

## DOCKETED

<b>Docket Number:</b>	16-TRAN-01
<b>Project Title:</b>	SB 350 Transportation Electrification (Publicly Owned Utilities)
<b>TN #:</b>	214649
<b>Document Title:</b>	Presentation - Vehicle-Grid Integration Communications Standards
<b>Description:</b>	Powerpoint Presentation
<b>Filer:</b>	Tami Haas
<b>Organization:</b>	California Energy Commission
<b>Submitter Role:</b>	Commission Staff
<b>Submission Date:</b>	12/7/2016 8:06:18 AM
<b>Docketed Date:</b>	12/7/2016



# Vehicle-Grid Integration Communications Standards

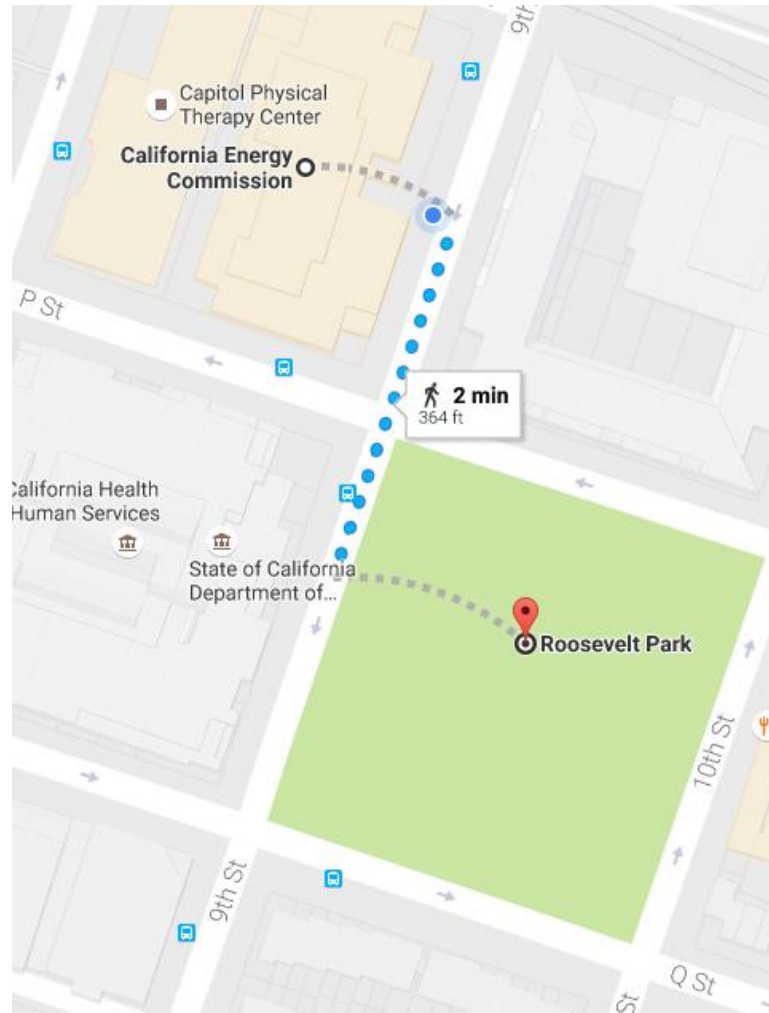
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**December 7, 2016**

Joint Agency Workshop –  
California Energy Commission  
California Public Utilities Commission

Imbrecht Hearing Room B, CEC, Sacramento

# Safety - Evacuation Instructions



# Agenda – Part 1: California's VGI Goals and Policy

Time	Topic
10:00-10:15	<b>Welcome, Logistics, Agenda, &amp; Purpose</b> <ul style="list-style-type: none"><li>• Energy Commission – Chair Weisenmiller</li><li>• Public Utilities Commission – Commissioner Peterman</li><li>• Office of the Governor</li><li>• Energy Commission – Office of Commissioner Scott</li></ul>
10:15-11:00	<b>California Vehicle-Grid Integration Working Group Activities</b> <ul style="list-style-type: none"><li>• Public Utilities Commission – Amy Mesrobian</li><li>• Energy Commission – Noel Crisostomo</li><li>• Air Resources Board – Stephanie Palmer</li><li>• Independent System Operator – Jill Powers</li><li>• Q&amp;A (10 min)</li></ul>



# Agenda – Part 2: Enabling Industry Efforts

Time	Topic
11:00-11:45	<b>Approaches to Implement Vehicle-Grid Integration</b> <ul style="list-style-type: none"><li>• Electric Power Research Institute, Fiat/Chrysler, BMW North America, Ford</li><li>• Q&amp;A (10 min)</li></ul>
11:45-12:45	<b>Lunch</b> <ul style="list-style-type: none"><li>• On your own</li></ul>
12:45-1:30	<b>ISO/IEC 15118 Vehicle to Grid Communication Interface</b> <ul style="list-style-type: none"><li>• KnGrid, Daimler/Mercedes-Benz, Volkswagen Automotive Group</li><li>• Q&amp;A (10 min)</li></ul>
1:30-2:00	<b>Public Comment – Additional Techniques for Grid Integration</b> <ul style="list-style-type: none"><li>• Individual duration determined by prepared remarks, queue and remaining time.</li></ul>



# Agenda – Part 3: A Pathway to 2020

Time	Topic
2:00-2:30	<b>Benefits and Costs of Implementing Standards</b> <ul style="list-style-type: none"><li>• Smart Inverter Working Group Chair – Frances Cleveland</li><li>• Q&amp;A (10 min)</li></ul>
2:30-3:00	<b>Maintaining Progress to Timely Meet Requirements of Senate Bill 350 &amp; Executive Order B-16-2012</b> <ul style="list-style-type: none"><li>• Facilitated Discussion between Agencies and Public</li></ul>
3:00-3:30	<b>Next Steps – Proceeding Timeframes, Comment Prompts, &amp; Implementation Proposal</b> <ul style="list-style-type: none"><li>• Energy Commission &amp; Public Utilities Commission</li></ul>
3:30-4:00	<b>Public Comment</b> <ul style="list-style-type: none"><li>• Individual duration limited to 3 minutes.</li></ul>



# Ground Rules

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- Question & Answers
  - Time for technical and clarifying questions are allocated during the presenters' sessions. Please wait until after they finish.
- Public Comments
  - During the 2 Public Comment periods raise a blue card so that the Public Advisor can deliver your comment to the Moderator and wait to be identified.
- Facilitated Discussion – Broader, open questions and brainstorm.
- Participants, please state your name and affiliation.
  - In Person: Please use the microphone so remote participants can hear.
  - Remote: Please remain on mute by pressing “\*6”. To speak, please raise your hand on Webex and wait for the moderator's recognition.

**Welcome, thank you for your contributions and feedback!**



# Welcome and Purpose

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- Chair Weisenmiller
  - California Energy Commission
- Commissioner Peterman
  - California Public Utilities Commission
- Office of Governor Brown
- Office of Commissioner Scott
  - California Energy Commission



# California Vehicle-Grid Integration Activities

## Joint Staff VGI Working Group

- Noel Crisostomo
  - Energy Commission
- Amy Mesrobian
  - Public Utilities Commission
- Stephanie Palmer
  - Air Resources Board
- Jill Powers
  - Independent System Operator



# Contents and Overview

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- Context and Policies to Decarbonize Transportation
- The Imperative for VGI: Dynamics in Market Growth
- Solving Grid Challenges Now and in the Future
- Values for VGI Data and Example State Efforts
- One Option to Consider on Communicating PEV Data
- Policy and Regulatory Needs:
  - Feedback for timely, continued progress on grid-integration.





# SB 350 Transportation Electrification

- **TE: Use of external sources of electrical power for:**
  - Vehicles, vessels, trains, boats, & other equipment that are mobile sources of air pollution and greenhouse gases
- **CPUC, in coordination with ARB and CEC, should direct IOUs to file applications to accelerate widespread TE**
  - Obj: reduce petroleum usage, meet air quality standards, improve public health, reduce GHGs
  - Reqt: Min costs, max benefits, don't unfairly compete with non-utility enterprises, performance accountability, ratepayer interests





# CPUC's SB 350 TE Implementation

- **2016: planning & guidance**
  - Mar: began regulatory process to address TE components of SB 350
  - Apr: public workshop to get stakeholder feedback
  - May: parties submit comments on workshop and straw proposal
  - Sep: Cmr. issued guidance to 6 electric IOUs (adopted in November)
  - Dec: workshops on IOU pilot results and VGI comm. standards
  - Throughout: confer with other state agencies, CEC and ARB
- **2017: application review**
  - Jan: 3 large IOUs file applications
  - Jul: 3 small IOUs file applications
- **2018 and beyond: program implementation**
  - IOUs implement approved programs





# CPUC's SB 350 TE Guidance

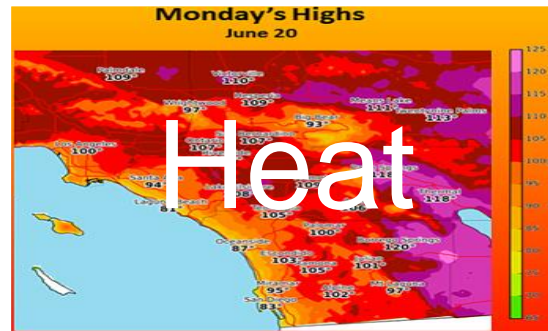
Sept 14, 2016 [ruling](#) directed electric IOUs to file applications with CPUC to propose a portfolio of TE investments

- **Basic requirements**
  - 3 large utilities file applications by 1/20/17
  - 3 small utilities file applications by 6/30/17
  - IOU must show how proposed TE portfolio meets SB 350 requirements (accelerate TE, minimize costs, maximize benefits, etc.)
- **Identified priority investment areas, need for alignment, etc.**
- **Identified issue of VGI Communications Standards**
  - Record is insufficient on whether CPUC should adopt one or more standards
  - IOUs' applications should address how they will comply with ISO/IEC 15118 or provide justification for alternative
  - Appendix B to ruling: Energy Division staff recommendation proposing ISO/IEC 15118 as a standard that could facilitate VGI



