DOCKETED

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Document Title:	Presentation - Alternative and Renewable Fuel and Vehicle Technology Program
Description:	Staff Workshop on Executive Order B-48-18 (â€œZEV Executive Orderâ€) by Jennifer Allan & Jean Baronas.
Filer:	Tami Haas
Organization:	California Energy Commission
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Docketed Date:	5/16/2018

Alternative and Renewable Fuel and Vehicle Technology Program

Staff Workshop on Executive Order B-48-18
("ZEV Executive Order")

Art Rosenfeld Hearing Room
May 14, 2018

Introductions, Logistics, and Diversity

- Facilities and Logistics
- In case of emergency
- Diversity Survey
  - https://www.surveymonkey.com/r/D52N5HV

Commitment to Diversity

The Energy Commission adopted a resolution on April 8, 2015, to firmly commit to:

- Increase participation of women, minority, disabled veteran and LGBT business enterprises in program funding opportunities.
- Increase outreach and participation by disadvantaged communities.
- Increase diversity in participation at Energy Commission proceedings.
- Increase diversity in employment and promotional opportunities.

Commitment to Diversity

Fairness – Increase funding accessibility to all Californians.

Inclusion – Small businesses make up a significant portion of the U.S. economy.

Job Creation – Projects can create jobs for residents of the under-served communities.

Diversity of Ideas – Great ideas occur in a variety of areas.

Diversity in Communities' Needs – Needs vary widely from one area to the next (air quality, socioeconomic, etc.).

Executive Order B-48-18

ZEV Deployment by 2030

- 5 million ZEVs on the road

ZEV Infrastructure by 2025

- 250,000 chargers (inc.10,000 DC fast chargers)
- 200 hydrogen refueling stations

Related ZEV Infrastructure Actions

- Strengthen the economy and create jobs
- Ensure affordability and accessibility for all drivers

Agenda

Overview of the FY 2018/19 ARFVTP Investment Plan Update	10:15 AM
Hydrogen Refueling Infrastructure: Staff Concepts	10:45 AM
Lunch Break	12:00 PM
Hydrogen Refueling Infrastructure: Staff Concepts (continued)	1:00 PM
Electric Vehicle Charging Infrastructure: Staff Concepts	1:30 PM
Public Discussion	3:00 PM
Adjournment	3:30 PM

Overview of 2018-2019 Investment Plan Update for the ARFVTP

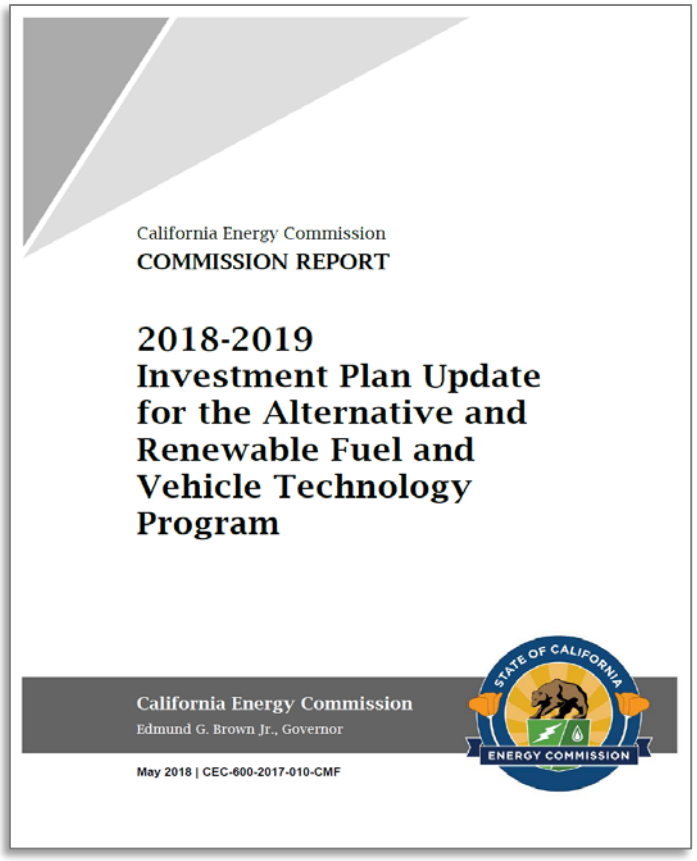
Charles Smith

Investment Plan Purpose

Basis for FY 2018-2019 solicitations, agreements, and other funding opportunities

$277.5 million funding allocation for a portfolio of fuels, technologies, and supporting elements

Funding allocations for categories (not individual projects)



Development of Investment Plan

November 2, 2017	Draft Staff Report released
November 7, 2017	First Advisory Committee meeting
January 10, 2018	Revised Staff Report released
March 5, 2018	2nd Revised Staff Report released
March 15, 2018	Second Advisory Committee meeting
April 25, 2018	Lead Commissioner Report released
May 9, 2018	Business Meeting approval

Governor's Proposed Budget for 2018-2019

$235 million for zero-emission vehicle infrastructure

Sources: ARFVT Fund; Air Quality Improvement Fund; New Solar Homes Partnership expiring funds

$17.5 million for advanced freight and fleet technologies

Source: ARFVT Fund

$25 million for low-carbon fuel production

Source: Greenhouse Gas Reduction Fund

Electric Vehicle Charging Infrastructure

$134.5 million

Supports B-48-18 goal of 250,000 chargers by 2025

Currently planned and expected chargers fall short by 122,000-174,000 by 2025

Public and private costs for remaining chargers:
$1.0 - $2.9 billion over 7 years

Hydrogen Refueling Infrastructure

$92 million

Funding support for additional 40+ refueling stations

- Help achieve goal of 200 stations by 2025
- Provide sufficient fueling capacity into 2022
- Enable further FCEV sales throughout the state

Continued funding for Operations & Maintenance

Manufacturing & Workforce Development
for Zero-Emission Vehicle Infrastructure

$8.5 million

Support ZEV infrastructure industry & workforce needs

Encourage new or expanded manufacturing facilities

Goals supported:

- Indirect support for other ARFVTP project types
- Equitable economic development

Advanced Freight and Fleet Technologies

$17.5 million

Medium- and heavy-duty vehicles (10,000 lbs & up)
Zero-emission and advanced technology powertrains

Open to broad range of project, fuel, and technology types

- Sustainable freight and goods movement
- Dedicated charging and refueling infrastructure for fleets
- Enabling technologies and non-propulsion projects

Low-Carbon Fuel Production and Supply

$25 million

Non-petroleum transportation fuels

- Diesel & gasoline substitutes, biomethane, renewable hydrogen

Focus on waste-based & renewable feedstocks

Pilot, demonstration, and commercial scale

Funding source: Greenhouse Gas Reduction Fund

Funding Allocations

Category	Funded Activity	Proposed Allocation
Zero-Emission Vehicle Infrastructure	Electric Vehicle Charging Infrastructure	$134.5 million
	Hydrogen Refueling Infrastructure	$92 million
	Manufacturing & Workforce Development	$8.5 million
Advanced Technology Vehicle Support	Advanced Freight and Fleet Technologies	$17.5 million
Alternative Fuel Production	Low-Carbon Fuel Production and Supply	$25 million
	Total	**$277.5 million**

H2 Refueling Infrastructure

Staff Concepts that Support Existing Vehicle Deployments and Provide Advancements To Drive Market Growth

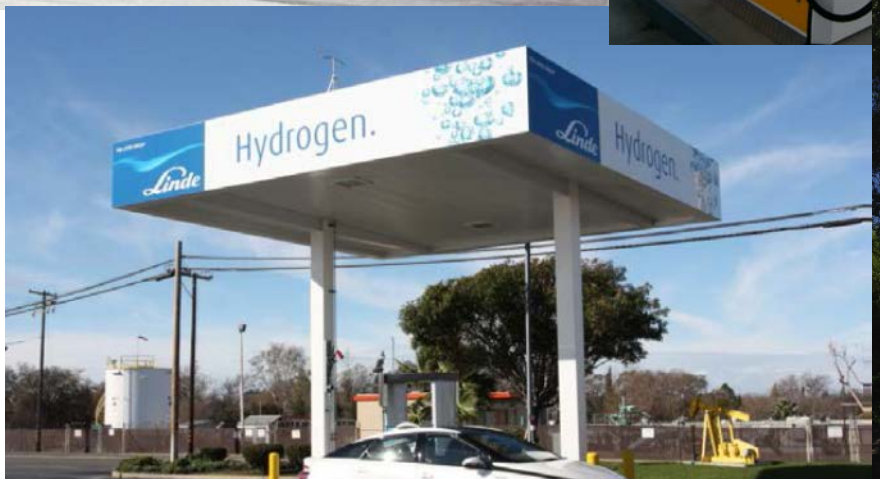
Jean Baronas

Focus on Hydrogen Refueling Infrastructure

- The consumer's acceptance of fuel cell electric vehicles (FCEVs) correlates with the availability of reliable fueling.

