CADMUS

FINAL EVALUATION REPORT
CALIFORNIA INVESTOR-OWNED UTILITY TRANSPORTATION ELECTRIFICATION PRIORITY REVIEW PROJECTS
Presentation Outline

• Introduction
• Program Summary
• Large Investor-Owned Utility (IOU) PRPs
  • San Diego Gas and Electric
  • Southern California Edison
  • Pacific Gas and Electric
• Small Multi Jurisdictional IOU PRPs
  • PacifiCorp
  • Liberty Utilities
  • Bear Valley Electric Service
$50M+ investment approval for six IOUs in 2018:

- CPUC Decision 18-01-024 approved 15 PRPs
  - $19M for 6 San Diego Gas and Electric (SDG&E) pilots
  - $16M for 5 Southern California Edison (SCE) pilots
  - $8M for 4 Pacific Gas and Electric (PG&E) pilots

- CPUC Decision 18-09-034 approved 7 small IOU PRPs
  - $6.1M for 4 Liberty Utilities pilots
  - $0.6M for 1 Bear Valley Electric Service (BVES) pilot
  - $0.4M for 2 PacifiCorp pilots

- Energetics selected as 3rd party evaluator (Oct 2018)
  - Team includes Cadmus Group, National Renewable Energy Laboratory, Idaho National Laboratory, and DAV Energy

CPUC directed IOUs in Fall 2016 to propose up to $20M PRP portfolio each with a max of $4M per PRP by January 2017
The 22 PRPs are **diverse innovative deployment efforts** requiring tailored evaluation methods. For evaluation purpose they have been categorized into 3 groups.

<table>
<thead>
<tr>
<th>Fleet Electrification</th>
<th>• Known vehicles utilizing the charging EV charging infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Access Stations</td>
<td>• Installed EV charging infrastructure that will serve a broad array of vehicles</td>
</tr>
<tr>
<td>Electrification Promotions</td>
<td>• Strategies to address education- and awareness-related barriers to EV adoption</td>
</tr>
</tbody>
</table>
## PRP Group 1 – Fleet Electrification

### INTRODUCTION

#### Priority Review Project (Off-road Infrastructure)
- **Airport Ground Support Equipment (SDG&E)** – $2.8M
- **Port Electrification (SDG&E)** – $2.4M
- **Port of Long Beach Rubber Tire Gantry Crane (SCE)** – $3M
- **Port of Long Beach Terminal Yard Tractor (SCE)** – $0.45M
- **Idle Reduction Technology (PG&E)** – $1.7M

#### Priority Review Project (MHD Infrastructure)
- **Charge Ready Transit Bus (SCE)** – $4M
- **Medium/Heavy Duty Fleet Customer Demo (PG&E)** – $3.4M
- **Electric School Bus Renewables Integration (PG&E)** – $2.2M
- **Green Shuttle (SDG&E)** – $3.2M
- **Fleet Delivery Services (SDG&E)** – $3.7M

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*MHD – medium- and heavy-duty vehicle*
PRP Group 2 – Public Access Stations

**Priority Review Projects**

<table>
<thead>
<tr>
<th>Project Description</th>
<th>Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban Charge Ready DCFC (SCE)</td>
<td>$4M</td>
</tr>
<tr>
<td>Electrify Local Highways (SDG&amp;E)</td>
<td>$4M</td>
</tr>
<tr>
<td>DCFC Project (Liberty)</td>
<td>$4M</td>
</tr>
<tr>
<td>Destination Make Ready (BVES)</td>
<td>$0.6M</td>
</tr>
</tbody>
</table>

**Quantitative Data Sources**

- Charging Stations
- Smart Meters

**Qualitative data sources**

- Drivers
- Site Hosts
- Local Business Owners
PRP Group 3 – Electrification Promotions

Priority Review Project

<table>
<thead>
<tr>
<th>Program</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge Ready Home Installation (SCE)</td>
<td>$4M</td>
</tr>
<tr>
<td>Home EV Charger Information Resource (PG&amp;E)</td>
<td>$0.2M</td>
</tr>
<tr>
<td>Dealership Incentive (SDG&amp;E)</td>
<td>$1.8M</td>
</tr>
<tr>
<td>Outreach and Education Program (PacifiCorp)</td>
<td>$0.2M</td>
</tr>
<tr>
<td>Demonstration and Development Program (PacifiCorp)</td>
<td>$0.3M</td>
</tr>
<tr>
<td>Residential Rebate Program (Liberty)</td>
<td>$1.6M</td>
</tr>
<tr>
<td>Small Business Rebate Program (Liberty)</td>
<td>$0.3M</td>
</tr>
<tr>
<td>Customer Online Resource (Liberty)</td>
<td>$0.3M</td>
</tr>
</tbody>
</table>

INTRODUCTION

Quantitative Data Sources
- Website Views
- Number of Participants

Qualitative data sources
- Participant Feedback
- Non-Participant Feedback
- Dealership Personnel
Utility PRP Timelines

INTRODUCTION
Key PRP Research Questions

- What barrier(s) to electrification are being addressed, and what was the PRP’s success at overcoming the barrier(s)?
  - Since PRPs are pilots and unique (evaluating technology against a use case hypothesis), it can be difficult to compare PRPs based on common metrics

- What were the net impacts (relative to the no-PRP scenario)?
  - GHG and pollution reduction / Fossil fuel displacement / Participant changes in cost

- What were the co-benefits?
  - For disadvantaged communities (DACs) / Operations, maintenance, and fuel costs / Noise reduction and time savings / Health and safety

- What were the lessons learned?
  - What worked well / How could implementation be improved based on lessons learned / What innovations were made

- How could the project be scaled up? Under what timeline?

- What was the cause of any implementation delays, and can these be avoided for future projects?
Final Evaluation Report

Submitted to CPUC and shared with SB350 PRP service list by SCE on 4/22/2021
Final Evaluation Report

Project Narrative
- Overview, Objectives, and Barriers Being Addressed
- Sites & Participants
- Timeline
- Areas for Implementation Improvement

Evaluation Methodology
- Selected Methods and Rationale
- Data Sources

Evaluation Findings
- Project Baseline
- Implementation Process
- Costs & Benefits
- Operational Impacts of Equipment
- Stakeholder and Customer Feedback

Conclusions & Recommendations
- Findings
- Lessons Learned
- Scale Up Potential

INTRODUCTION
Unspent funding to be returned to ratepayers upon program completion
Charging Ports Installed

309 charging ports (81 DCFC)
EV Charging Infrastructure Costs

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Cost ($/kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delivery Truck</td>
<td>2,280</td>
</tr>
<tr>
<td>Shuttle Bus</td>
<td>1,937</td>
</tr>
<tr>
<td>Forklift</td>
<td>1,933</td>
</tr>
<tr>
<td>Public Charging</td>
<td>1,635</td>
</tr>
<tr>
<td>TRUs</td>
<td>1,301</td>
</tr>
<tr>
<td>Transit Bus</td>
<td>985</td>
</tr>
<tr>
<td>Tractors</td>
<td>739</td>
</tr>
<tr>
<td>Airport GSE</td>
<td>647</td>
</tr>
<tr>
<td>RTG Crane</td>
<td>569</td>
</tr>
<tr>
<td>School Bus</td>
<td>490</td>
</tr>
</tbody>
</table>
Energy Consumption
Average Energy Costs

[Bar chart showing the average energy costs per kWh for different vehicles: Delivery Truck (0.40), Public Charging (0.37), Forklift (0.35), Tractors (0.24), Shuttle Bus (0.19), Transit Bus (0.18), School Bus (0.08)].
Avoided GHG Emissions

[Diagram showing avoided GHG emissions by different vehicles and equipment]
## Scale Up Potential