# California works globally to mitigate climate impacts

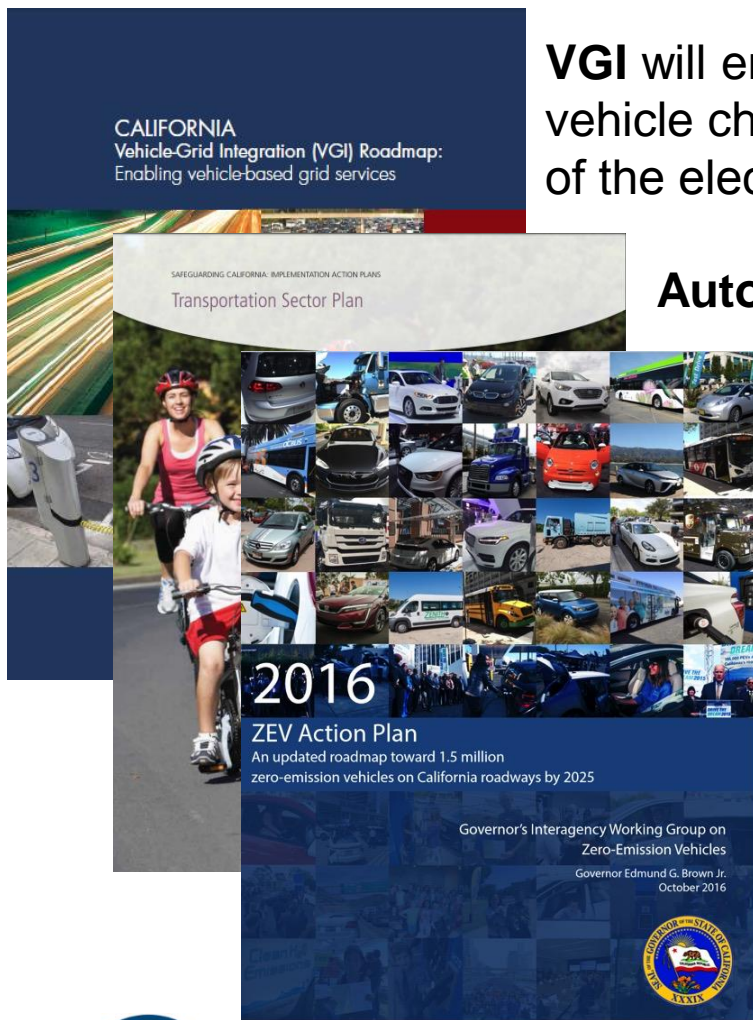
- To fulfill California's global commitment to limit temperature increases to 2°C, SB 32 requires State agencies to reduce GHG emissions to **40% below 1990 levels by 2030**.
- AB 197 highlights the need to **protect the State and its Disadvantaged Communities** – the first and most frequently adversely affected by extreme weather events:



[Senator Pavley](#)/[Governor Brown](#), [US Forest Service](#), [National Weather Service](#), [American Geophysical Union](#)

C A L I F O R N I A   E N E R G Y   C O M M I S S I O N

# ZEV Deployment + Data Modernization + Grid Integration



**VGI** will enable service providers and utilities to manage vehicle charging and discharging to help maintain the stability of the electricity grid while preserving drivers' mobility.

## Automate & Modernize Cross-Sectoral Information

The VGI interagency task force will:

- 1) Ensure technology research is coordinated with the development of standards, procurement policies and tariffs;
- 2) Help ensure vehicle interactions with the energy system are harmonized across utility territories and
- 3) Ratepayer investments return maximum benefits for the grid.



*Images hyperlinked to source documents*

# Alignments with CPUC DER Planning

## Wholesale Market Integration & Interconnection

### Visions

Electric vehicle charging systems, and mobility and driving behaviors, can be **predicted and overseen in the grid operations.**

Non-discriminatory market rules and regulations for mobile electric transportation resources **(addressing registration, interconnection, and physical connectivity)** are established to support customer mobility.

### Actions

By 2018 complete research critical to vehicle-grid integration and **incorporate results into transportation electrification policy.**

Develop policies that ensure that transportation electrification infrastructure and rates avoid unreasonable cross-subsidies.



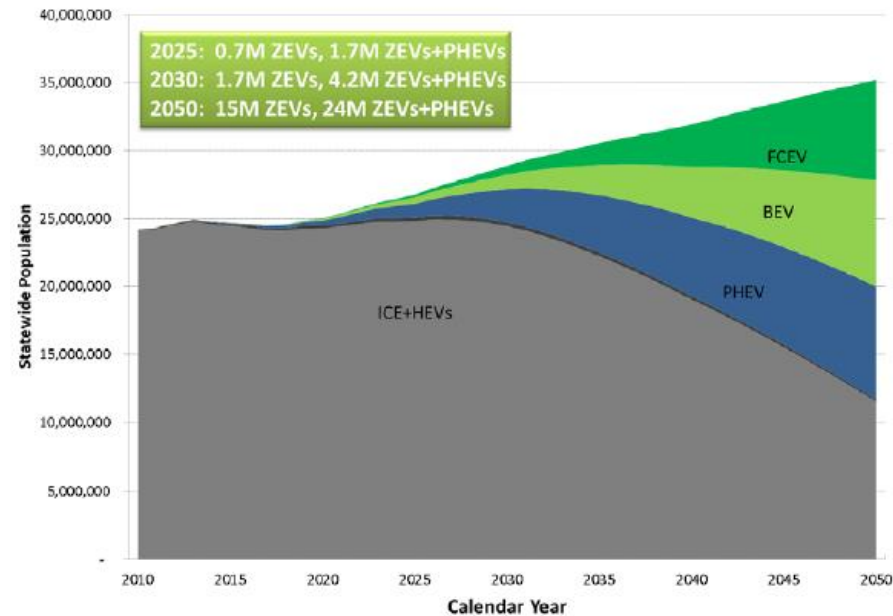
[California's DER Action Plan at 6-7, November 10, 2016](#)

C A L I F O R N I A   E N E R G Y   C O M M I S S I O N

# VGI is needed as policies are reinforced by market innovation

## SB 350 Decarbonization Goals + Advanced Vehicle Technologies = Large, Unexpected Demand

*Cleaner Technologies and Fuels Scenario\**

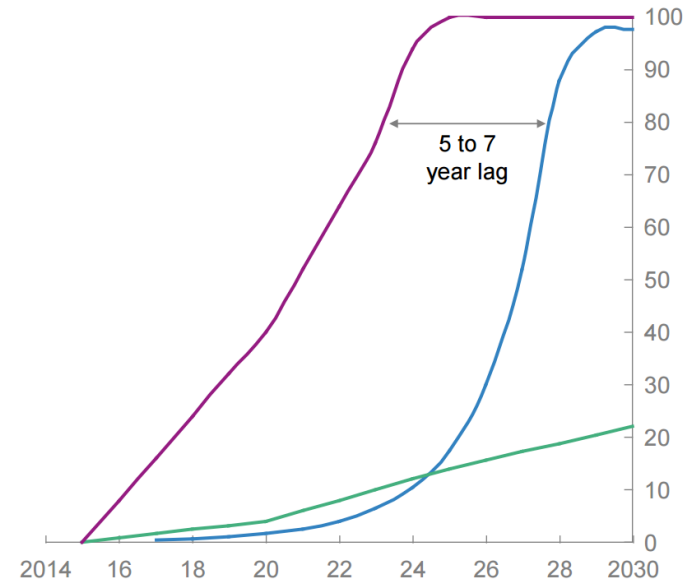


### Different possible adoption curves

- Base case curve**
  - Meets general fleet emission targets
- Regulatory-driven curve**
  - 100% of light vehicle sales to be electric by 2025 (e.g., Seamless Mobility)
  - Based on Norway's intentions
- Innovation and imitation curve**
  - Assuming early adopter and imitation effect
  - Speed of adoption and imitation based on historic sales, and the relative cost of ICE versus EV's

### Electric vehicle as share of car sales

Percent



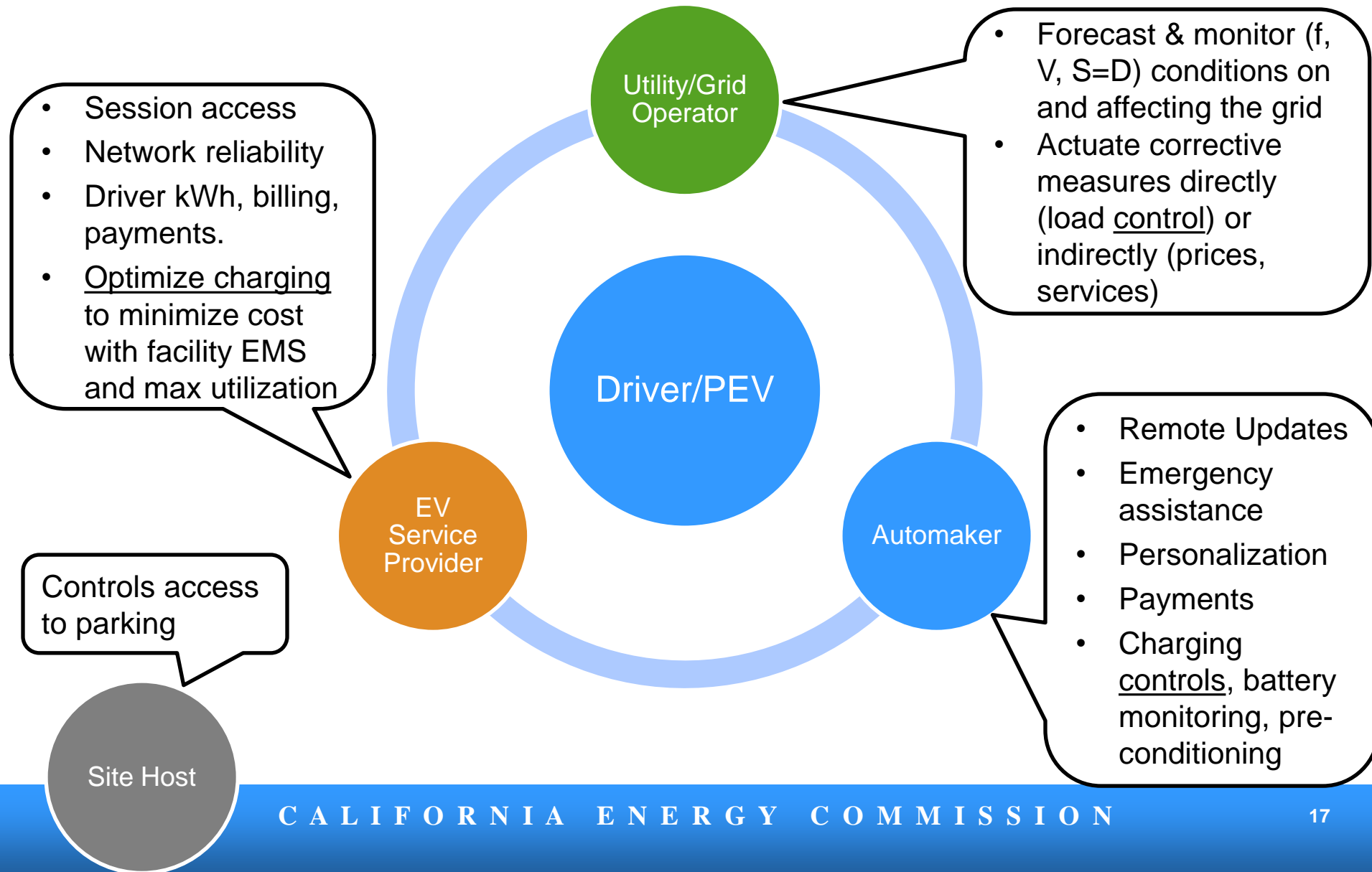
SOURCE: BNEF and McKinsey analysis

Fleets in dense metros may be 2/3 Electric, 40% Autonomous



[CARB 2016 Mobile Source Strategy](#), [Bloomberg/McKinsey](#)

