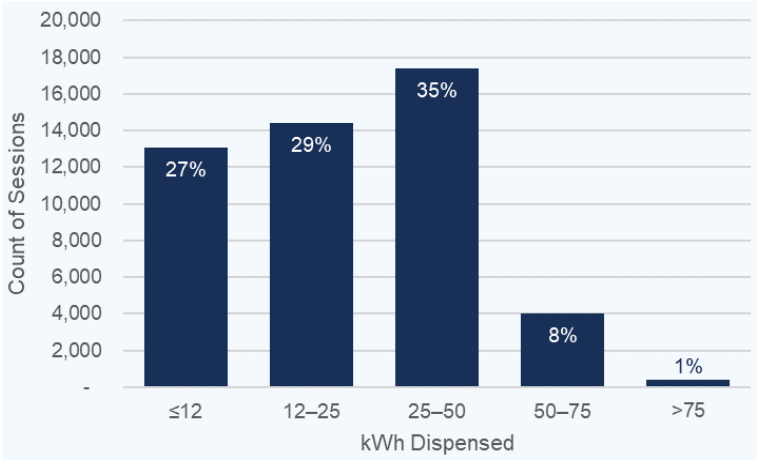


Figure 246. SDG&E Parks Pilot Daily Charging Session Count by Consumption Size

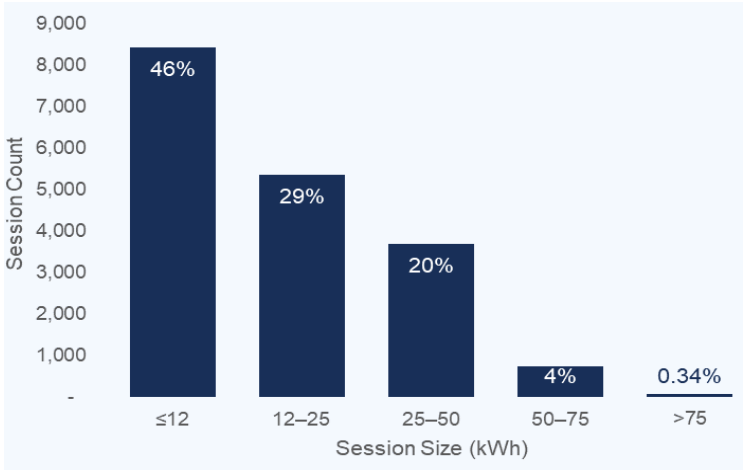
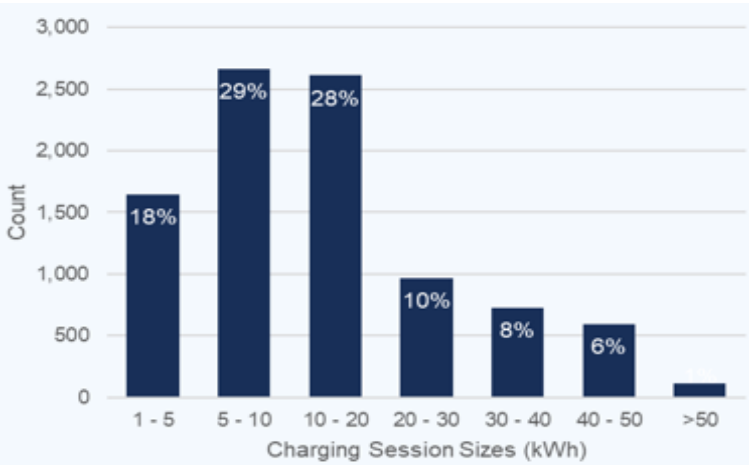


Figure 98. SCE Schools Pilot Program Count of Charging Sessions by Size



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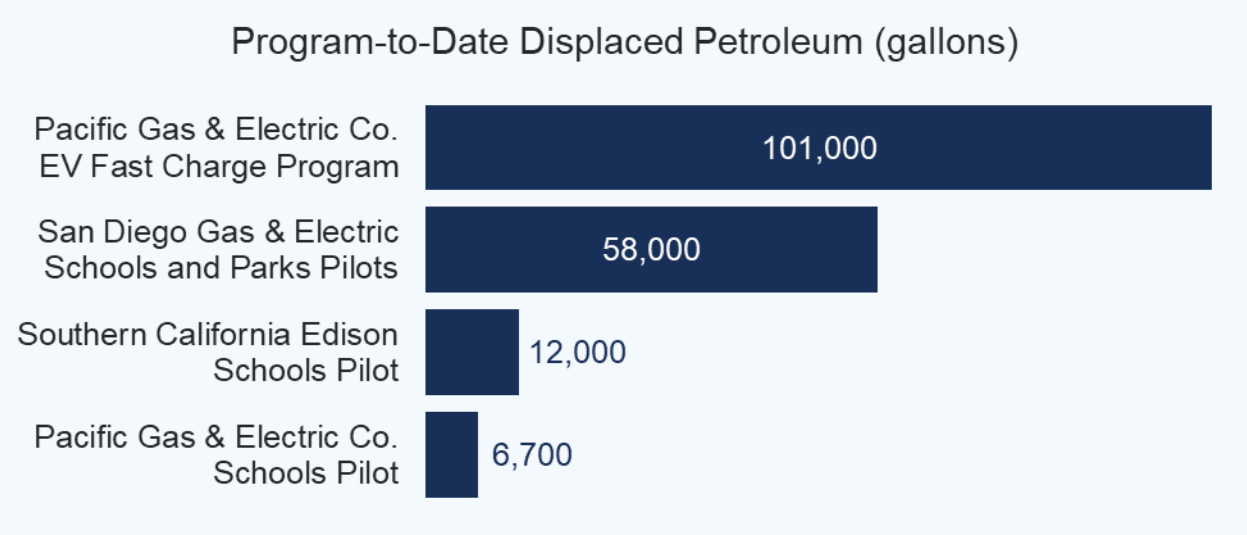
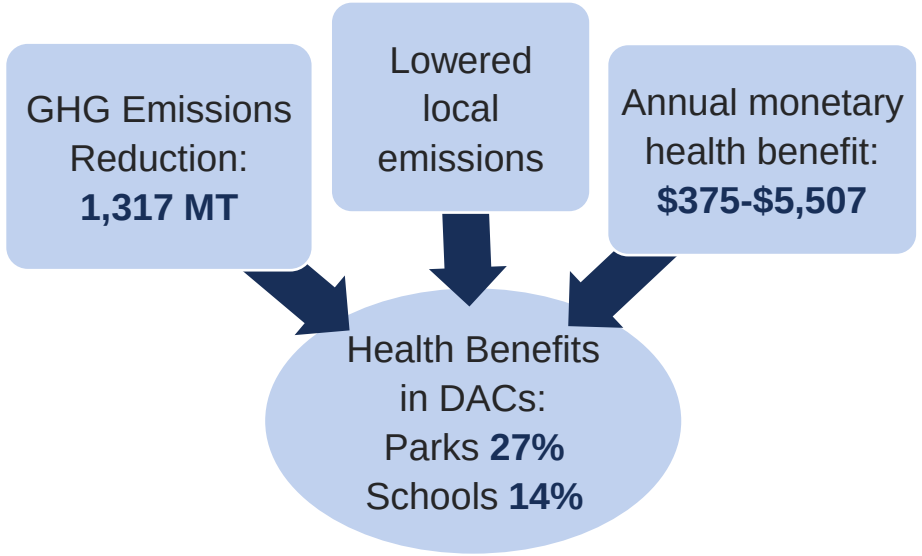
Public Charging | Lessons Learned

The Schools and Parks Pilots' sites and the EV Fast Charge program sites are resulting in the displacement of petroleum, reduction of greenhouse gas and local emissions, and improvement in health outcomes overall and within disadvantaged communities.