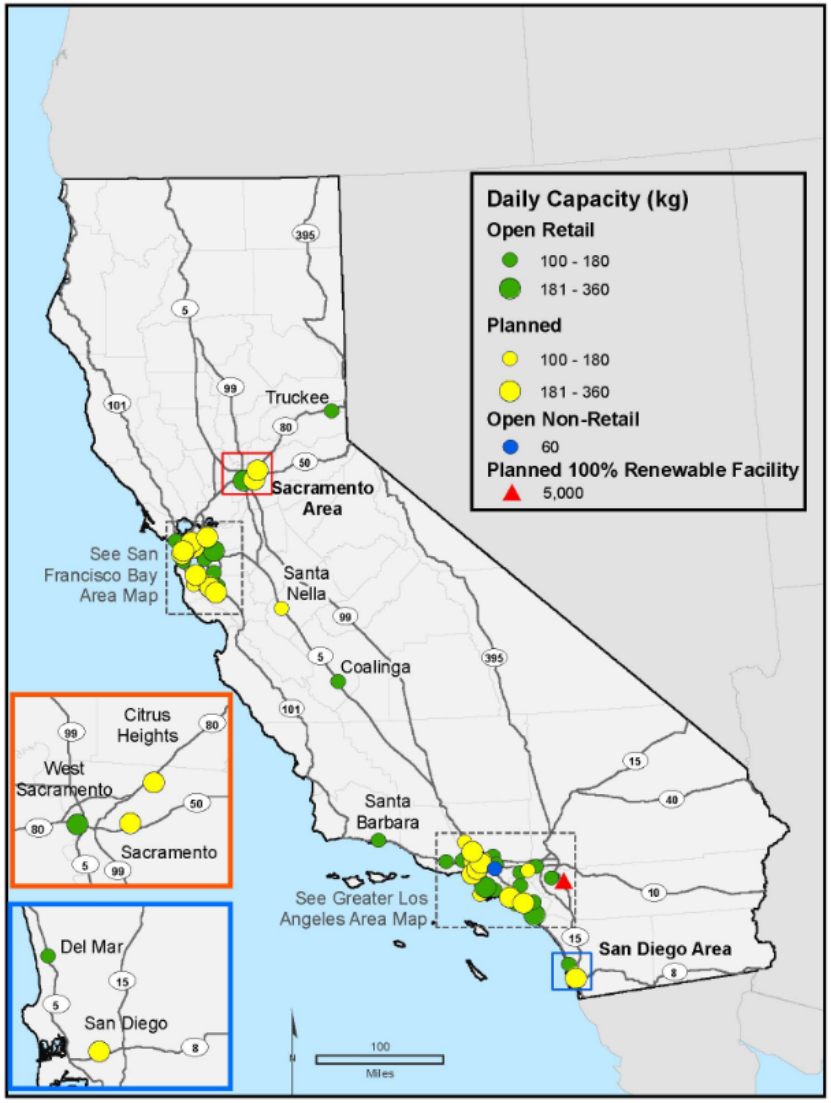
- The consumer's ability to reliably fuel FCEVs and drive to their destinations are integral to decisions to purchase and lease FCEVs.

California Energy Commission

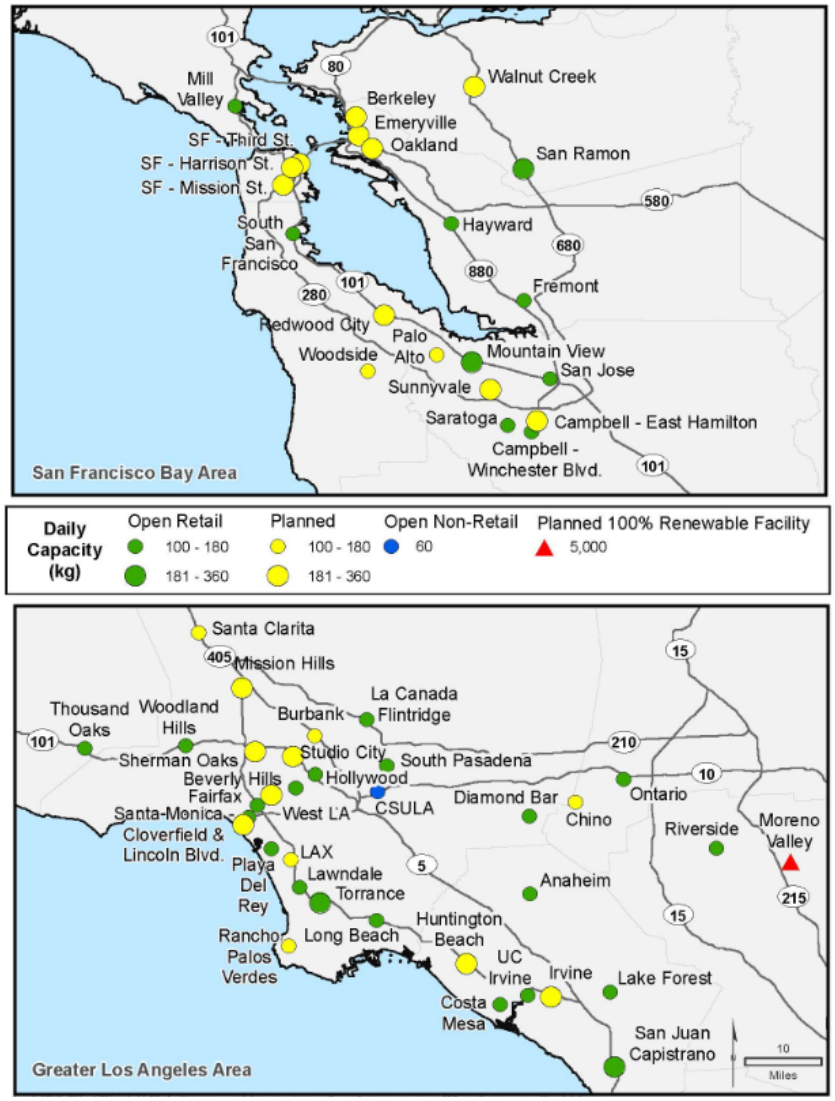


34 open retail hydrogen refueling stations
fuel over 4,200 fuel cell electric vehicles (FCEVs)

California Energy Commission



Statewide view of the Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP) funded stations (4 regions are identified)



View of the locations of the core market areas around the San Francisco Bay and Greater Los Angeles

Planned Competitive Funding Solicitations

- Light duty hydrogen refueling stations
- Medium/heavy duty hydrogen refueling station demonstrations

Planned Support Projects for the Stations and the Network

- Hydrogen refueling education
- Energy efficient lighting installations and assessments
- Station and freeway signage
- Community outreach events
- Permitting streamlining
- Station nameplate capacity evaluation
- Quantitative and qualitative performance assessments

Nick Barillo, Hydrogen Safety Panel, outreach

Planned Competitive Solicitation for Light Duty Hydrogen Refueling Infrastructure

- Fund multiple tranches of stations to support economies of scale in hydrogen station development
  - ❖ Cost competitiveness will be evaluated and scored
  - ❖ Long term investments in manufacturing will be evaluated and scored
  - ❖ Supply chains for sourcing hydrogen will be evaluated and scored

Planned Competitive Solicitation for Light Duty Hydrogen Refueling Infrastructure (continued)

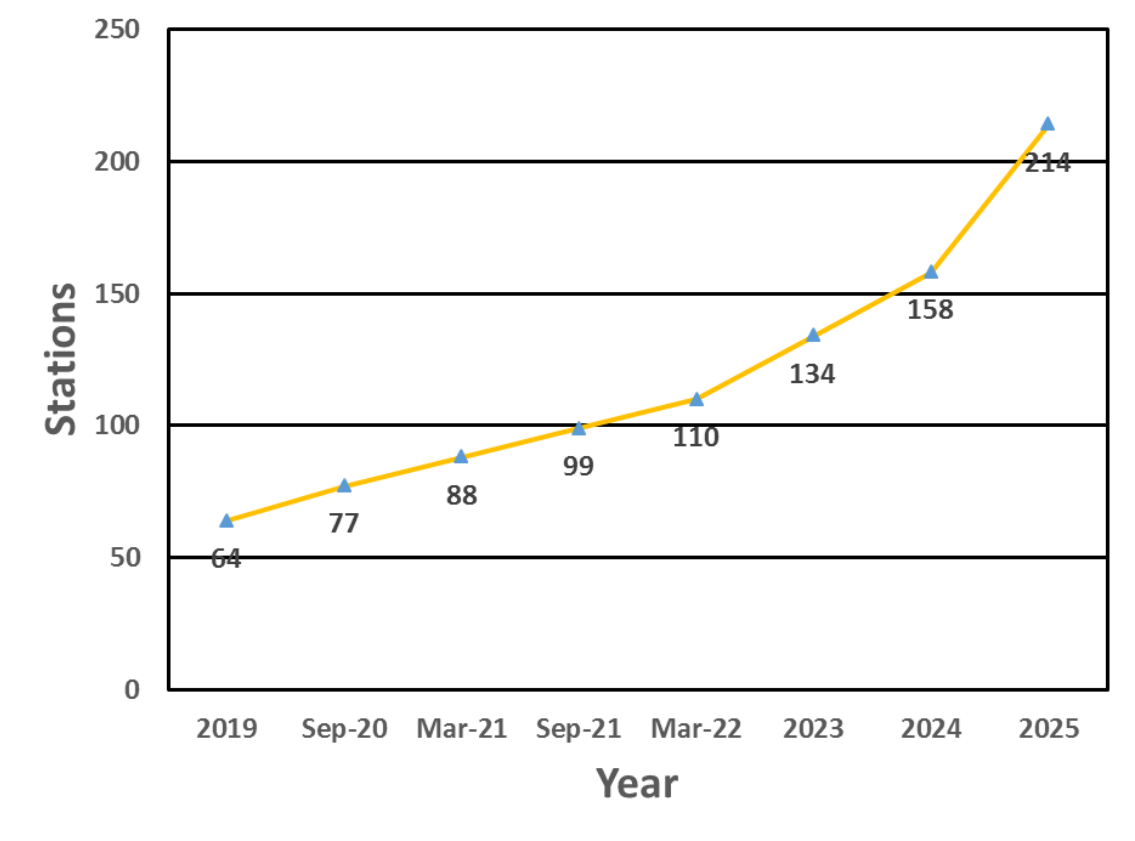
- Applicant may opt to combine capital expense funding with operations and maintenance funding
- Station performance declarations including station nameplate capacity
- Streamlined station location techniques
- Draft Concepts Q3 2018

Planned Competitive Solicitation For Light Duty Hydrogen Refueling Stations

- As early as 2021, or sooner, in some regions, today's hydrogen refueling station network is expected to experience great demand from FCEVs and drivers.
- Plan for 200 strategically-placed hydrogen stations by 2025.
  - ❖ Multi solicitation approaches, or tranches in one solicitation, to enable a path to build consumer demand for approximately 1 million FCEVs in California by around 2030 and 1,000 hydrogen refueling stations by around 2030
  - ❖ Line up long term supplies for equipment and hydrogen sources