# Competencies of Actors Communicating with PEVs



# A Fragmentation of Actor Objectives hinders VGI

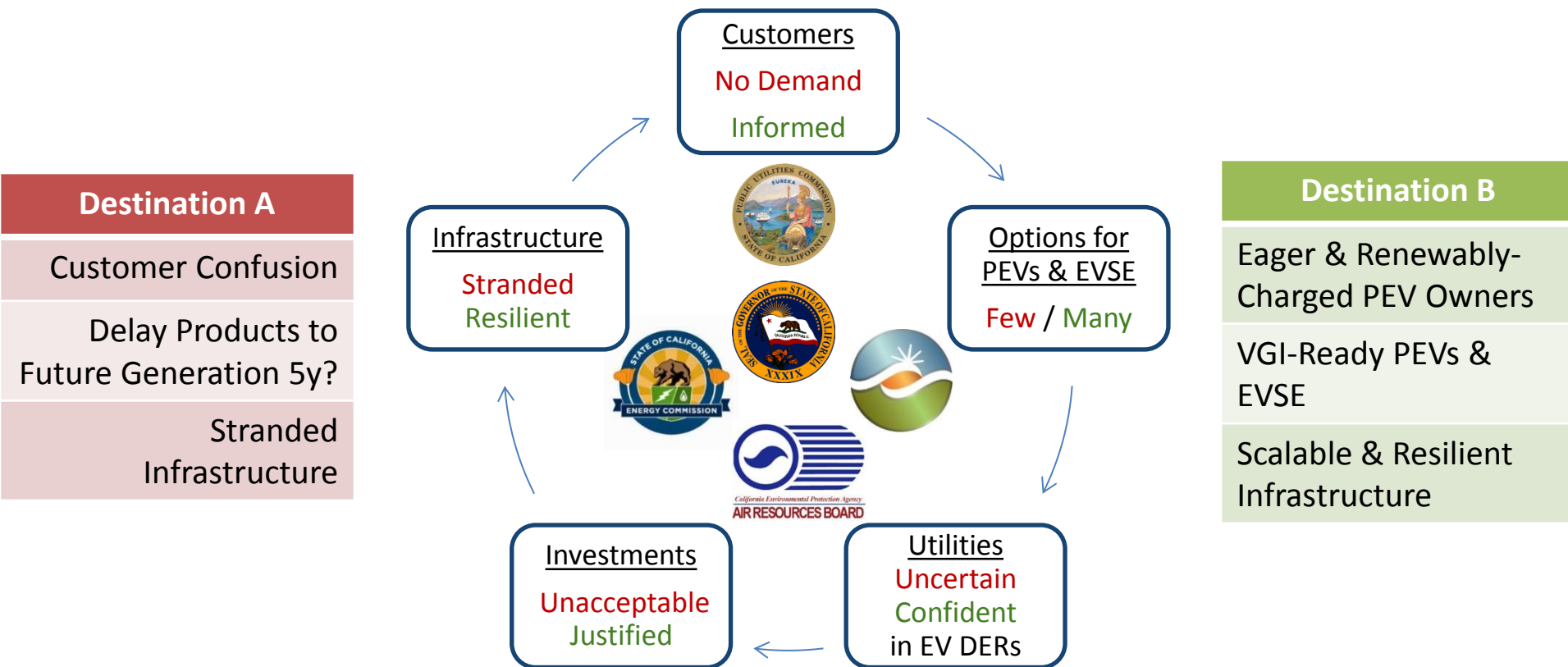
- A common ability to control charging causes actors to compete for “the resource” of vehicle electrification load, where the market is ill-suited.

Actor	Core Data Needed for VGI	Disincentives to Coordinate
Utility	Real-Time Grid Operations, Distribution Plans	Return on ratebase from upgrades, Operational siloes
Automaker	Driver Mobility Preferences, Battery Chemistry Management	PEVs seen as unprofitable, Marginal costs with unknown returns, Disinterest in aggregation complexity
EV Service Provider	Network Availability, Aggregate Load and Trip Demands	High install and operational costs with limited utilization at present, Potential for aggregator revenues

- Observed Technologies
- Failing to 1) harmonize the core data needed for VGI and 2) define the resource could result in sub-optimal or adverse outcomes where higher costs are incurred, customers are confused (or at worst, stranded) and discordant signals fail to deliver services.



# Two Pathways: Vicious or Virtuous Cycle



[CPUC Energy Division, Incubating our Charging "Egg" at PEV Collaborative July 22, 2015](#)

# Proposed 11 Exemplary Criteria for Standards

1. Driver Mobility, Simplicity, and Privacy
2. Battery-Secure
3. Scalability
4. Electric Reliability
5. Resiliency to Technology Change
6. Backward Compatibility
7. Transportation Network Compatibility
8. Globally-Informed Design
9. Immediacy
10. Leveraged National Capabilities
11. Protective of Ratepayers' Investments



[CPUC September 14, 2014 Ruling in R.13-11-007 Appendix B](#)

C A L I F O R N I A   E N E R G Y   C O M M I S S I O N

# Renewables require more flexibility, sooner than forecast!

Figure 2: Lowest March Daytime Net Load, 2011–2016

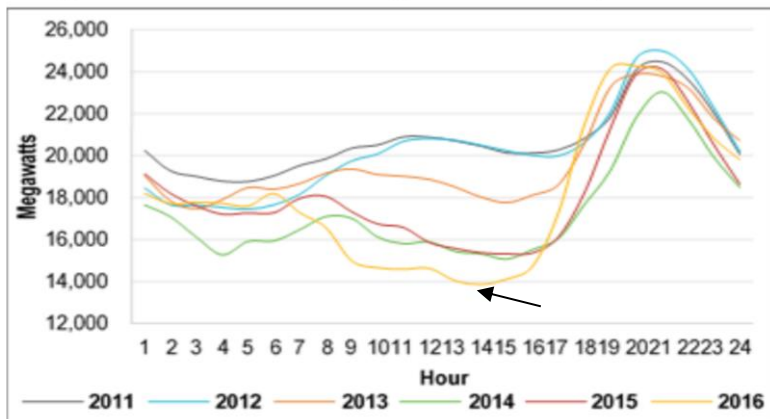


Figure 3: Daily Daytime Minimum Net Load, 2011–2015

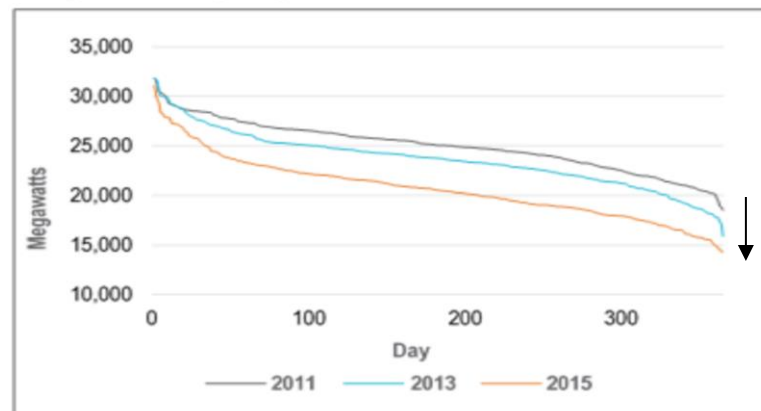


Figure 4: Daily Late-Day Three-Hour Ramp, 2011–2015

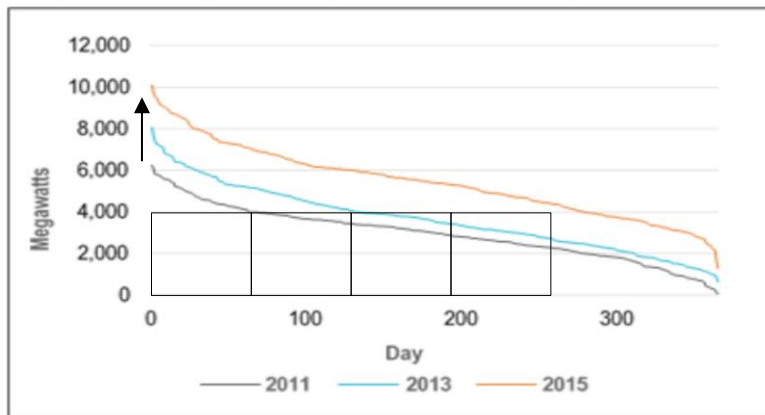
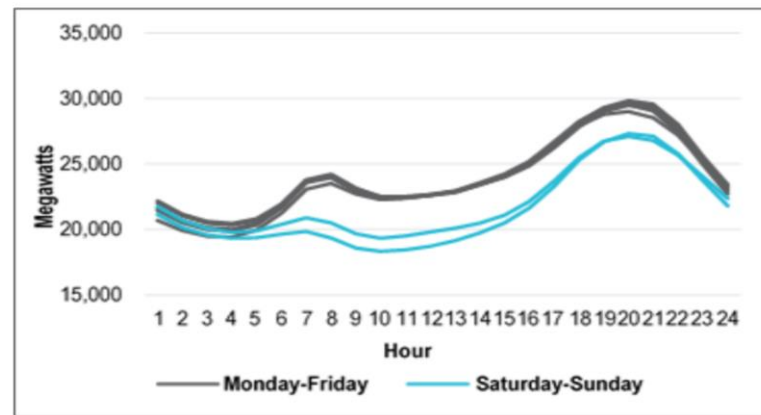


Figure 5: Average Net Load by Day of the Week, 2015



[Scott Madden, Revisiting the Duck Curve, October 2016](#)