The Schools and Parks Pilots' sites and the EV Fast Charge program sites are promoting regional EV adoption.

The Pilots and program have positively influenced electric vehicle adoption in households neighboring the charging infrastructure, ranging from **8 to 55 additional electric vehicles**.

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With higher-than-expected site costs and project delays that continue to strain approved budgets for the Schools and Parks Pilots and the EV Fast Charge program, staff are interested in adapting the Pilots and program to mitigate impacts and encourage customer engagement.

2023 **site development delays** due to:

- Accommodation of Americans with Disability Act requirements
- Electric vehicle service provider staff turnover

Economic impacts from COVID-19 resulted in **original funding estimates not reflecting actual costs of implementation**.

Although cross-jurisdiction coordination remains a challenge, Utility staffs' commitment to the Parks Pilot development is starting to show progress.

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Vehicle to Grid Pilot

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V2G | Pilot Background

SDG&E selected the Cajon Valley Union School District for the V2G pilot.

SDG&E installed **six Rhombus 60 kW DCFC bi-directional chargers**.

Construction was completed in summer EY2021, but **school bus retrofits and interconnection issues delayed commissioning** until June 2022.

Pilot team:

- **SDG&E:** Site manager
- **CVUSD:** Site host
- **Lion Electric:** School bus provider
- **Nuvve:** Charging provider
- **Baker Electric:** Construction manager
- **ViriCiti:** School bus telematics provider

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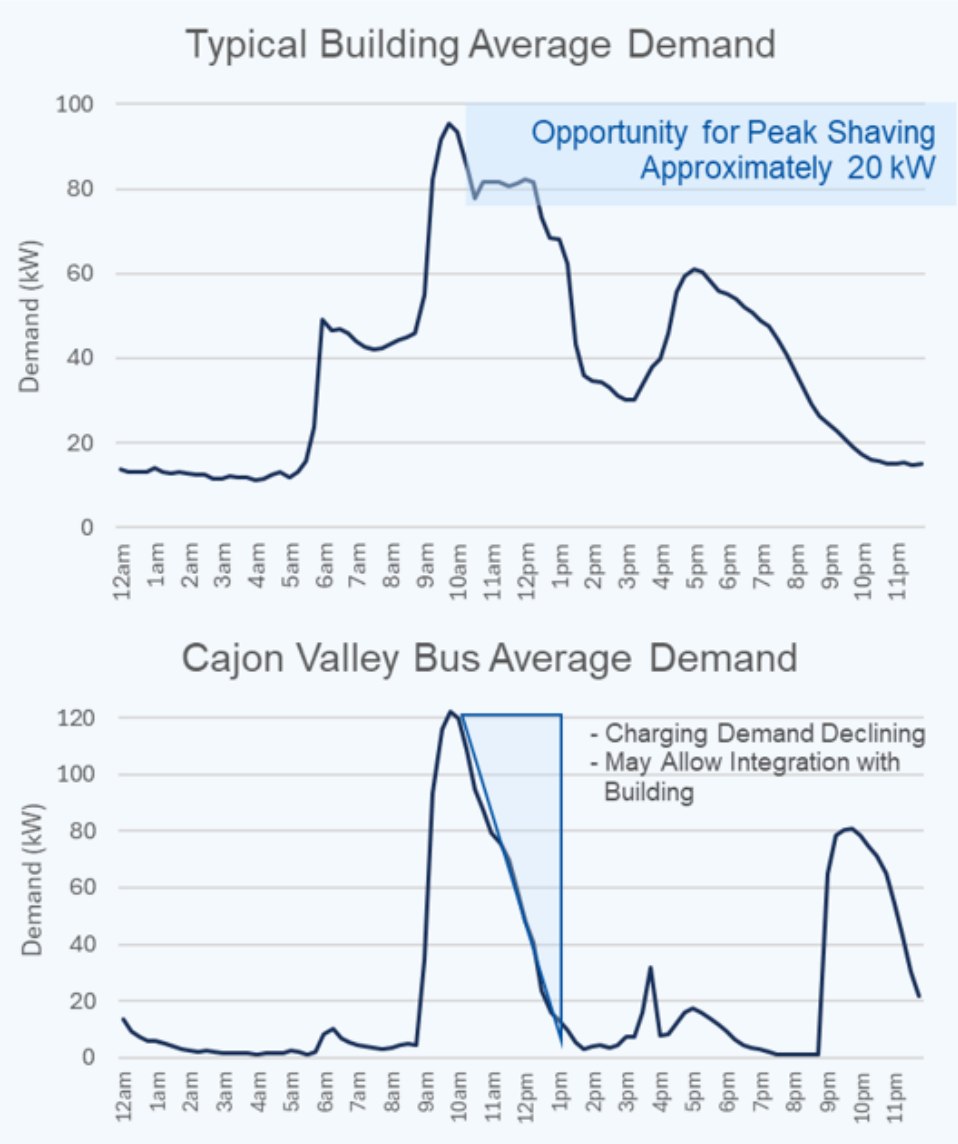
V2G | Pilot Operations-Based Modeling

Comparing Emergency Load Reduction Program to other Financial Opportunities

Figure 256. V2G Pilot Building and Bus Charging Load Curves



- Emergency Load Reduction Program provides a short window (<1% of annual hours)
  - Almost $1,500/bus annually (assuming average remaining kWh)
- Net Metering (Virtual Solar discharge 4PM – 9PM daily; ~15% of annual hours)
  - Almost $3,000 per bus annually (assuming average remaining kWh)
- Peak Shaving of building load spikes (daily year-round)
  - $7,200 annually at 20 kW reduction (small example)
  - Small amount of energy compared to remaining battery capacity of fleet
- Average bus remaining capacity after all daily driving:
  - ~60% or 74 kWh

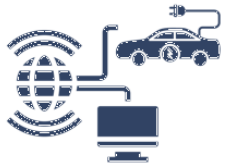
Vehicle-to-Grid financial benefits for the site could be increased by offering Vehicle-to-Grid–specific rates and using energy generation and battery storage outside of emergency load reduction program events and potentially for on-site load reduction.

Total electric energy generation:

2,850 kWh
in 2022 and 2023

Sites have opportunity to **reduce operating costs by expanding their generation** to support on-site load reduction.

Vehicle-to-Grid is still a nascent technology, and additional data collection efforts are needed to understand and resolve the issues associated with it.



Grid, hardware, and software interconnection issues were a consistent challenge, **delaying steady-state operation** until mid-2023.

Data challenges hindered the Team's ability to obtain a comprehensive understanding of the single Vehicle-to-Grid Pilot site's operation.

- Inconsistent datasets between the chargers, vehicles, and fleet records
- Poor network service provider electric vehicle charging session data quality

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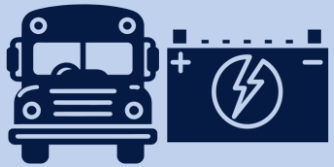
V2G | Recommendations

Prioritize the interoperability of buses, chargers, and battery software during the project planning phase.



Future Vehicle-to-Grid projects should prioritize the interoperability of buses, chargers, and battery software during the project planning phase to enable successful bus operation from the start.

Conduct additional third-party evaluations of Vehicle-to-Grid projects.

Additional third-party evaluations of Vehicle-to-Grid projects are needed to assess the challenges and opportunities of different Vehicle-to-Grid use cases to reduce operational costs (such as maximizing energy export, maximizing behind-the-meter load management, and participation in California Independent System Operator grid services).