Planned Competitive Solicitation For Light Duty Hydrogen Refueling Stations

200 station plan through cost reduction



Public and Private Sector Collaboration on Station Nameplate Capacity Metrics

- Compression and dispensing
- Pre-cooling
- On-site and delivered sources of hydrogen
- Station storage for each pressure level

Danny Terlip, NREL,
Researcher and Engineer

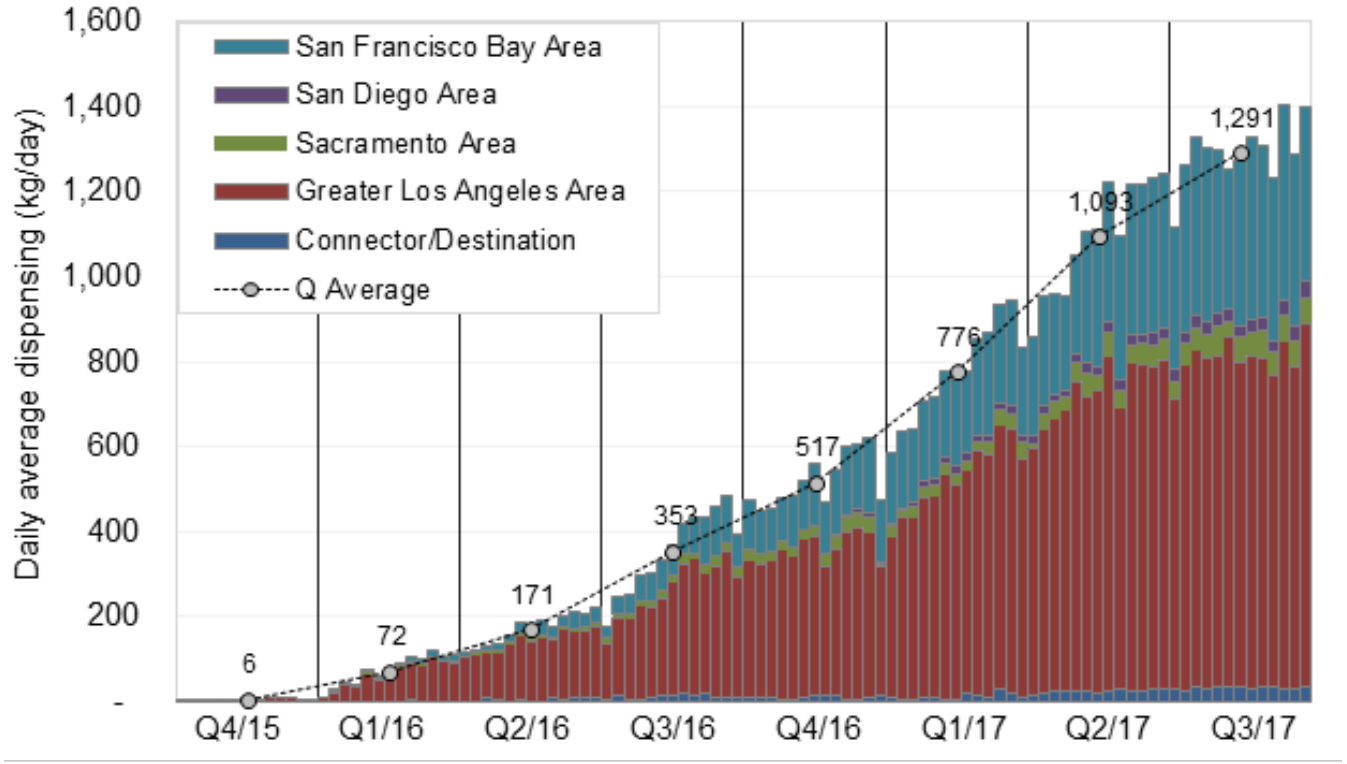
Jennifer Kurtz, NREL,
Laboratory Manager

Public and Private Sector Collaboration On Station Reporting

- National Renewable Energy Laboratory (NREL) data collection tool
  - Required workbook for reporting operational data from hydrogen refueling stations
  - Amount of hydrogen stored, compressed and dispensed and the energy consumption
  - Fuel logs
  - Parts replacement and cost
  - Monthly operating costs

Sam Sprik, NREL, Researcher and Engineer

Weekly Hydrogen Dispensing by County

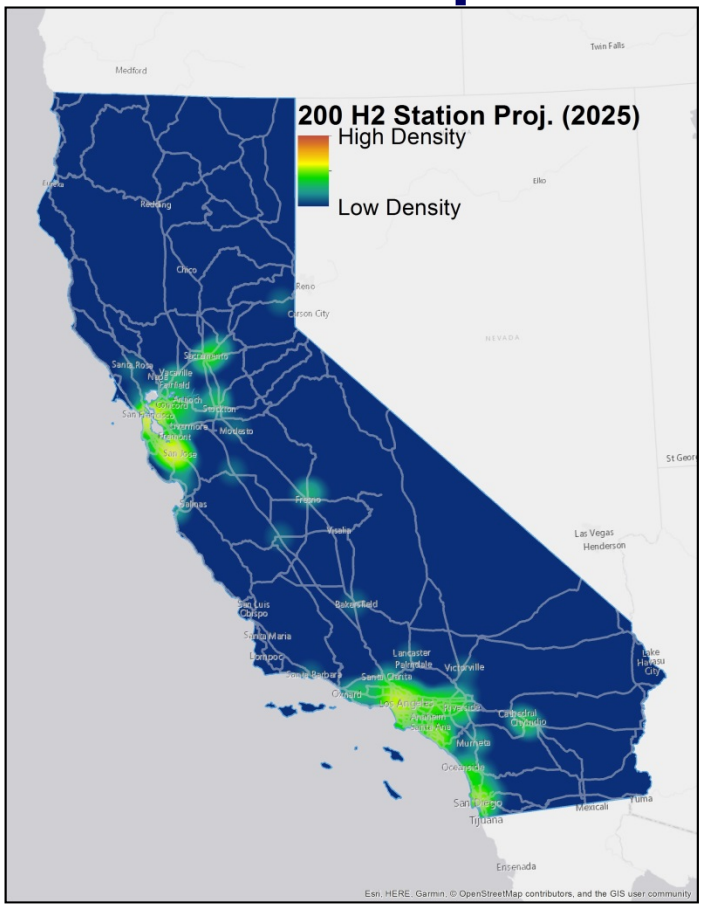


Source: NREL from 2017 AB 8 Joint Agency Staff Report

Streamlined Station Location Techniques

- Heat maps under development by CARB for approximately 200 potential retail hydrogen stations using the density of gas stations as a guide through CHIT evaluation.

- Future solicitations for light duty hydrogen refueling stations could use heat maps
  - Density of hydrogen refueling stations projected for 2025 to appropriately place 200 stations
  - Public and private sector discussions needed



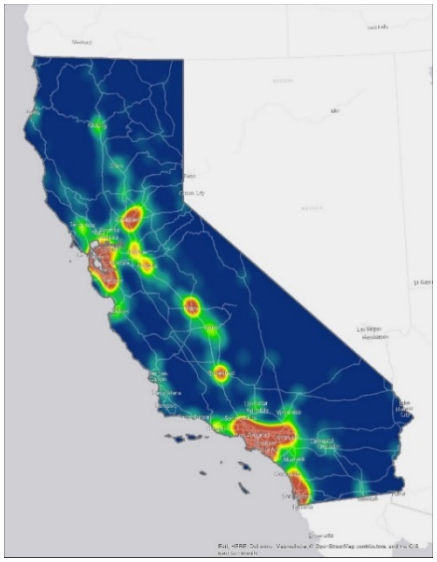
Source: CARB

Streamlined Station Location Techniques

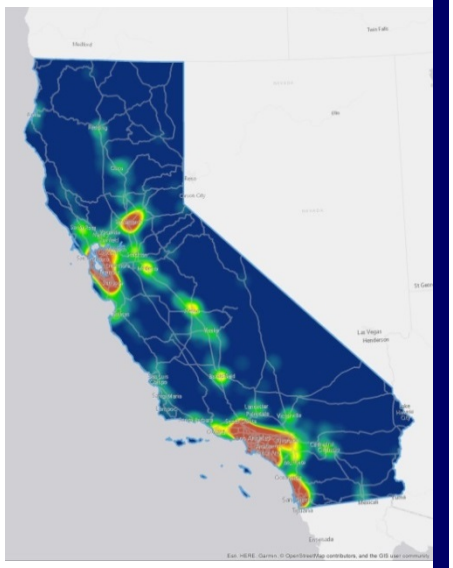
- CARB is working to project the station network development through 2030 and the proposed CaFCP Roadmap may include.

- CARB density map of approx. 1,000 potential retail hydrogen stations shown, compared with gasoline station network.

