

Track 14 Session 2: Federal Fleet Adoption of EV's



PEV-V2G

Plug in Electric Vehicle – Vehicle to Grid

Mr. Scott Kenner

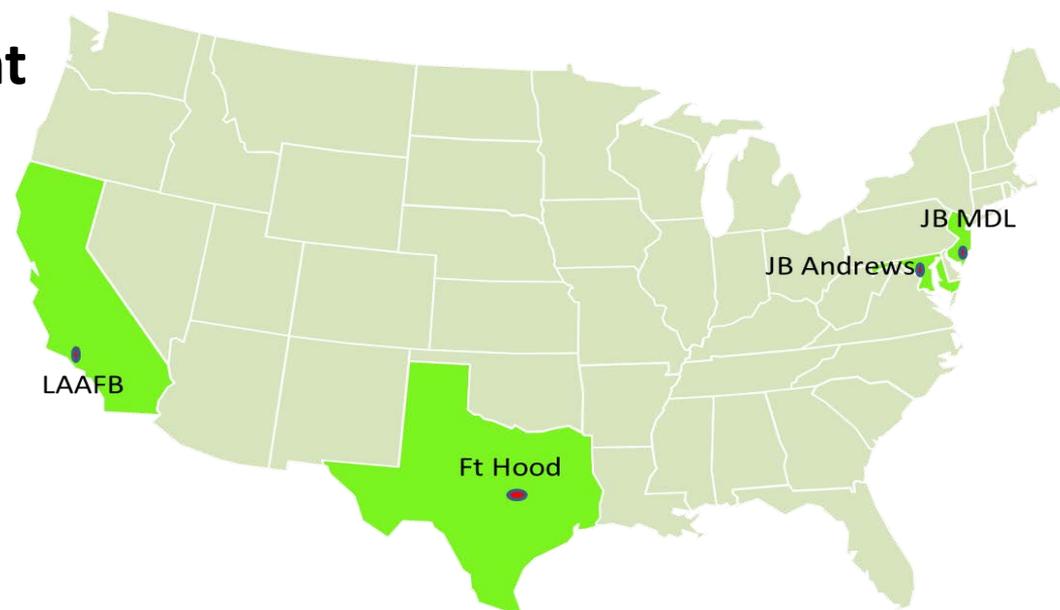
Concurrent Technologies Corporation (CTC)

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- **Demonstrate and validate V2G technology**
 - **PEVs**
 - **Bi-directional charging stations**
 - **Communication software system**
 - **Aggregator software controls**
 - **Electrical utility ancillary services markets**