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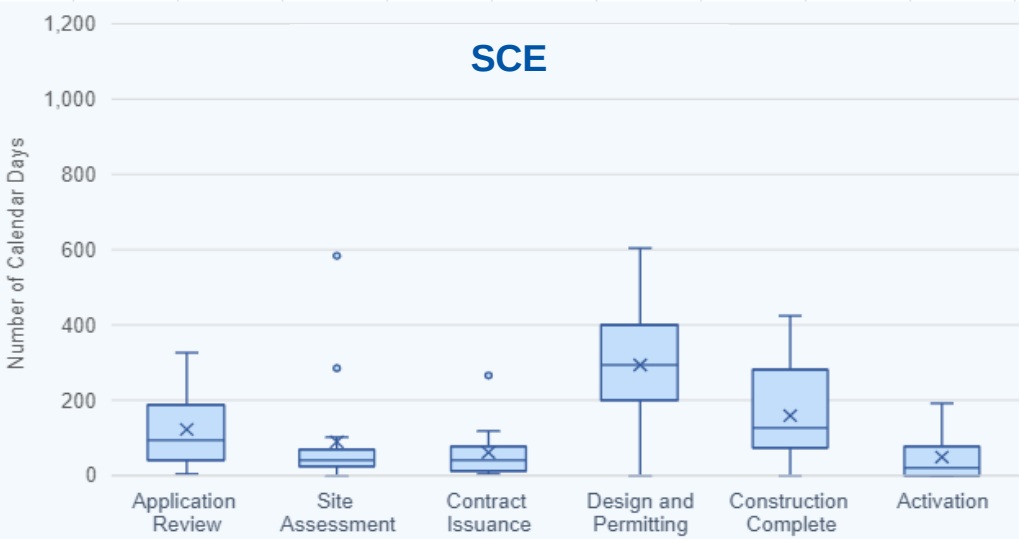
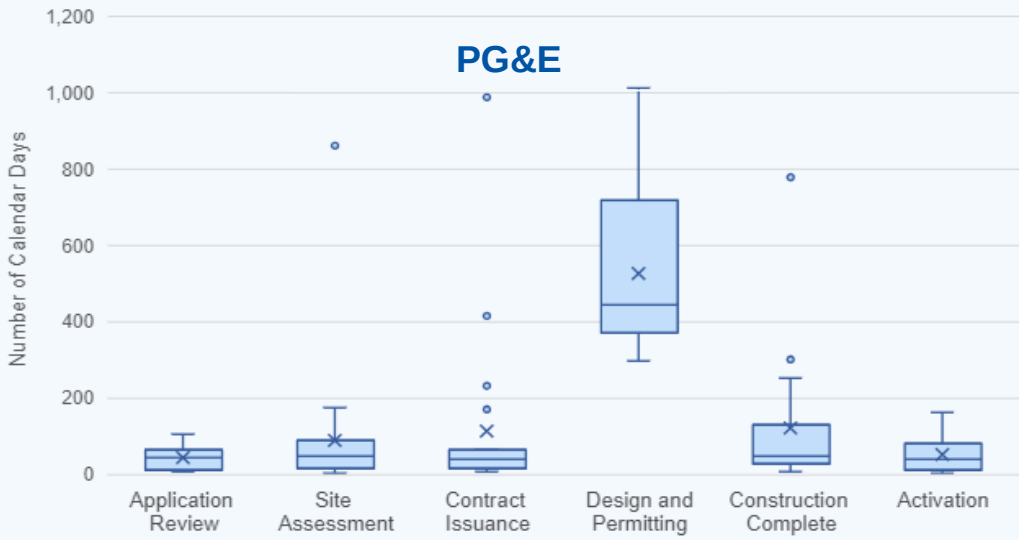
Q&A

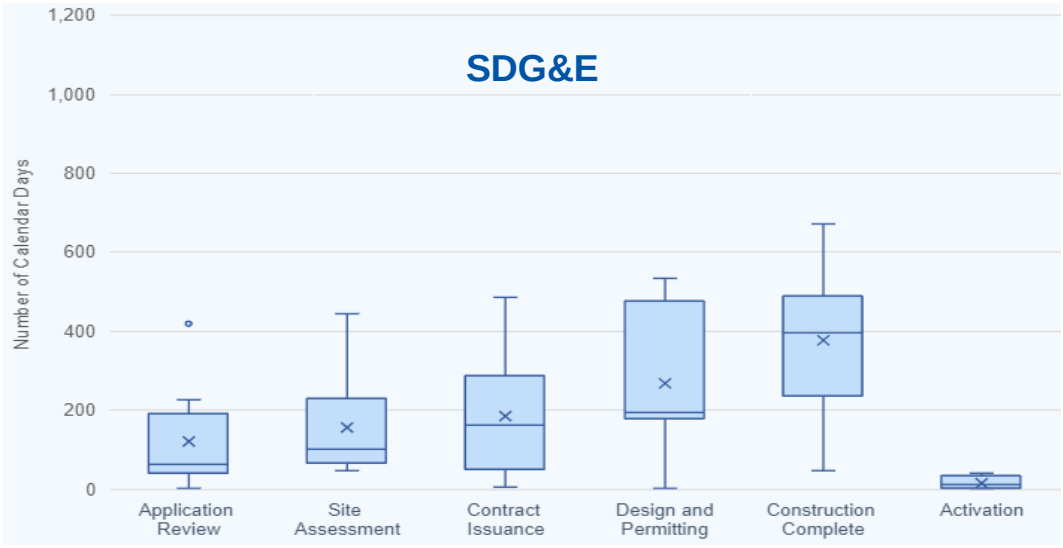
Project Manager: Michael.Colby@Cadmusgroup.com
Technical Director: Ziga.Ivanic@clearesult.com

MDHD | Site Timelines

Timelines are generally longer than expected and vary widely by phase







Timelines

- Original Utility estimates ranged between 11 and 19 months while program **medians** are between **16 and 23.5 months**.
- The **median start-to-finish** for all 44 EY2023 activated sites was **862 days**.
- **Design and Permitting** is **longest phase** with a median of **252 days** in PTD sites, followed by Construction Complete with a median of 133 days.

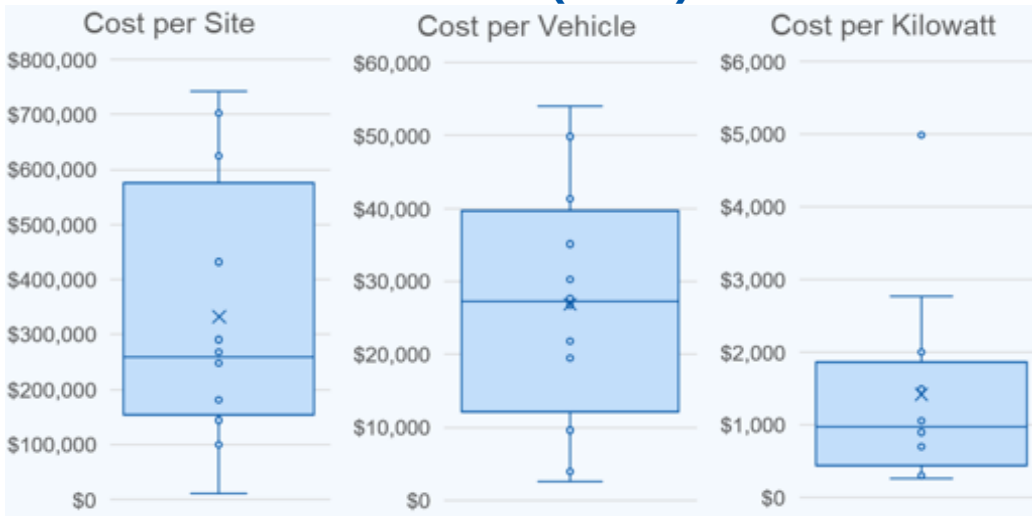
Delays

- The acquisition of switchgear is a primary driver for delays, with timelines extending to 35 to 40 weeks.
- Design and Permitting delays are often driven by the customer design schedule.
- Delays are also seen from customer changes to projects after contract execution.

