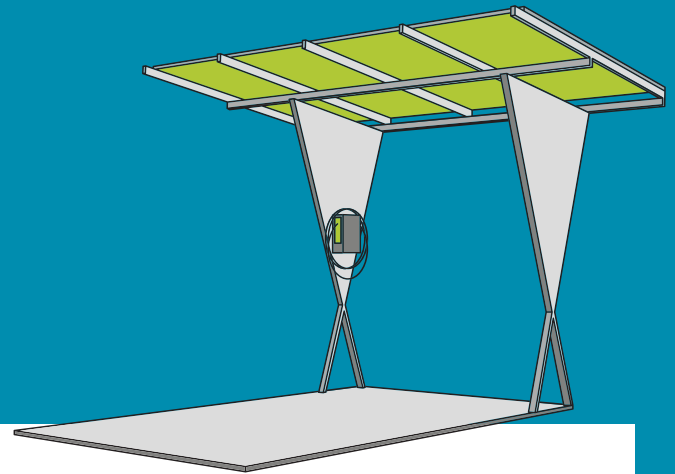




## Direct-DC Solar to EV Chargers and Portable Solar Canopy

Technology Early Deployment

# Paired Power



Paired Power offers a suite of grid-edge direct-DC solar PV-to-electric vehicle (EV) chargers that is built around its Solar Electric Vehicle Oasis (SEVO) technology. SEVO chargers are DC-to-DC chargers that deliver energy produced by PV to directly charge EVs without the need to be grid tied. The EV chargers are designed to alleviate grid congestion when electrical service is at capacity or not available. Three models are available:

### SEVO SUNSTATION

A fixed solar canopy with integrated EV chargers that manages charging multiple light duty EVs.

### SEVO HIGH POWERED CHARGER

A 60 kW DC fast charger that supports light, medium, and heavy duty EVs.

### SEVO PAIRTREE

A non-permanent carport structure designed to be quickly and inexpensively constructed to provide power for EV chargers or other loads.

## TECHNOLOGY BENEFITS



### REDUCED INFRASTRUCTURE

Eliminates redundant DC-AC-DC conversion.



### PEAK DEMAND REDUCTION

Up to 100% reduction in peak demand from EV charging.



### REDUCED CARBON EMISSIONS

100% reduction in GHG emissions from EV charging.



### RAPID DEPLOYMENT

Single day deployment by a two-person crew.



### HIGH EFFICIENCY

20% increase in energy production over AC EV chargers.

**Disclaimer:** Paired Power's SEVO products were chosen for TED because they support **California's clean energy goals** of increased energy efficiency, reduced GHG emissions, and peak demand reduction. This document does not constitute or imply endorsement, recommendation, or favoring by EPRI or SCE of the product or company described herein. This publication is funded and administered by Southern California Edison's Emerging Technologies Program.

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# Efficient and resilient direct PV-to-EV power

