Convene, educate and empower stakeholders to decarbonize electricity grids
Our Speakers

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Working Group Overview

Definition

VGI is “any method of altering the time, charging level, or location at which grid-connected electric vehicles charge or discharge in a manner that optimizes plug-in electric vehicle interaction with the electrical grid and provides net benefits to ratepayers”

Scope

a) What VGI use cases can provide value now, and how can that value be captured?

b) What policies need to be changed or adopted to allow additional use cases to be deployed in the future?

c) How does the value of VGI use cases compare to other storage or DER?

All-volunteer effort facilitated by Gridworks

• 85 participating organizations
• 10 month collaboration, concluding June 30, 2020
Working Group Results

- Defined and evaluated over 1,000 potential VGI use cases
- Developed 92 policy recommendations for California policy-makers and load serving entities
- Stopped short of comparing VGI and DER value
Defining Use Cases

Comprehensive consideration of VGI Use Cases

Costs and benefit scores not comparable

Use cases that passed screening with positive benefits as able to “provide value now,” regardless of cost and implementation difficulty.
Many high-scoring use cases produce customer benefits and are not limited to residential sector.
Use Case Highlights

Examples of use cases providing high benefit:

• Residential single-family home customer bill management

• Commercial workplace bidirectional charging for customer bill management

• Residential backup power during grid outage event

• Aggregator control of bus fleet charging for providing system grid services
V2G in Focus

V1G is single-direction charging that allows managed charging and flexible demand (“demand response”).

V2G (vehicle-to-grid) is bidirectional charging and discharging, allowing vehicles to discharge stored energy back onto the grid or into a building or local power system.

FIGURE 8. Sectors of All V2G Use Cases

- Residential single-family home
- Residential multi-unit dwelling
- Rideshare
- Commercial workplace
- Commercial public commute
- Commercial public destination
- Commercial fleet transit bus
- Commercial fleet school bus
- Commercial fleet large truck

FIGURE 9. Applications of All V2G Use Cases

- Customer backup/resiliency
- Customer bill management
- Customer renewable energy self-consumption
- Customer upgrade deferral
- System backup/resiliency
- System grid upgrade deferral
- System resource adequacy
- System renewable integration
- System frequency regulation
- System voltage support
- System ggh reduction
Medium- and Heavy-Duty Vehicles: Class 2b through 8

Class One: 6,000 lbs. or less
- Full Size Pickup
- Mini Pickup
- Minivan
- SUV
- Utility Van

Class Two: 6,001 to 10,000 lbs.
- Crew Size Pickup
- Full Size Pickup
- Mini Bus
- Minivan
- Step Van
- Utility Van

Class Three: 10,001 to 14,000 lbs.
- City Delivery
- Mini Bus
- Walk In

Class Four: 14,001 to 16,000 lbs.
- City Delivery
- Conventional Van
- Landscape Utility
- Large Walk In

Class Five: 16,001 to 19,500 lbs.
- Bucket
- City Delivery
- Large Walk In

Class Six: 19,501 to 26,000 lbs.
- Beverage
- Rack
- School Bus
- Single Axle Van
- Stake Body

Class Seven: 26,001 to 33,000 lbs.
- City Transit Bus
- Furniture
- High Profile Semi
- Home Fuel
- Medium Semi Tractor
- Refuse
- Tow

Class Eight: 33,001 lbs. & over
- Cement Mixer
- Dump
- Fire Truck
- Fuel
- Heavy Semi Tractor
- Refrigerated Van
- Semi Sleeper
- Tour Bus

Source: https://afdc.energy.gov/data/10381
Medium- and Heavy-Duty in Focus

**TABLE 4. Top-25 Ranked MHDV Use Cases According to Honda Value-Metric**

<table>
<thead>
<tr>
<th>ID</th>
<th>SECTOR</th>
<th>APPLICATION</th>
<th>TYPE</th>
<th>RESOURCE*</th>
<th>VEHICLE TYPE**</th>
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<td>LR Transit Bus A</td>
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<td>Customer - Bill Management</td>
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(*) Resource is “aligned” for all entries. (**) For details on vehicle types, see Annex 3. LR = long range, SR = short range.
FIGURE 2. Distribution of Total State-Wide Benefit in 2022 as Scored Across All Use Cases ($/year)
## Policy Recommendations

