FINAL REPORT OF THE CALIFORNIA JOINT AGENCIES VEHICLE-GRID INTEGRATION WORKING GROUP

JUNE 30, 2020

California Public Utilites Commission
DRIVE OIR Rulemaking (R. 18-12-006)

October 8, 2020

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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

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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

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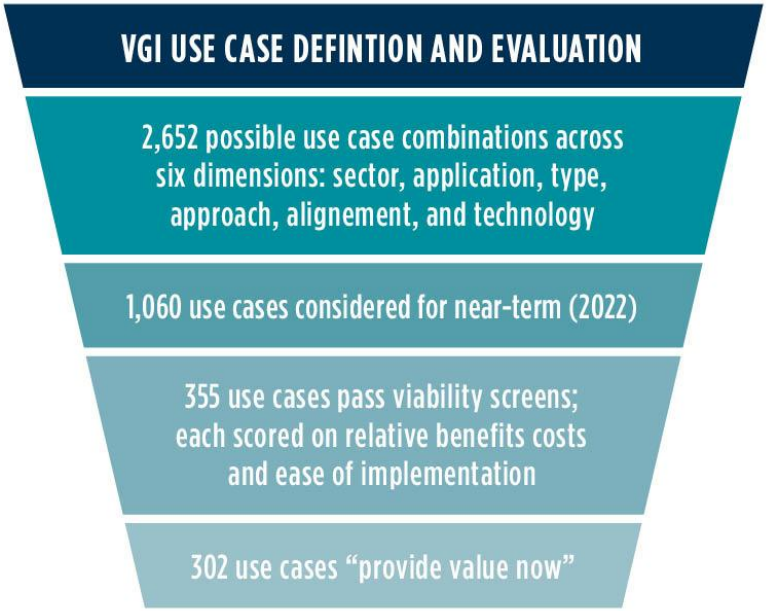
Defining Use Cases



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

Use Case Highlights

FIGURE 7. *Applications of LDV Use Cases Appearing in All Subsets*

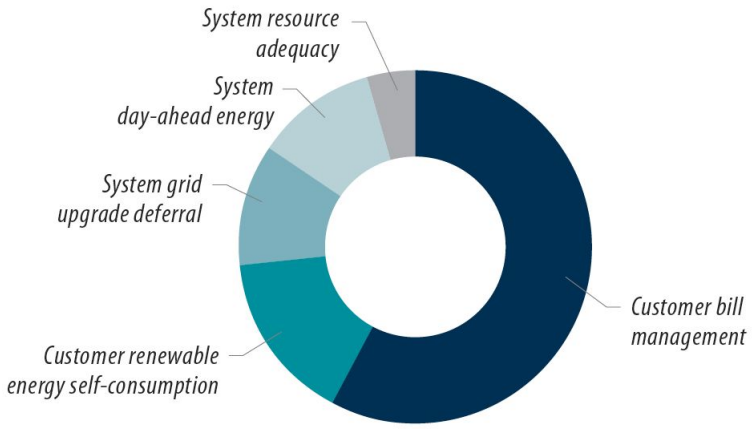
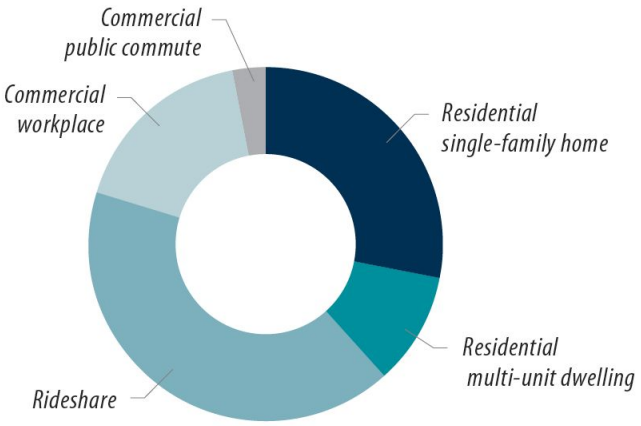


FIGURE 6. *Sectors of LDV Use Cases Appearing in All Subsets*



Many high-scoring use cases produce customer benefits and are not limited to residential sector

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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

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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*