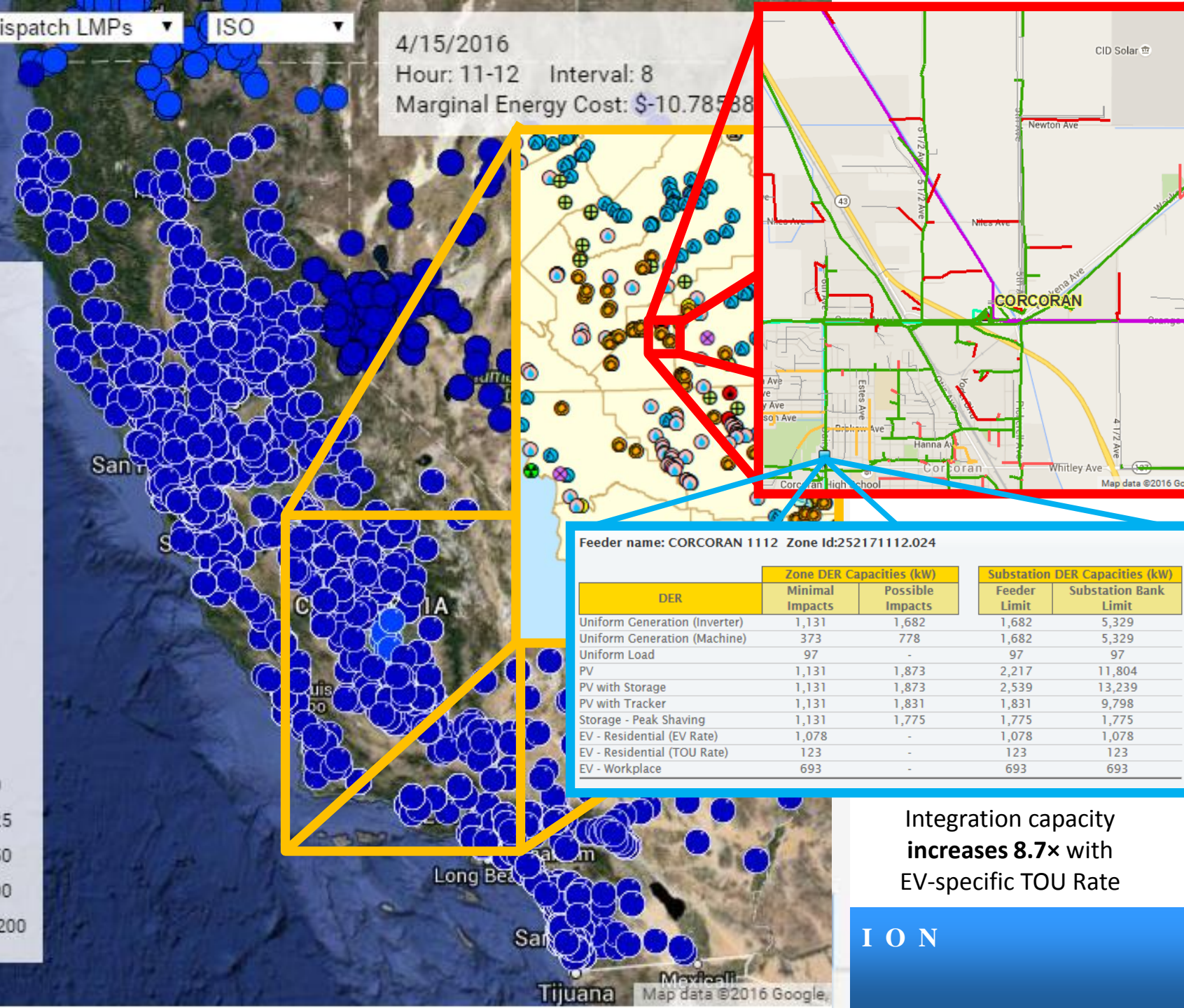
Real-Time Dispatch LMPs

ISO

4/15/2016  
Hour: 11-12 Interval: 8  
Marginal Energy Cost: \$-10.78588

- Legend
- Under -\$50
  - \$50 to \$0
  - under \$50
  - \$50 to \$55
  - \$55 to \$60
  - \$60 to \$65
  - \$65 to \$70
  - \$70 to \$75
  - \$75 to \$80
  - \$80 to \$85
  - \$85 to \$90
  - \$90 to \$95
  - \$95 to \$100
  - \$100 to \$125
  - \$125 to \$150
  - \$150 to \$200
  - at or over \$200

Google

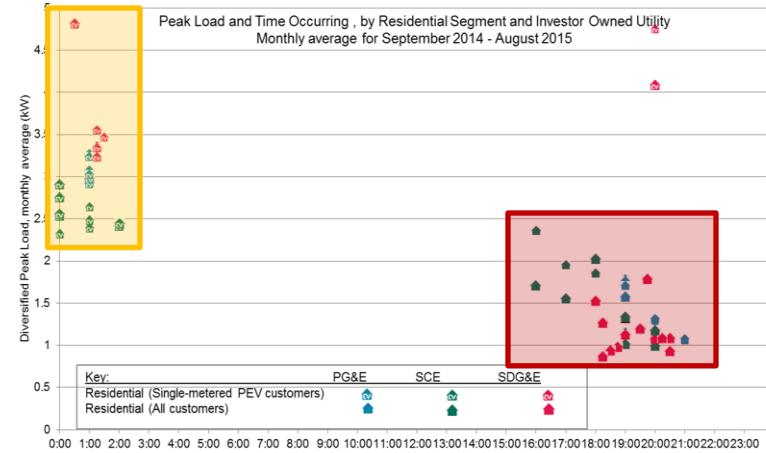
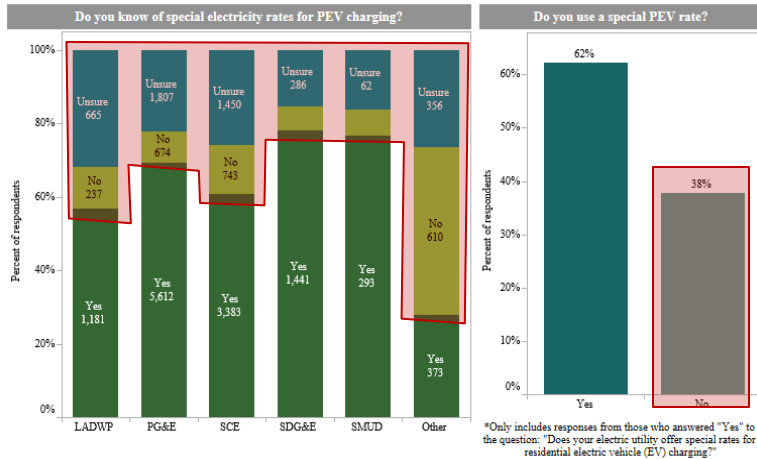


Integration capacity  
increases 8.7× with  
EV-specific TOU Rate

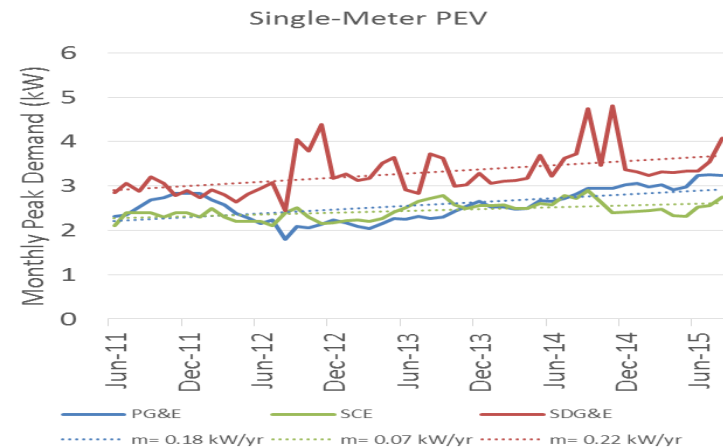
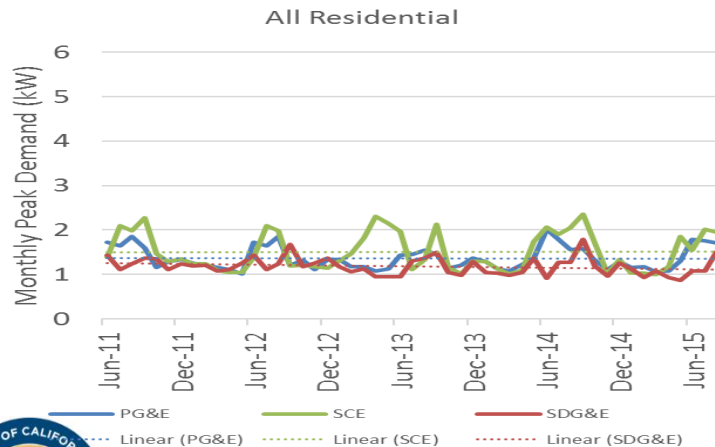
ION

# Needs for distribution-level dynamic management of PEVs.

150k PEVs charged **without TOU** (initiated upon arrival) likely add 450 MW to system peak



PEVs charged **coincidentally** in clusters may overload transformers by outpacing flat residential load growth.



Clean Vehicle Rebate Project, Meta-analysis of IOU PEV Load Research Reports

CALIFORNIA ENERGY COMMISSION

# Value of VGI Investments: Opportunity Amidst Risks

- Evolving markets and values potentially pose risks to participants.
  - VGI valuations (Navigant, UC Irvine, LBNL, etc.) assess current market.
  - Difficult to exactly quantify the value of marginal technology investments due to dynamics at different grid domains (T, D, BTM), due to multiple solutions proffered.
  - Furthermore, new markets for services have up to this point necessarily required detailed regulatory processes.
- However, what strengths and opportunities can we explore to avoid stagnation?
  - How can we leverage the thesis of VGI (dual-purpose decarbonization of mobility and power) to achieve net benefits to Californians and our environment?
  - Are technologies critical to achieving VGI subject to substantial cost changes?
  - Do automakers' strategies and investments in stationary storage face similar risk?
  - What are the general trends in value related to location and speed/delivery of wholesale or distribution grid services? What are technical equipment, validation, and other requirements that we can identify today?



