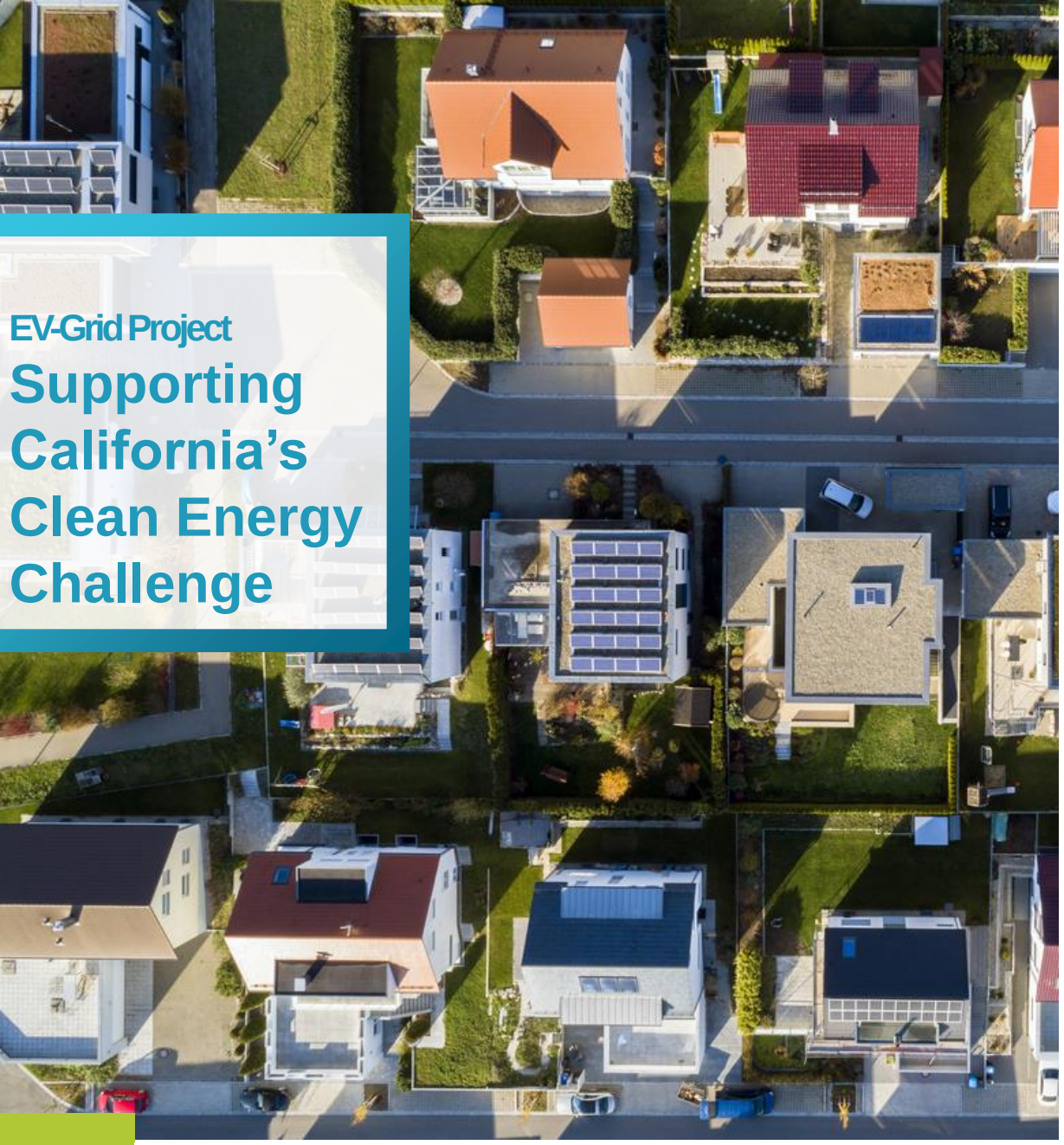
EV-Grid Project

CEC EPC-14-086

CEC EPC-14-086: Develop a Distribution System Aware Vehicle to Grid Services for Improved Grid Stability and Reliability



EV-Grid Project

Supporting California's Clean Energy Challenge

SUPPORTING EV-GRID INTEGRATION

- Plug-in electric vehicles (PEVs) are poised to become viable distributed energy resources, enabling improved grid stability and reliability.
- EPC 14-086 blends analysis, simulation, and implementation of an integrated vehicle to grid (V2G) system managed through a transformer management system.
- Led by Electric Power Research Institute (EPRI) tests protocols for verifying electric V2G interoperability and compatibility with CPUC interconnection requirements.