Andrew Martinez, CARB, Air Resources Engineer



Density map of approx. 8,000 retail gas stations (actual)



Density map of approx. 1,000 retail hydrogen stations (potential) (2030)

Source: CARB

Competitive Solicitation Medium-duty/Heavy-duty Hydrogen Refueling Demonstration

- Infrastructure plan and coverage:
  - Refueling support for MD/HD vehicles travelling from Los Angeles (port) to Central Valley
- Fueling protocols are part of the demonstration
- Draft Concepts Q2 2019

Hydrogen Refueling Infrastructure Directed Projects

- Quantitative assessment of station cost
- Quantitative and qualitative assessment of network performance
- Streamlined administration, local planning, and permitting

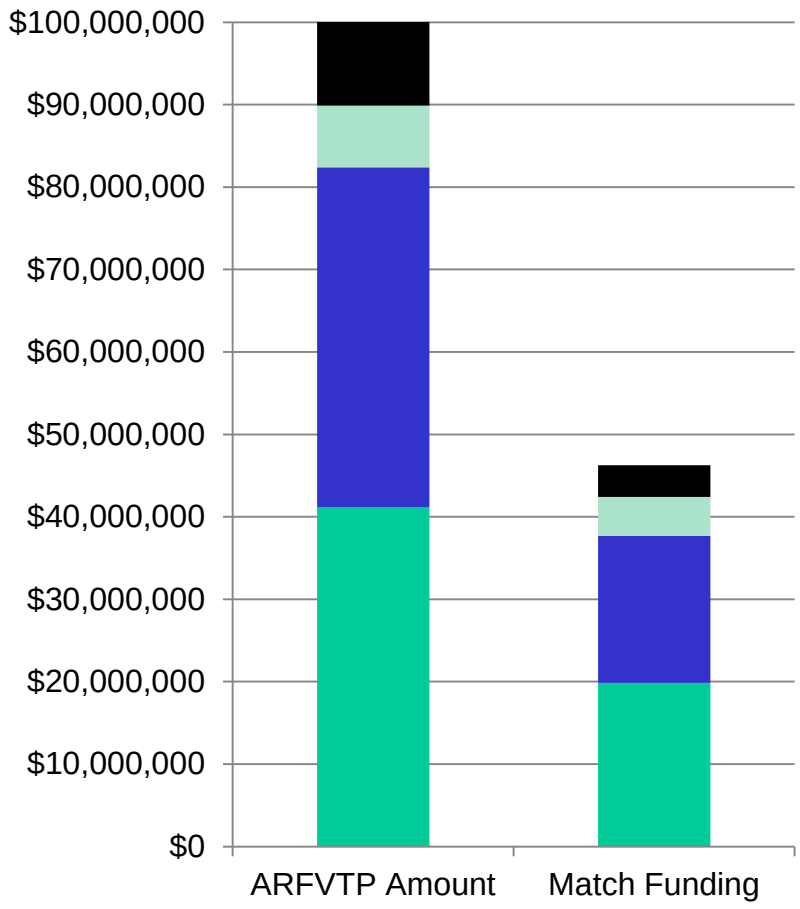
Trend Toward Larger Stations

- Higher capacity in GFO-15-605
- Multiple fueling positions and serving more customers is a ***future*** trend

Funding	Number of Stations Funded	Total Capacity Funded (kg/day)	Average Station Capacity (kg/day)
PON-09-608	10	2,140	214
PON-12-606	4	730	183
Upgrade Contract	3	480	160
PON-13-607	27	4,745	176
GFO-15-605	20	6,420	321
Network Totals	**64**	**14,515**	**227**

Source: California Energy Commission

Match Funding and ARFVTP Funding



- Match
  - PON-09-608: 20%
  - PON-12-606: 39%
  - PON-13-607: 30%
  - GFO-15-605: 33%
- Total for 4 previous solicitations
  - ARFVTP: $99,102,180
  - Match: $46,267,540

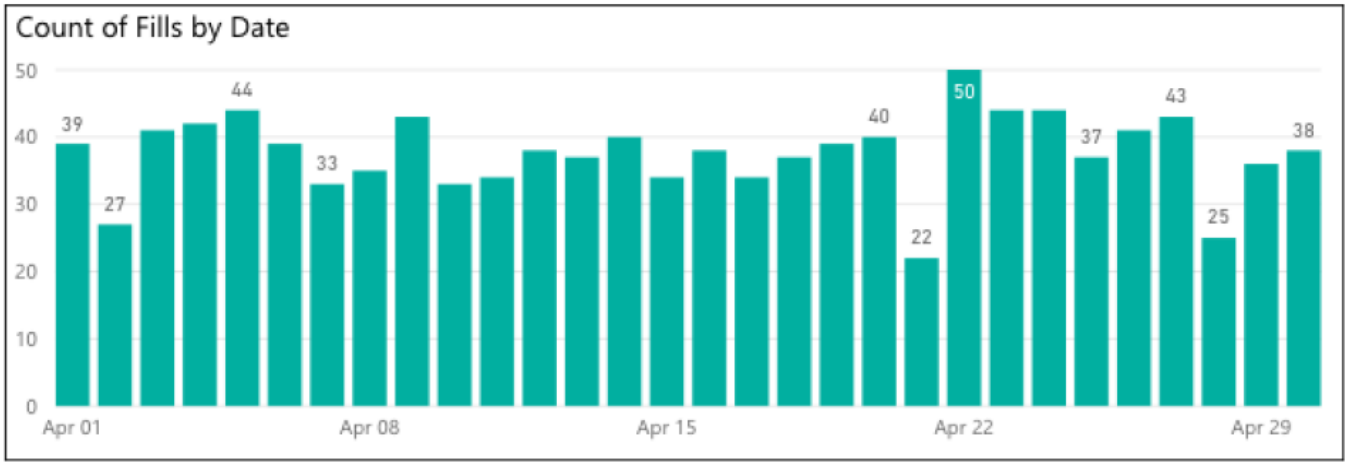
Source: California Energy Commission

Quantitative Assessment of Station and Network Performance

- Monthly progress reports

ARV-15-030: Long Beach-Long Beach Blvd.

- 1127 Fills – 3.68k Total Kgs

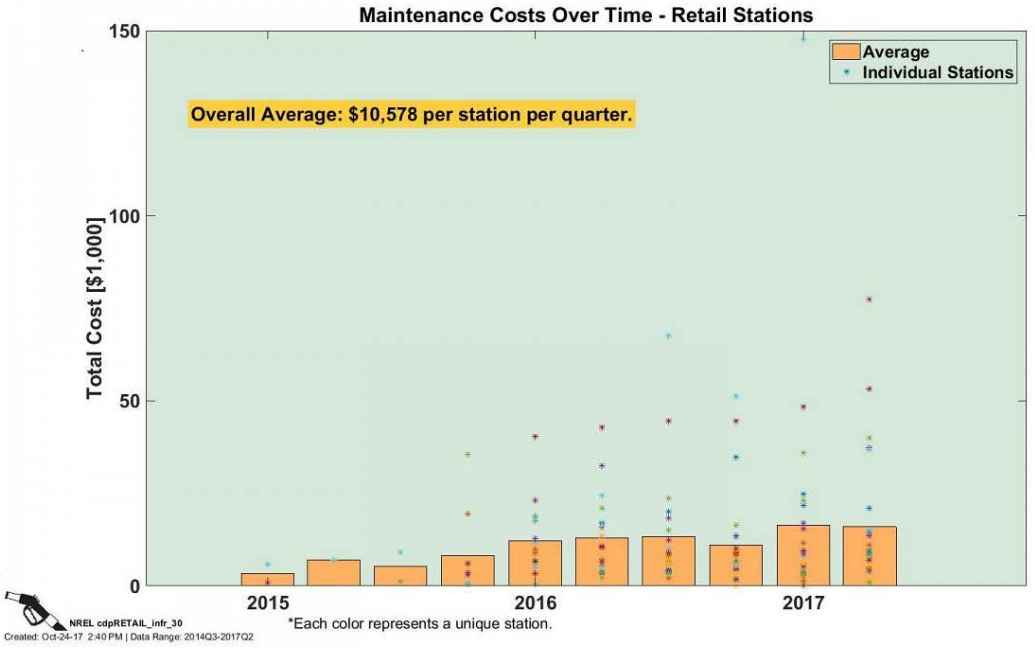


- Quarterly NREL Data Collection Tool

Monthly Report figure example from FirstElement Fuel

Quantitative Assessment of Station and Network Performance

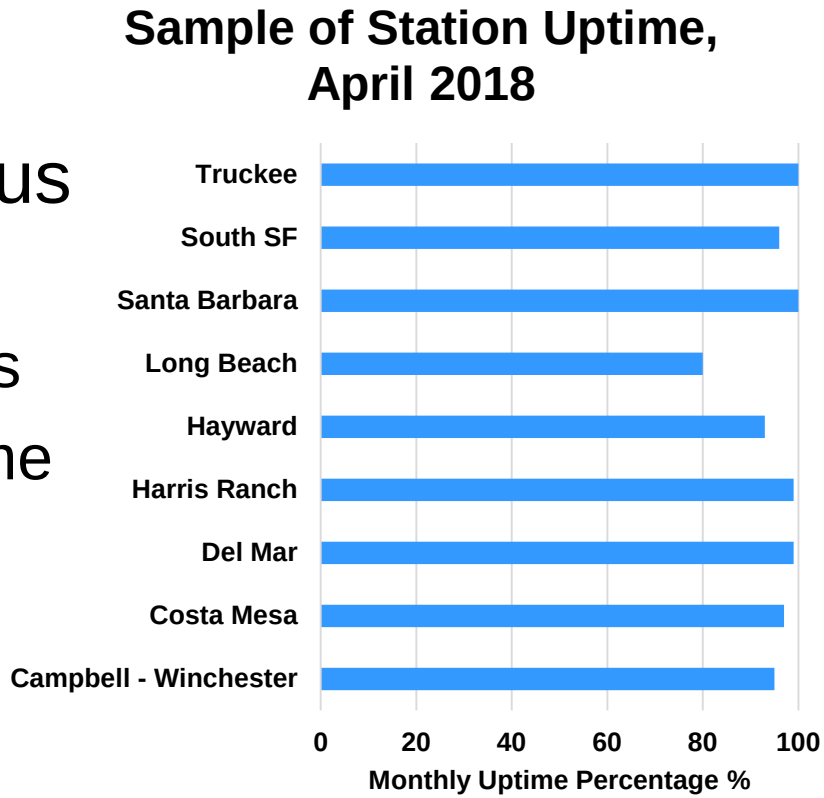
- NREL Composite Data Products on Hydrogen Stations
  - Deployment
  - Safety
  - Maintenance and Reliability
  - Performance
  - Cost
  - Utilization
  - Hydrogen Quality
  - Component Energy



