



# Designing Infrastructure for Vehicle-Grid Integration



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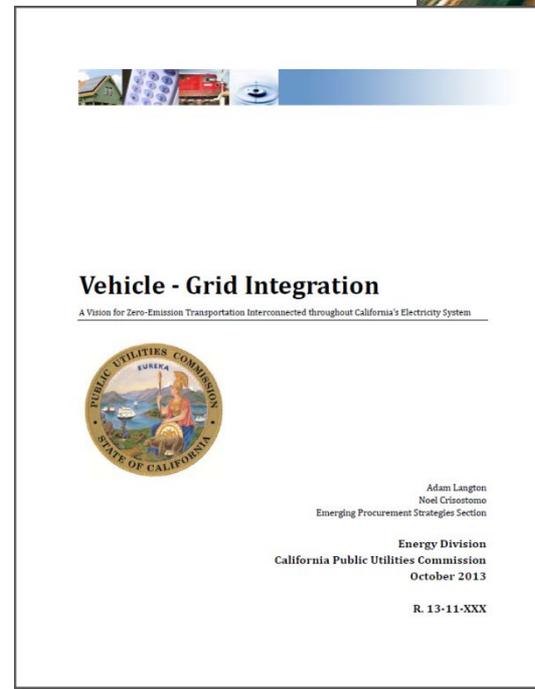
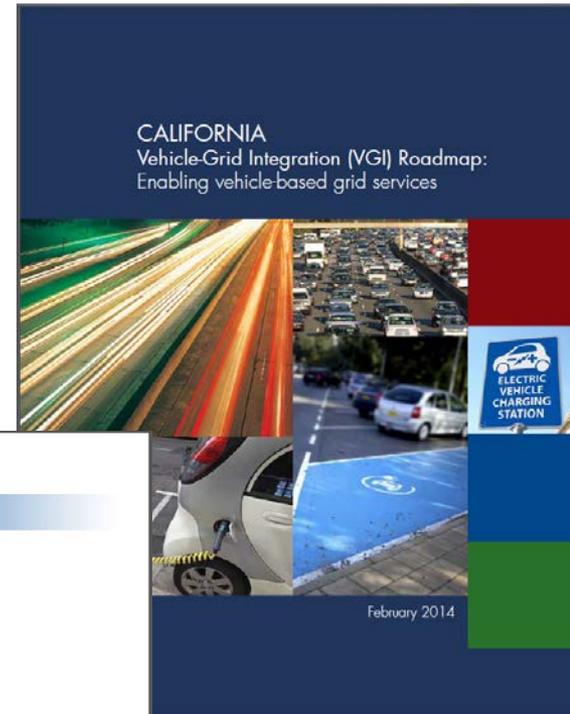
***Air Resources Board: PEV Infrastructure Information Gathering, July 15, 2014***