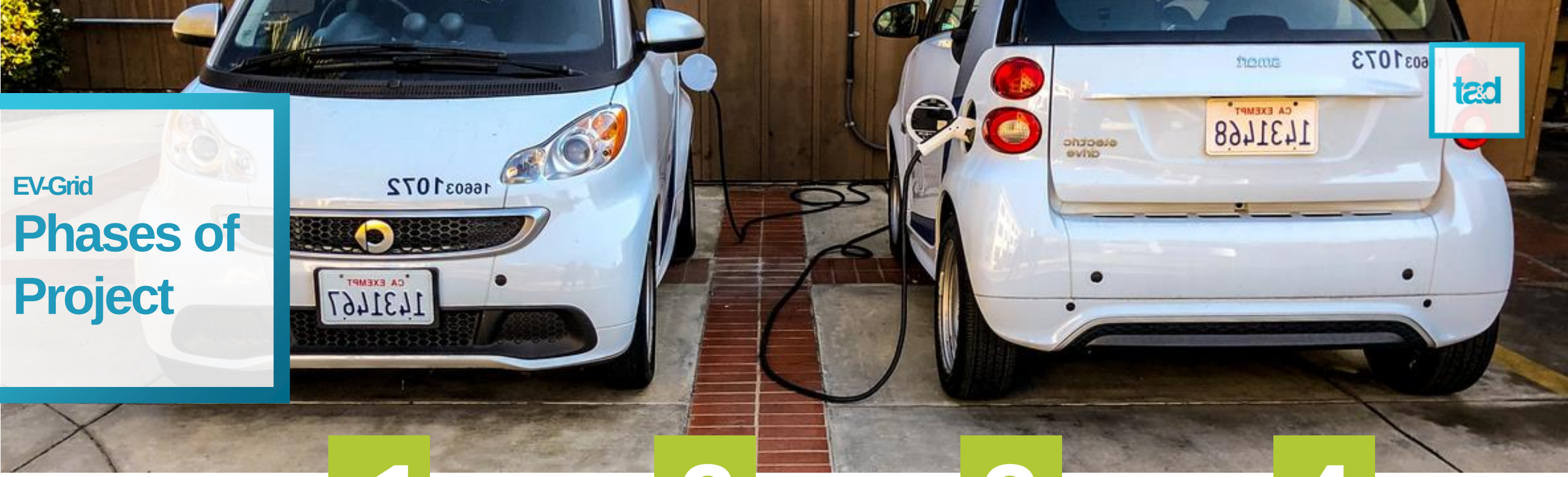
V-Grid Project

Project Objectives

1. Develop and implement an end-to-end V2G communications system using applied open standards
2. Implement dynamic V2G management use cases
3. Implement data collection and performance analysis
4. Assess the cost/benefit for the customer, the utility and CA