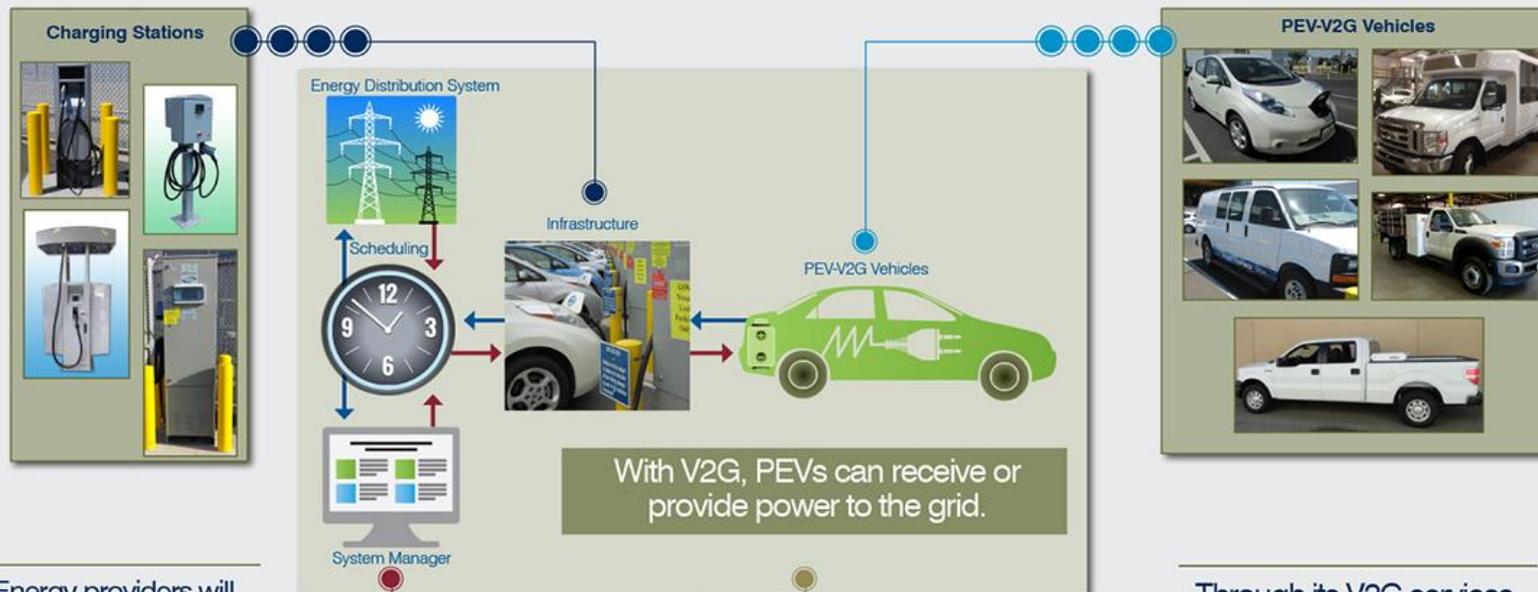
V2G Pilot Locations

- **Selection Benefits:**
 - Different Services (USAF, Army, and Joint Base installations)
 - Different electrical utility territories
 - Different installation sizes
 - Different climates
 - Different vehicle requirements



What is V2G

What is Plug-in Electric Vehicle – Vehicle to Grid (PEV-V2G)?



Energy providers will **PAY** for V2G services – vehicle batteries provide an energy source to stabilize the grid.



Software Capabilities

- Fleet Management System
- Charge Control
- Grid Scheduling
- EV Asset Coordination
- Grid Interface

Sites

- Los Angeles Air Force Base (LAAFB), California
- Fort Hood, Texas
- Joint Base (JB) Andrews, Maryland
- JB McGuire-Dix-Lakehurst (MDL), New Jersey

Through its V2G services, a military base **REDUCES** its energy costs and greenhouse gas emissions.



V2G Pilot Vehicles



What Plug-In Electric Vehicles (PEVs) and Plug-In Hybrid Electric Vehicles (PHEVs) are in the V2G fleet?



Nissan LEAF Sedan



VIA Motors VTRUX Van



Electric Vehicle International (EVI) Range Extended Electric Vehicle (REEV)



Phoenix Motorcars Electric Shuttle

Range Description



PEV
electric range: 75 miles
fuel efficiency: 99 MPGe

PHEV*
electric range: 31 miles
fuel efficiency: 38 MPG**

PHEV*
electric range: 40 miles
fuel efficiency: 43 MPG**

PEV
electric range: 100 miles
fuel efficiency: 32 MPGe

General Purpose Fleet Role



23.6 cubic feet cargo capacity

2650 lbs payload (cargo van only)

5300 lbs payload

116 cubic feet cargo capacity



5 seats

2 seat cargo
12 seat passenger

2 seats

visitor transport:
12 passengers + driver

Battery Capacity



24 kWh

21 kWh

54 kWh

102 kWh

at Locations



| | |
|------------|-----|
| LAAFB | 13 |
| Fort Hood | 8 |
| JB Andrews | 8 |
| JB MDL | --- |

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Miles per gallon (MPG), Miles per gallon equivalent (MPGe), Kilowatt-hours (kWh)
Los Angeles Air Force Base (LAAFB), Joint Base Andrews (JB Andrews), Joint Base McGuire-Dix-Lakehurst (JB MDL)

*Fuel used only when electric range exceeded
**Averaged over 60 miles

V2G Charging Station Types

Princeton Power System (PPS)



*DC charging station
(Nissan LEAF using CHAdeMO)*

Coritech Services



*AC charging station
(V2G using SAE)*



*DC charging station
(V2G using SAE Combo)*

V2G Control

How is the V2G infrastructure controlled?