<table>
<thead>
<tr>
<th>Application</th>
<th>Technology Maturity</th>
<th>Operational Applicability</th>
<th>Grid Integration Ability</th>
<th>Operational Cost Effectiveness</th>
<th>GHG Reduction per Investment</th>
<th>Market Size and Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transit Bus</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Airport Ground Support Equipment</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Public Charging for Light-duty EVs</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Trailer Refrigeration Units</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Delivery Truck</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>School Bus</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Shuttle Bus</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Forklifts</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Drayage/Terminal Tractors</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Rubber Tire Gantry Crane</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

- 1 – significant vehicle or charging technology deployment challenges, 4 – minimal deployment challenges
- 1 – not a good fit for electrification, 4 – very good fit for electrification
- 1 – no flexibility in avoiding on-peak charging, 4 – significant opportunity for off-peak charging
- 1 – minimal operational energy savings, 4 – operational energy savings cover significant portion of charging infrastructure costs
- 1 – less than 200 MT of CO₂ emissions reduction annually per $1M of charging infrastructure investment, 4 – more than 1,000 MT of CO₂ emission reduction annually per $1M of charging infrastructure investment
- 1 – less than 1,000 vehicles/equipment in California suitable for electrification, 4 – more than a million vehicles suitable for electrification

Upcoming regulation, existing eTRU technology, limited charge scheduling opportunities, significant benefits and market size.
Evaluation Findings & Lessons Learned

- Make-ready planning, design, and construction activities were well executed
- Many PRP schedules were extended by 12 months or more
- Incentive programs fell short of spending their budget due to eligibility and application requirements
- Electrical infrastructure upgrades are required for significant fleet electrification; utilities are necessary partners for infrastructure support
- Advising fleets on EV technologies and charging solutions increases TE program success
- Periodic review of fleet operational performance increases project benefits
- Electricity rates are a key factor in total cost of ownership. Variable rates provide opportunities for significant cost savings if customers can manage their charging patterns.
- Statewide vehicle purchase incentives (CARB HVIP), charging infrastructure funding (utility make-ready programs), and fueling credits (CARB LCFS) are needed for most vehicle applications to ensure a successful transition to ZEVs over the next decade.
<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>MHD (Off-road Infrastructure)</td>
<td>Airport Ground Support Equipment (SDG&amp;E)</td>
<td>$2.8M</td>
</tr>
<tr>
<td></td>
<td>Port Electrification (SDG&amp;E)</td>
<td>$2.4M</td>
</tr>
<tr>
<td>MHD Infrastructure</td>
<td>Green Shuttle (SDG&amp;E)</td>
<td>$3.2M</td>
</tr>
<tr>
<td></td>
<td>Fleet Delivery Services (SDG&amp;E)</td>
<td>$3.7M</td>
</tr>
<tr>
<td>Public Access Stations</td>
<td>Electrify Local Highways (SDG&amp;E)</td>
<td>$4M</td>
</tr>
<tr>
<td>Electrification Promotions</td>
<td>Dealership Incentive (SDG&amp;E)</td>
<td>$1.8M</td>
</tr>
</tbody>
</table>
**Airport GSE – Overview**

**Objectives**

Phase I – Retrofit 16 existing GSE-specific charging ports with utility owned EV chargers on the air side of terminal

Collect and analyze data to understand GSE charging load patterns

Phase II – Install up to 45 additional charging ports for new eGSE

**Key Results**

Budget: Approved $2.8M, Spent $0.85M (29%)

EV charging: 16 charging ports (8 DCFC EVSE)

EVs supported: 31 eGSE

Petroleum reduction: 19,318 GGE annually

GHG reduction: 470 MT CO₂ annually

DAC: SDIA is not in a DAC

Grid Impacts: 96 MWh annually (19% on peak)
Airport GSE – Participant

<table>
<thead>
<tr>
<th>Fleet</th>
<th>Chargers</th>
<th>Baseline and eGSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Diego International Airport American Airlines</td>
<td>Eight Webasto 10-40 kW PosiCharge ProCore</td>
<td>• 31 electric baggage tractors and cargo belt loaders</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Gasoline GSE (baseline)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Terminal 2 Location</th>
<th>Configuration</th>
<th>Ports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gate 23</td>
<td>3 dual-port chargers</td>
<td>6</td>
</tr>
<tr>
<td>Gate 25</td>
<td>3 dual-port chargers</td>
<td>6</td>
</tr>
<tr>
<td>Gate 35</td>
<td>2 dual-port chargers</td>
<td>4</td>
</tr>
</tbody>
</table>
Airport GSE – Findings (1)

On average less than 5 hours per day charger use (opportunity to support additional eGSE)
Airport GSE – Findings (2)

Opportunity for shifting charging to lower cost periods (nighttime and daytime with onsite solar)

Morning and afternoon charging is more costly than late at night and likely contributes to demand charges.
Insights and Lessons Learned

Timeline significantly extended; participation agreement between the utility and the SDIA took nearly a year to execute

Utility challenges due to restrictions on access and control on the airside of the terminal (construction, maintenance & repair, data collection)

Redundancy in high use operation is important (old chargers were used during charger downtime)

Remote data access capability is important (single utility meter for airport; utility check meters installed and EVSP online portal developed)

Phase II not pursued due to airlines postponing new eGSE purchases (COVID-19 pandemic impact)
Port Electrification – Overview

**Objectives**
Install, operate, maintain, and own EV charging infrastructure, load research meters, and data loggers for 30–40 installations within the Port District tidelands

Obtain consumption, charging, and operational dataset to facilitate development of an optimized grid integration solution for electrification of MD/HD vehicle and forklift applications

**Key Results**

- **Budget:** Approved $2.4M, Spent $0.65M (27%)
- **EV charging:** 12 charging ports (12 DCFC EVSE)
- **EVs supported:** 12 (9 forklifts, 3 Class 8 tractors)
- **Petroleum reduction:** 4,000 GGE annually
- **GHG reduction:** 26.5 MT CO₂ annually
- **DAC:** Pasha location is in a DAC
- **Grid Impacts:** 54 MWh annually (54% on peak)
<table>
<thead>
<tr>
<th>Fleet</th>
<th>Chargers</th>
<th>Baseline and EVs</th>
</tr>
</thead>
</table>
| Port of San Diego – Metro Cruise | Nine Webasto 10 kW PosiCharge ProCore SDG&E owned | • 9 existing electric forklifts  
• Propane (modeled baseline) |
| Pasha Automotive               | 3 BYD DCFC (40 kW, 80 kW, 120 kW) Pasha owned | • 1 BYD Class 8 Terminal Tractor (off-road)  
• 2 BYD Class 8 Trucks (on-road)  
• Diesel trucks and tractors (baseline) |
Utility rate with demand charges significantly increased the average energy costs (forklift data)

Average of $0.35/kWh
Port Electrification – Findings (2)

Forklifts
- Charging at the end of the shift
- Chargers have networking capability and energy management features but were not implemented yet

Drayage Truck
- Single month of consistent use (May 2020)
- Non networked charger
- Charging upon return to base
- Yard tractor (100 kW charger) and smaller battery drayage truck (80 kW charger) minimal usage
**Insights**

Participants had a very positive experience with utility installing the charging infrastructure.

Port operations and tenant locations regularly change which was a concern for several port tenants (they were uncomfortable committing to the program).

Larger battery capacity to provide a longer range between charges was critical for supporting truck operation and even longer range would be needed to electrify more of their regional fleet.

**Lessons Learned**

Port construction can be challenging and costly (i.e., environmental costs).

Chargers were not equipped with any data collection (trucks) or remote download capabilities (forklifts).

The shorter-range drayage truck did not meet the minimum range needed (<80 miles daily).

