

PG&E Vehicle Grid Integration

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Vehicle Grid Integration – Integrated Grid Planning and Innovation



Together, Building
a Better California



PG&E and BMW Collaboration 2019 Charge Forward Pilot

Pilot Objectives

- Optimized EV charging:
 - Maximize **renewable energy integration**, while minimizing customer bill
 - Account for **residential & away-from-home** charging
 - Offer **DR grid services**
- Better understand **customer engagement** and the role of financial and non-financial **incentives**

Operations

- ~350 participants
- BMW proprietary aggregation software and telematics
- Participant web-portal and app to track and compare performance
- Various customer incentives and notifications, depending on use-case



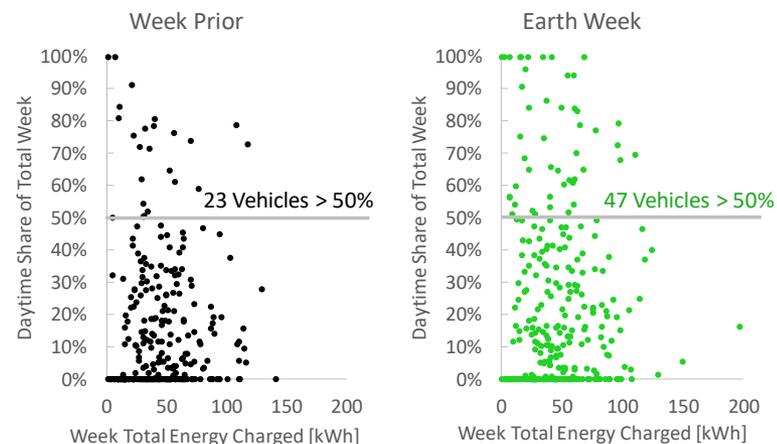
Participant map. BMW Charge Forward Phase II started 2017. Report published May 2020.



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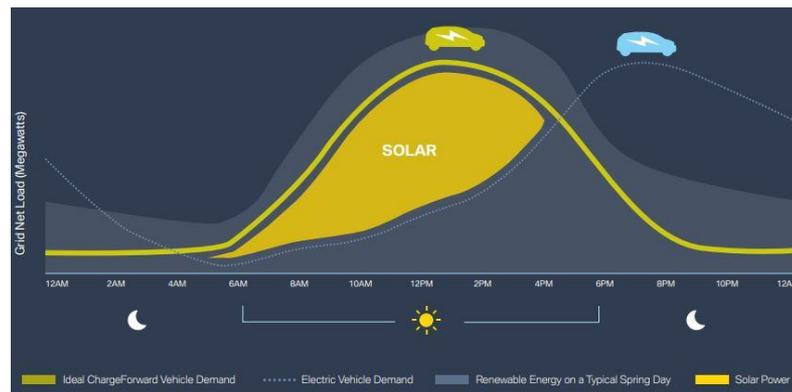
Key Findings

- Customers had a **positive response to financial and non-financial incentives** and modified **charging habits**
- **Renewable energy integration** and customer bill management possible through optimized charging window
- Optimization **shifts EV charging** to periods when renewable excess supply is high, especially **midday**



Lessons Learned

- Leaner customer enrollment process could help to increase participation
- Current commercial DR program requirements can still be a challenge for EVs:
 - Household baseline
 - Availability hours
 - 100 kW guaranteed of minimum capacity

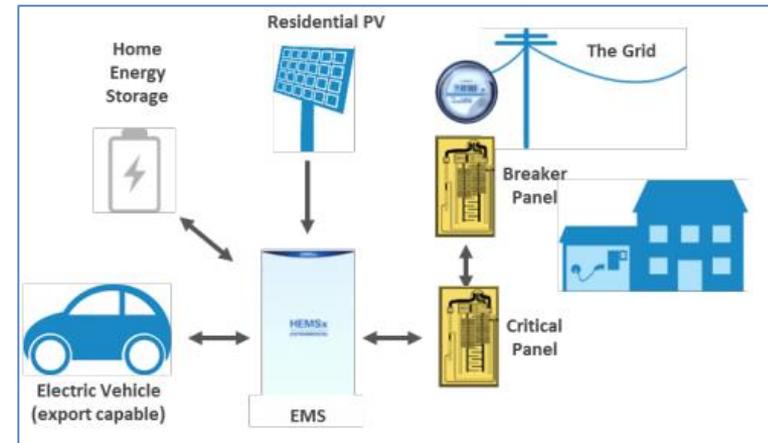




PG&E EPIC 2.03.b Vehicle to Home Demonstration (V2H)