Quantitative Assessment of Station and Network Performance

CaFCP Station Operational Status System (SOSS)

- Current Status
- Monthly Uptime
- Submitted by developer



Qualitative Assessment of Station Development

- Energy Commission Critical Project Review (CPR)
  - Budget and deliverables
- FCEV driver community

Exhibit A-1

Citrus Heights

Schedule of Products and Due Dates

Task Number	Task Name	Product(s)	Due Date
1.1	**Attend Kick-off Meeting**		
		Updated Schedule of Products	8/14/2017
		Updated List of Match Funds	8/14/2017
		Updated List of Permits	8/14/2017
		Kick-Off Meeting Agenda (CEC)	8/11/2017
1.2	**Critical Project Review Meetings**		
	1st CPR Meeting	Agenda and List of Expected Participants (CEC)	8/14/2018
		Schedule for Written Determination (CEC)	8/21/2018
		CPR Report(s)	7/30/2018
		Written determination (CEC)	TBD
	2nd CPR Meeting	Agenda and List of Expected Participants	4/19/2019
		Schedule for Written Determination	4/26/2019
		CPR Report(s)	4/5/2019
		Written determination (CEC)	TBD
1.3	**Final Meeting**		
		Written documentation of meeting agreements	5/29/2020
		Schedule for completing closeout activities	5/29/2020
1.4	**Monthly Progress Reports**		

Streamlined Administration, Local Planning, and Permitting

- Partner with the Governor's Office of Business and Economic Development
  (GO-Biz) to provide station developer assistance
  - Permitting Guidebook
  - Outreach to local officials
  - Community outreach

Gia Brazil Vacin,
GO-Biz, Project Manager

- Coordinate with other government agencies in California working on hydrogen transportation and local mobility services

Tyson Eckerle,
GO-Biz, Deputy Director

Conclusions

- Straw proposals on funding, areas, and quantitative and qualitative analyses.
- Significant collaboration needed, public/private sector.
- Timing of Draft Solicitation Concepts are estimates.
- Future discussions about solicitations, outlook, funding, and short and long term hydrogen supply are very important.

Electric Vehicle Charging Infrastructure Strawman Concepts for All Electric Vehicle Sectors

Supporting Existing Electric Vehicle Deployments and Providing Charging System Advancements To Drive Market Growth

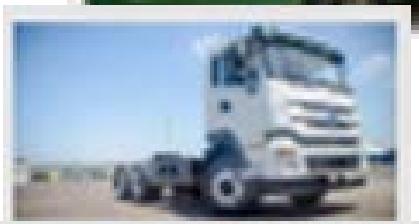
Electric Vehicle Infrastructure

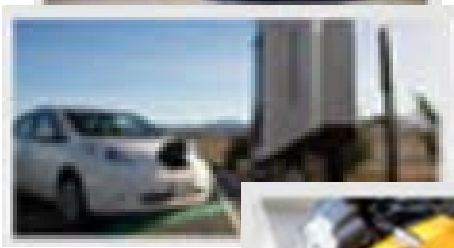
- *Analytics*
  - Modeling and analysis
- *CALeVIP*
  - Targeted projects based on requirements at local level
- *Competitive Solicitations*
  - Targeted projects based on application/technology needs statewide
- *Directed Projects*
  - Targeted projects based on defined problems that need additional support

Plug Count of ARFVTP Charging Installations

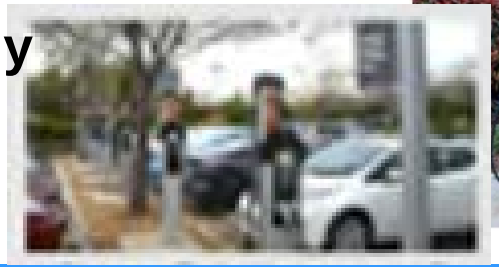
	Private Installations		Publicly Accessible Installations				Total
	Single-Family Residential	Private Fleet	Multiunit Dwelling	Commercial	Workplace	DCFC	
Installed	3,936	107	327	2,570	263	94	7,297
Planned (under construction)	0	0	18	741	161	461	1,381
Subtotal	3,936	107	345	3,311	424	555	8,678
Private/Public Subtotal	4,043		4,635				8,678

Infrastructure Projects





Electric vehicle projects have ranged from motorcycles to heavy-duty freight



But charging infrastructure has primarily been deployment of commercially available systems for light-duty cars

Electric Vehicle Infrastructure Projection tool or EVI-Pro

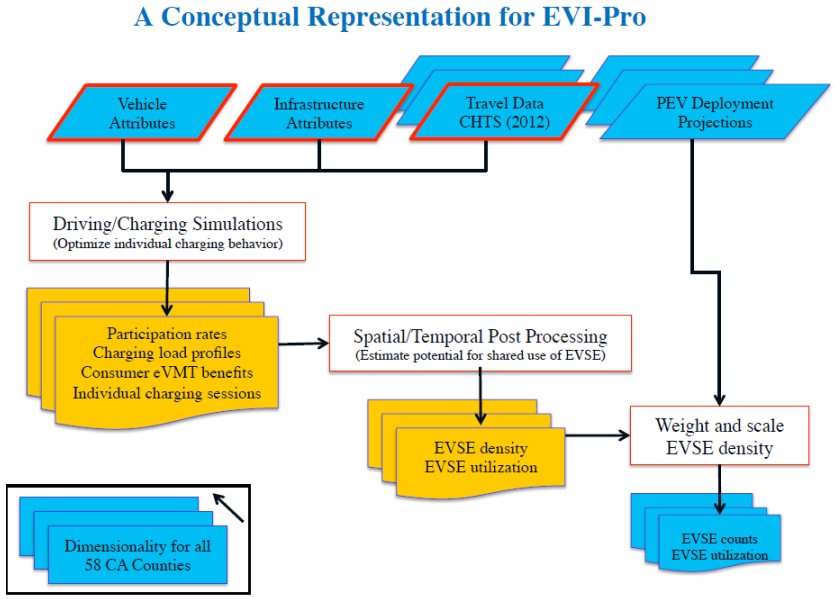
Very simply put, EVI-Pro analyzes plug-in electric vehicle infrastructure needs by modeling the “optimum” range of number of chargers needed at the local level.

- If existing charger numbers are below the modeled range, then the area has a gap.
- Conversely, if existing charger numbers are above the modeled range, then the area does not have a gap.

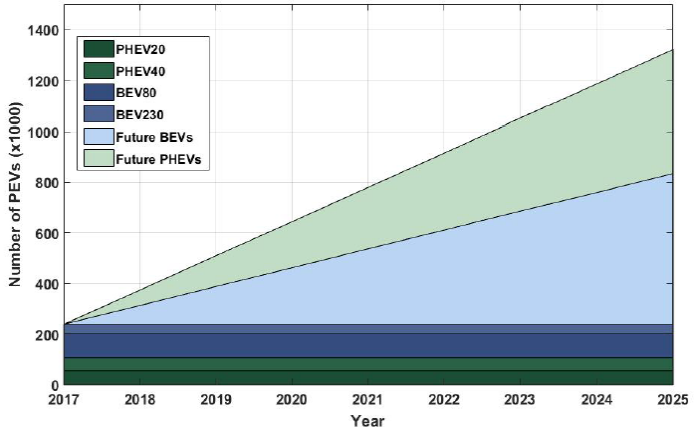
What is the optimum number of chargers for the local area?

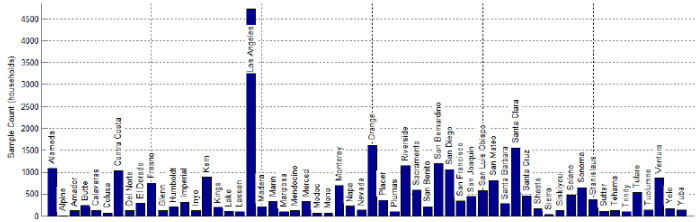
Somewhere within the range.

Conceptual Representation of EVI-Pro



Electric Range and Charger Power Level Projections			
PHEVs	**(As-of-2017)**		**(By 2025)**
Electric Range (miles):	29.6	→	40.0
Residential L2 (kW):	3.6	→	4.9
Destination L2 (kW):	3.6	→	4.9
BEVs	**(As-of-2017)**		**(By 2025)**
Electric Range (miles)	121.8	→	210.0
Residential L2 (kW)	6.6	→	11.4
Destination L2 (kW)	6.6	→	6.6
Fast Charging (kW)	50.0	→	105.0





Electric Vehicle Infrastructure Projection tool or EVI-Pro

Currently, EVI-Pro is designed to address two primary objectives, based on the premise that the vehicle is being used in place of an ICE. The charging infrastructure:

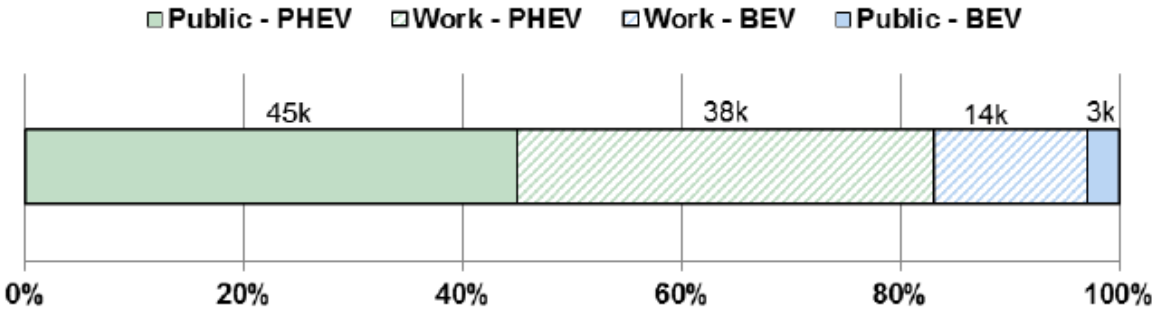
1. Enables travel for battery-electric vehicles and
2. Maximizes electric-vehicle miles of travel for plug-in hybrid-electric vehicles.