The yard truck lacked functionality and ergonomics to operate onboard a roll-on roll-off cargo ship.
Green Shuttle – Overview

Objectives

Support fixed-route shuttle fleets by installing and owning DCFC and L2 EVSE at up to 5 sites and providing a grid-integrated rate.

Can install solar and energy storage at one project location and investigate feasibility of additional EV drivers using the chargers.

Utilization and location optimization & impact of the GIR.

Key Results

Budget: Approved $3.2M, Spent $1.4M (46%)

EV charging: 12 charging ports (6 DCFC, 6 L2)

EVs supported: 2 + 10 delayed due to COVID-19 pandemic

Petroleum reduction: 2,889 GGE annually

GHG reduction: 0.9 MT CO₂ annually

DAC: 0% (adjacent to DAC only)

Grid Impacts: 37 MWh annually (2% on peak)
# Green Shuttle – Participants

<table>
<thead>
<tr>
<th>Fleet</th>
<th>Chargers</th>
<th>Baseline and EVs</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Diego Airport Parking Co.</td>
<td>2 ChargePoint CPE 250 62.5 kW EVSE SDG&amp;E owned</td>
<td>• 2 25-foot GreenPower EV Star shuttles</td>
</tr>
<tr>
<td></td>
<td>125 kW pairing kit installed</td>
<td>• Diesel Mercedes Sprinter, Ford Transit (baseline)</td>
</tr>
<tr>
<td>Aladdin (off-airport shuttle)</td>
<td>2 ChargePoint CPE 250 62.5 kW EVSE SDG&amp;E owned</td>
<td>• 4 Briton (Lightning Motors Ford E450 EV conversion)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Propane Ford E450 Cutaway (baseline)</td>
</tr>
<tr>
<td>Illumina (workplace shuttle)</td>
<td>6 Greenlots (EVSP) BTC 17 kW L2 (EVSE) SDG&amp;E owned</td>
<td>• 6 Briton (Lightning Motors Ford E450 EV conversion)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Propane Ford E450 Cutaway (baseline)</td>
</tr>
</tbody>
</table>
Green Shuttle – Findings (1)

83% of charging below $0.20/kWh but 30% of costs above $0.40/kWh

Graph Represents:
- 7,079 Hours
- 37,250 kWh
Green Shuttle – Findings (2)

EV operational costs below diesel but not avoiding high summer pricing can erase the benefit.
Insights and Lessons Learned

Airport parking fleet operators required 2 DCFCs to support operation of 2 to 4 electric shuttles with daytime opportunity charging. The workplace charging site only needed L2 chargers, one for each electric shuttle, for overnight charging.

Most shuttle bus companies have private facilities that are not equipped to allow other EVs to charge.

Electric shuttle bus options (Classes 2–4) are very limited, and there can be long lead times.

GIR rate resulted in the lowest electricity cost ($0.20/kWh) among the five SDG&E PRPs.

A load management plan was developed by SDAP, but only a rudimentary option was able to be used.

All three fleets have converted or are in process of converting to 100 percent electric influenced by PRP.
Fleet Delivery – Overview

Objectives

Provide utility owned charging infrastructure to support up to 90 medium-duty electric delivery vehicles at about six locations

Customers to use existing applicable time-varying rates that may include demand charges and encourage off-peak charging

Key Results

Budget: Approved $3.7M, Spent $1.3M (37%)

EV charging: 79 L2 charging ports

EVs supported: 15 (60 pending delivery)

Petroleum reduction: 16,670 GGE annually

GHG reduction: 124 MT CO₂ annually

DAC: 35% (Amazon location is in a DAC, San Marcos and San Diego are in SDG&E territory DAC)

Grid Impacts: 182 MWh annually (53% on peak)
# Fleet Delivery – Participants

<table>
<thead>
<tr>
<th>Fleet</th>
<th>Chargers</th>
<th>Baseline and EVs</th>
</tr>
</thead>
</table>
| UPS                           | 63 Greenlots (EVSP) BTC Power 17 kW L2 (EVSE) SDG&E owned 3 locations: San Diego (33), San Marcos (16), Chula Vista(16) | • Workhorse electric cutaway chassis  
• Diesel Workhorse Chassis     |
| Amazon to support Delivery Service Providers (small businesses) | 16 Greenlots (EVSP) BTC Power 17 kW L2 (EVSE) SDG&E owned National City location (in a DAC) | • Lightning Motors Ford Transit EV conversion  
• Gasoline and diesel Ford Transit and Mercedes Sprinter vans (baseline) |
Utility rate with demand charges & significant on-peak time charging increased the average energy costs.
Charging load curves during highest usage month show significant charging duration
Fleet Delivery – Summary

Insights & Lessons Learned

- New product challenges
  - EVs (60 for UPS) delayed more than 18 months
  - EVSP over the air update issue
  - EV on board charger limitation (6.6 kW)

- EV adoption and participation for locally owned MBE/WBE delivery business fleets is challenging

- A fleet dashboard to confirm vehicles begin and finish charging as planned would ensure vehicles readiness

- Given the likely electrical infrastructure upgrade requirements for significant fleet electrification, utilities are necessary partners for infrastructure support, as well as charging management plans

- Customers involved in energy management practices may prefer to add chargers to existing utility meters instead of a new service
# Electrify Local Highways – Overview

## Objectives

- Install, own, maintain, and operate 80 L2 and 8 DCFCs at four Caltrans-owned park-and-ride locations
- Study charging patterns and share the usage data for modeling charging infrastructure at these sites
- Test TOU pricing in the public domain, as well standards for public charging signage, rate display, and general retail EV fuel dispensers

## Key Results

<table>
<thead>
<tr>
<th>Key Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Budget:</strong> Approved $4.0M, Spent $2.5M (62%)</td>
</tr>
<tr>
<td>EV charging: 80 L2 and 8 DCFC charging ports</td>
</tr>
<tr>
<td>EVs supported: public charging</td>
</tr>
<tr>
<td>Petroleum reduction: 6,800 GGE annually</td>
</tr>
<tr>
<td>GHG reduction: 65 MT CO₂ annually</td>
</tr>
<tr>
<td>DAC: 50% within DAC, additional 25% adjacent</td>
</tr>
<tr>
<td>Grid Impacts: 57 MWh annually (25% on peak)</td>
</tr>
</tbody>
</table>

![PRP Data Collection through August 2020]

**Caltrans Park-and-Ride**
- Jan 2018
- Apr 2018
- Jul 2018
- Oct 2018
- Jan 2019
- Apr 2019
- Jul 2019
- Oct 2019
- Jan 2020
- Apr 2020
- Jul 2020
- Oct 2020

- Planning
- Installation Preparations
- Utility Construction
- Customer Acquisitions and Preparations
- Data Collection During Full Implementation
## Electrify Local Highways – Participants

<table>
<thead>
<tr>
<th>Site Host</th>
<th>Chargers</th>
<th>Utility Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>CalTrans (Park-and-Ride Lots)</td>
<td>20 ChargePoint 6.6 kW L2 and 2 62.5 kW CPE 250 DCFCs at each location (SDG&amp;E owned) 4 locations: Oceanside, National City, Chula Vista, and El Cajon</td>
<td>Residential EV TOU ($0.20-$0.59/kWh)</td>
</tr>
</tbody>
</table>
Electrify Local Highways – Findings (1)

Site usage: DCFC (top) & Level 2 (bottom)
ELH sites support local commuters and regional travel
Insights & Lessons Learned

L2 EVSE utilization was extremely low (less than 1%), but this is a larger than usual installation with 20 L2 EVSE at one site and COVID-19 pandemic significantly disrupted commuting patterns which these chargers were designed to support. DCFC use was also low (about 2%), but has significantly increased (up to 6%)

Based on the user survey:
- While access to public charging stations impacts a customer’s decision to purchase or lease an EV, other factors are more significant
- 8% would not drive an EV if public charging was not readily available; for 31% it was a motivating factor
- Station users are highly satisfied with their public charging station experience (92% satisfaction)