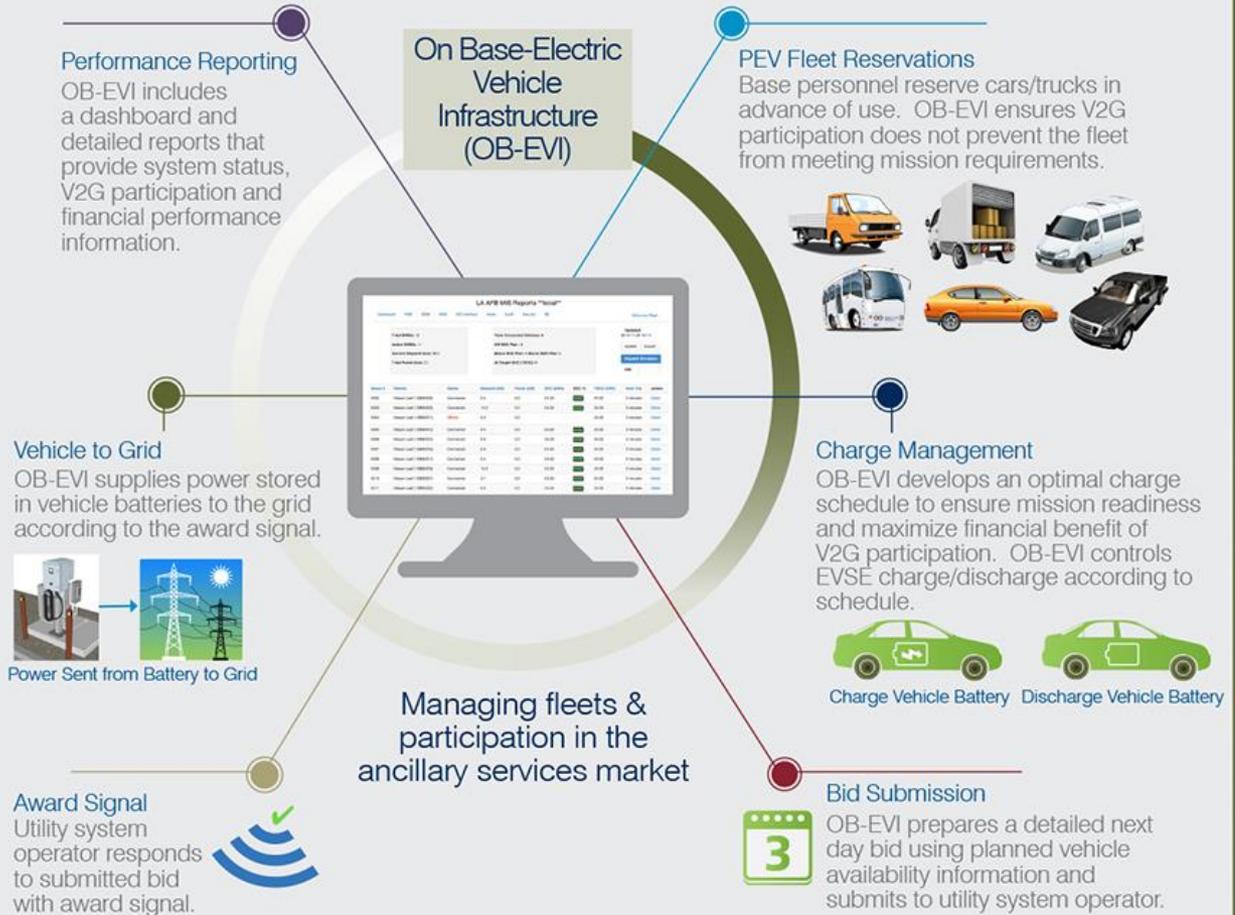
Introduction

A V2G system is comprised of plug-in electric vehicles (PEVs), bi-directional charging stations, and software controls that enable an installation to compete in utility ancillary services markets. Customized for each base, the OB-EVI provides the communication and software controls needed for all aspects of V2G.

Goal

Meet utility system operator's charge and discharge requirements

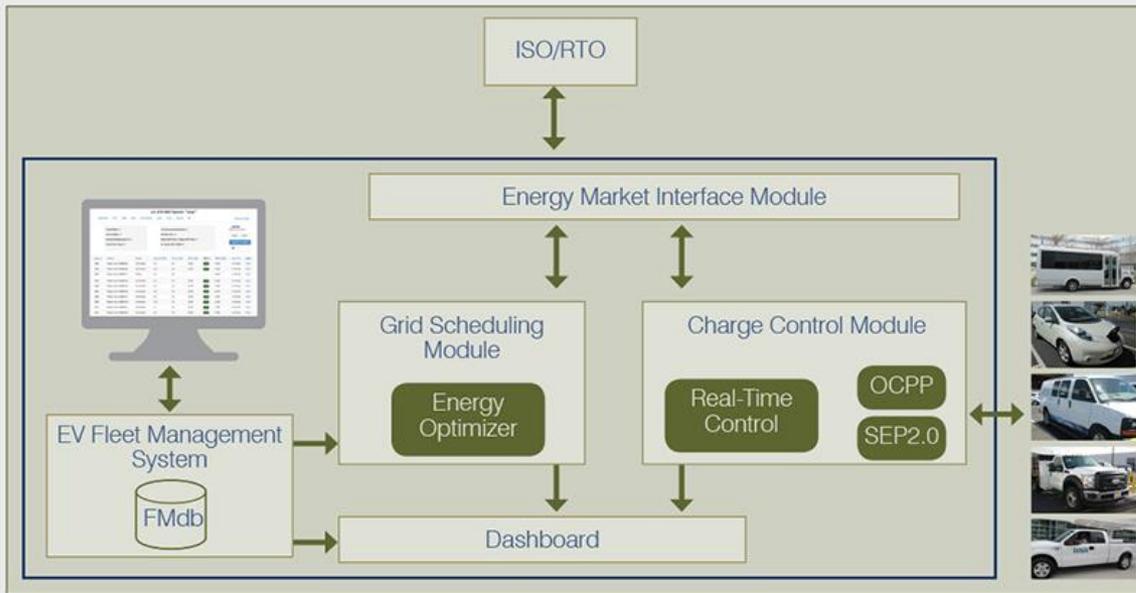
- Fulfill base fleet mission requirements
- Maximize ancillary services revenues
- Minimize non-conformance penalties



