Open Vehicle to Building/Microgrid Integration Enabling ZNE and Improved Distribution Grid Services

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Smart Power Integrated Node (SPIN) – ‘ZNE Microgrid in a Box’

Source: Microgrid Energy, GridScape

System Design – Single Site

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Open Vehicle-to-Building and Microgrid Integration: Enabling ZNE and Improved Distribution Grid Services

- **Objective**
  - Maximize V2G capability to prove its value to provide V2B and Vehicle to Microgrid (V2M) islanded / distribution system integrated energy services

- **Innovation**
  - Integrated intelligent smart inverter system with embedded DER data analytics and energy management algorithms - Smart Power Integrated Node (SPIN)

- **Approach**
  - Develop controls for aggregating and synchronizing V2G with multiple DERs within facilities’ EMS, and the distribution operating/transmission systems.
  - Leverage SPIN development and V2G functionality from DOE (EE-0007792)

- **Big Picture**
  - Innovative Systems Integrated solution for optimizing utilization of DER/V2G for grid services within building and microgrid environments
Purpose/Goals

**Purpose:**

• Create a set of balanced functional requirements with use cases and determine the control strategies/methodologies/algorithms that will enable V2G and V2B/V2Microgrid integration development.

**Goals:**

• Define use cases specific to Zero Net Energy Residential, Community Microgrid Resource and Distribution System Support through Advanced Smart Inverter functions:
  • Provide performance verification and analysis data from control system integration and functional testing within a real world microgrid host site.
  • Provide cost analysis and value assessment of each of the operating modes to determine the net value for each of the use case grid services.
  • Provide a technology information transfer plan that will direct V2G technology development toward a more product-intent focus
Objectives

 Develop optimized strategies to determine when PEVs provide energy services based on grid and building load conditions (inclusive of renewable energy-integrated scenarios).

 Determine cost benefits of V2G and V2B through DR and/or load shifting.

 Ensure V2G and V2B strategies maintain adequate PEV charge to meet PEV owner mobility needs.

 Determine how distributed PEVs can be aggregated (fleet or neighborhoods) by utilities or third parties into resources large enough to participate in utility or independent system operator markets for the purpose of bidirectional power flow.

 Identify V2G and V2B business model gaps and barriers.

 Determine impacts V2G and V2B strategies may have on PEV battery life.

 Provide necessary data for benefits analysis, economic analysis, methods to better predict charging behavior and associated impacts on the grid and customer facilities, and proposed adoption specifications to the utility and electric vehicle industry that would support future adoption.

 Perform a benefits analysis showing quantitative and qualitative benefits to California’s electric ratepayers.
Research Questions

- How capable is DC V2G in real-world environments
- Whether EVs are interoperable to be treated as a unified, aggregated resource
  - Whether they can be responsive to distribution grid conditions and capable of mitigating distribution congestion while providing V2G services
- How well the V2G technology implementation can optimize building energy efficiency – in coordination with other DERs such as Storage and PV
- How well V2G utilization can benefit facility ZNE and microgrid operational use cases
- What is the most optimal V2G control methodology to facilitate synchronization and aggregation as a DER to the DSO and ISO energy systems, and
- Define Measurement & Verification (M&V) requirements for microgrid-integrated DER system
Architectural Overview / Implementation

- EPRI – Lead Use Case Requirements, Grid Integration and Services Valuation extending StorageVET
- Kitu Systems is to define and develop the DER Aggregator Cloud functionality
  - Work with Flex Power Controls and Gridscape in the partitioning between the DER Aggregator Cloud and the Micro-Grid/Building energy management functions and SPIN EMS functions
- Flex Power work with Kitu Systems and Gridscape for implementation of the IEEE 2030.5 DER server/client communications and functions per the IEEE2030.5 CPUC Rule 21 Implementation Guide
- Key Tasks:
  - Development of the ISO/DSO IEEE2030.5 communications to Aggregator Client/Server
  - Integration and testing of system functions in response to IEEE2030.5 signals/commands from Aggregator to the micro-grid and building energy management function
  - Integration and testing of system functions in response to IEEE2030.5 signals/commands from Aggregator/Micro Grid/BMS to the SPIN functionality.

Microgrid and building energy management interface software based on SPIN adaptive DER control algorithms with modified constraints applicable to the microgrid controller and building energy management system requirements.
Standards Implementation and Gaps: IEEE2030.5 as the Foundation

- DC DER Integration through IEEE2030.5 including Smart Inverter functions
- DC V2G Implementation through SAE J2847/3 and J2847/2 as well as IEEE2030.5 DER client with California Smart Inverter Profile
- SPIN to Microgrid, Aggregator and DSO IEEE2030.5 integration for providing local (islanded), aggregated and DSO grid services
- Rule21 compliant interconnection using IEEE1547 and UL1741 qualification

- Gaps: Microgrid controller and BMS integration protocols – typically proprietary protocols, and require standardization
  - The project will develop core requirements as well as applicable protocols to apply or extend