Vehicle-Grid Integration
Research & Deployment

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California Energy Commission
CEC Transportation Electrification Staff Mission

• Support California’s public and private deployment of grid-integrated Plug-In Electric Vehicles and chargers
  – Validate innovative charging and vehicle technology with world-leading researchers and industrial partners
  – Accelerate the commercialization of viable and interoperable products through directive policies and customer-facing programs,
  – Harness technological and programmatic capabilities to positively impact electric system operations and infrastructure, and
  – Timely achieve reductions of air pollutants and greenhouse gases
Outline for Update

• Current portfolio of VGI research and demonstration projects funded under the first two Electric Program Investment Charge (EPIC) Triennial Investment Plans

• VGI research opportunities in the proposed EPIC 2018-2020 Triennial Investment Plan

• Energy Commission role in the VGI Communications Protocol Working Group, the POUs’ Integrated Resource Plans, and other initiatives

• Energy Commission role in the 2018 VGI Roadmap update effort
Portfolio of VGI projects under the first two EPIC Triennial Investment Plans

Seventeen projects stemming from 3+ competitive solicitations and covering two EPIC program areas

- **Applied Research and Development**: Includes activities to support pre-commercial technologies and approaches at applied lab-level or pilot-level stages.

- **Technology Demonstration and Deployment**: Involves installation and operation of pre-commercial technologies or strategies at a scale that will reflect actual operating, performance, and financial characteristics and risks.

Nearly $62 Million in VGI R&D* since 2012 including EPIC and ARFVTP* + match funds
Portfolio of VGI projects under the first two EPIC Triennial Investment Plans

• EPIC 2012-2014 Triennial Investment Plan
  – *PON-14-301* Demonstrating Secure, Reliable Microgrids and Grid-Linked Electric Vehicles to Build Resilient, Low-Carbon Facilities and Communities
  – *PON-14-310* Driving the Integration of Electric Vehicles to Maximize Benefits to the Grid
  – *GFO-15-311* Advancing Solutions That Allow Customers To Manage Their Energy Demand

• EPIC 2015-2017 Triennial Investment Plan
  – *GFO-16-303* Advanced Vehicle-Grid Integration Research and Demonstration
Portfolio of VGI projects under the first two EPIC Triennial Investment Plans

• EPIC 2012-2014 Triennial Investment Plan
  – PON-14-301  Released 7/3/2014
    • Two Technology Demonstration & Deployment (TD&D) VGI projects
  – PON-14-310  Released 12/18/2014
    • Five Applied Research & Development (AR&D) VGI projects
  – GFO-15-311  Released 12/14/2015
    • One AR&D VGI project

• EPIC 2015-2017 Triennial Investment Plan
  – GFO-16-303  Released 7/20/2016
    • Four AR&D and five TD&D VGI projects
Portfolio of VGI projects under the first two EPIC Triennial Investment Plans

Energy Innovation Showcase website:

innovation.energy.ca.gov
EPIC 2018-2020 Triennial Investment Plan

http://energy.ca.gov/research/epic/17-EPIC-01/
EPIC 2018-2020 Triennial Investment Plan

**Applied Research and Development**
Applied Research and Development includes activities to support pre-commercial technologies and approaches at applied lab-level or pilot-level stages.

**Technology Demonstration and Deployment**
Technology Demonstration and Deployment involves installation and operation of pre-commercial technologies or strategies at a scale that will reflect actual operating, performance, and financial characteristics and risks.

**Market Facilitation**
Market Facilitation focuses on a range of activities, such as commercialization assistance, local government regulatory assistance and streamlining, market analysis, and program evaluation to support deployment and expand access to clean energy technology and strategies.
CHAPTER 4: Increase Grid System Flexibility and Stability from Low-Carbon Resources

SB350 established a new 50 percent target for California’s Renewables Portfolio Standard. In 2015, the California Global Warming Solution Act was updated to require GHG reductions of 40 percent by 2030. For California to meet these goals and continue to drive down the cost of electricity generation, new innovations are needed that will increase the use of low-carbon resources for grid flexibility and stability.

Solar PV has become the preferred technology option for renewables in California, accounting for 97 percent of new utility-scale renewable generation added in 2016. This trend is expected to continue as solar PV prices continue to
Investment Plan Subtheme 3.2: Enable Electric Vehicle-Based Grid Services

3.2 Enable Electric Vehicle-Based Grid Services

Plug-in electric vehicles (PEVs) are poised to increase in California with policymakers targeting 1.5 million zero emission vehicles on California roads by 2025. PEVs will increase electricity demand, but they also offer unique opportunities for grid flexibility through vehicle grid integration (VGI). Successful deployment and integration of PEVs will reduce California’s dependence on petroleum, improve public health, reduce carbon emissions, and support California’s economy.