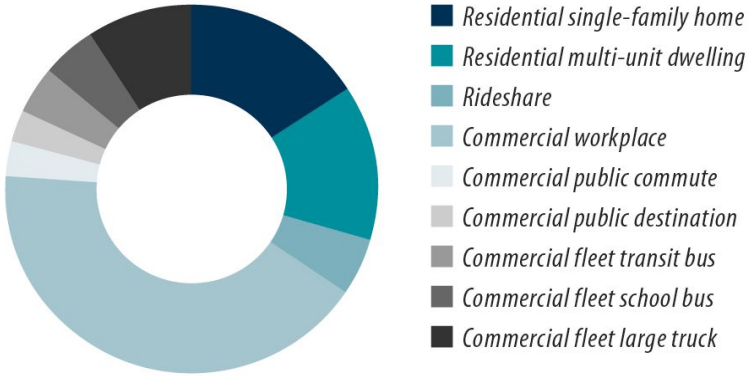
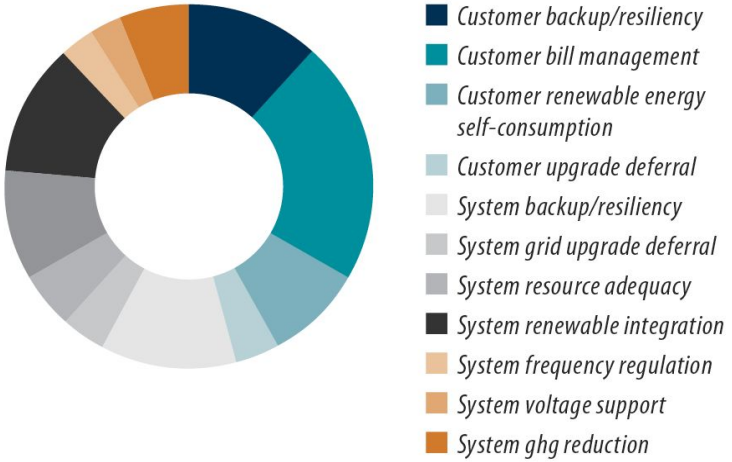
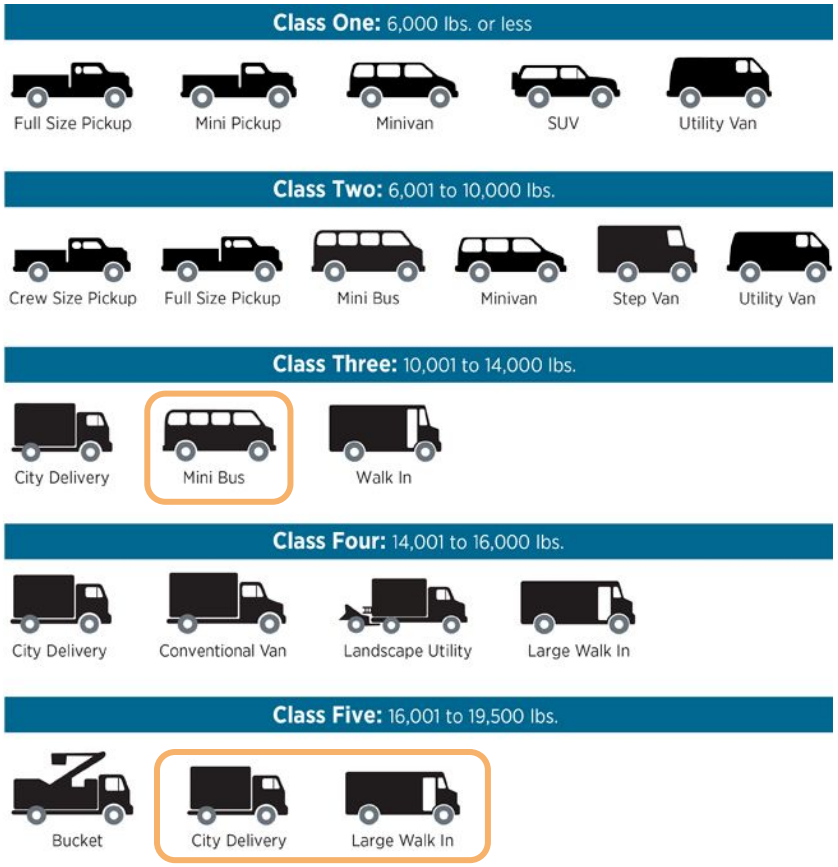


FIGURE 9. *Applications of All V2G Use Cases*



Medium- and Heavy-Duty Vehicles: Class 2b through 8



Source: https://afdc.energy.gov/data/10381

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Medium- and Heavy-Duty in Focus