Greater access to chargers would allow the next vehicle to charge at a staging space sooner
# Dealership Incentives – Overview

## Objectives

- Emphasize plug-in vehicle sales in DACs
- Educate dealerships and their salespeople on the benefits of driving electric and utility resources
- Encourage new EV owners to sign up for SDG&E’s residential EV time-of-use (EV-TOU) rates

## Key Results

- **Budget**: Approved $1.8M, Spent $0.76M (42%)
- **Incentive Claims**: 357 (232 with trained salespeople, 125 with untrained salespeople)
- **Participating Dealerships**: 15
- **Trained Staff**: 92

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### PlugStar Pilot

<table>
<thead>
<tr>
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<th>Planning</th>
<th>Participant Acquisition</th>
<th>Data Collection During Partial Implementation</th>
<th>Data Collection During Full Implementation</th>
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<tr>
<td>Jan 2020</td>
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</tbody>
</table>
Dealership Incentives – Participants

SDG&E selected Plug-In America (PIA), to run their turnkey program PlugStar

- Improved the plug-in vehicle buying experience by informing shoppers through a shopping assistant website
- Provided training for dealership staff (including information about charging, rates, and incentives) as well as a plug-in vehicle sales tool
- Provided a bonus of $500 per plug-in vehicle sold (split between the dealership and the trained salesperson). Sales by untrained staff at certified dealerships resulted in half the incentive.
- Dealerships participated in SDG&E’s promotional events to drive plug-in vehicle sales.

In 2019, the PlugStar program was offered in several other market areas (Los Angeles, St. Louis, New Jersey, Sacramento, and Boston). Sacramento was the only other one to offer dealership incentives; the evaluation compared the results of these two programs.

### Dealerships

<table>
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<th>DEALER</th>
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<tbody>
<tr>
<td>Audi Carlsbad</td>
</tr>
<tr>
<td>BMW of Escondido</td>
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<tr>
<td>*BMW of San Diego</td>
</tr>
<tr>
<td>Courtesy Chevrolet San Diego</td>
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<tr>
<td>Quality Chevrolet of Escondido</td>
</tr>
<tr>
<td>*Weseloh Chevrolet</td>
</tr>
<tr>
<td>Pacific Honda</td>
</tr>
<tr>
<td>Mossy Honda Lemon Grove</td>
</tr>
<tr>
<td>Jaguar Carlsbad</td>
</tr>
<tr>
<td>*Weseloh Kia Carlsbad</td>
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<tr>
<td>Mercedes-Benz of San Diego</td>
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<tr>
<td>MINI of San Diego</td>
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<tr>
<td>Mossy Nissan Kearny Mesa</td>
</tr>
<tr>
<td>Porsche Carlsbad</td>
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<tr>
<td>*Toyota of Poway</td>
</tr>
</tbody>
</table>

* Dealerships that participated in the initial pilot phase.
Dealership Incentives – Summary

Insights and Lessons Learned

Dealers can be trained and motivated via monetary reward

Positive feedback from dealership staff and customers’ high rating of participating dealerships, showed the education goals of the PRP were achieved

A better strategy or tools on how the dealership and utility could collaborate to encourage switching to the EV-TOU rate was needed

Market lift analysis of the impact from the PlugStar program on new plug-in vehicle sales in San Diego County was inconclusive

As a follow-on, the SDG&E Dealership Partner Network will support participating dealers with the tools and resources they need to increase EV sales and provide a positive customer experience

Decision 18-01-024 required the plug-in vehicle buyer or lessee to enroll in an EV-TOU rate before the dealership incentives could be paid. This resulted in delays to process the incentives and limited the claims actually paid. Some customers were ineligible for EV-specific rates. A Tier 2 advice letter filed in February 2019 and approved on August 1, 2019, waived the EV-TOU enrollment requirement but modified the customer release form to allow for following up with purchasers or lessees for evaluation and education. While this was retroactive to March 14, 2019, more than two-thirds of the program period had elapsed before this was known.
San Diego Gas & Electric PRP Portfolio

<table>
<thead>
<tr>
<th>Category</th>
<th>Project</th>
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<tr>
<td>MHD (Off-road Infrastructure)</td>
<td>Airport Ground Support Equipment</td>
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<td>Port Electrification</td>
<td>$2.4M</td>
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<td>MHD Infrastructure</td>
<td>Green Shuttle</td>
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<td>Fleet Delivery Services</td>
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<tr>
<td>Public Access Stations</td>
<td>Electrify Local Highways</td>
<td>$4M</td>
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<tr>
<td>Electrification Promotions</td>
<td>Dealership Incentive</td>
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Questions specific to these PRPs?
## Southern California Edison PRP Portfolio

### Electrification Promotions

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
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<tbody>
<tr>
<td>Charge Ready Home Installation (SCE)</td>
<td>$4M</td>
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### Public Access Stations

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
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<tbody>
<tr>
<td>Urban Charge Ready DCFC (SCE)</td>
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### MHD (Off-road Infrastructure)

<table>
<thead>
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<th>Description</th>
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<tr>
<td>Port of Long Beach Rubber Tire Gantry Crane (SCE)</td>
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<tr>
<td>Port of Long Beach Terminal Yard Tractor (SCE)</td>
<td>$0.45M</td>
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### MHD Infrastructure

<table>
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<th>Description</th>
<th>Cost</th>
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</thead>
<tbody>
<tr>
<td>Charge Ready Transit Bus (SCE)</td>
<td>$4M</td>
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</table>
### Charge Ready Home Rebate – Overview

#### Objectives
- Lower the cost of installing L2 home charging stations
- Learn about L2 home charging needs, costs associated with home EV infrastructure upgrades, customer behavior after installing L2 home charging, and customer satisfaction with residential TOU rates

#### Program Timeline: May 30, 2018 – May 29, 2019
- $500 for customers who enrolled in SCE’s whole-home time-of-use (TOU) program
- $1,500 for customers who installed a meter specifically for the EV charging station to participate in SCE’s TOU-EV-1 rate (discontinued after February 2019)

#### Key Results
- Budget: Approved $4.0M, Spent $2.1M (52%)

#### Applications
- 4,128 applications received
- 2,670 checks sent

#### Electric Vehicle Make
- Within all applications received, EVs were...
  - 71% Tesla
  - 9% Chevrolet
  - 6% Honda
  - 4% BMW
  - 11% Other

#### Disadvantaged Community Breakdown
- 7% of all applicants lived in DACs

#### Residence Type
- 93% of all applicants lived in single family homes

---

[Southern California Edison logo]
44% (474 out of 1,072) of respondents indicated the rebate was important to their decision to purchase an EV.

93% of survey respondents (998 out of 1,071) indicated that the program had at least some influence over their decision to install an L2 home charging station.
Most survey respondents (57%, 520 out of 911) strongly believed that enrolling in the TOU rate allowed them to charge their EVs for less than under their old non-TOU rate. Additionally, survey respondents reported that they pay attention to the TOU period (on-peak versus off-peak) when they charge their EVs.

Survey respondents reported being satisfied with their TOU rates.
The program successfully reduced barriers to EV adoption by providing a financial rebate for home charging infrastructure, which resulted in positive impacts for participants.

The program requirements may have limited participation (proof of a waiver for HOA permission or city permitting, separate receipt for the charging station, C-10 license numbers on electrician invoices, six-month time restraint on purchase/lease date of a new EV).

More early engagement for electricians or MUD managers might have resulted in more champions for the program.