# CA Highly Values Vehicle Electrification Data



## Select Agency ZEV Activities

Reliable operation of the grid by **scheduling PEV demand**

Locating electric vehicle **charging stations**

Open, **authenticated access** to public charging sessions

**Charge control** per Time-Of-Use or Dynamic rates

Provision and settlement of **grid ancillary services** as DERs

Accurate **receipt of commercial sale** of electric fuel

**Monitoring traffic** flows/congestion, road capacity, and tolling

Offering **Credit Generation** Opportunity for Low Carbon Fuel Std

**Analyzing utilization and maintenance** of deployed networks

Improving load and generation **forecasting and grid planning**

**Allocating construction** costs to drivers proportionate to use

Target future **strategic investments** in charging networks

Track **deployment, petroleum & emissions** reduction goals



# SB 454 – Electric Vehicle Charging Open Access Act requirements

- No membership requirement to use publically available EVSE
- All fees to use EVSE must be disclosed at point of sale
- Credit card/mobile technology for payment
- Location and payment info must be provided to NREL
- If national standards are not adopted by January 1, 2015, then State may adopt interoperable billing standards

# ARB timeline of work on SB 454

- Explore and evaluate requirements:
  - Equipment and Providers
  - User Interface
  - Locations and Signage
- Establish working relationships
- Form and convene workgroup
- Timeline for rulemaking not established

# The ISO is in support of standards that facilitate transportation electrification and the ability for electric vehicles to provide grid services

## Standards development which specifically enables:

- Economic market participation
  - Through EV fleet control capabilities that manage availability of capacity and response to ISO dispatch
- Provision of Ancillary services
  - Through resource monitoring and control (telemetry)
- Frequency response
  - Through automatic response or through ISO control signals



# Timeline of CAISO initiatives and FERC NOPR

Year	Initiative	Description
2013	Expanding Metering and Telemetry Options – Phase 1	Simplifying requirements for smaller resources
2015 - 2016	Expanding Metering and Telemetry Options – Phase 2	Created the Distributed Energy Resource Provider (DERP) to facilitate aggregation of smaller resources in the CAISO market
2015-2017	Energy Storage and Distributed Energy Resources (ESDER) Phase 1 & 2	Enhancements for CAISO connected and distribution connected resources to participate in the CAISO market

- 11/17 – FERC issued a notice of proposed rulemaking to require ISOs and RTO to define distributed energy resource aggregators as a type of market participant that can participate in the organized wholesale electric markets

# Opportunity to learn from Efforts in Europe and Asia

- Consistent with Governor Brown's calls to "scale" and "broaden collaboration," California can build its policies upon the learnings from other PEV markets about grid reliability and instilling customer confidence.
- As appropriate and conformable, California can scale based on other's "experiences and best ideas" on policy principles technologies.

Body	Year	Issues
European Commission	2009	Interoperability, Open and Competitive Markets
European Automotive Manufacturer's Association	2012	Preference for ISO 15118
European Commission	2014	Combined Charging Standard, Intelligent Metering
Chinese National Energy Administration	2015	Compatibility, Access, Safety, Grid Responsiveness



[Office of Governor Brown](#), [International ZEV Alliance](#),  
[2009/72/EC](#), [ACEA](#), [2014/94/EU](#) (Annex II – 1.2, Section 28), [E&E News](#) & [China Daily](#) or [CNEA](#)

# EU 7<sup>th</sup> Framework Programs on Grid Integration

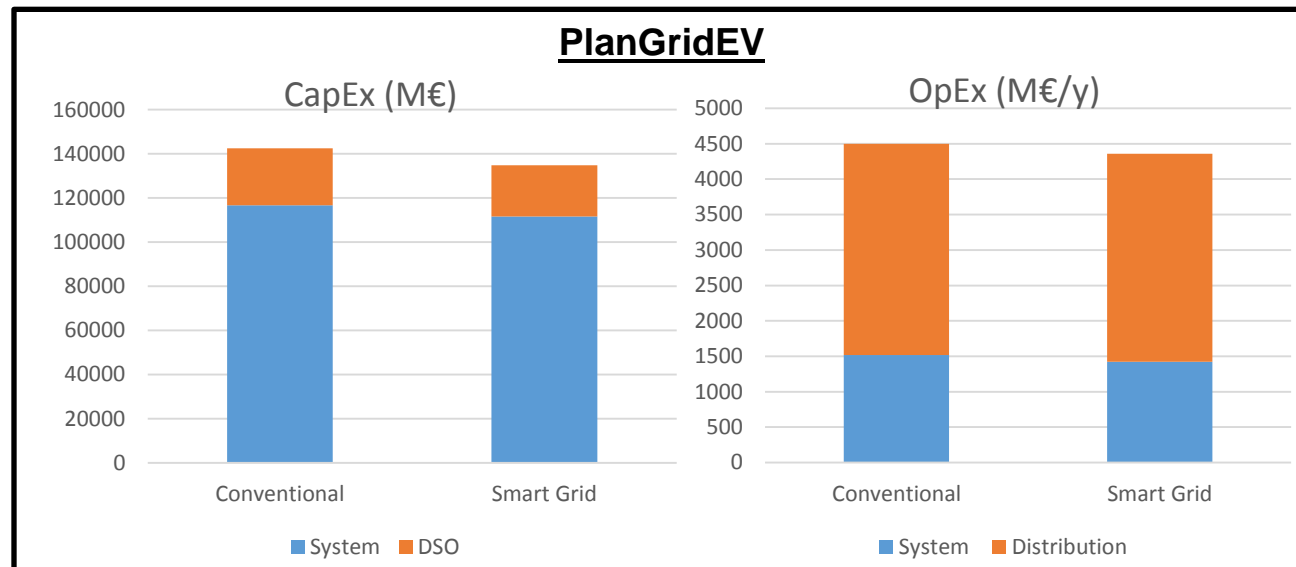
## 21+ Relevant and Recent Policy, Technology, & Economic Assessments

Projects	Status
<a href="#">COTEVOS</a>	Ongoing Feb 2016
<a href="#">e-Dash</a>	Completed Aug 2014
<a href="#">eCo-FEV</a>	Ongoing May 2015
<a href="#">ELVIRE</a>	Completed Mar 2013
<a href="#">EMERALD</a>	Ongoing Sep 2015
<a href="#">FABRIC</a>	Ongoing Dec 2017
<a href="#">FastInCharge</a>	Ongoing Sep 2015
<a href="#">G4V</a>	Completed Jan 2012
<a href="#">Green eMotion</a>	Ongoing Feb 2015
<a href="#">ICT4EVEU</a>	Completed Dec 2014
<a href="#">IoE</a>	Completed Apr 2014
<a href="#">MERGE</a>	Completed Jan 2012
<a href="#">Mobi.Europe</a>	Completed Dec 2014
<a href="#">MOBINCITY</a>	Ongoing Jun 2015
<a href="#">MOLECULES</a>	Completed Dec 2014
<a href="#">OpEneR</a>	Completed Apr 2014
<a href="#">P-MOB</a>	Completed Apr 2013
<a href="#">PowerUp</a>	Completed Jun 2013
<a href="#">smartCEM</a>	Completed Dec 2014
<a href="#">SMARTV2G</a>	Completed May 2014
<a href="#">UNPLUGGED</a>	Ongoing Mar 2015

### Grid4Vehicles

	Scenario worlds		
	Conservative	Pragmatic	Advanced
<b>Customer ID communications</b>	RFID	RFID	RFID NFC
<b>Electric Vehicle to Charging Pole communications</b>	CAN-bus, PWM	CAN-bus PLC	CAN-bus PLC
<b>Power exchange process communications</b>	-	GPRS, UMTS, PLC, Ethernet,	GPRS, UMTS, PLC, Ethernet, WiMax
<b>Billing process communications</b>	GPRS, UMTS, Ethernet	GPRS, UMTS, PLC, Ethernet,	GPRS, UMTS, PLC, Ethernet, WiMax

### PlanGridEV



[European Green Vehicles Initiative](#), [Grid4Vehicles](#), [PlanGridEV](#)

# An Option\*: ISO/IEC 15118

- Jointly developed over multiple years at the International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC).
- Utilized a consensus-based negotiation of numerous global expert stakeholders.
- Multiple versions exist, and it continues to develop use cases for bi-directional (V2G), wireless power transfer, and pantograph charging.
- Embedded in the Combined Charging Standard widely supported for DC Fast Charging by many automakers.

*\*CPUC Energy Division staff's recommendation (9/14/16 Ruling Appendix B) does not reflect a consensus from the Joint VGI Group at this time.*

[International Standards Organization](#), [Charging Interface Initiative](#)



# ISO/IEC potential\* interaction with CA's DER system

*\*CPUC Energy Division staff's recommendation (9/14/16 Ruling Appendix B) does not reflect a consensus from the Joint VGI Group at this time.*

**Rule 21** scope is red bolts 1, 2, 3.

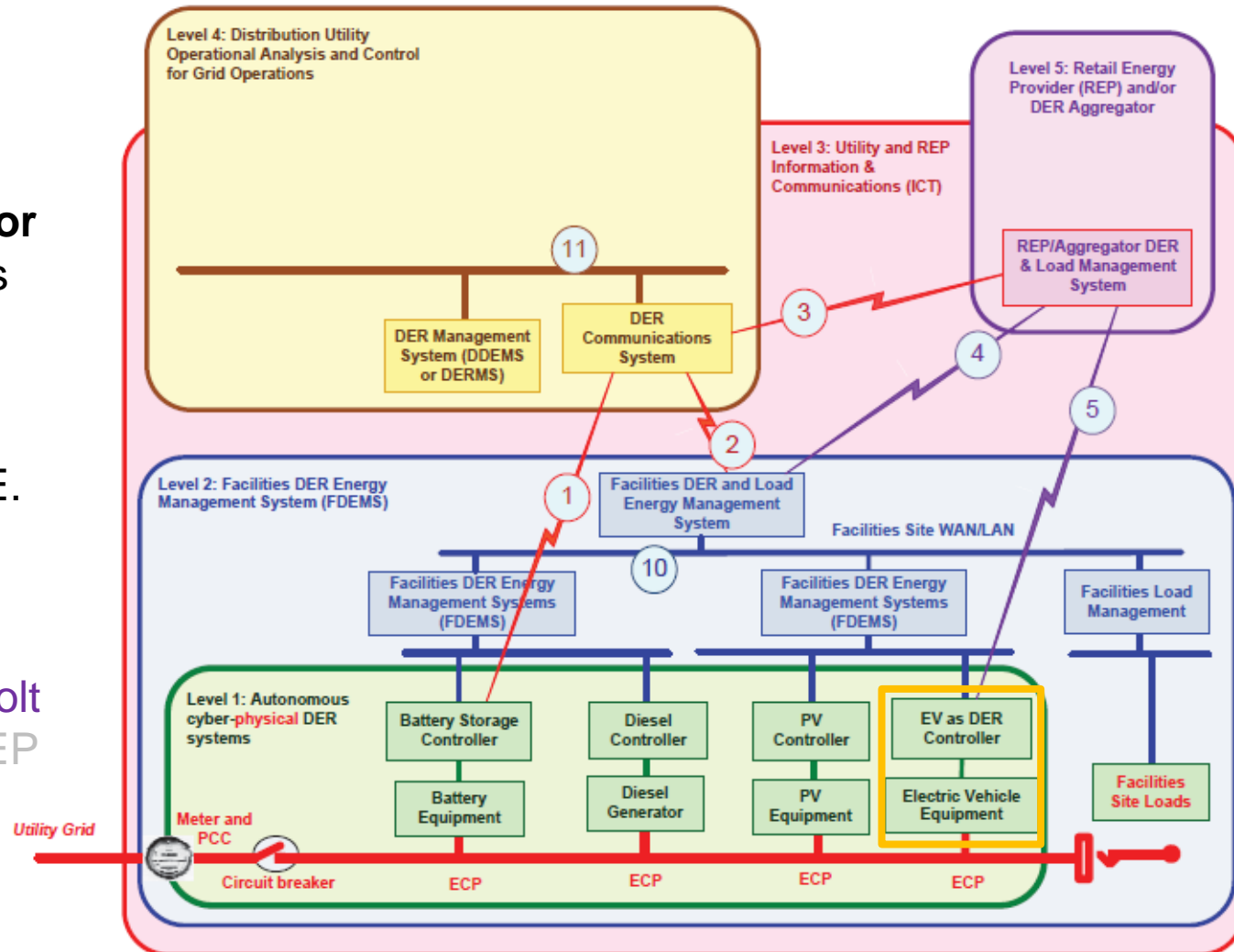
- Default Utility ↔ DER protocol is **SEP 2.0b** or **IEEE 2030.5**, which is based on IEC 61850