EV-Grid

Phases of Project

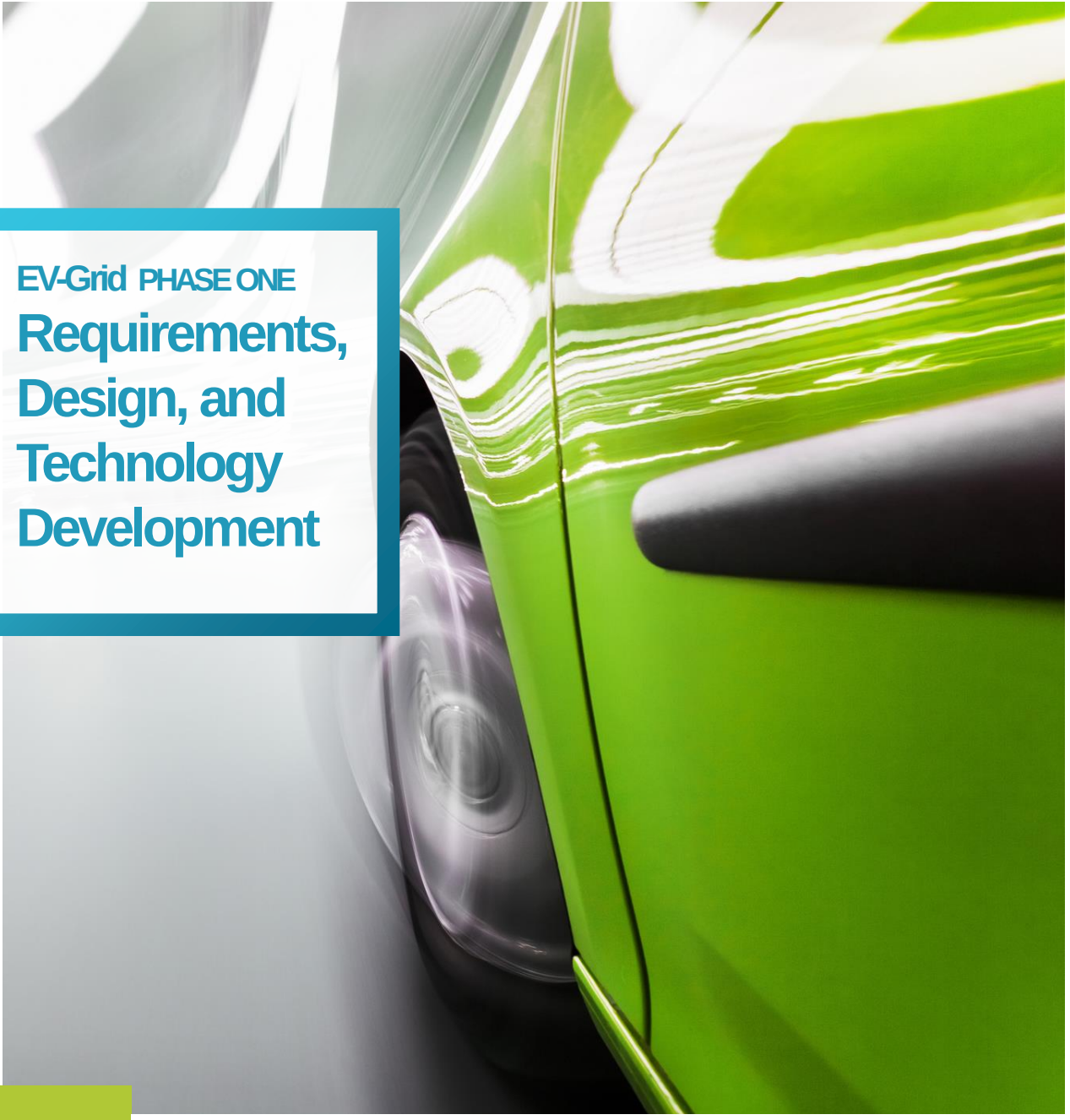


1 Requirements, Design, and Technology Development

2 Technology Integration, Deployment, and Testing

3 Value and Planning Pathways Assessment

4 Technology Dissemination and Transfer Activities



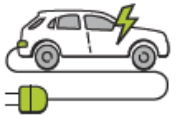
EV-Grid PHASE ONE

Requirements, Design, and Technology Development

Transformer Management System (TMS) Design

Transformer Power Measurement Unit (TPMU)

- Measures voltage, currents and phase
- RS485 Communications Interface to the TC



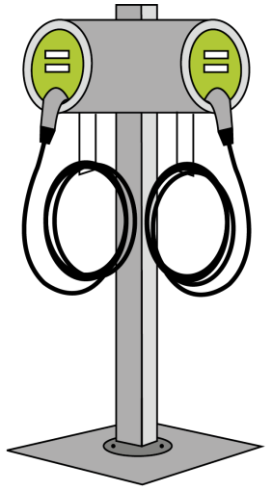
Transformer Controller (TC)

- Linux based open Router Platform
- Communications to each EVSE(s) and PEV(s) via HomePlug AV Adaptor
- Performs Energy Management Algorithm

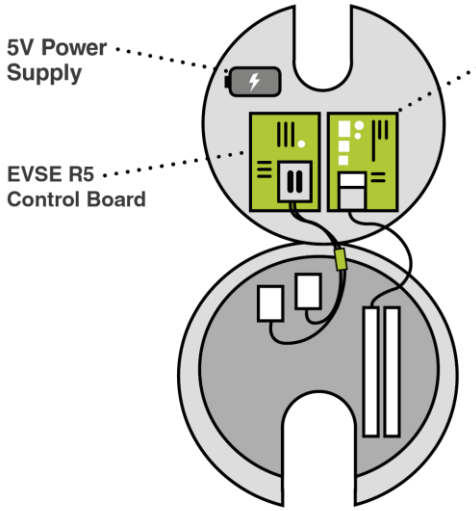
Secure Neighborhood Area Network through HomePLug AV (IEEE1901)