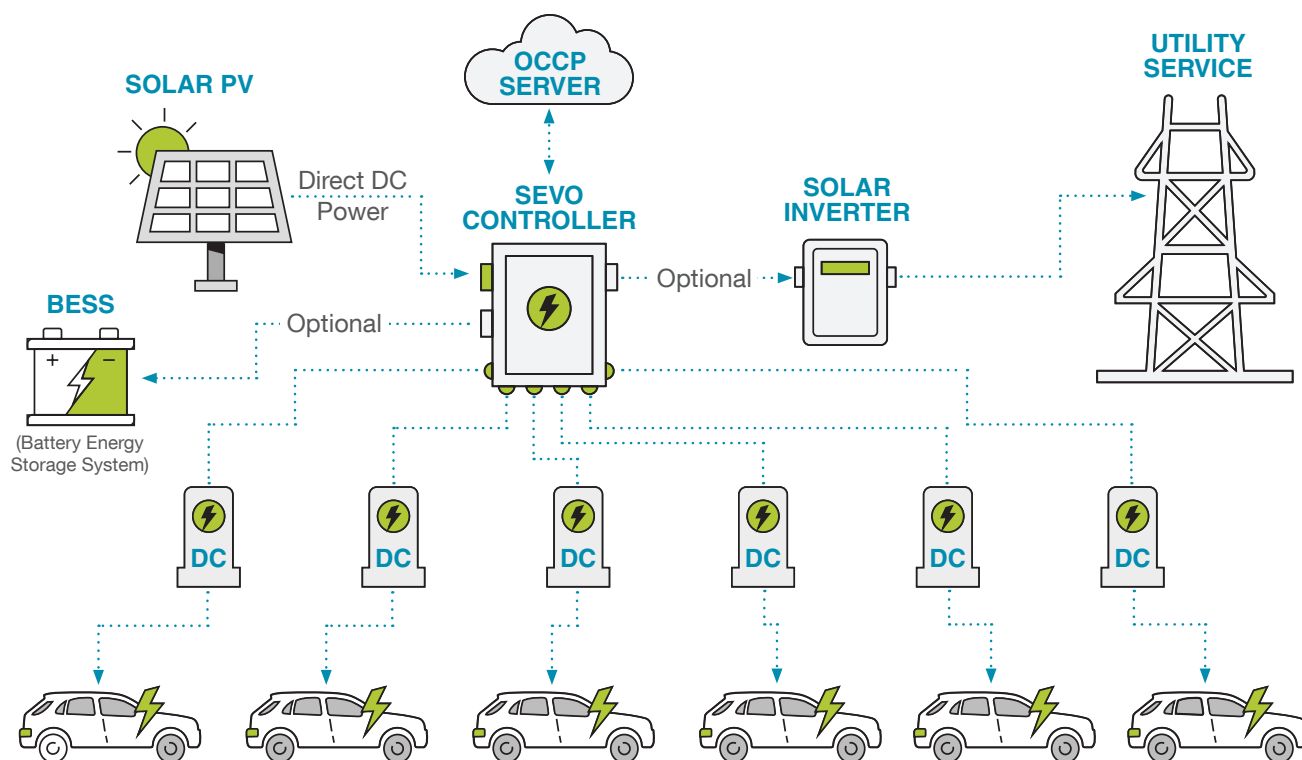
Paired Power's direct-DC solar EV charging technology integrates solar PV systems with its patented smart DC charging stations, enabling deployment of onsite renewable electricity to scale up EV charging infrastructure without negative grid impacts.

SEVO SunStation's software controller manages power flows from a 20 kW solar PV system to multiheaded direct-DC chargers based on EV demand. Available miles delivered to each EV are variable based on the number of chargers in simultaneous use, but the system is designed to meet the daily range of the average commuter and can deliver 30 - 200 miles of range per vehicle per workday.

SEVO High Powered Charger offers a higher capacity, direct-DC solar EV charging solution for all electric vehicle classes, including electric school and transit buses. SEVO HPC can deliver a fast charge to EVs at up to 100 kW from onsite renewable energy.

SEVO PairTree integrates its direct-DC solar EV charging technology with a low-cost, portable 5 kW PV carport structure, which can be scaled up to larger sizes by cascading units and assembled in a single day by a two-person crew. It is considered a temporary structure, which dramatically reduces the permitting and construction costs and parking lot disruption associated with traditional PV carport installations.

All Paired Power products can interface with the grid via a solar inverter to supply clean energy back to the grid either from the PV system or from the EV through Paired Power's vehicle-to-grid (V2G) capability.



## TARGET CUSTOMERS

- ✓ Public/Private EV fleet customers (SEVO HPC and PairTree).
- ✓ Public/private entities for workplace charging (SEVO SunStation and PairTree).
- ✓ Public/private entities for retail fast charging (SEVO HPC and PairTree).
- ✓ State parks and beaches (SEVO HPC and PairTree).
- ✓ Renewable DC Microgrids (SEVO HPC and PairTree).
- ✓ Agricultural fleet sites (SEVO HPC).