MDHD | Utility Infrastructure Costs

SCE CRT (n=29)

SDG&E PYDFF (n=12)



PG&E Fleet (n=52)

- **Costs** include Utility-funded **TTM plus BTM** for financially closed-out sites.
- The **PG&E Fleet program provides TTM infrastructure** upgrades for all sites: only 1 of 52 had Utility-constructed BTM infrastructure.
- **Larger sites** have **lower costs** per vehicle and per kilowatt than smaller sites, although the scale effect is relatively modest.
- There is a mix of L2 and DCFC across market sectors.

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MDHD | Costs Per Site

Figure 55. SCE Charge Ready Transport Program Per-Site Costs Organized by Three Perspectives, Across 29 Closed-out PTD Sites

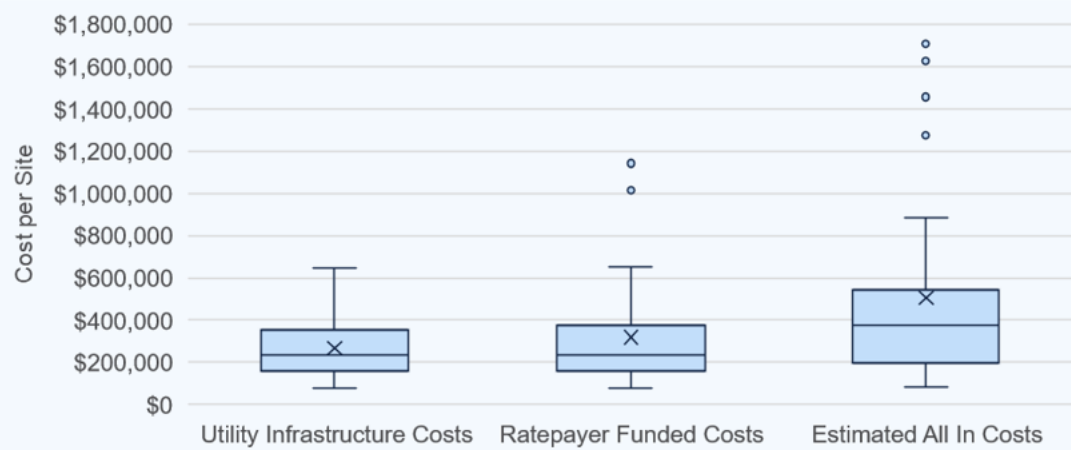
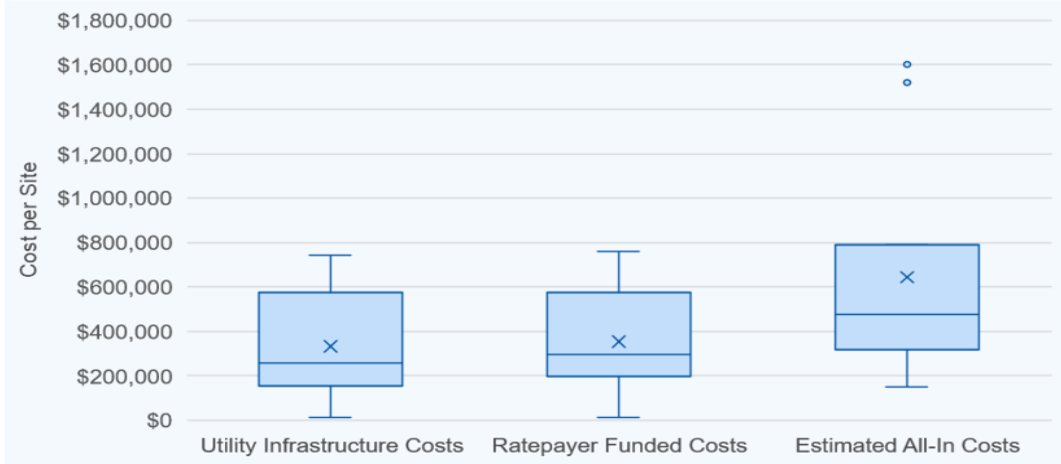
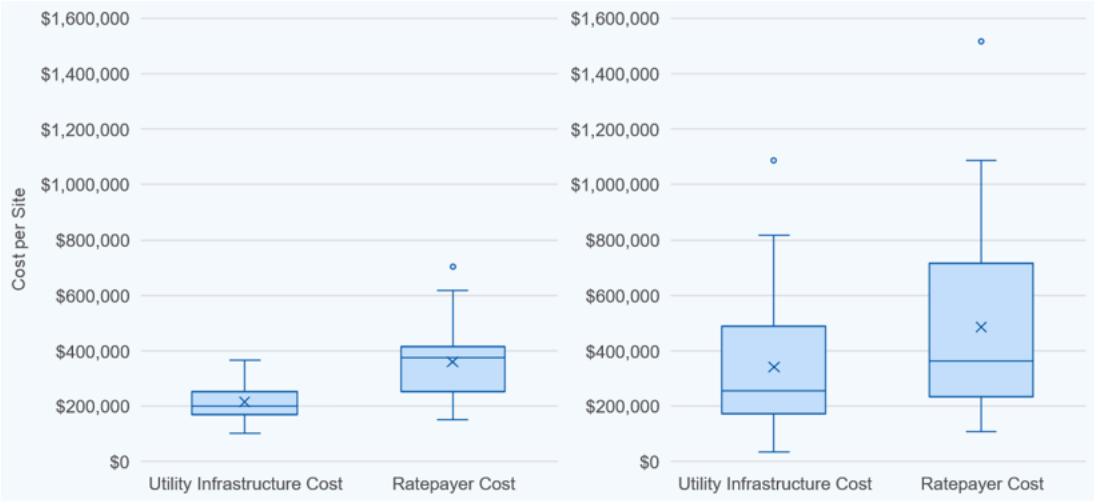


Figure 191. SDG&E PYDFF Program Per Site Costs Organized by Three Perspectives, Across Closed-out Sites



- Distribution of site-level costs for the all sites.
- The **PG&E Fleet program provides TTM infrastructure** upgrades for all sites: only 1 of 52 had Utility-constructed BTM infrastructure
- Three panels are defined as:
  - **Utility Infrastructure Costs**. Site costs borne by the Utility for TTM and BTM.[53]
  - **Ratepayer-Funded Costs**. All site costs paid for by the Utility, including TTM, BTM (or BTM incentive if infrastructure is customer owned), and EVSE rebate.
  - **Estimated All-in Costs.** The total estimated cost of installing the site, including capital and labor costs for the Utility and the customer. The value is calculated by summing 100% of TTM,[54] BTM,[55] and EVSE costs.[56]