The implementer struggled to engage individuals living in DACs and/or MUDs, despite targeted marketing efforts. With the program requiring an applicant to have a dedicated parking spot for the EV for 24 months and to switch to a TOU rate, two items that many MUD residents cannot ensure, most of the individuals in DACs or MUDs who might have been interested in buying EVs were ineligible for this program.
Charge Ready DCFC – Overview

Objectives

Deploy utility-owned make-ready infrastructure for 5 sites with up to 5 DCFC in urban areas nearby MUDs in or near a DAC

Provide an incentive to deploy EV chargers

Provide commercial EV rate to minimize operating costs of EVs. Participating sites must be public access but can set charging fees.

Key Results

Budget: Approved $4.0M, Spent $1.7M (43%)

EV charging: 14 DCFC EVSE (50 – 125 kW)

EVs supported: public charging

Annual petroleum reduction: 8,800 gal of gasoline

Annual GHG reduction: 80 MT of CO₂

DAC: 43% of DCFCs in a DAC, 15% electric miles

Grid Impacts: 88 MWh annually (10% on peak)
## Charge Ready DCFC – Site Hosts

<table>
<thead>
<tr>
<th>Site</th>
<th>Chargers</th>
<th>Location Characteristics</th>
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</thead>
<tbody>
<tr>
<td>1 – Corona Sun Square (DAC)</td>
<td>Four 62.5 kW ChargePoint CPE 250</td>
<td>Several nearby MUDs, retail outlets and restaurants</td>
</tr>
<tr>
<td>2 – H Mart center in Garden Grove</td>
<td>Four 62.5 kW ChargePoint CPE 250</td>
<td>Surrounded by restaurants, retail and nearby MUDs Proximity to I-5</td>
</tr>
<tr>
<td>3 – AAA Upland (DAC adjacent)</td>
<td>Two 62.5 kW ChargePoint CPE 250</td>
<td>Nearby mobile home park, retail, and a few restaurants</td>
</tr>
<tr>
<td>4 – AAA Artesia (DAC adjacent)</td>
<td>Two 62.5 kW ChargePoint CPE 250</td>
<td>Nearby MUDs, a large mall, and several restaurants Proximity to I-5</td>
</tr>
<tr>
<td>5 – 7-Eleven Pomona (DAC)</td>
<td>Two 62.5 kW ChargePoint CPE 250 (chargers paired for 125 kW output)</td>
<td>Nearby MUDs and restaurants</td>
</tr>
</tbody>
</table>
Increasing electricity use over first 5 months, a significant COVID-19 impact over next 6 months
Consistent usage during the day including during on-peak time period (4-9 pm)
Commercial EV rate results in much lower electricity costs due to no demand charges
Charge Ready DCFC – Summary

Insights and Lessons Learned

DC fast charger use was low (about 2.5%), but it has significantly increased over time and for certain locations (24% for AAA Artesia). The utilization over the project period was similar to the SDG&E ELH pilot at 2%, but that project only had its best utilized week reaching 14% (compared to 24%).

Make-ready incentive and a rebate that often covered the full cost of the station attracted site host interest.

Based on driver survey responses:
- 31% don’t charge at home likely because they do not have home charging; 16% don’t reside in a single-family home with a dedicated parking space
- 8% would not drive an EV if public charging was not readily available; for 36% it was a motivating factor

Site host interest indicates 3-4 DCFC per site (not 10 as planned) for community-based installations.
Objectives

Deploy make-ready infrastructure to serve nine cranes at the Port of Long Beach
Stevedoring Services of America (SSA) Marine Terminal J

Design, install, own, and maintain the electric infrastructure, including two new distribution substations that will serve nine new electric motorized RTG cranes

Key Results

Budget: Approved $3.0M, Spent $2.3M (76%)

EV charging: 9 grid-tied (4 kV) eRTG connections

EVs supported: 9 RTGs

Annual petroleum reduction: 194,400 gallons of diesel (projected)

Annual GHG reduction: 1,601 MT of CO₂ (projected)

DAC: 100% DAC adjacent

Grid Impacts: 795 MWh annually (6% on peak) (projected)
<table>
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<tr>
<th>Fleet</th>
<th>Chargers</th>
<th>Baseline and Electric Buses</th>
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</thead>
<tbody>
<tr>
<td>Stevedoring Services of America (SSA) POLB Marine Terminal J</td>
<td>Grid-connection mechanism tied to a high-voltage utility connection (4,000 V)</td>
<td>• 9 electric grid-tied RTG conversions (Cavotec vendor)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 9 diesel 1,000 hp generator set RTGs (baseline)</td>
</tr>
</tbody>
</table>
POLB Rubber Tire Gantry – Summary

**Insights and Lessons Learned**

Customers tend to be very cautious when working on equipment that is critical to their operations

Undertaking such a significant project requires grant funding but acquiring and managing the funding lengthens the project timeline

Lengthy construction on an active terminal causes logistical challenges for tenant operation

Phasing in a project of this complexity or coordinating with other terminal development plans could reduce the risk

Because of timing issues, implementation complexity, and costs to electrify RTGs, SSA is considering alternatives (i.e., hybrid systems or fuel cells) for complying with upcoming zero-emissions regulations

**Status Update:**

- No data collected during evaluation
  - CEC grant reporting
- Significant delays with guidance system
- 1st eRTG entered service in November 2020
- 2nd eRTG conversion completed and entered service in April 2021
- 3rd out of 9 eRTGs started conversion at the end of April 2021
Objectives
Deploy make-ready infrastructure to serve charging stations for new electric yard tractor at the Port of Long Beach Marine Terminal G
Design, install, own, and maintain the electric infrastructure that will accommodate 20 EVSE

Key Results
Budget: Approved $0.45M, Spent $1.6M (362%)
EV charging: 7 DCFC (100-200 kW)
EVs supported: 7 Terminal Tractors
Annual petroleum reduction: 17,000 diesel gallons
Annual GHG reduction: 177 MT of CO₂
DAC: 100% DAC adjacent
Grid Impacts: 158 MWh annually (10% on peak)
POLB Terminal Yard Tractor – Participant

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<th>Baseline and Electric Buses</th>
</tr>
</thead>
<tbody>
<tr>
<td>International Transportation Service, Inc. (ITS) POLB Marine Terminal G</td>
<td>6 200 kW BYD DCFC</td>
<td>• 7 BYD Class 8 Terminal Tractors</td>
</tr>
<tr>
<td></td>
<td>1 100 kW Cavotec automated DCFC</td>
<td>• 130 diesel Kalmar and Ottawa tractors (baseline)</td>
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</tbody>
</table>
POLB Terminal Yard Tractor – Findings (1)

Four distinct operating durations in support of rail service
Two shift rail operation with charging during break and after each shift
POLB Terminal Yard Tractor – Summary

**Insights and Lessons Learned**

SCE installed 480 V charging station infrastructure terminating in seven fused service disconnect make-ready positions. Also installed ducts and structures to support an additional 13 future EVSE installations.

Early commercial product challenges (EVs and EVSE) contributed to sporadic and low utilization rates for much of the relatively short data collection period.

Field certification of charging equipment that is not already NRTL-listed can add significant complications.

Utility needs to account for the customer-side infrastructure costs and include them as part of their initial estimates when supporting grant funded demonstration projects. This was inadvertently omitted from the initial application (recorded to Shareholder O&M account).

Electricity prices of $0.18–$0.22 per kWh on a commercial EV-TOU rate. On-peak high pricing during summer accounted for approximately 30% of costs.