***This deliberative staff product does not constitute the opinion of the Commission.***



# What is Vehicle Grid Integration?

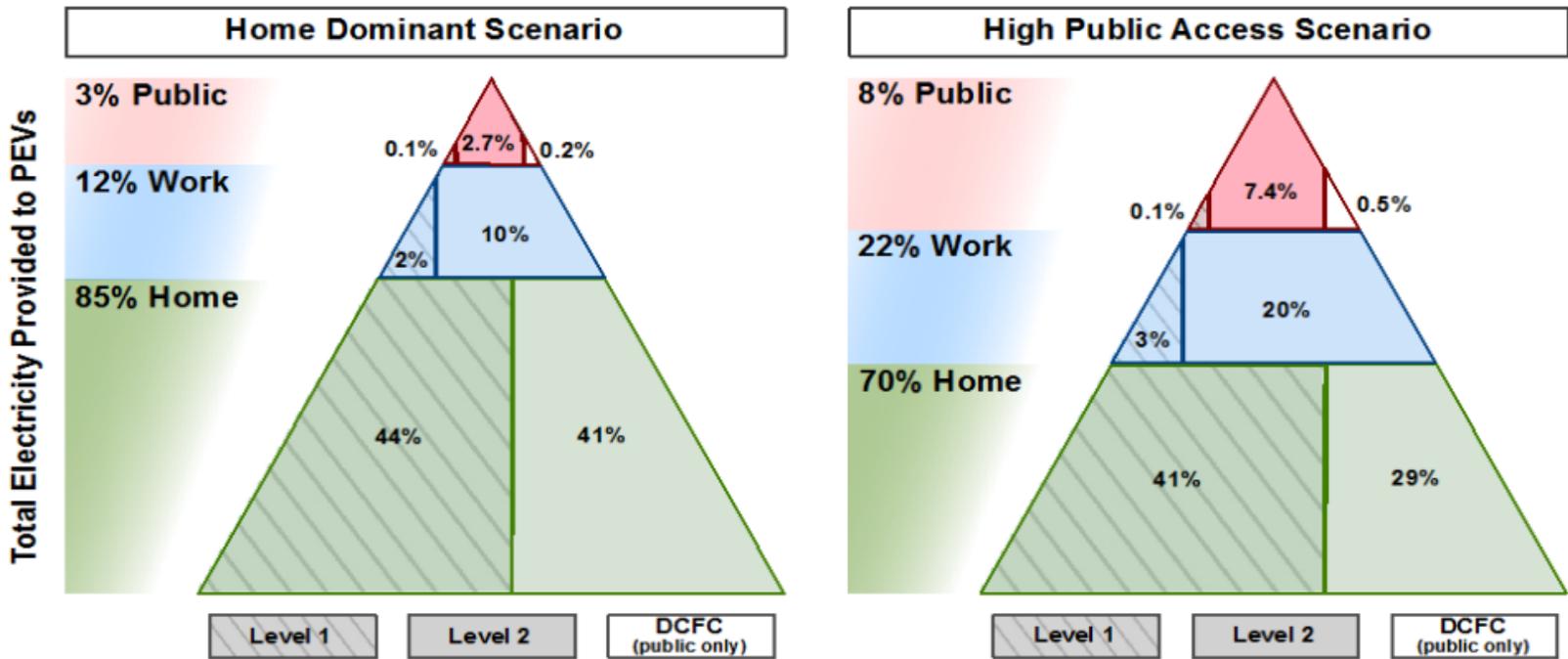
- Proactive preparation for influx of PEVs
- Harness PEV usage characteristics & technologies to minimize grid impact or utilize them as an asset and potentially:
  - Reduce owner & customer operational costs
  - Reduce infrastructure maintenance & upgrade costs
  - Moderate the effects of RPS and OTC on the electrical system & wholesale markets.





# Plugging-in is a prerequisite to VGI.

Figure 10 : Distribution by Scenario of EVSE Electricity by EVSE Type (a) and PEV Type (b)



However, it is possible that the public's *perceived need* for EVSE requires even more installations...

Source: NREL



# Multiple actors need to coordinate.

- Stakeholders at each EVSE type must resolve agency issues to construct and assign costs for infrastructure installations.
- The site specificity of EVSE installations will result in a spectrum, instead of a defined set of agency characteristics.

EVSE Type	Property Owner	Facility Manager	Tenant	Vehicle Users
Publicly-Available	Tejon Ranch Co.	Land Manager Co.	Tesla Motors	Any Visitors
Workplace	State of CA	Department of General Services	CPUC	Employees, Visitors
Single Family Residential	Self	Self	Self	Self