**TABLE 6. Policy Categories**

<table>
<thead>
<tr>
<th>#</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reform retail rates</td>
</tr>
<tr>
<td>2</td>
<td>Develop and fund government and LSE customer programs, incentives, and DER procurements</td>
</tr>
<tr>
<td>3</td>
<td>Design wholesale market rules and access</td>
</tr>
<tr>
<td>4</td>
<td>Understand and transform VGI markets by funding and launching data programs, studies and task forces</td>
</tr>
<tr>
<td>5</td>
<td>Accelerate use of EVs for bi-directional non-grid-export power and PSPS resiliency and backup</td>
</tr>
<tr>
<td>6</td>
<td>Develop EV bi-directional grid-export power including interconnection rules</td>
</tr>
<tr>
<td>7</td>
<td>Fund and launch demonstrations and other activities to accelerate and validate commercialization</td>
</tr>
<tr>
<td>8</td>
<td>Develop, approve, and support adoption of technical standards not related to interconnection</td>
</tr>
<tr>
<td>9</td>
<td>Fund and launch market education &amp; coordination</td>
</tr>
<tr>
<td>10</td>
<td>Enhance coordination and consistency between agencies and state goals</td>
</tr>
<tr>
<td>11</td>
<td>Conduct other non-VGI-specific programs and activities to increase EV adoption</td>
</tr>
</tbody>
</table>
Policy Recommendation Highlights

- 38 short-term recommendations with strong/good agreement
- 15 medium/long-term recommendations
- Examples (short-term):

  • Create an “EV fleet” commercial rate with a more dynamic rate structure (Rec. #1.07)
  • Pilot funding for EVs as a form of backup power to customers not on microgrids (Rec. #5.02)
  • Expand NEM eligibility to include EVs and/or EVSE with bi-directional capabilities (Rec. #1.16)
  • Implement VGI demonstrations across VGI applications for a number of MHD vehicle segments (See, e.g., Rec. #s 7.04, 7.07, 7.09, 7.13, 7.14)"

(Note: Bullets above are paraphrased from full recommendation language in Final Report)
V2G Policy Recommendation Highlights

Short-term, strong agreement:
Installation and infrastructure buildout
2.17: Enable customers, via Rules 15/16 or any new EV tariff, to employ load management technologies to avoid distribution upgrades, and focus capacity assessments on the Point of Common Coupling
11.03: Streamline permitting for charging infrastructure

Medium-Long term:
Market access for behind the meter aggregations
3.04: Need clarity and conclusive decision on what pathway (PDR vs. NGR) will enable V2G resources to offer Day-Ahead Energy and RA System services, and clarity on PDR timeline and roadmap if PDR is the chosen pathway
Lessons Learned

- There are many VGI use cases that can provide value now; take an inclusive and collaborative approach
- Comparing VGI value to other DER
  - Requires more/better cost data, expertise in storage and other DERs, quantitative analysis and literature reviews
  - Need a framework and analysis criteria to make true “apples-to-apples” comparisons
- Lack of private-sector cost information — could only assess costs on a relative basis, precluding cost-benefit analysis or assessment of net value
- Need deeper understanding of the barriers to customer participation, if any.
Next Steps for Vehicle Grid Integration in California

Policy

- Continue inter-agency efforts to advance VGI understanding, piloting, and large-scale deployment, leveraging private and public funds
- Prioritize actions and resources to ensure robust and streamlined implementation of the 92 policy recommendations

Analysis

- Conduct comparisons of the relative value of VGI use cases with other DER options
- Assess customer interest, acceptance, and retention, and what is required to get customers to participate in VGI (incentives, marketing, dealership education)
- Identify and obtain publicly available data on VGI costs, as well as baseline data on driving and charging patterns relevant to different use cases.
- Conduct cost-effectiveness tests and cost-benefit analyses

Resources

- Final Report of the VGI Working Group
- Supporting Working Group Materials
- CPUC’s Docket