Railroad operation support is a heavier duty cycle than supporting the cargo ships which represent the majority of operations at the ports. This project suggests that tractor electrification can have significant impacts on diesel fuel consumption.
## Charge Ready Transit – Overview

### Objectives

- Deploy utility-owned make-ready infrastructure to serve expected growth in EV charging
- Provide an incentive to deploy EV chargers
- Provide commercial electric vehicle rate to minimize operating costs of EVs

### Key Results

- **Budget:** Approved $4.0M, Spent $2.1M (52%)
- **EV charging:** 30 depot DCFC EVSE (62–200 kW)
- **EVs supported:** 31 transit buses
- **Annual petroleum reduction:** 336,143 DGE of CNG
- **Annual GHG reduction:** 1,443 MT of CO₂
- **DAC:** 38% of electric bus miles
- **Grid Impacts:** 2,340 MWh annually (5% on peak)
## Charge Ready Transit – Participants

<table>
<thead>
<tr>
<th>Fleet</th>
<th>Chargers</th>
<th>Baseline and Electric Buses</th>
</tr>
</thead>
</table>
| 1 – Victor Valley Transit Authority | Seven 62.5 kW CPE 250 ChargePoint (500 kW transformer) | • 64 bus fleet with 23 routes  
• Natural gas 40-foot buses (baseline)  
• 7 New Flyer Xcelsior EX 40-foot electric buses |
| 2 – Porterville Transit      | Ten 200 kW BTC Power (2.5 MW transformer)      | • 20 bus fleet with 9 routes  
• Natural gas 35-foot buses (baseline)  
• 10 GreenPower EV350 40-foot electric buses |
| 3 – Foothill Transit         | Twelve 60 kW Proterra V2G, one 125 kW (1 MW transformer) | • 373 bus fleet (16 electric previously) with 39 routes  
• Natural gas 40-foot buses (baseline)  
• New Flyer Xcelsior EX 40-foot electric buses |
Charge Ready Transit – Findings (1)

High Energy Use + Low Electricity Rates = Lower Operational Fuel Costs

![Graph showing lifetime energy consumption and average energy costs for different fleets.]

- Fleet 1: 488,278 kWh, $0.42/kWh, $0.41/mi
- Fleet 2: 221,332 kWh, $0.14/kWh, $0.18/mi
- Fleet 3: 612,877 kWh, $0.18/kWh, $0.16/mi
Fleets are sensitive to electricity costs and charge after on peak time period (4-9 pm)
Insights and Lessons Learned

Make-ready construction planning, design, and execution went smoothly.

2 of 3 transit fleets experienced good availability of buses (one experienced technology readiness issues).

Energy management software can be very effective. Manual management is not sustainable.

Commercial EV rate provided very low average rate.

Direct access to EVSP and EV telematics data provided a richer and more reliable data than fleet records.

EVSE power rating (>50 kW) might not be the limiting factor for charging speed (i.e. EV BMS limitations).

Battery capacity (~460 kWh) and bus efficiency (~2 kWh/mile) do not reflect real bus range (130-150 mi).

Depot chargers for routes < 150 miles per day (buses with <500 kWh). High-power charging on route or hydrogen fuel cell bus alternatives for 100% ZEV fleet.
### Southern California Edison PRP Portfolio

#### Electrification Promotions
- Charge Ready Home Installation (SCE) – $4M

#### Public Access Stations
- Urban Charge Ready DCFC (SCE) – $4M

#### MHD (Off-road Infrastructure)
- Port of Long Beach Rubber Tire Gantry Crane (SCE) – $3M
- Port of Long Beach Terminal Yard Tractor (SCE) – $0.45M

#### MHD Infrastructure
- Charge Ready Transit Bus (SCE) – $4M

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Questions specific to these PRPs?
Pacific Gas and Electric PRP Portfolio

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<td>MHD (Infrastructure)</td>
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<td>Electric School Bus Renewables Integration (PG&amp;E)</td>
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<tr>
<td>MHD (Off-road Infrastructure)</td>
<td>Idle Reduction Technology (PG&amp;E)</td>
<td>$1.7M</td>
</tr>
<tr>
<td>Electrification Promotions</td>
<td>Home EV Charger Information Resource (PG&amp;E)</td>
<td>$0.2M</td>
</tr>
</tbody>
</table>
Located in and serves a Disadvantaged Community

Existing fleet of 17 electric buses
- 12 Proterra legacy electric buses (49 to 62-mile range) using 500 kW pantograph overhead extreme fast chargers (XFC)
- 5 new electric buses with 251-mile range joined the fleet in 2018

PRP installed infrastructure and evaluated three test phases at three sites:
- Site 1 (Regional Transportation Center) installed (5) 60 kW depot chargers
- Site 2 (Downtown Transit Center) installed charge management software to control XFCs
- Site 3 (Union Transfer Station) installed new overhead fast charger (RTD funded) and battery electric storage system (BESS)

SJRTD plans for an all-electric bus fleet by 2025

Project Partner: San Joaquin Regional Transit District (SJRTD)

Insights and Lessons Learned

<table>
<thead>
<tr>
<th>PRP Budget</th>
<th>$3,355,000 ($1,021,554 spent through 10/2020, 30%)</th>
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<tbody>
<tr>
<td>Implemented</td>
<td>5 buses operating, test sites 1 and 2 operational</td>
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<tr>
<td>Annualized Utilization</td>
<td>22,069 miles/bus/year</td>
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<tr>
<td>Petroleum Reduction Annually</td>
<td>23,546 diesel gallons</td>
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<tr>
<td>Avoided GHG Emissions Annually</td>
<td>245 MT CO₂</td>
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<tr>
<td>Annual Grid Impact</td>
<td>240 MWh (39% on peak)</td>
</tr>
<tr>
<td>DAC Impact</td>
<td>100% of vehicle operation</td>
</tr>
</tbody>
</table>
MHD Customer Fleet Demo – Test Phases

• **Test 1**: Five 60 kW overnight depot chargers
  
  **Site 1: RTC**

  1. Can the new long-range e-buses be fully charged every night at the depot and meet their daily route needs?
  2. Can fueling $/mile be reduced through different charging protocols, and how does this compare with diesel hybrids on the same route?

• **Test 2**: Demand Management Software with XFC
  
  **Site 2: DTC**

  1. Can demand management software reduce operation costs for legacy e-buses relative to uncontrolled charging and still meet route needs?

• **Test 3**: 500 kWh* battery energy storage system with XFC
  
  **Site 3: UTS**

  1. To what extent can the BESS reduce charging costs?
  2. Do the additional savings make a BESS economical for this application? In what scenarios might it offer benefits?

  *Battery energy storage system capacity note*
MHD Customer Fleet Demo – Insights

Test 2: Demand Charges at DTC

- Demand Charge
- Remainder of the Bill
- % Demand Charge

<table>
<thead>
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**Insights and Lessons Learned**

Limited technology availability and compatibility issues in a growing industry can cause challenges for fleet managers and operators.

Battery energy storage systems are costly and may require extra time to plan and install.

Utility and transit agency partnerships are key to project success.

Open access to charge management software improves the evaluation data collection process and increases transparency for operations staff.

Implementing charging management protocols for multiple generations of electric buses and mixed EVSE is complex and requires sophisticated management.
Electric School Bus Renewables Integration – Overview

Project Partner: Pittsburg Unified School District (PUSD)

- K-12 school district, serving 13 school sites, including 8 elementary schools
- Located in and serves a Disadvantaged Community
- Current fleet of 4 electric buses, (2) eLion, (2) Blue Bird
- ~200 kW onsite wind and solar renewable generation
- Built Learning Center for students
- Installed (9) Level 2 chargers, 19 kW each, ~180 kW total load
- Charge management software to optimize charging for cost and GHG reductions
- Architecting novel communications design to integrate onsite renewables

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>PRP Budget</td>
</tr>
<tr>
<td>$2,209,500</td>
</tr>
<tr>
<td>($1,332,369 spent, 60%)</td>
</tr>
<tr>
<td>Implemented</td>
</tr>
<tr>
<td>1 to 3 buses concurrent, test phases 0, 1, and 2 demonstrated, phases 3 and 4 modelled</td>
</tr>
<tr>
<td>Annualized Utilization &amp; Performance</td>
</tr>
<tr>
<td>3,572 total miles, 2.96 kWh/mile</td>
</tr>
<tr>
<td>Petroleum Reduction Annually</td>
</tr>
<tr>
<td>714 diesel gallons</td>
</tr>
<tr>
<td>Avoided GHG Emissions Annually</td>
</tr>
<tr>
<td>6.3 MT CO₂</td>
</tr>
<tr>
<td>Annual Grid Impact</td>
</tr>
<tr>
<td>10.6 MWh (30% on peak)</td>
</tr>
<tr>
<td>DAC Impact</td>
</tr>
<tr>
<td>89% of vehicle operation</td>
</tr>
</tbody>
</table>
**Phase 1: Static schedules**  
*May 2019*

- Minimize PUSD bill based on existing rate structure and support route service with fixed, pre-determined charge schedules.
- Demonstrate technical system integration.