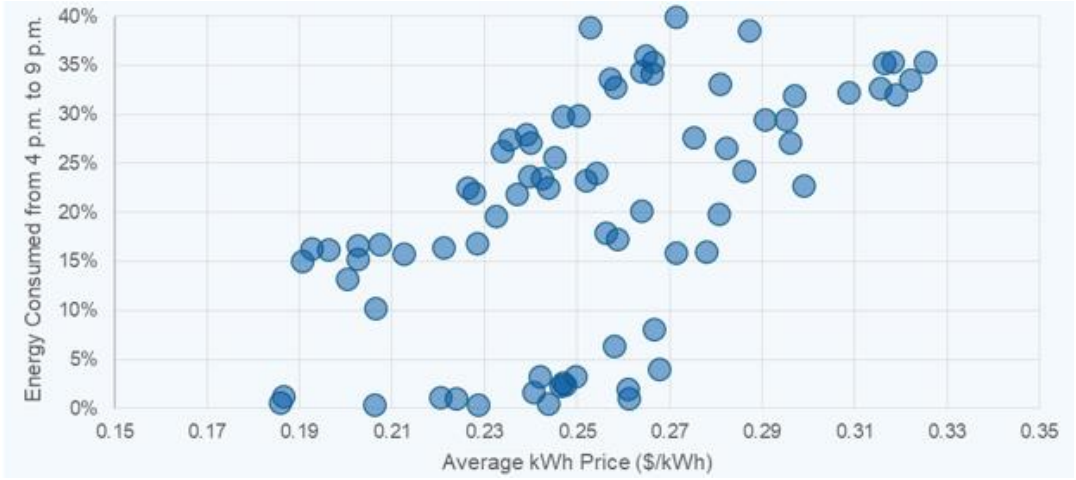
Figure 123. PG&E EV Fleet Program Per Site Costs Organized by Two Perspectives Across 52 Closed-out School Bus and Non-School Bus PTD Sites



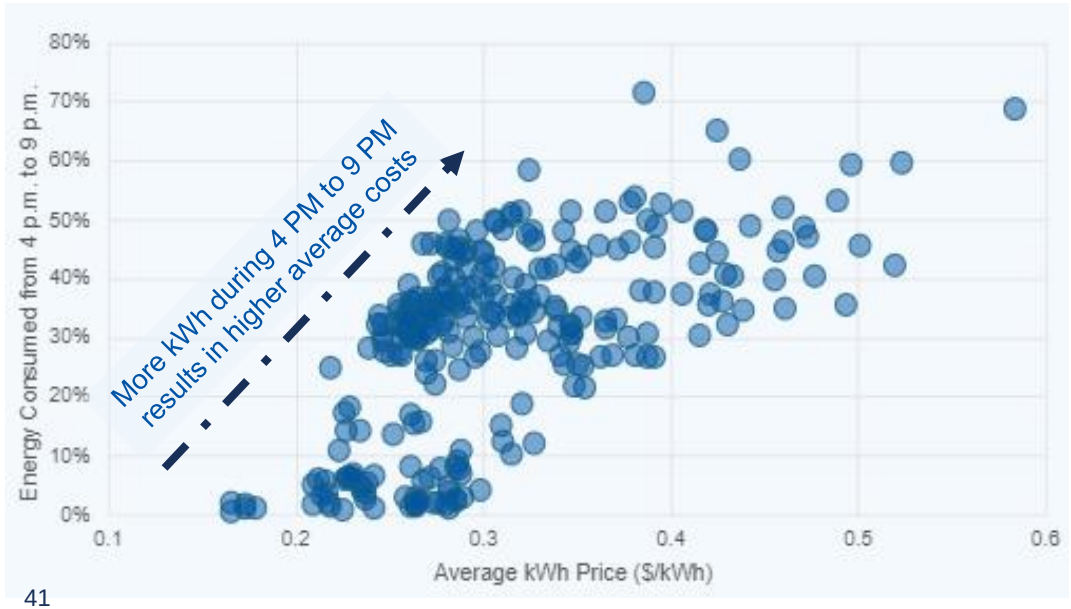
MDHD | Grid Impacts – Billing

SCE Charge Ready Transport Program

High Consumption Billing Months (>20 MWh)

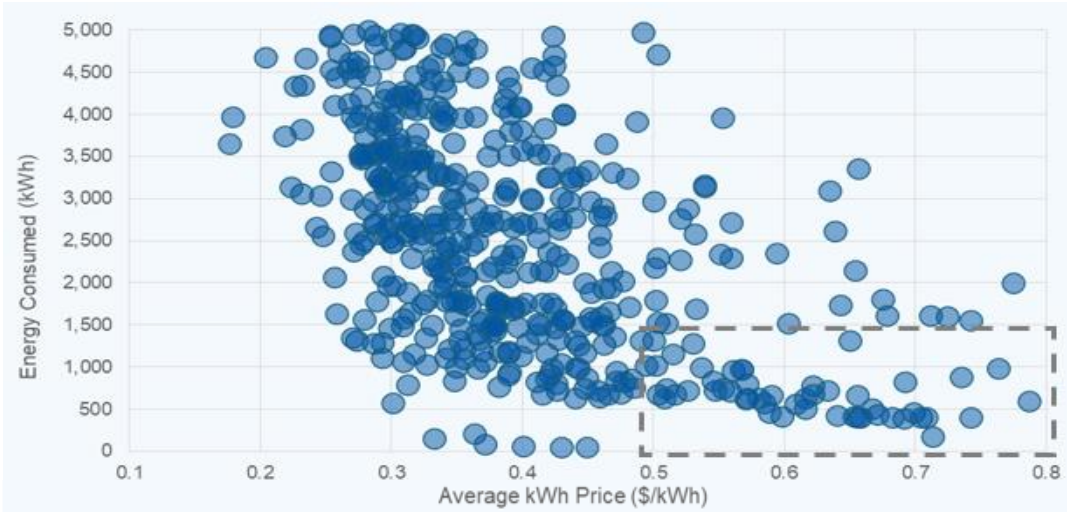


Medium Consumption Billing Months (5-20 MWh)



Percentage of Monthly Energy Consumed from 4-9pm vs. Average Energy Price for Consumption Billing Months for PTD Sites

Low Consumption Billing Months (<5 MWh)



Higher average costs per kWh appear coincident with very low consumption Or High On-Peak proportion

- **High billing months** (top left) generally had consistently **lower costs per kilowatt-hour**. This could be due to around-the-clock charging (4 PM to 9 PM still has significant consumption but low percentage).
- **Medium billing months** (bottom left) appear to see **costs scale by proportion of 4-9 PM consumption**.
- **Small billing months** (right) appear to show **average cost decrease with increased consumption**. Many examples may represent vehicles not fully implemented.
- Some CCA's offer exceptionally low pricing during certain seasonal hours, heavily influencing fleets that are in the know and able to adapt.

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MDHD | NREL Optimization

Figure 64. SCE Charge Ready Transport Program Hourly TOU Electricity Rates and Average Carbon Intensity Used for Generating LCFS Credits in 2023

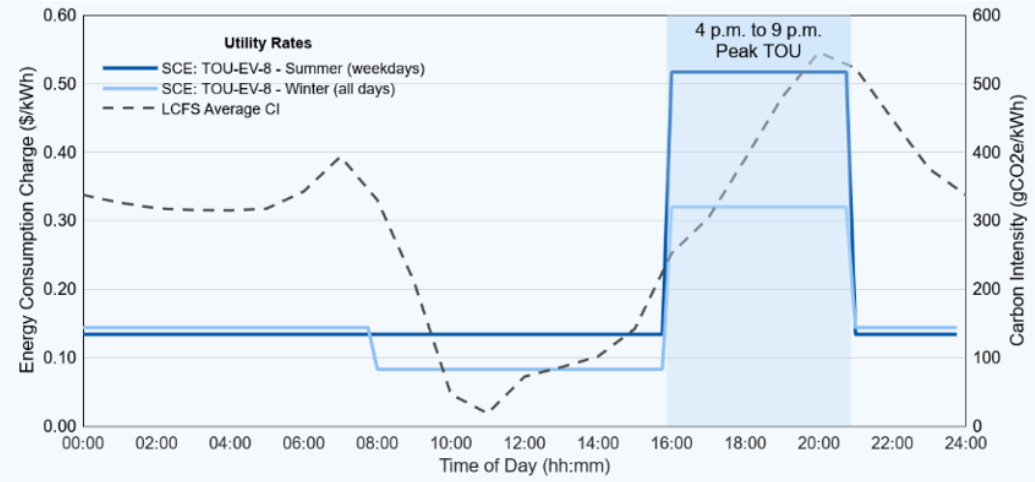


Figure 200. SDG&E PYDFF Program Hourly TOU Electricity Rates and Average Carbon Intensity Used for Generating LCFS Credits in 2023