**ISO/IEC 15118** scope is gold box on EV ↔ EVSE.

- Information Model s based on IEC 61850.

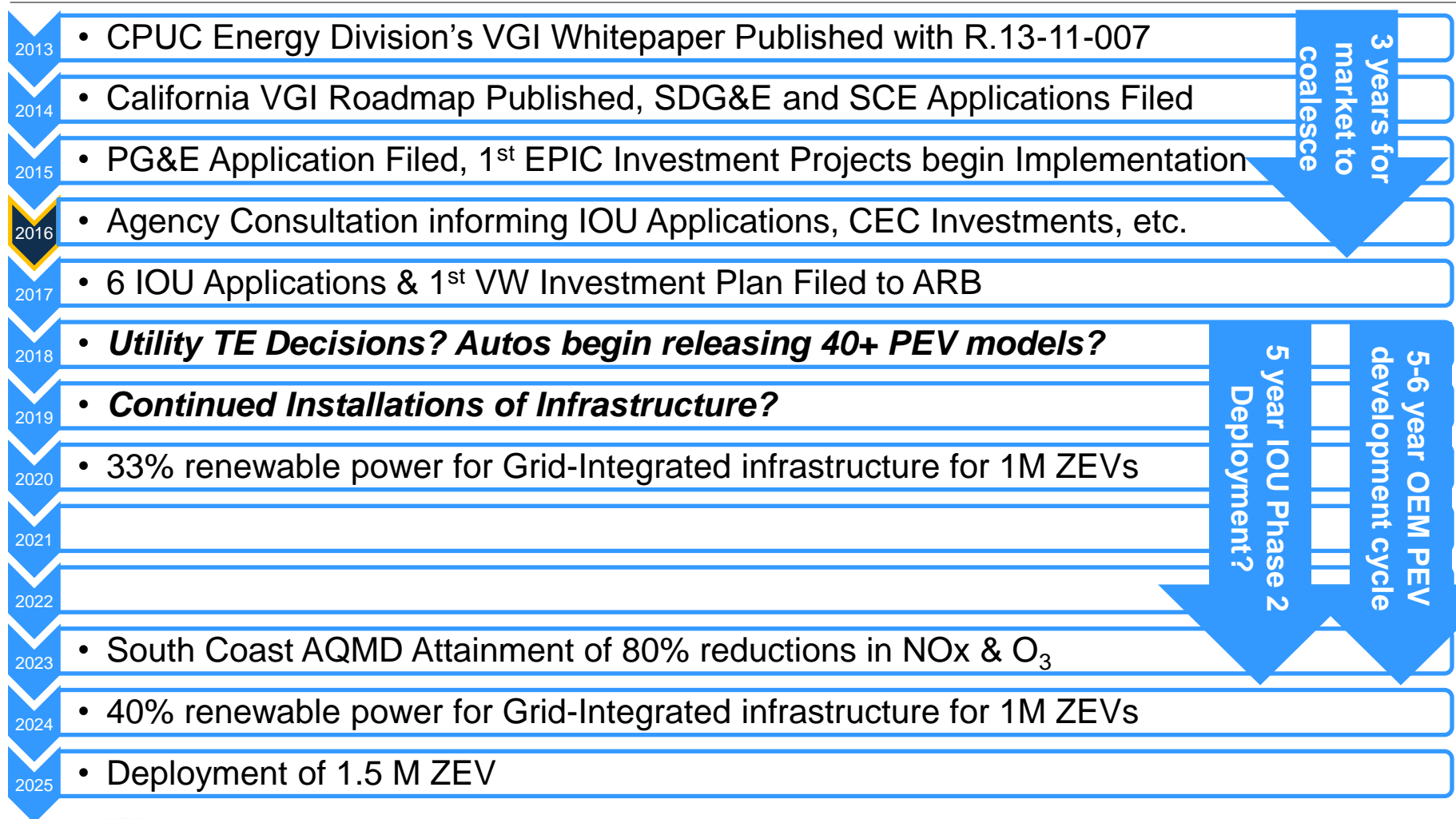
**OCPP** scope is purple bolt 5 between EVSE ↔ REP DER Aggregator

- In development at OASIS (an SDO)



CPUC D.16-06-052/[Smart Inverter Working Group](#), [CPUC Rule 21](#), OASIS OCPP Committee

# How should California protect its scaled ZEV investments?



# Summary: A Request for Feedback to Progress VGI

- California's energy and environmental agencies could act to ***provide the market a consistent signal*** that prioritizes the protection of state investments and recognizes the global progress in Vehicle-Grid Integration.
- California is responsible for ensuring that “technologies employed in [PEVs] work in a harmonious manner across service territories” while avoiding “wasteful [...] or uneconomic energy consumption,” which can help ***achieve its vision for zero-emission transportation*** interconnected throughout the state's electricity systems.
- Standardization, in concert with other efforts, could be utilized as an ***accelerant to the adoption of plug-in electric vehicles*** by establishing an interoperability blueprint for EVSE, improving competition, decrease cost, and simplifying the customer experience.
- ***We welcome your ideas: how do we electrify transportation with grid-integrated infrastructure by 2020?***





Questions, comments, and  
feedback welcome.

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[\*\*energy.ca.gov/transportation\*\*](http://energy.ca.gov/transportation)



# Appendix - Commonalities Across Agency Codes

Topic	Public Utilities Code	Public Resources Code
Agency Coordination on ZEV Policy	740.2 Widespread use of PEV 740.3 Adopt policies to develop infrastructure	25218 (d) Utilize Advice 25403 Give recommendations to avoid peak load to PUC
Utility Responsibilities include Electrification	701.1 Widespread TE as defined in 237.5	25000.1 References to ensure consistency with PUC 701.1
Ratepayer Interests in Measures	740.8 Social Costs 740.12(b) Max Ben & Min Cost	25000.1 Cost Effectiveness 25000.5(b) All practicable
Charging Standards	740.3(a)(2) Statewide standards for connections 8362)(a) refer to std. dev. orgs. 740.12(c) No stranded assets	25403.5 Adopt standards to avoid waste, manage peak load 25618 Develop infrastructure plans for ZEVs (but not ltd to...)
ZEV Commercialization	740.3 Facilitate the use of electric power 740.12(a)(1)(F) Stimulate innovation and competition	25004.3(b) Assistance for Adv. Transportation businesses 25618(a)(1) Develop plans for infrastructure
Grid Integration	740.12(a)(1)(G) Manage RE	25001 Maintain reliability



# Appendix – Select VGI related Public Resources Codes

25000.1 (c) In calculating **the cost effectiveness of energy resources**, including conservation and load management options, the commission shall include a value for any costs and benefits to the environment, including air quality. The commission shall ensure that any values it develops pursuant to this section are consistent with values developed by the Public Utilities Commission pursuant to Section 701.1 of the Public Utilities Code.

25000.5 (a) The Legislature finds and declares that overdependence on the production, marketing, and consumption of petroleum based fuels as an energy resource in the transportation sector is a threat to the energy security of the state due to continuing market and supply uncertainties. In addition, petroleum use as an energy resource contributes substantially to the following public health and environmental problems: air pollution, acid rain, global warming, and the degradation of California's marine environment and fisheries. (b) Therefore, it is the policy of this state to fully evaluate the economic and environmental costs of petroleum use, and the economic and environmental costs of other transportation fuels, including the costs and values of environmental impacts, and to establish a state transportation energy policy that results in the least environmental and economic cost to the state. In pursuing the "least environmental and economic cost" strategy, it is the policy of the state to exploit **all practicable and cost-effective conservation and improvements in the efficiency of energy use and distribution**, and to achieve energy security, diversity of supply sources, and competitiveness of transportation energy markets based on the least environmental and economic cost.

25001 The Legislature hereby finds and declares that electrical energy is essential to the health, safety and welfare of the people of this state and to the state economy, and that it is the responsibility of state government to ensure that **a reliable supply of electrical energy** is maintained at a level consistent with the need for such energy for protection of public health and safety, for promotion of the general welfare, and for environmental quality protection.

25004.3. The Legislature further finds and declares all of the following: (a) Advanced transportation technologies hold the promise of conserving energy, reducing pollution, lowering traffic congestion, and promoting economic development and jobs in California. (b) There is a pressing need to provide **business assistance to California companies engaged in producing and commercializing advanced transportation technologies**. (c) It is the policy of the state to provide financial assistance to California companies, particularly small businesses, that are engaged in commercial efforts in the field of advanced transportation technologies.

25218. In addition to other powers specified in this division, the commission may do any of the following: (d) **Request and utilize the advice and services of all federal, state, local, and regional agencies.**

25403. The commission shall submit to the **Public Utilities Commission and to any publicly owned electric utility, recommendations designed to reduce wasteful, unnecessary, or uneconomic energy consumption** resulting from practices including, but not limited to, differential rate structures, cost-of-service allocations, the disallowance of a business expense of advertising or promotional activities which encourage the use of electrical power, peakload pricing, and other pricing measures. The Public Utilities Commission or publicly owned electric utility shall review and consider such recommendations and shall, within six months after the date it receives them, as prescribed by this section, report to the Governor and the Legislature its actions and reasons therefor with respect to such recommendations.