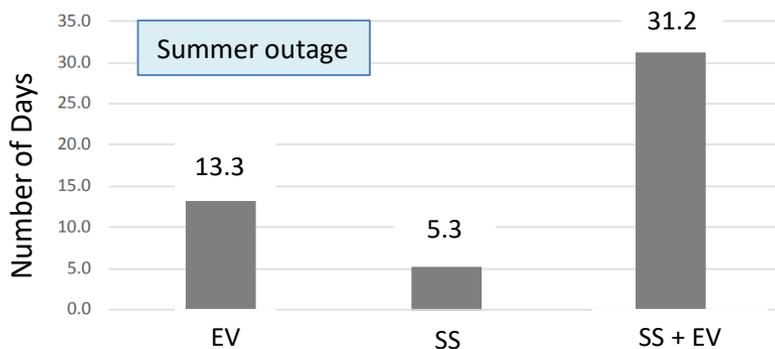
Pilot Objectives

- Goal was to complement EPIC 2.03 solar photovoltaics (PV) smart inverter assessment project by including electric vehicle related technology.
- EPIC 2.03.b – Vehicle to Home demonstration focuses on charging and discharging of the EVs in response to DR event (providing load drop by islanding the house) or hard islanding events in different configurations.



Lab installation: Modified EV with bi-directional capability, 60 kWh, 5 kW (Max DC export mode). Solar PV system rated at 5 kW. Residential stationary storage 5 kW, total capacity 8.6 kWh

Outage Scenario – Days of resiliency for each configuration combined with PV system



- Electric vehicle (EV) adds significant incremental value when combined with stationary storage (SS) in long-term outage scenarios.
- Evidence from test results suggests that an EV-only V2H system can provide hard islanding and DR functionality.



PG&E EPIC 2.03.b

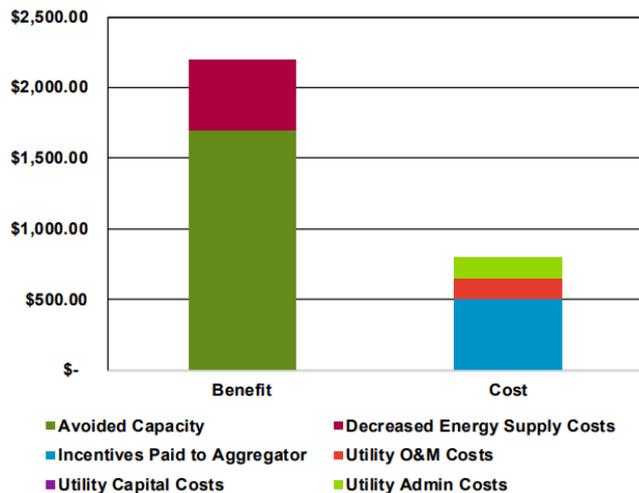
Vehicle to Home Demonstration (V2H)

Key Findings and Lessons Learned

- V2H and V2G are **technically feasible** but not commercially available (nascent technology).
- **High customer interest** in V2H (PG&E survey) but discouraged by high cost and implementation challenges (PCT).
- V2H **proved to be cost-effective** responding to a demand response event from a program administrator standpoint (PACT) when purchased and installed by a customer.
- **Several barriers** for V2H and V2G commercialization: customer's upfront cost, battery warranty, unclear V2G path

Cost – Effectiveness tests considering EV-only configuration

Program Administrator Cost Test (PACT)



Participant Cost Test (PCT)