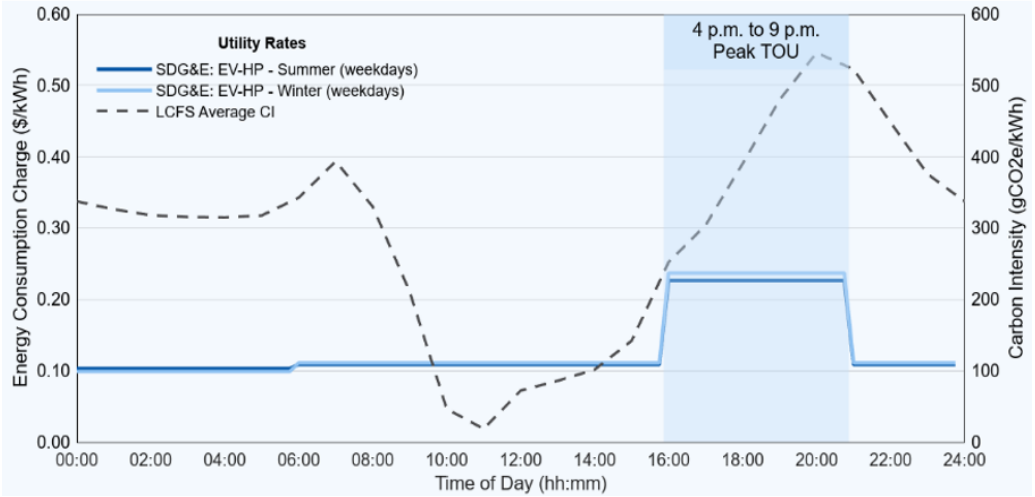
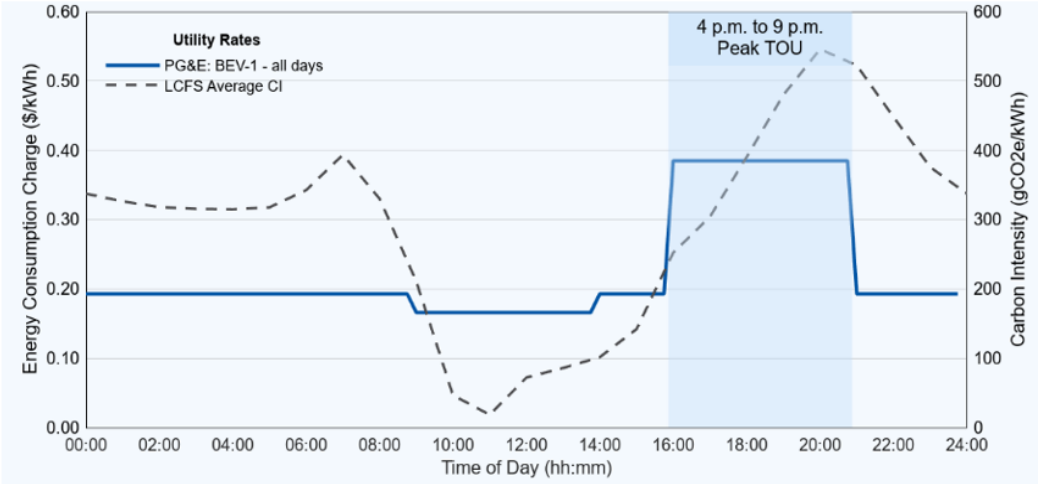


Figure 131. PG&E EV Fleet Program Hourly TOU Electricity Rates and Average Carbon Intensity Used for Generating LCFS Credits in 2023

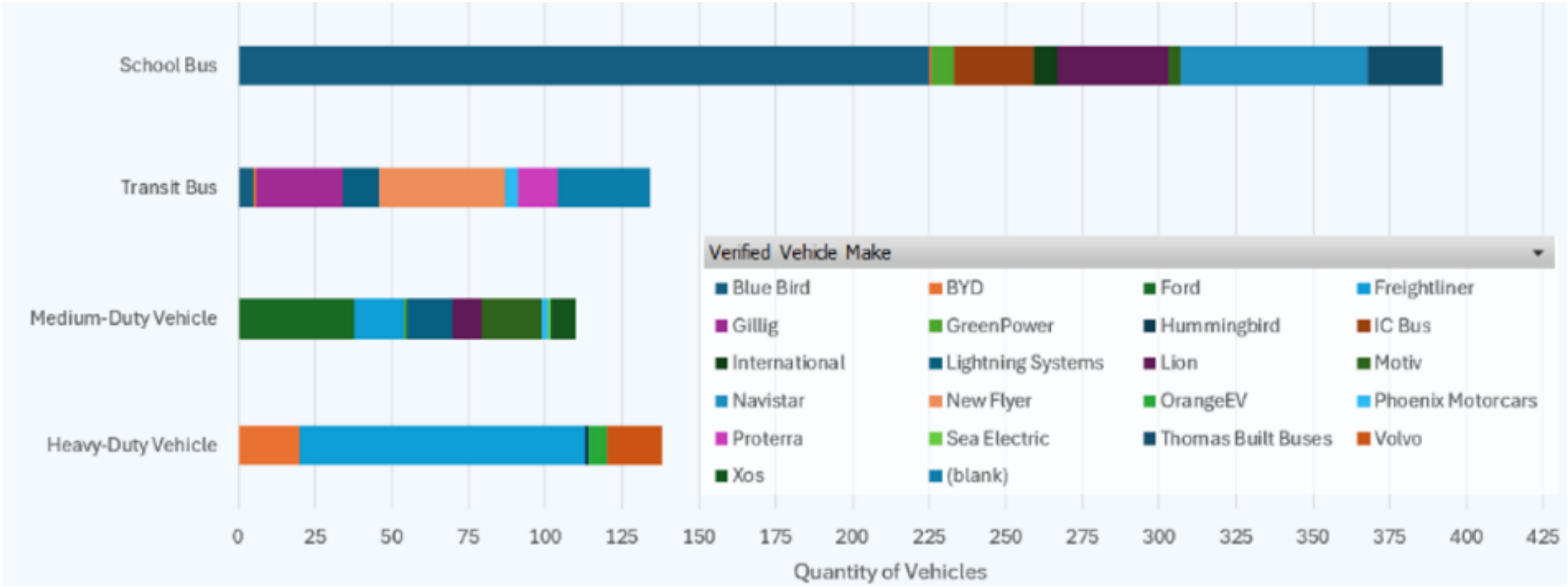


- On-Peak period for TOU: 4-9pm
- TOU rate structures:
  - SCE CRT: 20-500kW and >500kW demand respectively
  - PG&E: <100kW demand
  - SDG&E: >20kW demand