V2G On Base Electric Vehicle Infrastructure OB-EVI

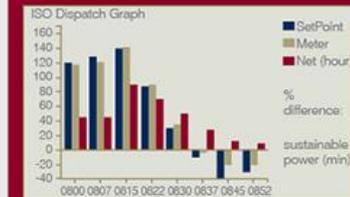


On Base-Electric Vehicle Infrastructure (OB-EVI) The software that enables V2G integration



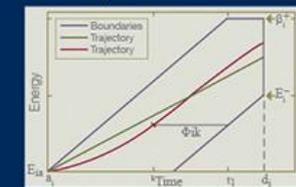
Energy Market Interface Module

- Supporting CAISO, PJM, ERCOT
- Bid-Award in Ancillary Services Energy Market
- Demand Response Market to Frequency Regulation Market Support



Charge Control Module

- Calculate optimal charging and discharging trajectories for both operational requirements and market participation
- Manage the aggregated state of charge across the entire fleet (Virtual Battery)
- Controls the EV Charging Station (EVSE) through industry standard protocols



EV Fleet Management System

- Support for base vehicle fleet
- Vehicle management to accomplish operational mission
- Assigns available vehicles to energy market participation

Grid Scheduling Module

- Day ahead and real-time bidding into energy markets
- Continuous monitoring and re-optimization based on actual vehicle status
- Complies with FERC-ISO rules in each energy market

Dashboard

- Tracks revenue generation in the energy markets
- Management tool for system monitoring and control
- Detailed views of vehicle usage, energy trading history, forthcoming schedules, audits, alerts, and dispatches

V2G Partnerships

V2G integration is complex and technically challenging. Success is a reflection of collaborative communication by all parties to develop solutions and overcome obstacles.

Consortium PEV-V2G Achievements

- Accelerating the nation's adoption of electric vehicles
- Advancing the state of electric vehicles and charging stations
- Advancing the state of engineering and software applications
- Providing installations with a means to lower energy and fleet vehicle costs
- Providing utility operators with an alternative energy solution for electric distribution system stability
- Promoting energy surety across the nation

Who are the Public-Private Consortium members deploying V2G technology?



Department of Defense Organizations

- Air Force Civil Engineer Center (AFCEC)
- Air Force Research Laboratory – Advanced Power Technologies Office (AFRL - APTO)
- Air Force Vehicle and Equipment Management Support Office (VEMSO)
- Army Engineer Research and Development Center-Construction Engineering Research Laboratory (ERDC-CERL)
- Army Tank Automotive Research, Development, and Engineering Center (TARDEC)
- Fort Carson (SPIDERS)
- Fort Hood
- General Services Administration (GSA)
- Joint Base Andrews
- Joint Base McGuire-Dix-Lakehurst (JB MDL)
- Los Angeles Air Force Base (LAAFB)
- Office of the Secretary of Defense (OSD)
- Secretary of the Air Force Installations, Environment, and Logistics (SAF I/E)
- Secretary of the Army Installations, Energy & Environment (ASA [IE&E])

State Government and National Laboratories

- California Energy Commission (CEC)
- Lawrence Berkeley National Laboratory (LBNL)
- Massachusetts Institute of Technology Lincoln Laboratory (MIT LL)