- Ethernet connected to the TC
- Secure IPv6 to all Gateways via the premise drop

Electric Vehicle Supply Equipment (EVSE) System



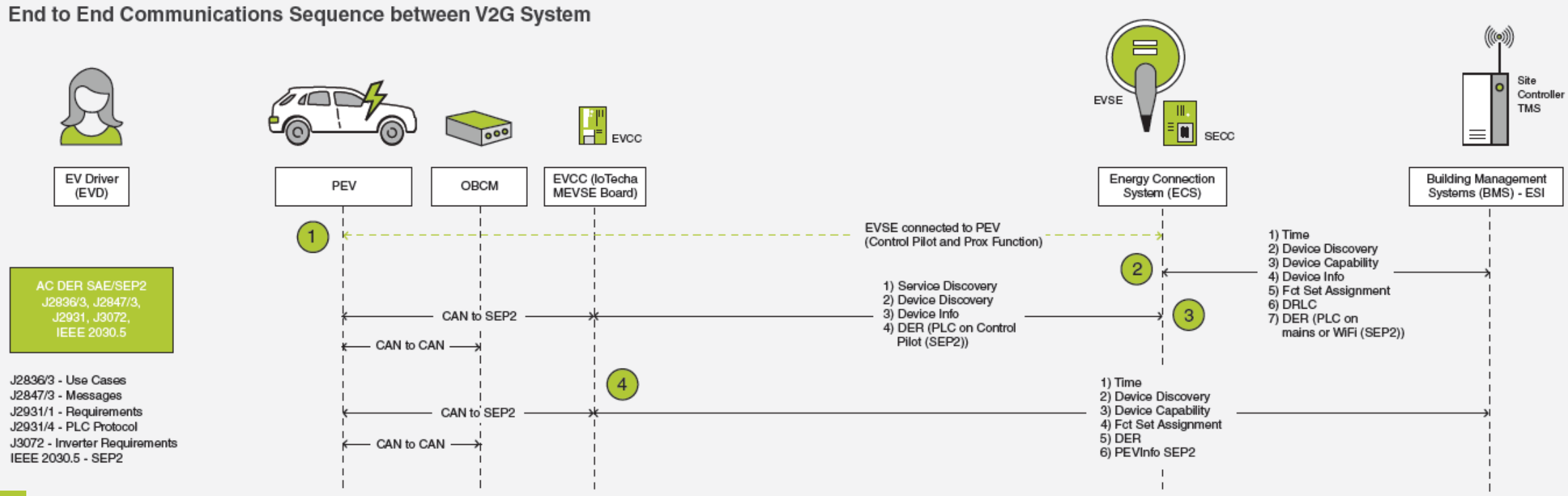
Dual L2 AV EVSE
UL-Certified



IoTecha Board contains the J3072 and IEEE 2030.5 software and connects to EVSE RS Control Board through UART (serial port). Pilot signal is generated by the EVSE RS Control Board. PLC signal is injected onto the pilot wire on the Expansion Board. The Pilot to the output cable to the EV is connected to the Expansion Board.