## HARDWARE COMPATIBILITY

- ✓ Compatible with ground-mount and carport solar PV systems between 400-1000 volts.
- ✓ Compatible with EVs equipped with DC ports (CCS1 and CHAdeMO).
- ✓ Scalable from 20 kW up to 60 kW per direct-DC solar charger.
- ✓ Delivers solar PV energy directly into mobile or stationary battery storage systems.

## SYSTEM FEATURES



**BESS INTEGRATION**



**HIGH EFFICIENCY**



**DISPATCHABLE DER**



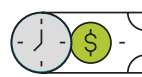
**SCALABLE SYSTEM**



**NO HEAVY CONSTRUCTION**



**NO ELECTRICAL UPGRADES**



**REDUCES DEMAND CHARGES**

## California's decarbonization challenge

California's executive order B-55-18 mandates that the state achieve carbon neutrality by 2045. Additional legislation supports this goal through multiple strategies that include double energy savings by 2030 (SB 350), increased demand flexibility (19-OIR-01), transportation electrification and 100 percent of all retail electricity from renewable energy (SB 100). Applying these strategies to new construction and upgrades to existing buildings provides a path to achieving carbon neutrality but also comes with a new set of challenges:

### 1.

#### **New technologies for buildings**

must support desired outcomes for CA.

### 2.

#### **Testing, compliance & standards**

including utility participation and enabled workforce.

### 3.

#### **Establishing trust**

that replacement of old systems will meet/exceed performance expectations.

## PAIRED POWER SUPPORTS CALIFORNIA'S DECARBONIZATION GOALS



### **SUPPORTS DECARBONIZATION**

by using solar PV to directly charge electric vehicles.



### **SUPPORTS DEMAND FLEXIBILITY**

by presenting a method by which EVs can island and charge when needed (grid connected scenario) without negative grid impacts.



## Addressing market barriers to decarbonization through PV to EV charging across commercial, industrial and agricultural sectors

California's state mandate is to install 250,000 public EV chargers by 2025, a ZEV mandate (N-79-20) by 2035 and 100% clean energy mandate (SB 100) by 2045. These collective goals support a potential market for a technology like Paired Power's, with the beach-head market opportunity in utility demonstrations (CA).

### BARRIERS STILL EXIST IN SEVERAL AREAS:

#### Barriers

##### CURRENT

- ✓ In its base configuration, Paired Power's direct-DC solar EV chargers are not equipped with an energy storage system. This keeps costs down, but limits the use to daytime only applications.
- ✓ Utility EVSE incentive programs currently don't support Paired Power's grid-edge technology.

### CREATING A PATH TO COMMERCIALIZATION THROUGH THE FOLLOWING ACTIVITIES:

#### Opportunities

##### LEVERAGE POINTS

- ✓ California needs 85,000 public EV chargers to reach 2025 goal.
- ✓ US EV charging market of \$10 billion by 2025.
- ✓ CA EV charging market of \$3.5 billion by 2025.
- ✓ Initial markets businesses, schools, and public parks.
- ✓ Future markets include vehicle fleets, parking garages, and apartment buildings.
- ✓ Eligible for multiple local, state, and federal incentives.
- ✓ Collaboration with EPRI.
- ✓ Field testing in CA.
- ✓ CA stakeholder supported grants worth >\$3M.

## Market readiness



**5/7**

**TECHNOLOGY  
READINESS LEVEL  
SCORE**

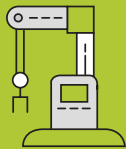
- SEVO PairTree: 5
- SEVO SunStation and HPC: 7



**1-2**

**YEAR TO  
MARKET**

- SEVO PairTree: 1-2 years
- SEVO SunStation and HPC: <1 years.



**6/7**

**MANUFACTURER  
READINESS  
LEVEL SCORE**

- SEVO PairTree: 6
- SEVO SunStation and HPC: 7



**1**

**KEY  
OUTCOME**

- Proposed case studies of the SEVO PairTree in Solana Beach and Chula Vista can demonstrate the reduced construction time and quantify the overall cost of energy for the product, allowing comparison with other EV charging options.