Private Industry

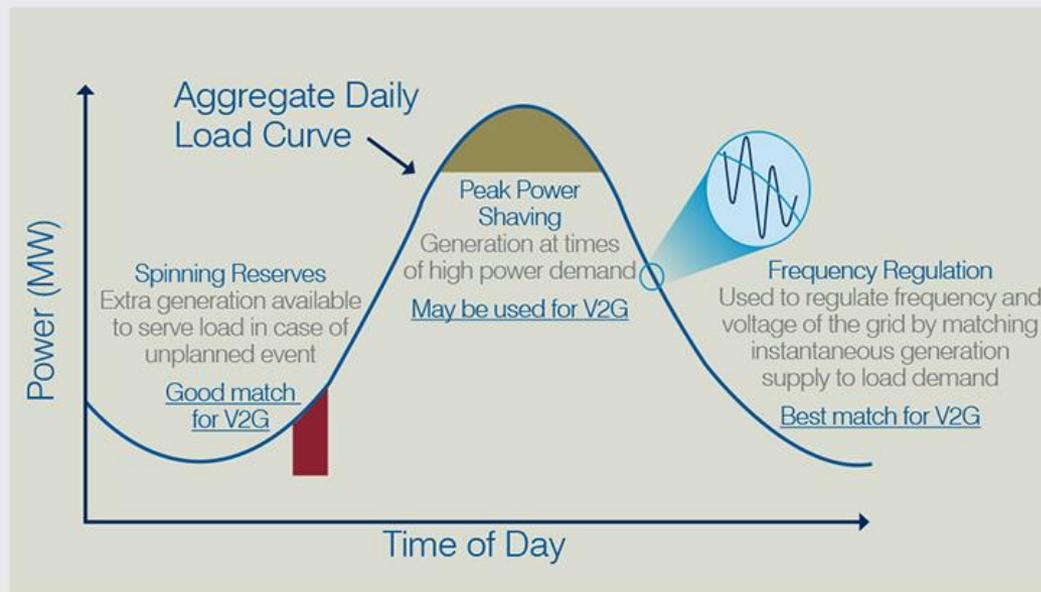
- ACDD
- Akuacom, Inc.
- Bel Fuse Inc.
- Clean Wave Technologies, Inc
- Concurrent Technologies Corporation (CTC)
- Coritech Services, Inc.
- Eaton Corporation
- Electric Vehicle Add-On Systems, Inc (EVAOS)
- Electric Vehicles International LLC (EVI)
- Electricore, Inc.
- Ford® Motor Company
- Kisensum, Inc.
- Nissan® Motor Corporation
- Phoenix Motorcars, LLC
- Princeton Power Systems, Inc. (PPS)
- VIA Motors Inc.

Energy Providers and Regulators

- California Independent System Operator (CAISO)
- California Public Utilities Commission (CPUC)
- Electric Reliability Council of Texas (ERCOT)
- Oncor Electric Delivery Company (Oncor)
- Pepco
- PJM Interconnection LLC (PJM)
- Southern California Edison (SCE)
- Viridity Energy Inc

V2G Implementation

What benefits will the DoD obtain from future large-scale V2G implementation?



Frequency regulation is a continuous adjustment of power generation or electrical demand to maintain the grid frequency at or near the nominal 60 hertz standard.



Cuts Installation Electricity Costs

- Earns energy revenue to offset installation utility expenses
- Increases penetration of energy storage systems
- Encourages use of lower cost, off-peak electricity

Increases Resiliency & Reliability

- Overcomes natural disasters and intentional threats with on-site power support
- Serves as backup power to mission critical facilities during outages

Aids Energy System Stabilization

- Reduces failure and degradation of system's electrical devices with bi-directional power flow
- Increases power distribution efficiency with on-demand reserve supplies
- Supports ancillary services market that provides grid operators with real-time adjustment capabilities
- Cuts electrical generation operational costs

Provides a Positive Environmental Impact

- Promotes use of renewable energy
- Supports the national goal of reducing fossil fuel and energy consumption
- Reduces dependence on foreign energy sources
- Reduces greenhouse gas emissions

- **Through the DOD V2G development impediments to grid interconnection process identified:**
 - Internal coordination between utility offices
 - Poorly conveyed interconnection processes
 - Poorly conveyed interconnection requirements
 - Defaulting to negative conclusions
 - Lack of cohesion between utility ISO requirements

- **Proactive establishment of teams to address current and future barriers**
- **Regular meetings to identify and resolve challenges throughout the system development**

- **Support Renewable Energy Requirements**
- **Support Electric Vehicle Integration**
- **Offset Utility costs for charging**
 - Spinning Reserve
 - Peak Shaving
 - Frequency Regulation