**Phase 2: Excess Supply Pilot (XSP)**  
*Aug 2019 – Nov 2019*

- Demonstrate system’s ability to deliver load-increase events with PG&E’s XSP program.
- Capture value of consuming green energy from the grid during wholesale overgeneration.

**Phase 3: Renewable Self-Consumption**  
*Dec 2019 – Jan 2020*

- Demonstrate the system’s ability to dynamically maximize local renewable powering of e-school bus fleet.
- Minimize PUSD bill while maximize onsite renewable consumption.

**Phase 4: Renewable Optimization**  
*Jan 2020 – Apr 2020*

- Demonstrate the system’s ability to combine wholesale and local renewable generation to maximize green energy for the e-school bus fleet.
Electric School Bus Renewables Integration – Findings

Load Profiles: Pilot Phases 0, 1, and 2
1. Feasibility of combining **low-cost, non-networked EVSE and DER technologies** for dynamic charge management functions

2. Feasibility of dynamic signaling to provide grid services and renewables integration

### Effects of Managed Charging Protocol

<table>
<thead>
<tr>
<th></th>
<th>Phase 0</th>
<th>Phase 1</th>
<th>Phase 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Electric Fuel Cost ($/kWh)</td>
<td>$0.21</td>
<td>$0.17</td>
<td>$0.02</td>
</tr>
</tbody>
</table>

### Carbon Intensity Per Mile

<table>
<thead>
<tr>
<th></th>
<th>Industry Average</th>
<th>Phase 0</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Entire Pilot</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Diesel)</td>
<td>1.54</td>
<td>0.97</td>
<td>0.68</td>
<td>0.87</td>
<td>0.86</td>
</tr>
<tr>
<td>(Electric)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Insights and Lessons Learned

<table>
<thead>
<tr>
<th>Topic</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity of initial buses, project delays, and COVID-19 resulted in low utilization</td>
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</tr>
<tr>
<td>Bus battery management systems are not designed for delayed power and advanced charge management</td>
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</tr>
<tr>
<td>Contracting, constructing, and implementing test protocols with schools may require extra time</td>
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<tr>
<td>Electric school buses have potential to reduce fleet TCO due to the large fuel and O&amp;M savings</td>
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<tr>
<td>Commercial BEV rate design is effective in motivating desired charging behavior and consumption patterns but does not align well with XSP participation</td>
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</tr>
</tbody>
</table>
Idle Reduction Technology – Overview

Project Partner: Safeway Albertson’s Food Distribution Service Center (Tracy, CA)

- Located in and serves a Disadvantaged Community
- 2.2 million square feet, ~300 loading dock spaces and >400 staging spaces
- Current fleet of 780 trailers and 280 trucks with electric standby transport refrigeration units (eTRUs) capable of running on diesel or electricity
- Added (25) 15-17 kW SafeConnect connection ports for trailers with eTRUs
  - 10 eTRU ports at staging areas
  - 15 eTRU ports at loading docks
- Plan of 360 eTRU ports now, with total of 550 – 600 eTRU ports expected

<table>
<thead>
<tr>
<th>Insights and Lessons Learned</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PRP Budget</td>
<td>$1,719,400 ($599,675 or 35% spent)</td>
</tr>
<tr>
<td>Charging Infrastructure</td>
<td>25 SafeConnect ports, 15-17 kW each (total = 425 kW)</td>
</tr>
<tr>
<td>Average Port Utilization</td>
<td>11.9% utilization (1,039 hours/year)</td>
</tr>
<tr>
<td>Petroleum Reduction Annually</td>
<td>22,089 diesel gallons</td>
</tr>
<tr>
<td>Avoided GHG Emissions Annually</td>
<td>246 MT CO₂</td>
</tr>
<tr>
<td>Annual Grid Impact</td>
<td>210 MWh (26% on peak)</td>
</tr>
<tr>
<td>DAC Impact</td>
<td>100% of equipment operation</td>
</tr>
</tbody>
</table>
Idle Reduction Technology – Findings

Albertsons Tracy Total eTRU Port Demand

Total eTRU Port Demand on Peak Day: 8/29/2020
**Idle Reduction Technology – Summary**

<table>
<thead>
<tr>
<th>Insights and Lessons Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefits and challenges of working with private-sector facilities and fleets</td>
</tr>
<tr>
<td>Consider legacy electrical switchgear equipment condition</td>
</tr>
<tr>
<td>Lack of standardization in eTRU technology</td>
</tr>
<tr>
<td>Individual eTRU port data collection is logistically challenging and expensive</td>
</tr>
<tr>
<td>Site operations resulted in eTRU port utilization differences at loading docks vs staging areas</td>
</tr>
<tr>
<td>Site operator and truck driver education and training are needed to increase utilization</td>
</tr>
</tbody>
</table>
## Home Charger Information Resource (HCIR) Program

### HCIR Program Overview

- Web-based EV research tool for customers
- $500k for tool development after initial T2AL approval
- Scaled back to $200k based on market research with another T2AL to only be a resource linking to external tools

### Evaluation Methodology

- PG&E staff interviews (November 2019 and September 2020)

### Lessons Learned

- Ability to adapt in a rapidly changing market, while reflecting customer needs, is essential for any innovative customer-oriented program
## Pacific Gas and Electric PRP Portfolio

<table>
<thead>
<tr>
<th>Infrastructure</th>
<th>Project Description</th>
<th>Budget</th>
</tr>
</thead>
<tbody>
<tr>
<td>MHD</td>
<td>Medium/Heavy Duty Fleet Customer Demo (PG&amp;E)</td>
<td>$3.4M</td>
</tr>
<tr>
<td></td>
<td>Electric School Bus Renewables Integration (PG&amp;E)</td>
<td>$2.2M</td>
</tr>
<tr>
<td>Off-road Infrastructure</td>
<td>Idle Reduction Technology (PG&amp;E)</td>
<td>$1.7M</td>
</tr>
<tr>
<td>Electrification Promotions</td>
<td>Home EV Charger Information Resource (PG&amp;E)</td>
<td>$0.2M</td>
</tr>
</tbody>
</table>

**Questions specific to these PRPs?**
### Small Multi Jurisdictional Utilities PRPs

#### Public Charging Stations

<table>
<thead>
<tr>
<th>Project Description</th>
<th>Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCFC Project (Liberty)</td>
<td>$4M</td>
</tr>
<tr>
<td>Demonstration and Development Program (PacifiCorp)</td>
<td>$0.3M</td>
</tr>
<tr>
<td>Destination Make Ready (BVES)</td>
<td>$0.6M</td>
</tr>
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</table>