25403.5. (a) The commission shall, by July 1, 1978, adopt standards by regulation for a program of electrical load management for each utility service area. In adopting the standards, the commission shall consider, but need not be limited to, the following **load management techniques:** (3) **Mechanical and automatic devices and systems** for the control of daily and seasonal peakloads.

25618. (a) The commission shall facilitate development and commercialization of ultra low- and zero-emission electric vehicles and advanced battery technologies, as well as **development of an infrastructure to support maintenance and fueling of those vehicles in California**. Facilitating commercialization of ultra low- and zero-emission electric vehicles in California shall include, but not be limited to, the following:



# Appendix – Select VGI-related Public Utilities Codes

701.1. (a) (1) The Legislature finds and declares that, in addition to other ratepayer protection objectives, a principal goal of electric and natural gas utilities' resource planning and investment shall be to minimize the cost to society of the reliable energy services that are provided by natural gas and electricity, and to improve the environment and to encourage the diversity of energy sources through improvements in energy efficiency, development of renewable energy resources, such as wind, solar, biomass, and geothermal energy, and widespread transportation electrification.

740.2. The commission, in consultation with the Energy Commission, State Air Resources Board, electrical corporations, and the motor vehicle industry, shall evaluate policies to develop infrastructure sufficient to overcome any barriers to the widespread deployment and use of plug-in hybrid and electric vehicles. (c) The technological advances that are needed to ensure the widespread use of plug-in hybrid and electric vehicles and what role the state should take to support the development of this technology. (d) The existing code and permit requirements that will impact the widespread use of plug-in hybrid and electric vehicles and any recommended changes to existing legal impediments to the widespread use of plug-in hybrid and electric vehicles. (e) The role the state should take to ensure that technologies employed in plug-in hybrid and electric vehicles work in a harmonious manner and across service territories.

740.3. (a) The commission, in cooperation with the State Energy Conservation and Development Commission, the State Air Resources Board, air quality management districts and air pollution control districts, regulated electrical and gas corporations, and the motor vehicle industry, shall evaluate and implement policies to promote the development of equipment and infrastructure needed to facilitate the use of electric power and natural gas to fuel low-emission vehicles. Policies to be considered shall include both of the following: (2) The development of statewide standards for electric vehicle charger connections and compressed natural gas vehicle fueling connections, including installation procedures and technical assistance to installers. (b) The commission shall hold public hearings as part of its effort to evaluate and implement the new policies considered in subdivision (a).

740.8. As used in Section 740.3 or 740.12, "interests" of ratepayers, short- or long-term, mean direct benefits that are specific to ratepayers, consistent with both of the following: (a) Safer, more reliable, or less costly gas or electrical service, consistent with Section 451, including electrical service that is safer, more reliable, or less costly due to either improved use of the electric system or improved integration of renewable energy generation. (b) Any one of the following:

740.12 (F) Widespread transportation electrification should stimulate innovation and competition, enable consumer options in charging equipment and services, attract private capital investments, and create high-quality jobs for Californians, where technologically feasible. (G) Deploying electric vehicles should assist in grid management, integrating generation from eligible renewable energy resources, and reducing fuel costs for vehicle drivers who charge in a manner consistent with electrical grid conditions.

8362. (a) By July 1, 2010, the commission, in consultation with the Energy Commission, the ISO, and other key stakeholders shall determine the requirements for a smart grid deployment plan consistent with Section 8360 and federal law, including the provisions of Title XIII (commencing with Section 1301) of the Energy Independence and Security Act of 2007 (Public Law 110-140). The commission shall institute a rulemaking or expand the scope of an existing rulemaking to adopt standards and protocols to ensure functionality and interoperability developed by public and private entities, including, but not limited to, the National Institute of Standards and Technology, Gridwise Architecture Council, the International Electrical and Electronics Engineers, and the National Electric Reliability Organization recognized by the Federal Energy Regulatory Commission.



# Appendix – US and EU Decarbonization Parallels

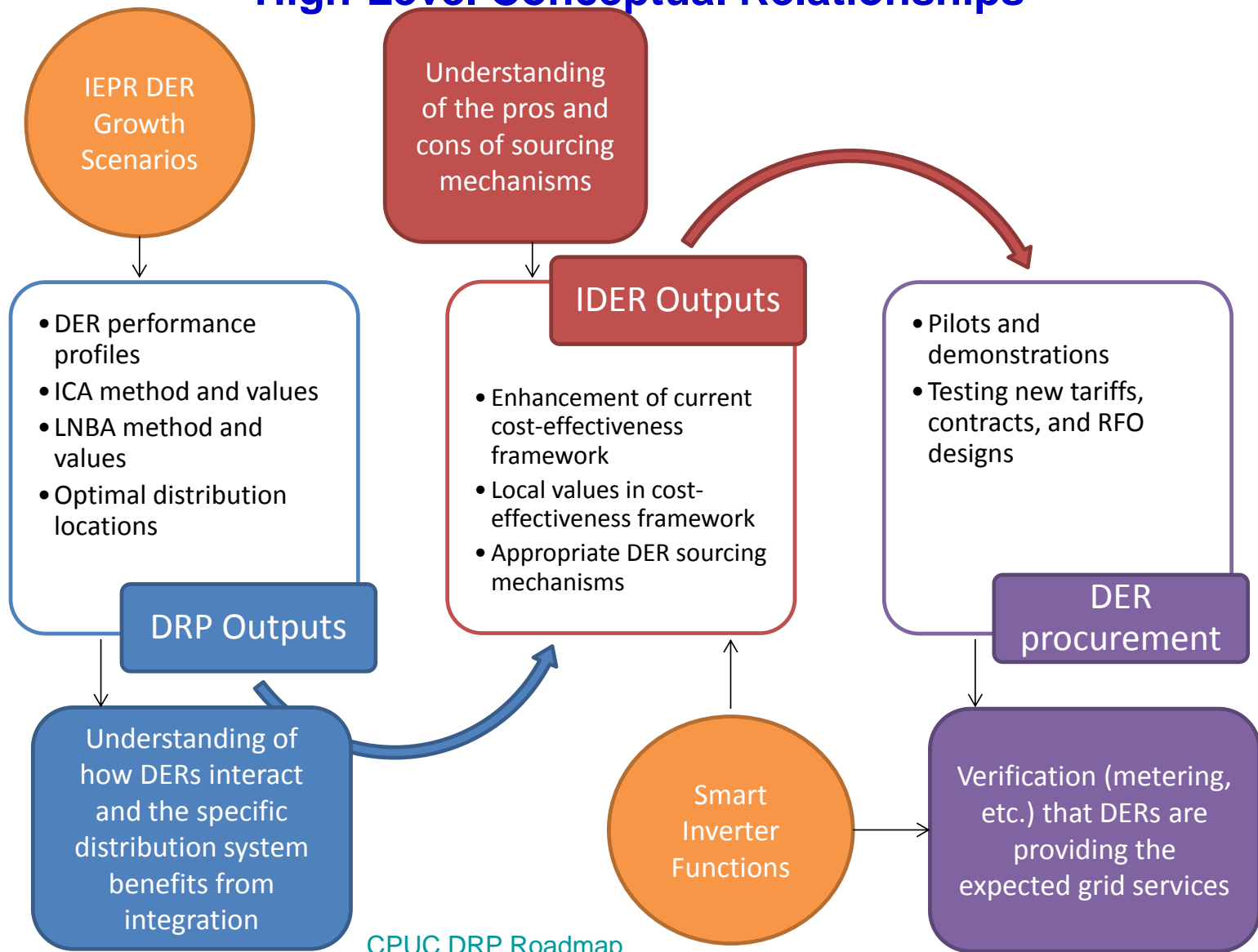
	California	Europe
Electr. Distribution Utilities	3,306 (United States)	2,400
GHG Reductions	1990 Levels by 2020 40% below 1990 by 2030	20% Reduction by 2020 40% below 1990 by 2030 80% below 1990 by 2050
Renewables	33% by 2020 50% by 2030	20% by 2020 27% by 2030
Efficiency	Doubling by 2030	20% improvement by 2020 27% improvement by 2030
Transportation	Reduce CI 10% by 2020 ZEV Mandate ½ Petroleum Use by 2030 80% below 1990 by 2050 100% ZEV Sales by 2050	10% RE Fuels by 2020 GHG Targets & ICE Bans ICE phase-out proposals 60% below 1990 by 2050 100% ZEV Sales by 2050



Sources: American Public Power Association, Eurelectric, European Comm., International ZEV Alliance