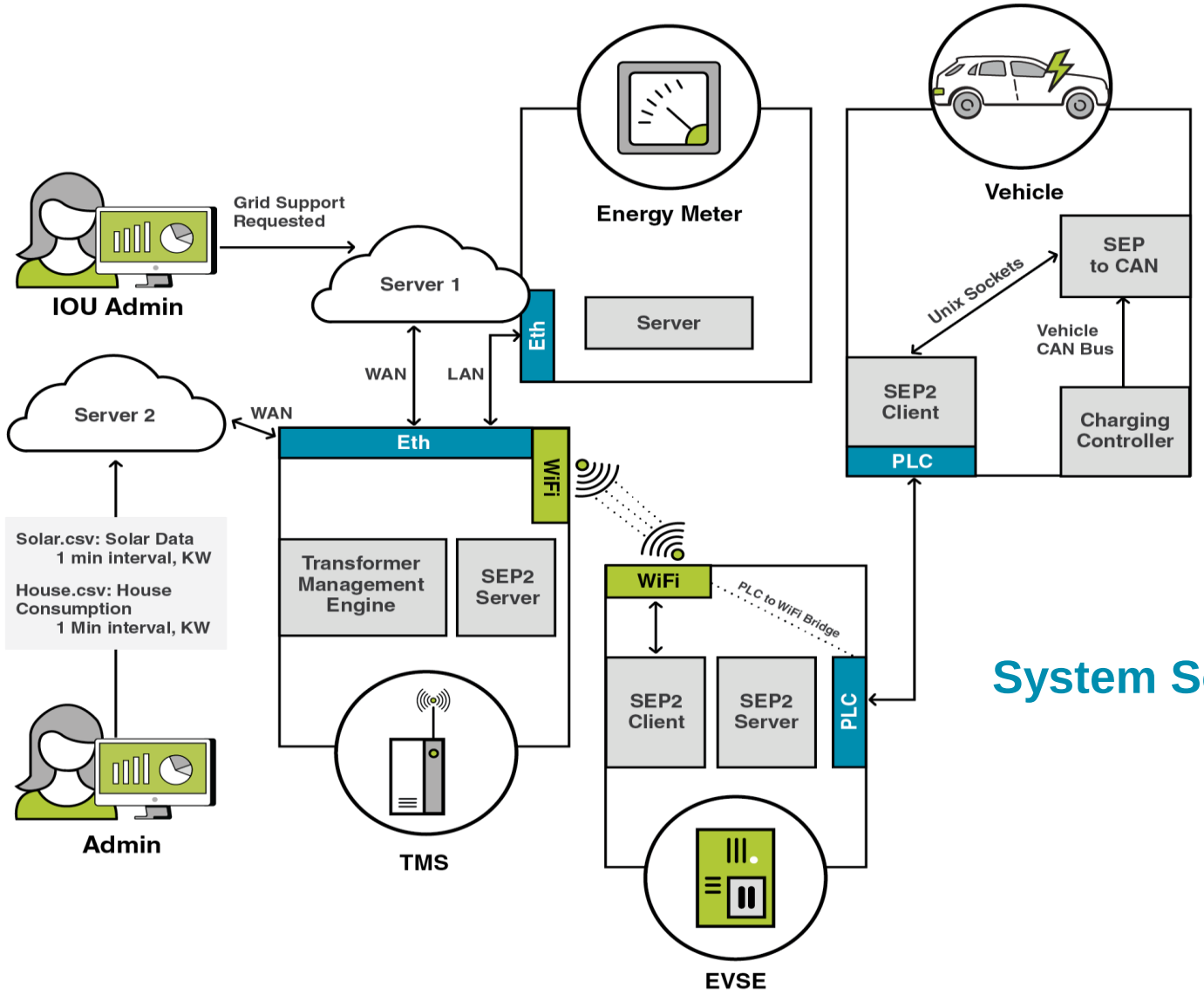
On-Vehicle Control Modules

- Implements two separate on-vehicle V2G communications modules
- Incorporates multiple protocols
- Assess the cost/benefit for the customer, the utility and CA
- Demonstrates effectiveness of standards through verification of interoperability with common EVSE



EV-Grid PHASE TWO

Technology Integration, Deployment, and Testing



System Software Integration

UCSD Site Vehicle Integration

EV-Grid PHASE TWO

System Deployment and Integration

Honda Accord PHEV – V2G Integration

- Based on 2014 model
- 6.7kWH battery
- 2kW prototype bidirectional charger (OBC)
- Modified VSL to add PLC and SEP2 and includes SW and HW changes

Vehicle Smart Link (VSL) Module (NUVVE / UDel)