EVI-Pro uses statewide travel data from the 2010-2012 California Household Travel Survey.

The travel behavior of electric vehicle drivers is representative of mainstream drivers, not early adopters.

Conceptual Representation of EVI-Pro

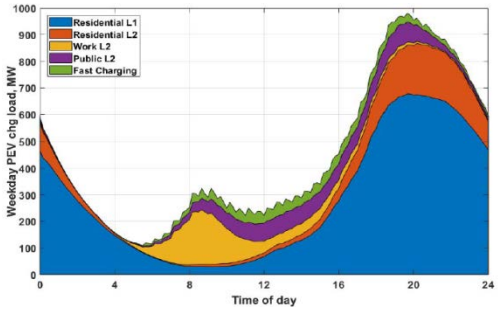
Statewide Demand for Destination Chargers by PEV Type by 2025



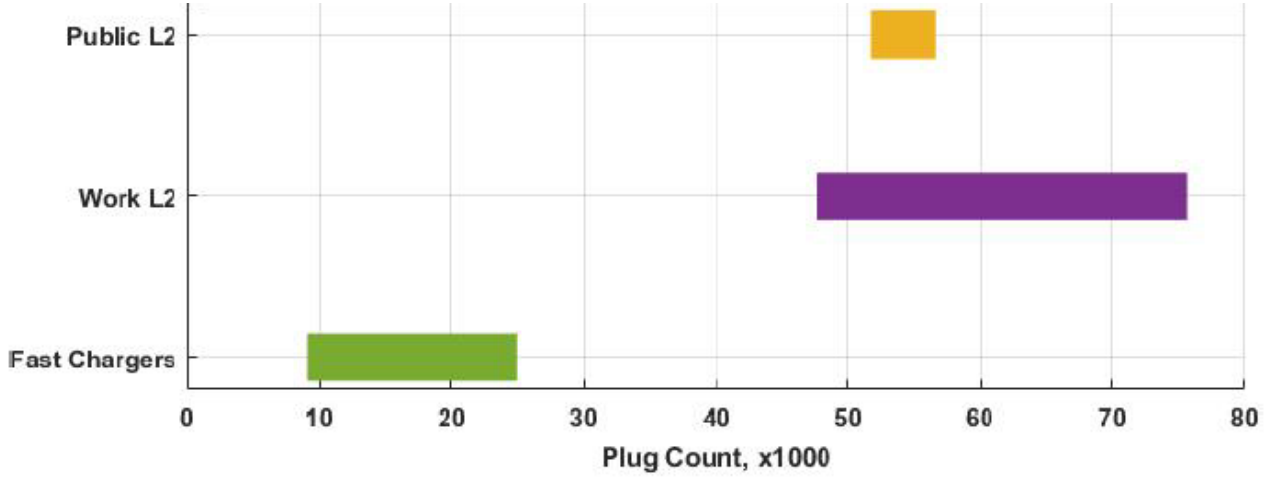
Location Fuel Price Sensitivity

Demand for L2 Destination (Workplace and Public) Chargers (The Default Scenario)			
	Total PEVs	Lower Estimate (Chargers)	Higher Estimate (Chargers)
As of 2017	239,328	21,502	28,701
By 2020	645,135	53,173	70,368
By 2025	1,321,371	99,333	133,270
Demand for DC Fast Chargers (The Default Scenario)			
	Total BEVs	Lower Estimate (Chargers)	Higher Estimate (Chargers)
As of 2017	133,446	2,005	5,877
By 2020	356,814	4,881	13,752
By 2025	729,150	9,064	24,967

Statewide Aggregated Electricity Load for a Typical Weekday



Ranges for Statewide Charger Demand by 2025



Electric Vehicle Infrastructure Projection tool or EVI-Pro

Staff Report: ***California Plug-In Electric Vehicle Infrastructure Projections: 2017-2025,*** *Future Infrastructure Needs for Reaching the State's Zero-Emission-Vehicle Deployment Goals*

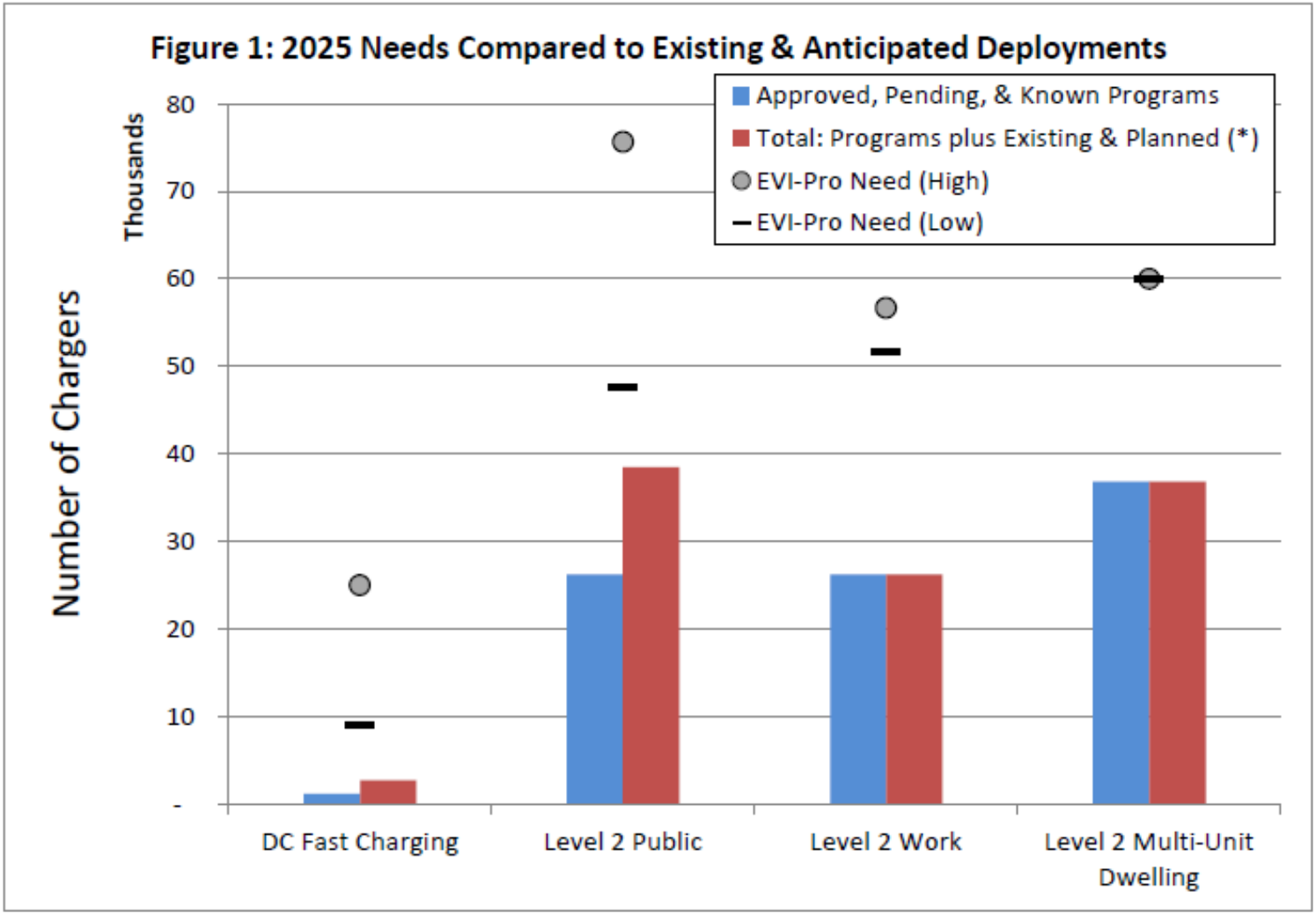
Goals identified in EO B-48-18 – construction and installation of 250,000 chargers, including 10,000 DC fast chargers.

Preliminary analysis indicate that public agencies and the private sector will need to exceed those numbers "to put at least 5 million zero-emission vehicles on California roads by 2030."