## Supporting utility goals for decarbonization

**1.**

### Energy savings

Increases energy production by approximately 20% by avoiding power conversion losses.

**2.**

### Decarbonization

Increases driver access to EVSE by lowering the cost of installation.

**3.**

### Demand flexibility

Saves 20 kW-60 kW of electrical demand & up to 163 MWh/annually per unit.





# Example Use Case

## CUSTOMER WORKPLACE EV CHARGING CHALLENGE

A commercial tech employer located in San Diego, California, had 18 grid-tied EV chargers onsite. An employee survey conveyed a strong demand for more EV charging stations, but the electrical service was fully subscribed, and would require an expensive service expansion to accommodate the new EV chargers. The employer selected Paired Power’s SEVO SunStation with 24 EV chargers to be deployed on the top-deck of their employee parking garage. Solar analysis demonstrated that EVs charging there received on average of over 45 miles of range/per day at zero added energy or demand cost or electrical service upgrade cost.

## BY THE NUMBERS

Location.....	San Diego, CA
Commissioned.....	December 2019
DC capacity.....	67.2 kW
Solar EV chargers (DC) .....	24 ports
DC charger capacity.....	Up to 16.8 kW
Annual kWh generation .....	120,000 kWh
LCFS Credit Generation.....	\$18,000 annually

## PROJECT LIFETIME COST SAVINGS

Energy & Demand Cost Savings: \$720,000 .....	
LCFS Credit Savings: \$162,740 .....	
Electrical Service Upgrade Cost Savings: \$500,000 .....	



# Paired Power Opportunity Assessment



## TECHNOLOGY CATEGORY

### Plug Loads and Appliances

### Electric Vehicle Supply Equipment



## ETP PRIORITIES

### ENERGY SAVINGS

Increases PV production by up to 20% by reducing power conversion losses.

### DECARBONIZATION

Increases driver access to EVSE by lowering the cost of installation.

### DEMAND VALUE PROPOSITION & BUSINESS USE CASE

### FLEXIBILITY

Saves 20-100 kW of charging demand per unit.



## KNOWLEDGE INDEXES

### TECHNICAL PERFORMANCE

High

### MARKET KNOWLEDGE

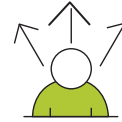
High

### PROGRAM INTERVENTION

Medium

### UTILITY VALUE

- Reduces demand from EV charging.
- Enables charging in capacity constrained locations.



## OPPORTUNITIES

### CRITICAL ETP ACTIONS

- Socialize with SCE.
- Socialize with other IOUs.
- Socialize with city leaders.
- Field test of SEVO PairTree.

### LEVERAGE POINTS

- Potential demonstration projects of SEVO PairTree in Southern California cities of Solana Beach and Chula Vista.
- \$3M+ in local and state California grants.
- EPRI.

### GAPS TO FILL

- Field demo data.
- Utility-specific use case.



## BARRIERS

### CURRENT

- Restricted to daytime and sunny areas.
- Manufacturing Supply Chain.

### CURRENT

- Utility incentive programs currently do not support Paired Power's grid edge technology.
- Customer adoption.
- Code restrictions.

### SOLUTION

- Grid tie or integrate with batteries as needed.
- Expand supplier network.
- Federal incentives + financing options.



## NEXT STEPS

### COMPANY

- Resolve PairTree supply chain issues and proceed with demonstration projects.
- Pursue opportunities with EV fleets.
- Utility-specific cost benefit analysis.

### UTILITY

- Value proposition & business use case.
- Field demo results.

### OTHER

- EPRI M&V testing and/or grant collaborator.



TED is a process where innovative technologies are selected for assessment and review based on the technology application, team strength, and alignment with the Technology Priority Maps, to fulfill the California decarbonization challenge.

## FOR MORE INFORMATION

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