- TOU on-peak energy costs:
  - SCE: $0.07-$0.52/kWh (depending on time of year and day)
  - PG&E: ~$0.385/kWh
  - SDG&E: $0.226-$0.237/kWh depending on time of year
- TOU off- and super-off peak energy costs:
  - PG&E: $0.193 and $0.166/kWh
  - SDG&E: $0.099-$0.111/kWh
- In many cases, lower-cost TOU periods correlate with lower carbon intensity of the grid

Statewide MDHD | Summary Statistics

Vehicle Make by Market Sector



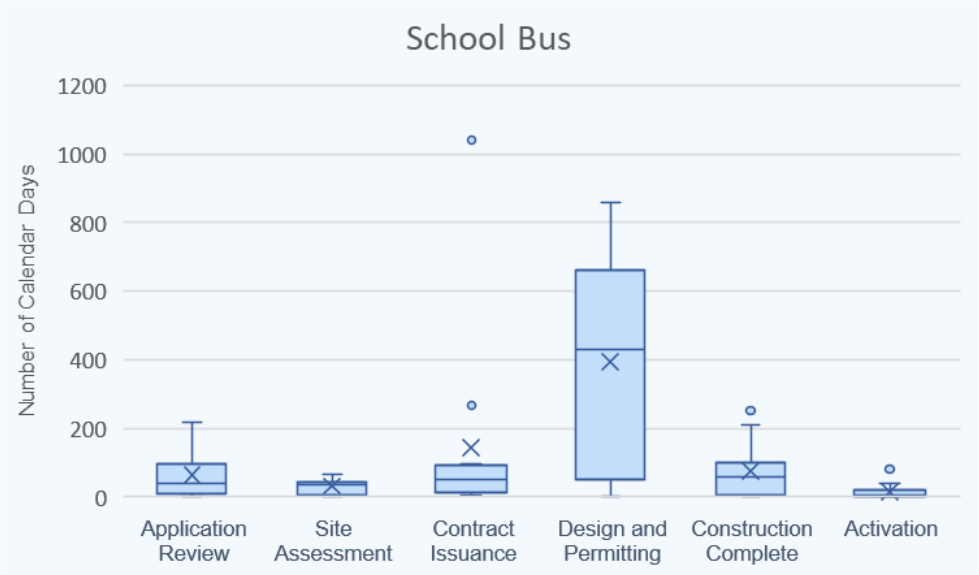
Statewide MDHD | Site Activation Timelines

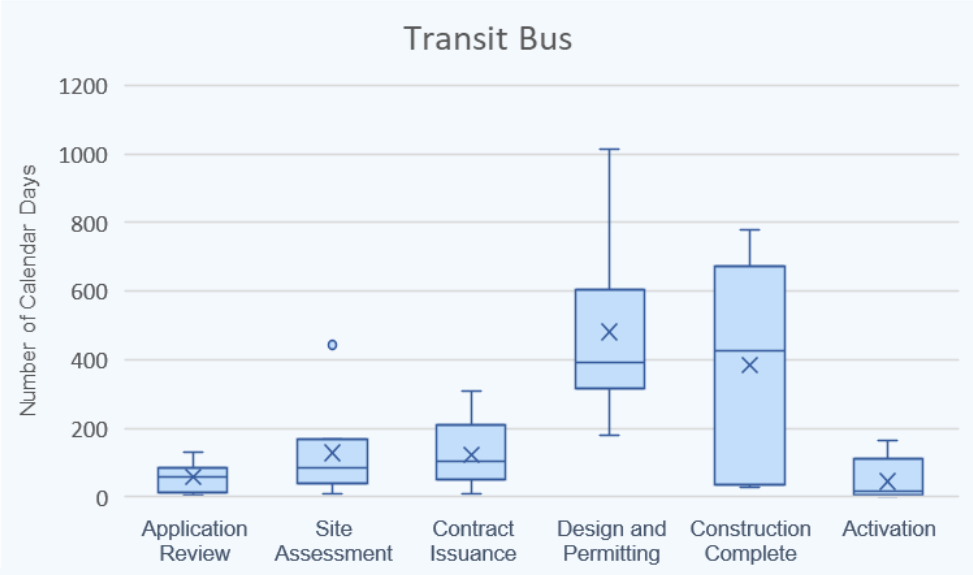
Median Calendar Days by Evaluation Year and Program Phase

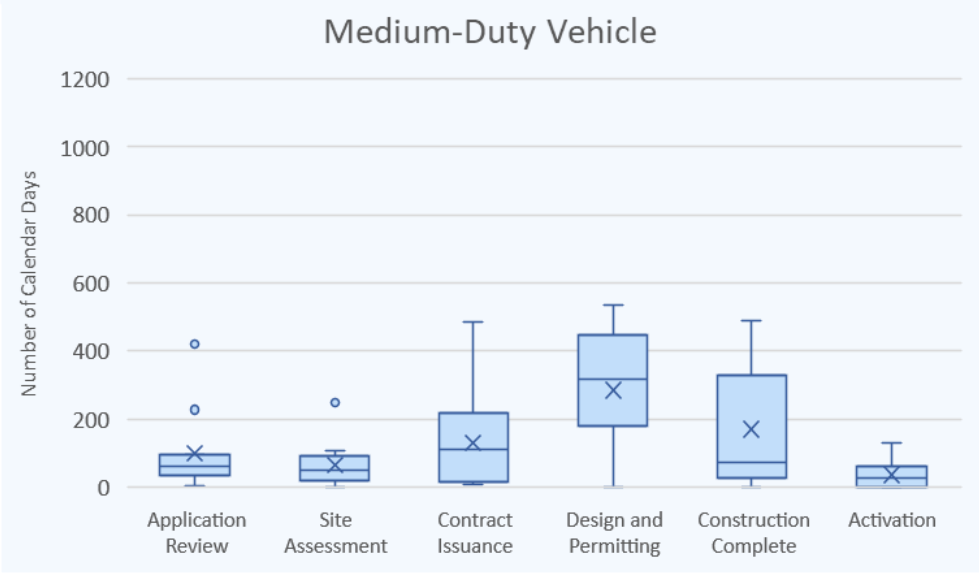
CPUC Program Phase	Median Calendar Days		
	EY2021	EY2022	EY2023
Application Review	35	33	56
Site Assessment	35	54	46
Contract Issuance	31	45	52
Design and Permitting	225	280	344
Construction Complete	84	133	105
Activation	29	20	20
Start-to-Finish	615	728	852

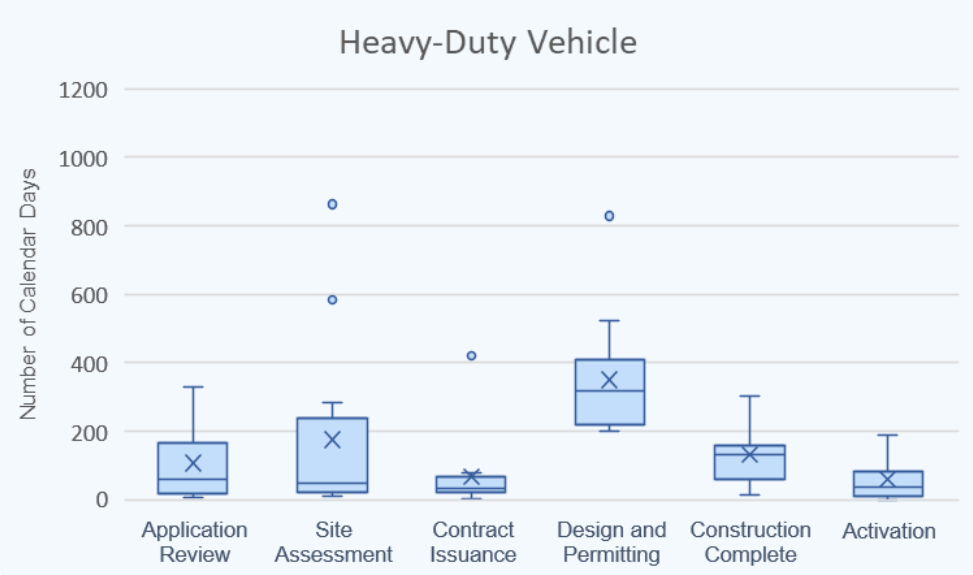
Statewide MDHD | Site Activation Timelines