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

ID	SECTOR	APPLICATION	TYPE	RESOURCE*	VEHICLE TYPE**
1837.2	Commercial-Fleet, Transit Bus	Customer - Bill Management	Indirect	Unified	LR Transit Bus A
1837.3	Commercial-Fleet, Transit Bus	Customer - Bill Management	Indirect	Unified	LR Transit Bus B
1838.2	Commercial-Fleet, Transit Bus	Customer - Bill Management	Indirect	Fragmented	LR Transit Bus A
1921.2	Commercial-Fleet, Transit Bus	System - Day-Ahead Energy	Indirect	Unified	LR Transit Bus A
1921.3	Commercial-Fleet, Transit Bus	System - Day-Ahead Energy	Indirect	Unifie	SR Transit Bus B
1969.2	Commercial-Fleet, Transit Bus	System - RA, System Capacity	Indirect	Unified	LR Transit Bus A
2041	Commercial-Fleet, School Bus	Customer - Bill Management	Indirect	Unified	
2042	Commercial-Fleet, School Bus	Customer - Bill Management	Indirect	Fragmented	
2245	Commercial-Fleet, Small Truck	Customer - Bill Management	Indirect	Unified	
2245.1	Commercial-Fleet, Small Truck	Customer - Bill Management	Indirect	Unified	Small Truck B
2246	Commercial-Fleet, Small Truck	Customer - Bill Management	Indirect	Fragmented	
2246.1	Commercial-Fleet, Small Truck	Customer - Bill Management	Indirect	Fragmented	Small Truck B
2248.1	Commercial-Fleet, Small Truck	Customer - Bill Management	Direct	Unified	Small Truck B
2281	Commercial-Fleet, Small Truck	Customer-RE Self-Consumption	Indirect	Unified	Small Truck B
2284	Commercial-Fleet, Small Truck	Customer-RE Self-Consumption	Direct	Unified	Small Truck B
2329.1	Commercial-Fleet, Small Truck	System - Day-Ahead Energy	Indirect	Unified	Small Truck B
2353	Commercial-Fleet, Small Truck	System - Renewable Integration	Indirect	Unified	Small Truck B
2354	Commercial-Fleet, Small Truck	System - Renewable Integration	Indirect	Fragmented	Small Truck B
2356	Commercial-Fleet, Small Truck	System - Renewable Integration	Direct	Unified	Small Truck B
2365	Commercial-Fleet, Small Truck	System - GHG Reduction	Indirect	Unified	Small Truck B
2368	Commercial-Fleet, Small Truck	System - GHG Reduction	Direct	Unified	Small Truck B
2449.1	Commercial-Fleet, Large Truck	Customer - Bill Management	Indirect	Unified	Large Truck A
2450.1	Commercial-Fleet, Large Truck	Customer - Bill Management	Indirect	Fragmented	Large Truck A
2452.1	Commercial-Fleet, Large Truck	Customer - Bill Management	Direct	Unified	Large Truck A
2458.1	Commercial-Fleet, Large Truck	Customer - Bill Management	Direct	Unified	Large Truck A

(*) Resource is "aligned" for all entries. (**) For details on vehicle types, see Annex 3. LR = long range, SR = short range.

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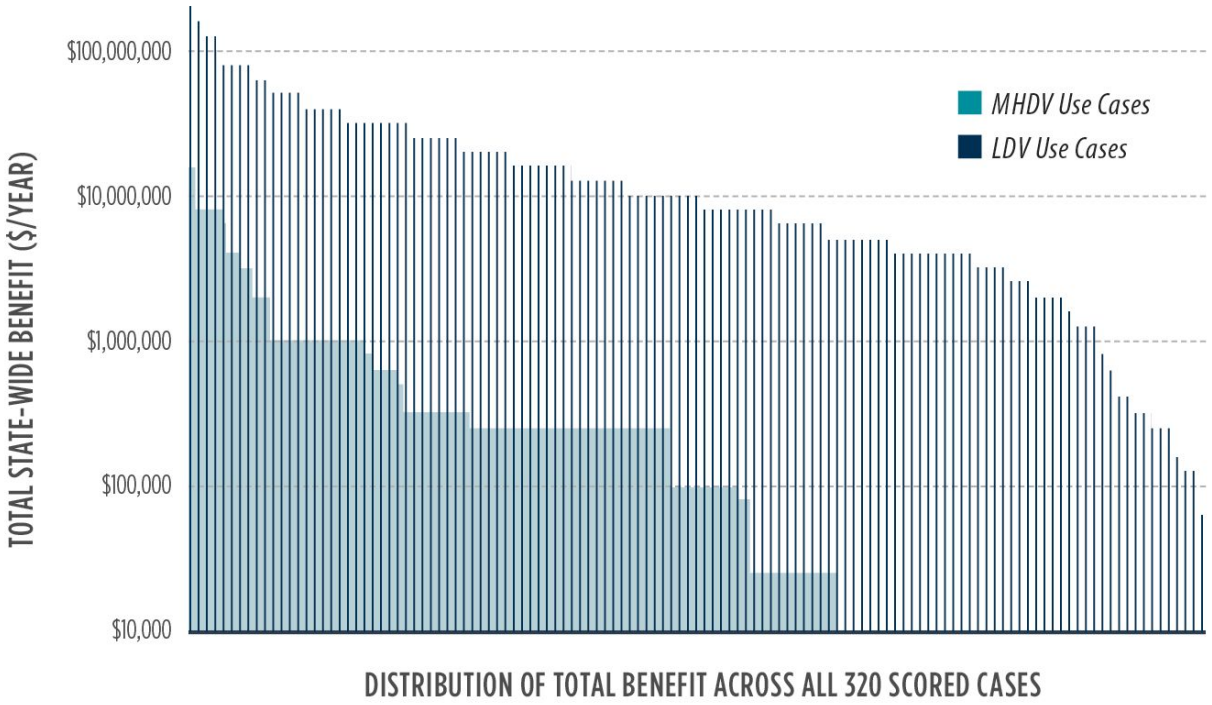
Medium- and Heavy-Duty in Focus

FIGURE 2. *Distribution of Total State-Wide Benefit in 2022 as Scored Across All Use Cases ($/year)*



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Policy Recommendations

TABLE 6. *Policy Categories*

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

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.

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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

Resources

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

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