# EVSE Business Models

## Hardware (Fixed & O&M Cost)

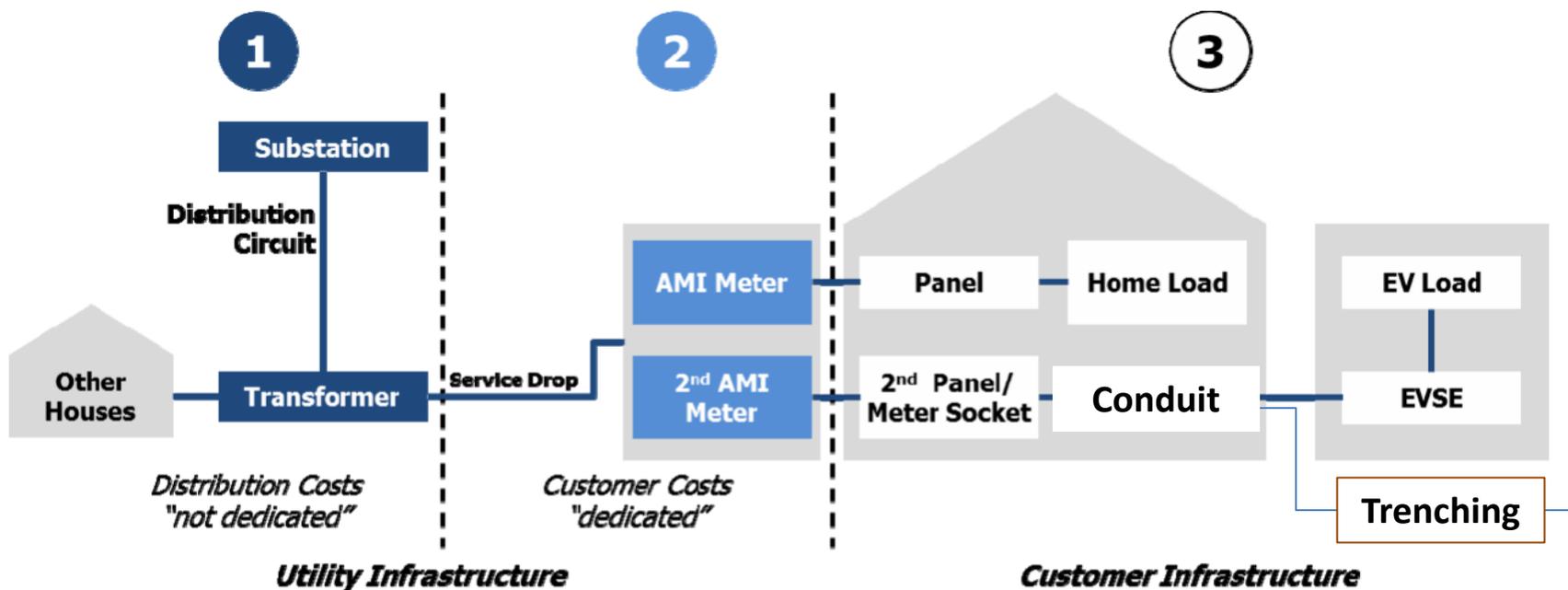
- Who finances and owns the installation?
- What are its capabilities?
- Who is responsible for maintenance?

## Access (Operations)

- Who establishes access to the EVSE?
- Is it designed to maximize utilization and if so, how?
- How is it managed?



# Hardware Elements



Rule 15/16 Exemption until 2016



# Access Elements



## Authentication

- Can a driver charge their PEV from the EVSE or network?



## Proximity

- Is the EVSE cord long enough for the connector to reach the inlet?  
Can installations be designed to with a “defrost” setting?



## User Scheduling

- Can driver A unplug B without fear of interrupting? Who needs to complete their charge first? Do either have time to re-park?



## Grid Conditions

- Will the charging session exacerbate grid loading or facility costs?  
Can charging be throttled as a compromise?



# Objectives of Actors in the PEV Value Chain

A potential\* principal-agent problem

**Figure 10:** Unified Actor Objectives



**Corporate PEV:** Understands travel departure and energy demands with scheduling system.

**Corporate Charging Station:** Wants to fluctuate during the afternoon to minimize costs

**Employer Facility:** Wants to curtail demand during the afternoon to mitigate demand charge

**Figure 11:** Fragmented Actor Objectives



**Employee PEV:** Wants a full battery to return home from work.

**Network Charging Station:** Wants to fluctuate during the afternoon to minimize costs.

**Employer Facility:** Wants to curtail demand during the afternoon to mitigate demand charge

\*CPUC has previously received feedback, and Auto OEMs have suggested that the Central Server will resolve this. See: <http://www.energy.ca.gov/research/epic/documents/index.html#06302014>



For each installation, the stakeholders must determine the level of involvement of entities along the charging value chain.

Key Actors: Residents, Employees, Visitors, Property Owner, Facility Manager, EV Service Provider, Utility & Shareholders, Ratepayers

### Hardware Questions

	Distribution Upgrade	Service Drop	Meter/ Panel	Conduit & Trenching	Stub Installation	EVSE
Who owns?	Utility Shareholders					
Who pays?	Ratepayer					
Who maintains?	Utility Shareholders					

### Access Questions

	Authentication	Proximity	Grid Condition	User Scheduling
Who establishes access?				
How is it designed?				
How is access managed?				

These implicate EVSE infrastructure capabilities, market competition, deployment rate<sup>9</sup>



# Questions

- What is the need for infrastructure? What steps should be taken to meet this need?
- What involvement, if any, should the utility have on hardware elements?
- What involvement, if any, should the utility have on access elements?



**Thank you!**

**CPUC Alternative Fuel Vehicles Page**

**<http://www.cpuc.ca.gov/PUC/energy/altvehicles/>**

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