#### Electrification Promotions

<table>
<thead>
<tr>
<th>Program Description</th>
<th>Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Rebate Program (Liberty)</td>
<td>$1.6M</td>
</tr>
<tr>
<td>Small Business Rebate Program (Liberty)</td>
<td>$0.3M</td>
</tr>
<tr>
<td>Customer Online Resource (Liberty)</td>
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</tr>
<tr>
<td>Outreach and Education Program (PacifiCorp)</td>
<td>$0.2M</td>
</tr>
</tbody>
</table>
Outreach and Education Program

Program Overview

- $140k budget ($59k spent through end of 2020)
- Three modes of customer engagement and participation
  - Targeted mailing campaign, community events, and a technical assessment
- Outreach and Ride and Drives (April 2019 start, Forth Mobility contractor)
- Technical Assessments (May 2019 start, C2 Group contractor)
  - 4 commercial customer requests, 1 customer assessment
- On-site and in person events suspended in 2020 due to the COVID-19 pandemic

Evaluation Methodology

- Program data review (outreach events)
- Utility and contractor staff interviews (Nov 2019 & Oct 2020)
- Residential online survey (Feb 2020, 73 responses)
  - Focused on customer awareness, interest, motivation, and perceived barriers of EVs and EVSE
Program Overview

• $270k budget ($15k spent through end of 2020)
• EV workshop aimed at driving interest in the program (Nov 2019)
• Grant applications (Q2 2019 start, Nexant contractor)
  • 5 Quarterly applications cycles (2019/2020)
  • 3 applications in 2019, one approved ($71k)

Evaluation Methodology

• Program data review (grant applications)
• Utility and contractor staff interviews (Nov 2019 & Oct 2020)
PRP Successes and Lessons Learned

• COVID-19 impacted the two programs, limiting outreach and possibly increasing the barrier to participation in the Demonstration and Development program.

• **Continued efforts will be required to mitigate customer concerns and increase awareness**

  PRPs began to address awareness and informational barriers regarding EV ownership for residential customers and on a more limited basis charging station installations for commercial customers.

• **Developing complementary programs leverages limited resources**

  With limited internal resources, developing complementary programs allows staff to expand customer awareness, reduce perceived barriers, promote technical knowledge through on-site and virtual assessments, and provide financial support to commercial customers who want to install charging infrastructure.

• **Programs must be designed to meet customers where they are on their journey**

  Rural customers are not as far along in their EV journey as customers in other areas of the state. This sentiment was supported by survey responses, 83% indicating they agree that utility should do more EV customer education.
Program Overview

- $4M budget ($116k spent through end of 2020)
- Site host provides make-ready infrastructure for the installation of EVSE
  - Utility rebate (up to 50 percent of the EVSE base cost) if site host owns the EVSE
  - Site hosts that opt out of EVSE ownership pay a participation fee (50% of base EVSE cost)
  - Utility EVSE ownership limited to 35 percent of charging ports
- CLEAResult contracted for online application portal development (PowerClerk)

Evaluation Methodology

- Program data review
- Utility and contractor staff interviews (Nov 2019 & Oct 2020)
DCFC Project

Program Status

• Tier 2 Advice Letters
  • Approved for use of small commercial customer rate with no demand charges as a temporary rate for DCFC infrastructure installed
  • Request for proposal to calculate EVSE base cost to be used to calculate the rebate and participation amounts for all PRPs installing infrastructure

• Online pre-application site launched in Aug 2019

• Working with one site, City of Portola (no agreement signed yet)

• Unable to conduct planned in-person meetings and site visits in 2020, as these were suspended because of the COVID-19 pandemic.

• Projecting the 5 to 9 sites selected to complete construction by Q3 2024
Rebate Programs

Residential Rebate Program Overview
• $1.6M budget ($24k spent through end of 2020)
• Incentivize EV adoption by offsetting the costs of installing residential EVSE
  • First 1,000 qualifying residential customers will receive rebates of up to $1,500
  • Rebate covers permitting, installation, equipment, and service upgrades
• 10-year participation agreement (networked and charging session data)
• Agree to time-of-use (TOU)-EV rate.

Small Business Rebate Program Overview
• $0.3M budget ($17k spent through end of 2020)
• Similar in design to Residential Program with 2 exceptions:
  • Owning or leasing an EV is not required
  • Public access to charging stations must be provided. A rebate of up to $2,500
• Up to $2,500 rebate for the first 100 qualifying small commercial customers
Rebate Programs

Program Status

• The materials for the programs have been developed, including the online application intake and management portal and the Participant Program Handbook.

• The marketing strategy for the programs was being finalized at the end of 2020 and will be ready for deployment when the program is opened. Most initial marketing efforts will be online because of the COVID-19 pandemic.

• The application activity in the residential rebate program will peak in early 2023, and the final projects (of the 1,000-project target) will be completed in Q4 of 2023.

• The application activity in the small business rebate program will peak in the middle of 2022, and the final projects (of the 100-project target) will be completed in Q2 of 2023.
Customer Online Resource

Program Overview

• $0.24M budget ($27k spent through end of 2020)
• Provide opportunity for residential customers to learn about EVs and for commercial customers to learn about rebates for charging stations
• The residential and small business rebate programs then provide financial support to residential and commercial customers interested in installing charging infrastructure

Program Status

• Contracted with Clean Power Research in 2019 to develop a customized version of their EV savings tool, WattPlan
• The resource will be offered throughout the term of residential and small business rebate programs
PRP Successes and Lessons Learned

• While PRPs are not yet fully deployed, utility has **successfully coordinated marketing and outreach efforts across the PRPs and with local ongoing efforts**
  
Liberty will encourage customers to utilize WattPlan, developed under the Customer Online Resource, where, along with information about current vehicle rebates, customers will find details on the residential and small business charger rebate programs.

• **Developing complementary programs leverages limited resources**
  
With limited internal resources, launching all 4 related PRPs simultaneously allows staff to expand customer awareness, reduce perceived barriers, promote technical knowledge, and provide rebates to residential and small business customers who want to install charging infrastructure.
PRP Successes and Lessons Learned

• Ten-year data sharing and network service requirements for the residential rebate program presented a significant challenge
  Customer costs to maintain network subscription would likely exceed rebate value. Negotiating with selected EVSPs for direct access to customer data to alleviate fees.

• Utility staffing has proven to be a challenge
  • PRP project manager departure and 8-month delay to hire replacement because of COVID-19 pandemic-related hiring challenges
  • Competing interests for limited staffing resources (management, design, and construction teams), to support several ongoing EVSE installation programs
Destination Make Ready

Program Overview
• $607,500 budget ($75k spent through end of 2020)
• Install, own, and operate the make-ready infrastructure for up to 50 L2 chargers
• 10-year charger operational requirement with EV-TOU rates
• BVES conducting outreach
• Center for Sustainable Energy contracted for program implementation

Evaluation Methodology
• Program data review
• Utility and contractor staff interviews (Nov 2019 & Oct 2020)
Destination Make Ready

Program Status

• Dec 2019 launch with a community outreach and electrical contractor and commercial customers meetings
  • 7 entities expressed interest, 4 in the application process; 3 site visits
  • Engaging the City of Big Bear on 2 sites (no applications yet)

• Engaging with electrical contractors to advise them of installation best practices, working with EV service providers on commissioning process, and assisting interested customers with the application process.

• Additional information mailers targeted to commercial properties because COVID-19 pandemic restrictions are preventing any direct customer engagement (i.e., in-person workshops, education and outreach events)
Successes and Lessons Learned

• BVES has successfully developed all required program materials and launched the program for applications in December 2019

• Customer concerns about limited EVs in the region (lack of four- or all-wheel drive capabilities), loss of parking with installation of EV chargers, and customer participation costs

• The pandemic has increased the cost barrier to EV adoption, as many commercial customers, especially small businesses, are dealing with COVID 19’s impact and do not consider installing EV chargers a priority

• Anticipating to install the first commercial EV charging site in 2021 and to complete the last installations by the end of 2022
<table>
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Thank You

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