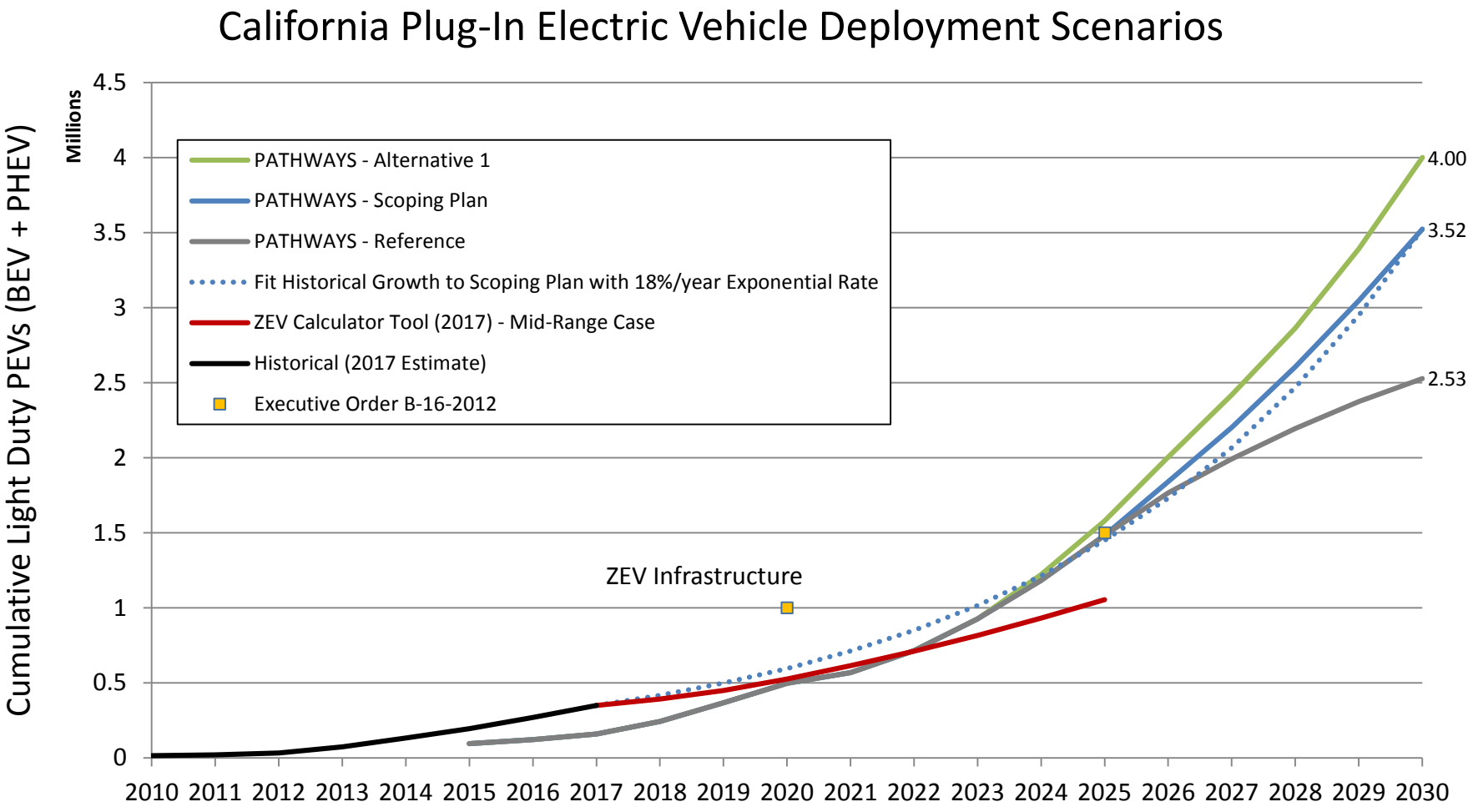
Total number needed to support 2025 goal ranges from 229,000 to 279,000.

Light-Duty Vehicle Charging Need by Currently Available Type

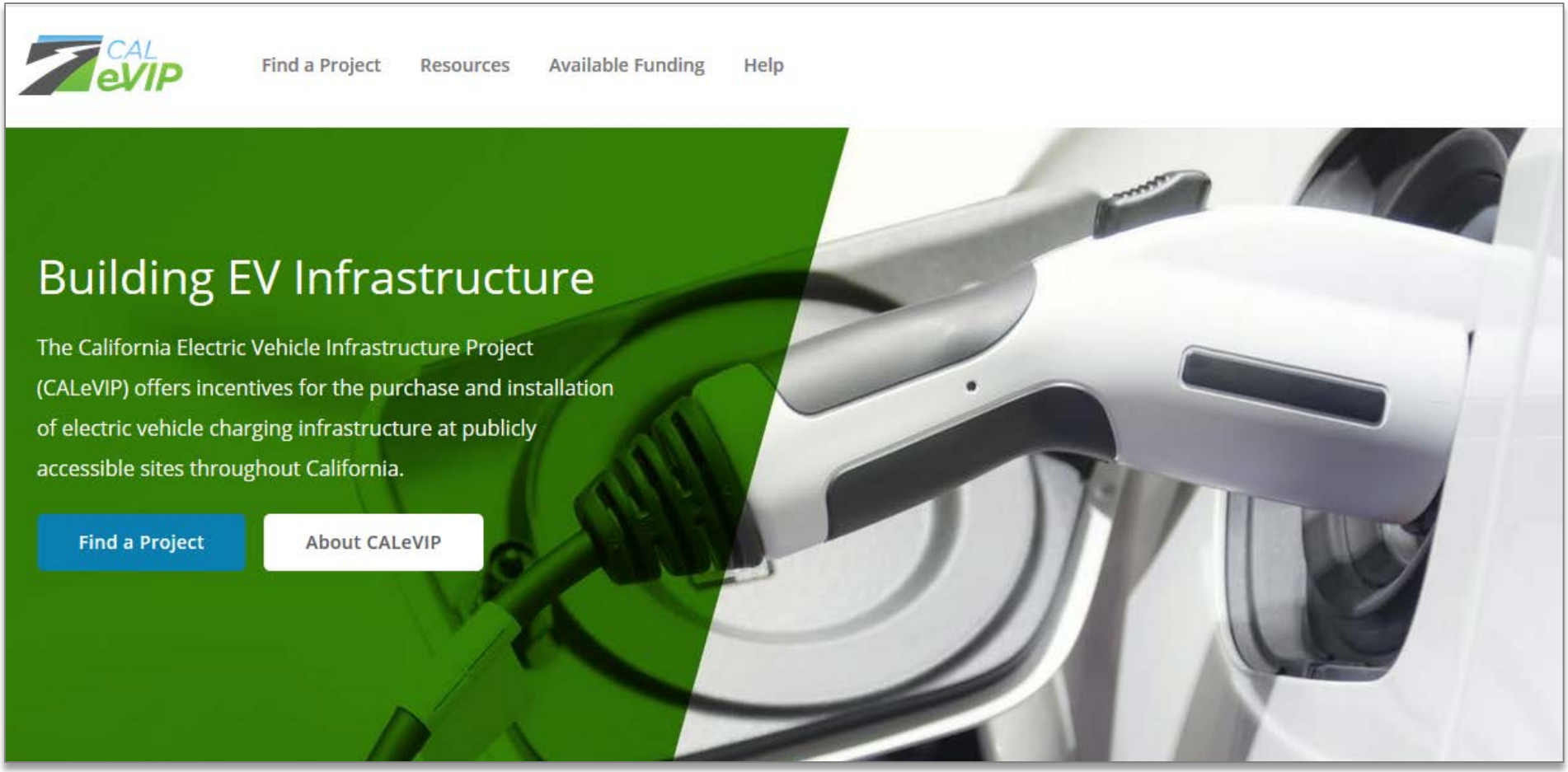
$0.96B to $2.89B = total gap in additional investments needed before 2025