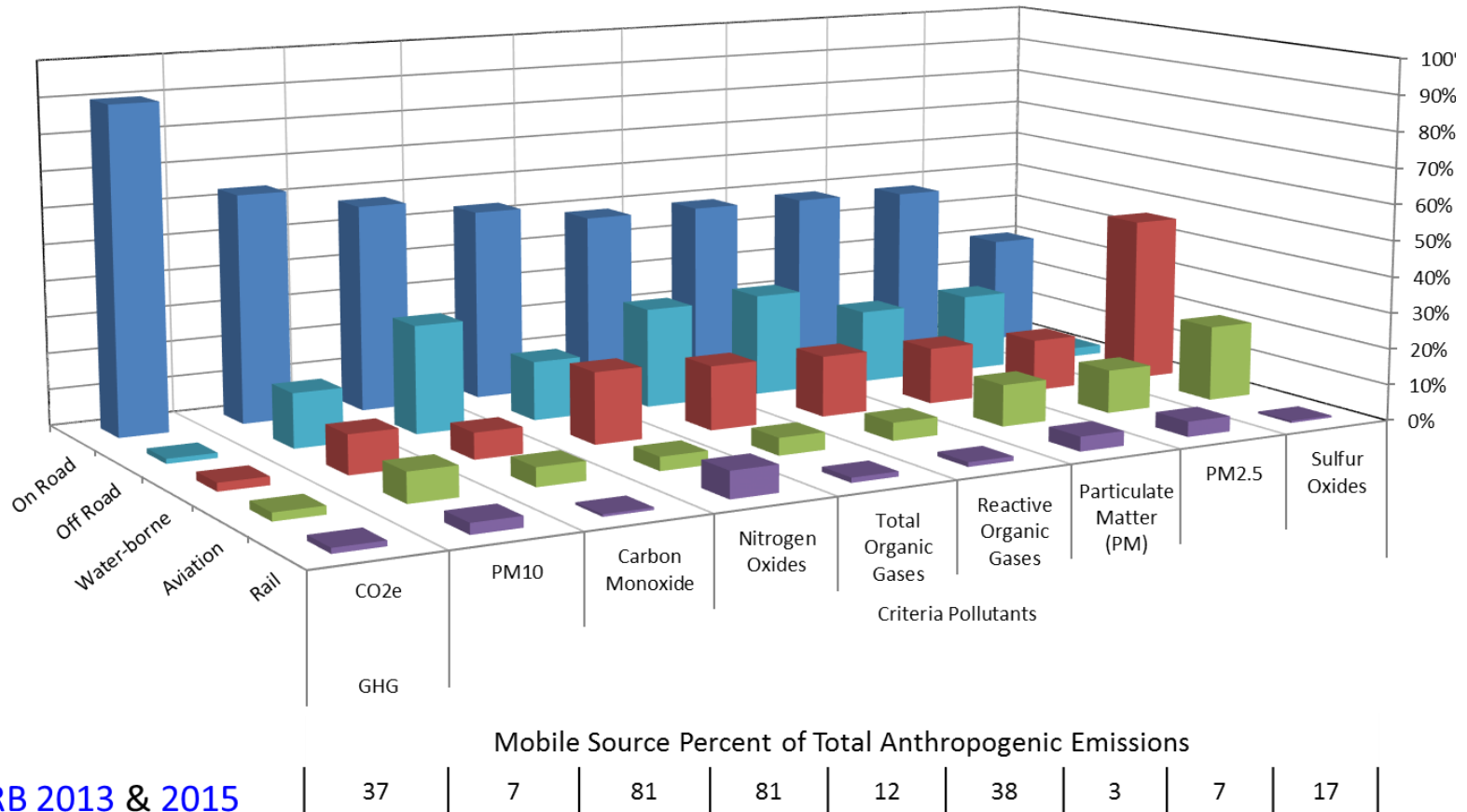


## Distributed Resource Plan and Integrated DER High-Level Conceptual Relationships



# Widespread Transportation Electrification is Needed to Meet CA's Multi-Pollutant Emission Constraints

Segment Contributions to Total Emissions, by Pollutant Type



[CARB 2013](#) & [2015](#)



# Approaches to Vehicle-Grid Integration

45 minutes

- Sunil Chhaya
  - Electric Power Research Institute
- Rich Scholer
  - Fiat Chrysler
- Adam Langton
  - BMW North America
- Dave McCreadie
  - Ford



# ISO/IEC 15118 – Vehicle to Grid Communication Interface

45 minutes

- Stephen Davis
  - KnGrid
- Stephan Voit
  - KnGrid
- Barry Sole
  - Volkswagen Automotive Group
- Judy Brunson
  - Daimler / Mercedes - Benz



# Public Comment

30 minutes

- ***Are there other techniques that the State should consider to enable VGI?***
- Pre-submitted Prepared Remarks:
  - John Holmes, University of California, San Diego



# Benefits and Costs of Implementing Standards

30 minutes

- Frances Cleveland
  - Xanthus Consulting
  - Chair, Utility Electric Rule 21 Smart Inverter Working Group (convened by CPUC/CEC)



# Facilitated Discussion

30 minutes

- How can the State develop values for VGI data?
  - PUC DPR/IDER
  - CEC IEPR forecasting and AB 8 investment planning
  - ARB Open Access, LCFS fuel path
  - ISO DERP/ESDER initiatives and new FERC rulemaking
  - (Others: Road Charge, commercial sale, transport network modernization)



# Discussion Prompts



- How can California incentivize private investments in technologies that realize the values of VGI data?

## Select Agency ZEV Activities

Reliable operation of the grid by **scheduling PEV demand**

Locating electric vehicle **charging stations**

Open, **authenticated access** to public charging sessions

**Charge control** per Time-Of-Use or Dynamic rates

Provision and settlement of **grid ancillary services** as DERs

Accurate **receipt of commercial sale** of electric fuel

**Monitoring traffic** flows/congestion, road capacity, and tolling

Offering **Credit Generation** Opportunity for Low Carbon Fuel Std

**Analyzing utilization and maintenance** of deployed networks

Improving load and generation **forecasting and grid planning**

**Allocating construction** costs to drivers proportionate to use

Target future **strategic investments** in charging networks

Track **deployment, petroleum & emissions** reduction goals



# Discussion Prompts

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- How do we accelerate the driver and social/general customer benefits of using electric vehicles to hasten transport and electricity decarbonization?
- Do markets appropriately value investments in higher functions that aren't yet useful or known to customers but can be "unlocked"?
  - e.g. Smart Meters, VHS vs. Betamax, Smart Inverters, Autonomous
- How must automotive, EV service providers, or other actors justify their investments in marginal technology functions?
- How can the State encourage innovation in advanced functions to ensure resilience?



# Next Steps

30 minutes

- What *specific, concerted, and results-oriented* implementation steps can the State and stakeholders take?
  - Achieve State Goals (ZEV and DER Action Plans)
  - Align rules in development that utilize EV energy data
  - Bring R&D into demonstrated/validated technologies into parking lots for the next generation of charging systems and vehicles

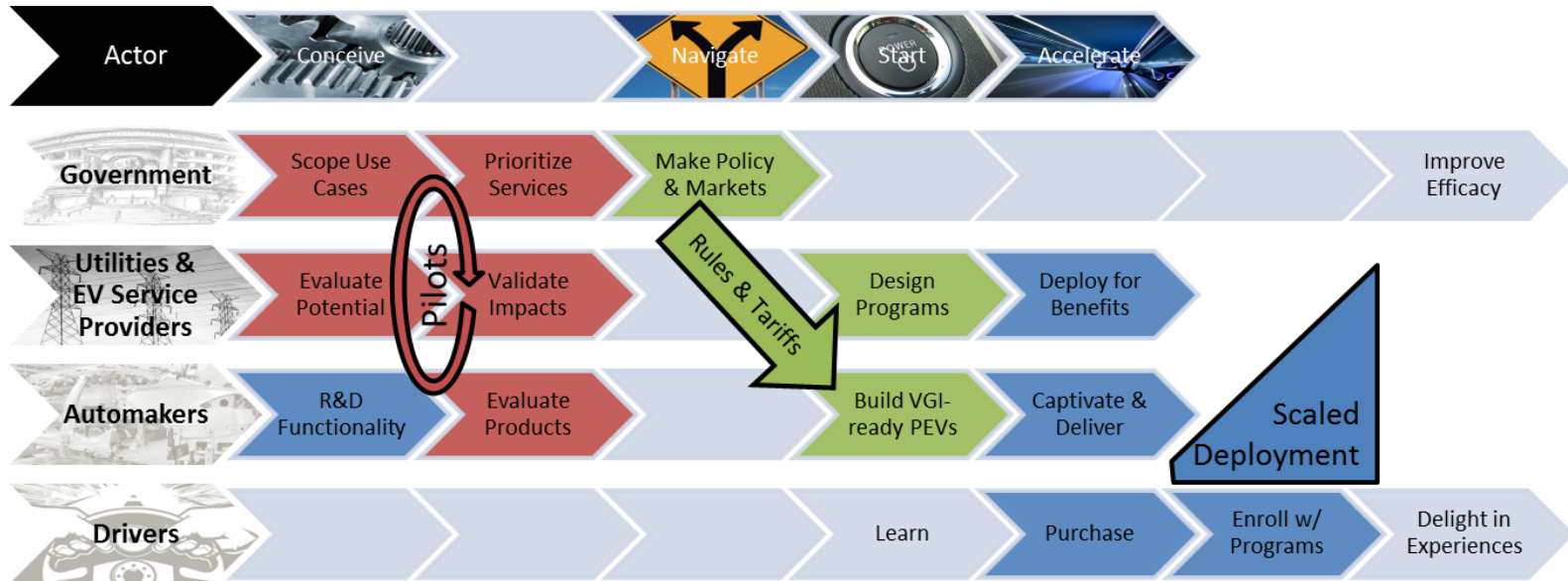


# Solutions: Aligning CEC's Data Collection Efforts

- Per SB 350 and AB 802, CEC is developing regulations under Title 20 to better understand PEV customer charging behaviors, which could ultimately inform demand forecasting at the local level.
  - Section 1344(g) requests data to characterize Behind the Meter loads, including PEVs (residential & commercial)
  - Section 1344(h) requests data from Networked PEV chargers (public & workplace)
- Process Integration between 16-OIR-03 and 16-TRAN-01
  - <http://www.energy.ca.gov/sb350/energydata/>
  - Energy Data Workshop on November 16, 2016
  - Cross-Docketed with Today's Workshop (16-TRAN-01)
  - Comments due to 16-OIR-03 on December 12, 2016
- If possible please coordinate comments across dockets on scope of data requested, technical issues, and costs of providing data.



# Solutions: Bringing Research to Roads



1. **Pilots:** test PEV technologies, grid transactions (services, communications)
2. **Rulemakings and Tariff Initiatives:** stakeholders work in formal agency processes to set requirements for programs and market participation
3. **Scaled Deployment:** customers' vehicles charge in concert with the grid



[CPUC Energy Division, presentation at CEC VGI Research Review December 14, 2015](#)

# Role of Existing Research and Future Directions

- Mike Gravely, Research & Development Division
- CEC and the IOUs have invested in several VGI projects
  - Funded by the CPUC's Electric Program Investment Charge (EPIC) & AB 8 Alternative & Renewable Fuel Vehicle & Technology (ARFVTP) Programs
  - Cross-industry teams have built projects that are serving drivers and fleets with new hardware, controls, and optimization algorithms, and are testing grid/market responses and more.
  - Future investments (research, testing, validation, commercialization) should learn from previous work to the greatest extent possible.
    - [Tiny.cc/evreports](http://Tiny.cc/evreports)
- Learn more at the 3<sup>rd</sup> Annual VGI Research Review on December 12
  - [http://www.energy.ca.gov/research/notices/2016-12-12\\_workshop/2016-12-12\\_Notice\\_of\\_Staff\\_Workshop\\_VGI\\_Research.pdf](http://www.energy.ca.gov/research/notices/2016-12-12_workshop/2016-12-12_Notice_of_Staff_Workshop_VGI_Research.pdf)



# Next Steps

- Stakeholders may submit comments to 16-TRAN-01 by December 14
  - Use content presented, prompts, questions, ideas, and discussions from today as the basis for your responses.
  - <http://www.energy.ca.gov/altfuels/2016-TRAN-01/documents/>
- Staff will draft a workshop report and whitepaper
  - For review by Agencies and made available for public comment.
  - May propose a plan for a VGI Implementation Group (contingent upon feedback we receive in Docket responses, and funding).
- Contact individual Agency or ISO staff regarding questions on rulemaking/proceeding/initiative-specific issues.



***Thank you for your engagement!***

# Public Comment

30 minutes

- Comments limited to 3 minutes.