FCA Pacifica Van PHEV - V2G Integration

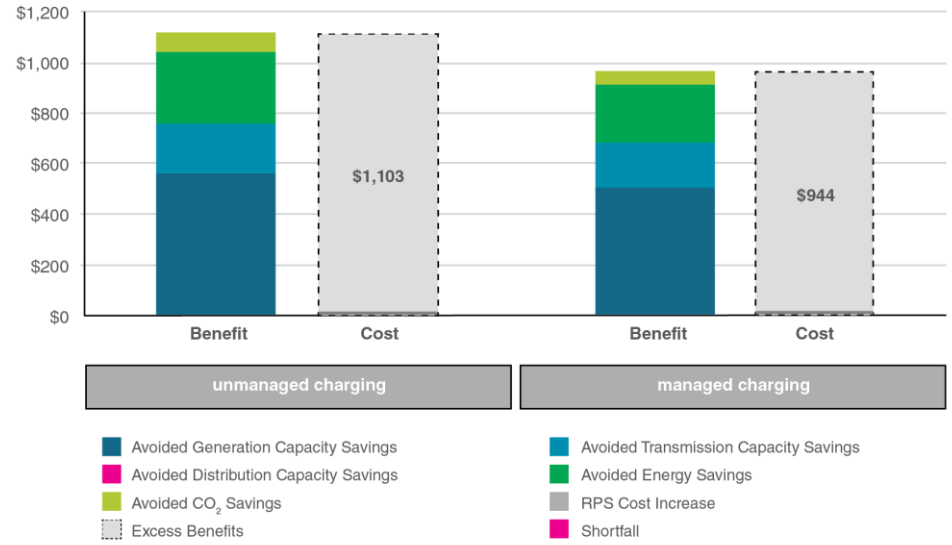
- On-board charging module is mounted under the vehicle
- Battery pack has total capacity of 16.4 kWh; 11.8 kWh is usable

Pacifica PHEV Battery Pack

EV-Grid PHASE THREE

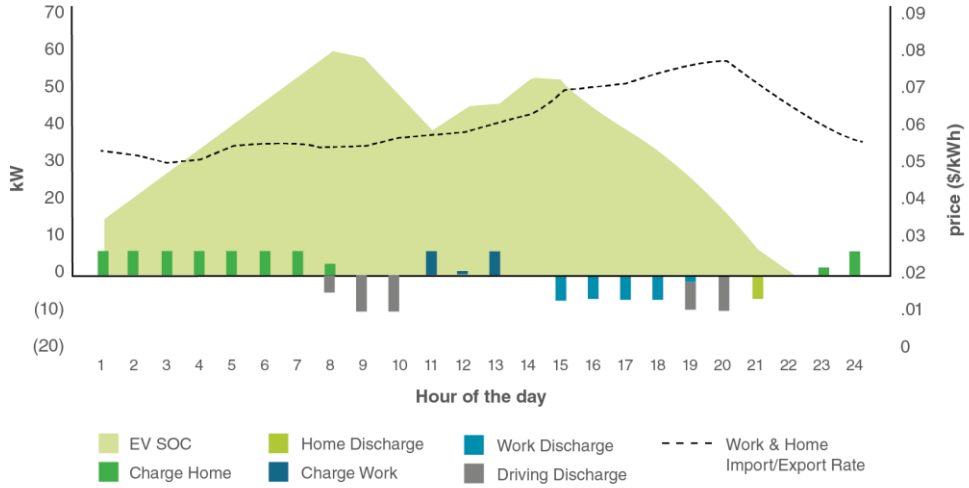
Value and Planning Pathways Assessment

Annual Net Benefits (2017$) for Total Resource Cost Relative to Unmanaged and Managed Charging



V2G with Real Time Pricing Results

Sample Dispatch for EV 4, Tuesday 7th June



EV-Grid PHASE FOUR

Technology Dissemination and Transfer Activities

Project Success Snapshot

- Validated end-to-end interoperability and application of desired standards.
- TMS-automated energy management supports grid service requests.
- Simulated data verifies algorithmic functionality.
- Positive value proposition for EV owners.
- Grid-tied bidirectional charger and J3072 client control module integrated.
- System integration revealed compatible and interconnected grid interaction.
- Effective for residential transformer energy monitoring – community aggregation application.

Opportunities

- Adoption of interconnection requirements for onboard inverters that meet Rule 21.
- Capability of on-vehicle V2G inverters to meet Rule 21 revisions.
- Synchronization between different original equipment manufacturers (OEM) vehicles.
- Reducing signal response times to support ancillary fast response services.
- Better understanding of increased cycling on battery life and how this affects warranties.

Suggested Next Steps

1. Define SAE J3072 interoperability, certification requirements and harmonized labeling.
2. Develop V2G incentive structures acceptable to customers.
3. Define clearer electrical integration standards.
4. Develop next-gen ‘edge of grid’ computing technology.
5. Address adoption of J3072 by utilities.
6. Test capability of on-vehicle V2G inverters to meet Rule 21 revisions.


Questions

Thank you for coming

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