A growing surplus of spent PEV batteries could also provide valuable services to the electric grid as second-use batteries, since about 70 percent of battery’s charge capacity remains when it completes its primary life. A battery resale market could bring down the net cost of PEV ownership, which is high because of costly battery components such as lithium and cobalt.

Battery second-use

Research on battery second-use as energy storage has focused on technical attributes such as charge capacity and duration of second life. With these results, new research will be able to develop innovative battery management systems with battery charge capacity diagnostic technologies to more effectively assess battery life and lower repurposing costs.

Smart charging

PEVs can serve as flexible loads by delaying their charging times or modulating their charge rates. This smart charging, also known as V2G, can make grid operation more efficient and reliable, but must be designed to compensate drivers and preserve mobility in diverse applications.

A state with 1.5 million PEVs needs charging stations as common and usable across brands of PEVs as gasoline stations are today. This becomes difficult if too many different groups of PEV manufacturers require different charger-to-car communication methods, yet that was the case until recently. EPIC is funding the demonstration of a common interoperability standard, ISO/IEC 15118. To date six car manufacturers have agreed to adopt it. EPIC research projects are developing methods to translate grid load conditions and pricing rates to each PEV through open-source communication standards.

THE CALIFORNIA VEHICLE-GRID INTEGRATION ROADMAP ESTABLISHES A RESEARCH AGENDA TO EFFECTIVELY USE A GROWING PEV POPULATION TO EXPAND THE ELECTRICITY GRID’S ABILITY TO COST-EFFECTIVELY HOST RENEWABLE ENERGY THROUGH BATTERY ENERGY STORAGE, WHILE POTENTIALLY REDUCING THE NET COSTS OF PEV OWNERSHIP.

CALIFORNIA ISO, CALIFORNIA VGI ROADMAP
Investment Plan Subtheme 3.2: Enable Electric Vehicle-Based Grid Services

- Initiative 3.2.1 Grid-Friendly PEV Mobility
  - Expand PEV aggregation and fleet management functions, reduce costs of bi-directionality, incorporate automated trip planning into VGI applications, and optimize grid integration of autonomous PEVs.

- Initiative 3.2.2 Battery Second Use
  - Develop monitoring technologies or test methods to assess PEV battery health in order to prolong transportation lifetime and optimize configuration of second-life battery packs in stationary applications.
Thank You

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Goals for VGI Communications Protocols Group

• **Accelerate** adoption of Plug-In Electric Vehicles toward widespread electrification throughout California

• **Simplify** the charging experience with a seamless interface

• **Commit** to open charging protocols

• **Reciprocate** EVSPs and OEMs’ long-term commitments to advanced VGI technologies

• **Harness** and make certain the achievement of benefits to customers, the grid, and the environment
Goal: Recognize VGI to enhance and affect long-term utility resource and infrastructure planning

**VGI-related suggestions:**

- Load & cost research of all transportation segments
- From Time-of-Use & Smart Charging toward EV DERs
- Preparation for easy PEV charging across-territories

CALeVIP Electric Vehicle Infrastructure Project

- Formerly a.k.a. EV Charging Block Grant Project
- Launching in December in Fresno
- ARFVTP currently requires reversion to open protocols
- Targeted incentives for Level 2
  - Energy Star + Connected Functionality (for Demand Response)
Role in the 2018 VGI Roadmap Update Effort

2013
ZEV Action Plan
A roadmap toward 1.5 million zero-emission vehicles on California roadways by 2025

Governor’s Interagency Working Group on Zero-emission Vehicles
Governor Edmund G. Brown Jr.
February 2013

2016
ZEV Action Plan
An updated roadmap toward 1.5 million zero-emission vehicles on California roadways by 2025

Governor’s Interagency Working Group on Zero-Emission Vehicles
Governor Edmund G. Brown Jr.
October 2016
Role in the 2018 VGI Roadmap Update Effort

Per the Draft Integrated Energy Policy Report & VGI Communications Protocols WG

• Reconvene VGI Roadmap stakeholders including non-technical parties
  1. Key CEC investments in the *value* of VGI
     1. Los Angeles Air Force Base Vehicle-to-Grid Project
        - *CEC Publication Pending*
     2. SLAC National Laboratory Smart Charging Infrastructure Planning Tool
        - *Project on-going*
  2. Evaluation of *costs and benefits* and *policy* solutions
  3. Building integration + increased *enrollment in Demand Response* programs

• **Thinking Ahead:** What technology and program issues are ripe research or demonstrations in order to improve the state of the art?
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