Calendar Days per Phase for EY2023 Sites by Market Sector





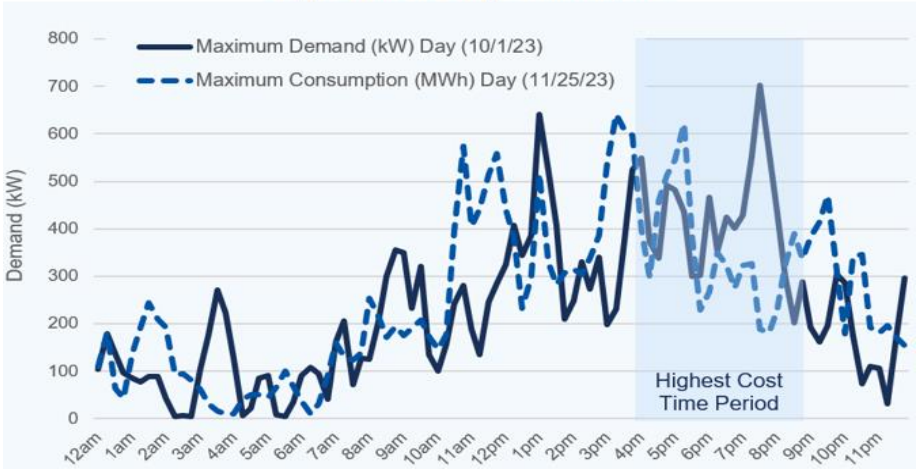




Start to Finish Days		
	School Bus	664
	Transit Bus	956
	Medium-Duty	722
	Heavy-Duty	720

Public Charging | Energy Trends – EVFC and AB1083 (Parks)

Figure 169. PG&E EV Fast Charge Program Comparing Days of Highest Demand to Highest Consumption



- Load curves reflect mid-afternoon focused usage
- Pricing to drivers reflects Time of Use pricing
  - Idle fees often used at DCFC locations
  - Greater study necessary on public impact of TOU rates

Figure 242. SDG&E Parks Pilot Highest Demand and Consumption Days

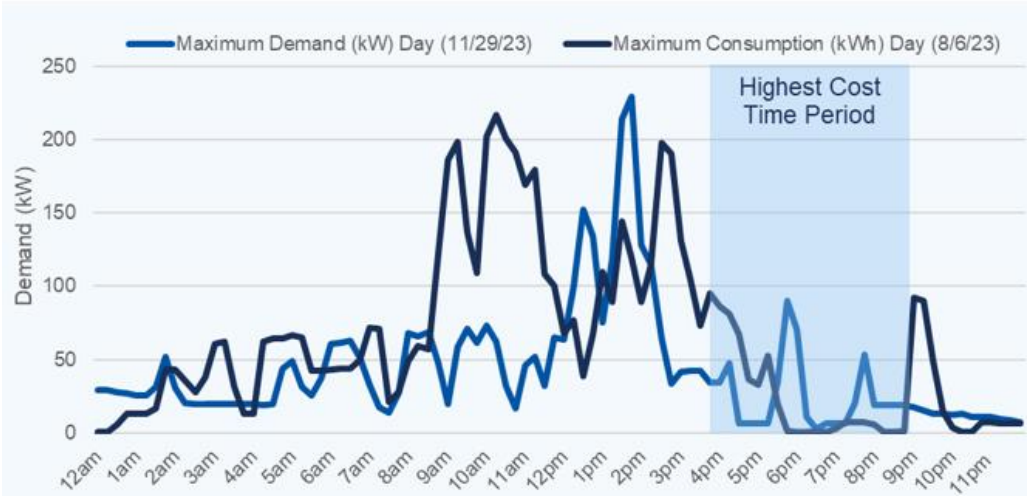
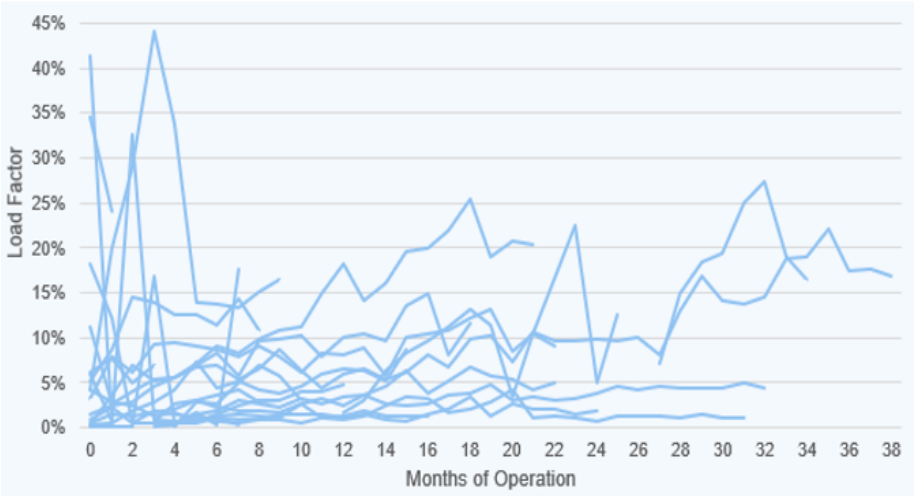
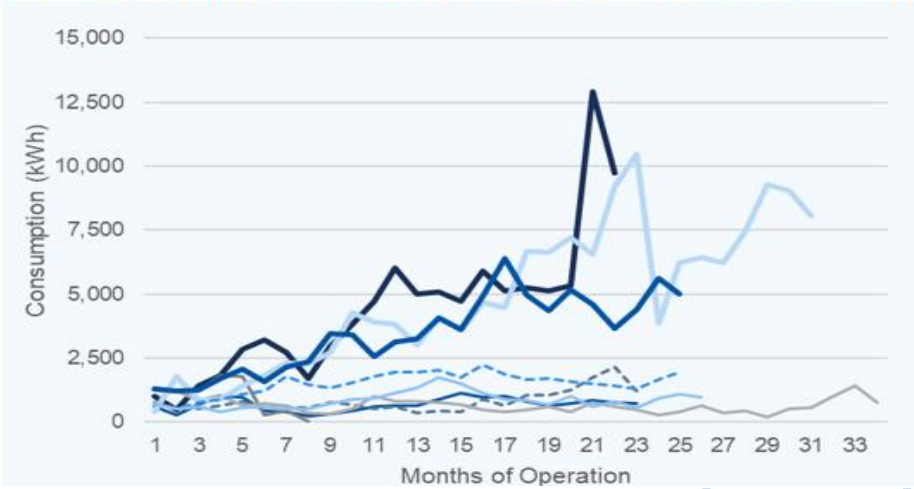


Figure 172. PG&E EV Fast Charge Program Monthly Load Factor by Site



- Some sites indicate more dramatic adoption by the public than others
- Monthly throughput may take several years to reach stability

Figure 244. SDG&E Parks Pilot Monthly Consumption based on Sites' Operational Time



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