Installations Must Accelerate to Meet Targets

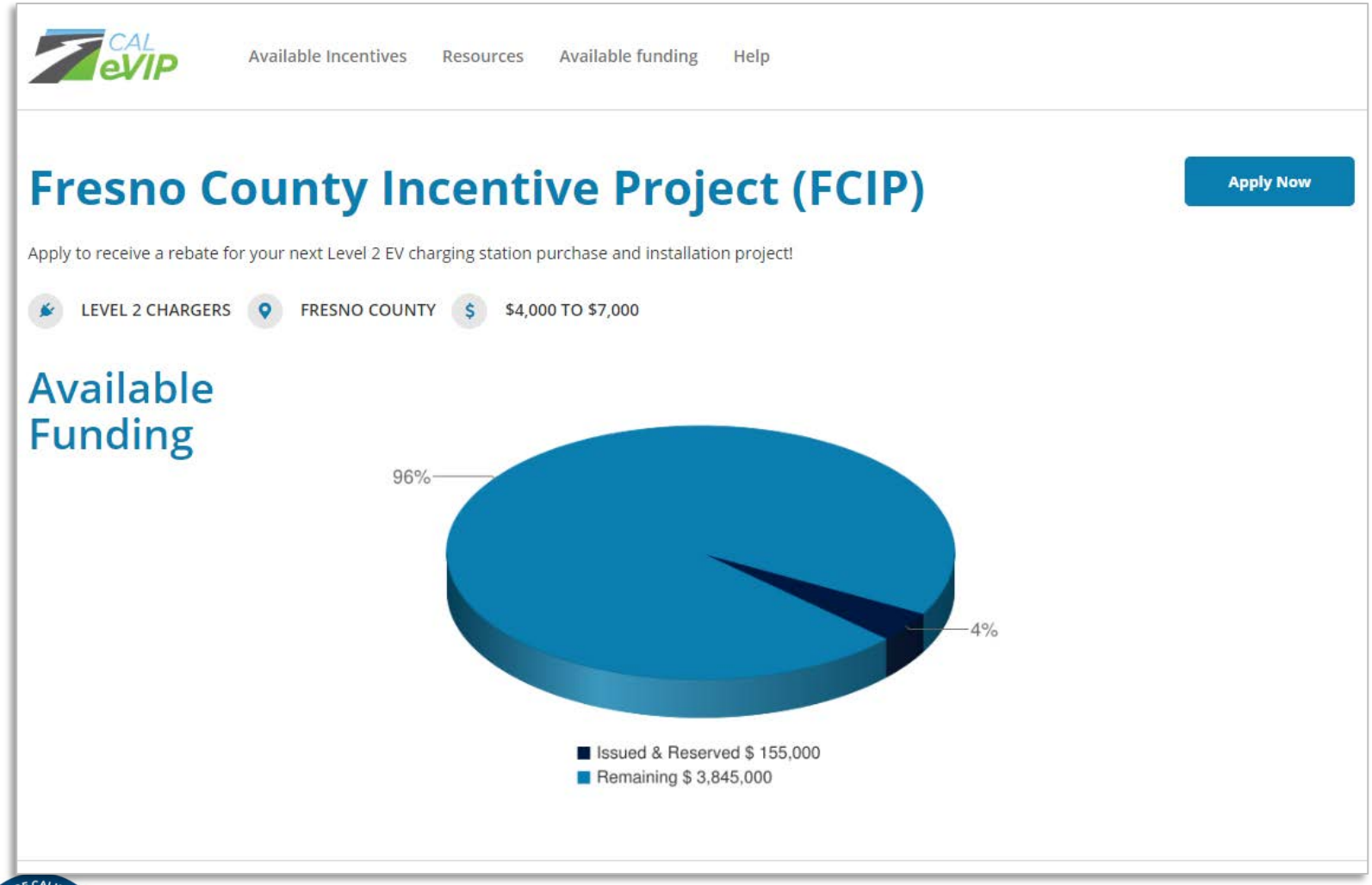


California Electric Vehicle Infrastructure Project



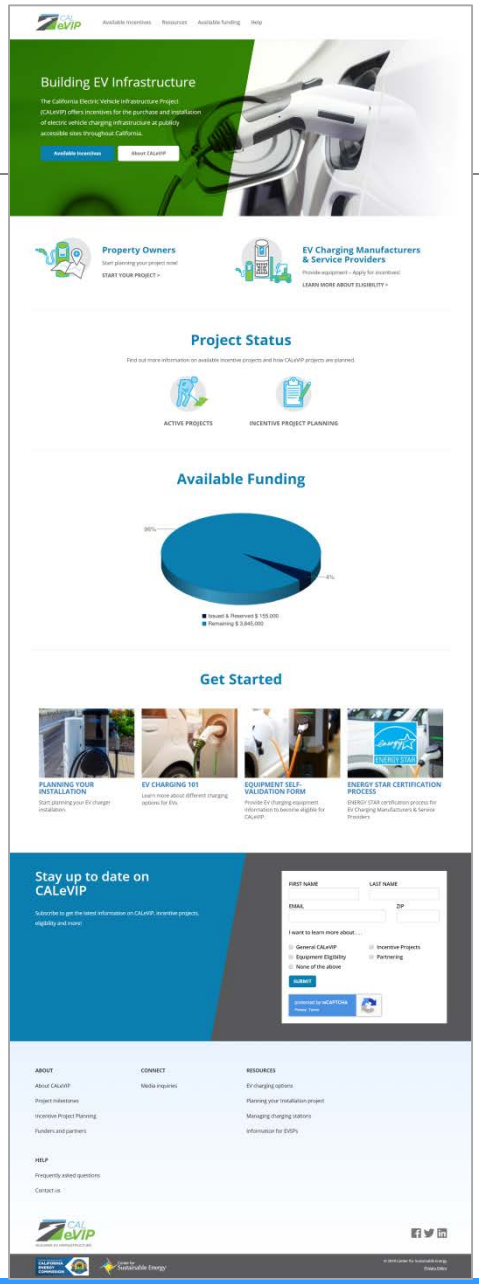
www.CALeVIP.org

Fresno County Incentive Project

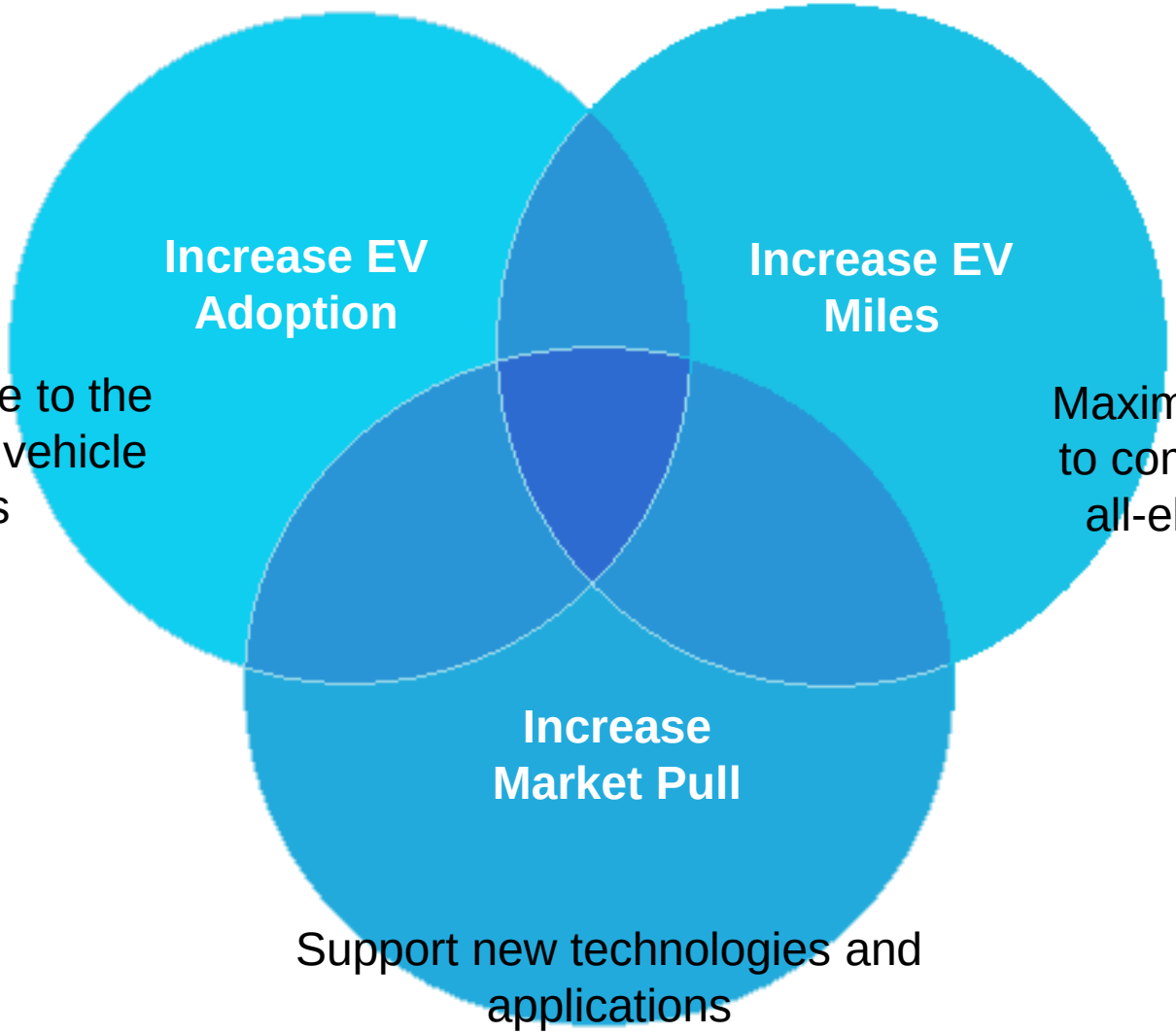


Southern California Incentive Project (July/August 2018)

- $29 million available
- Eligible Counties
  - Los Angeles
  - Orange
  - Riverside
  - Parts of San Bernardino
- DCFC stations
- Up to $80,000 per charger
- New or Replacement installations
- 1 year installation



Goals of New Infrastructure Investments for All Vehicle Weights



Be responsive to the needs of the vehicle buyers

Maximize the ability to complete trips in all-electric mode

Support new technologies and applications

Use CALeVIP to Support Charging for Wider Range of Vehicles

Light Duty Personal Vehicles

- Continue multiple rebate projects
- Install commercially available chargers targeted specifically tailored to local needs

Light-/medium-duty fleets

- Expand projects to install commercially available charging systems for fleets

Heavy-duty/freight

- Expand projects to install commercially available charging systems

Competitive Solicitations

- Infrastructure support for heavy-duty vehicles
  - Specific key highway corridors to support freight
  - Key junction, resting, or home areas

- New technologies and applications
  - Sidewalk/lamp post chargers
  - Automated garages
  - Charging plazas including charging at hydrogen refueling stations
  - Autonomous vehicle charging
  - Storage based and off-grid charging systems

- Support for car/ride sharing, ride hailing, “first/last mile” travel, Uber/Lyft, EV use in rural areas

Competitive Targeted Solicitations for Prescriptive Applications

GRANT FUNDING OPPORTUNITY

Alternative and Renewable Fuel and Vehicle Technology Program

DC Fast Chargers for California's North-South Corridors

GFO-15-601
www.energy.ca.gov/contracts/index.html
State of California
California Energy Commission
July 2015

GRANT FUNDING OPPORTUNITY

Alternative and Renewable Fuel and Vehicle Technology Program

DC Fast Chargers for California's Interregional Corridors

GFO-15-603
www.energy.ca.gov/contracts/index.html
State of California
California Energy Commission
February 2016

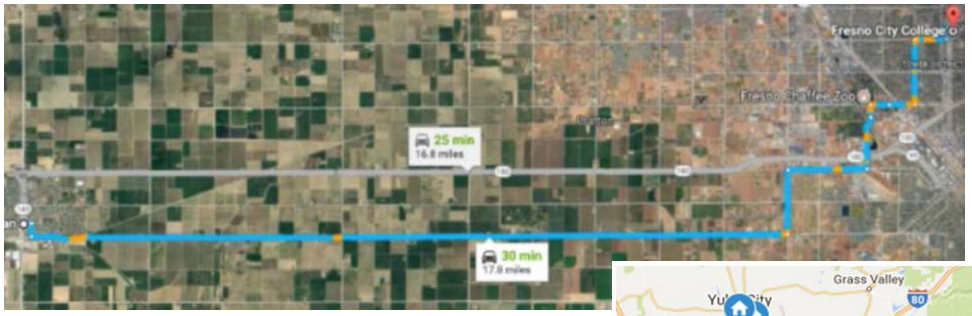
Competitive Targeted Solicitation
Where Scope is Narrow & Potential Applicants Broad

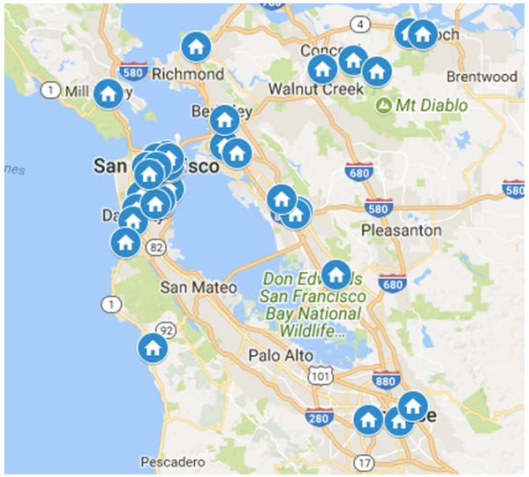
GRANT FUNDING OPPORTUNITY

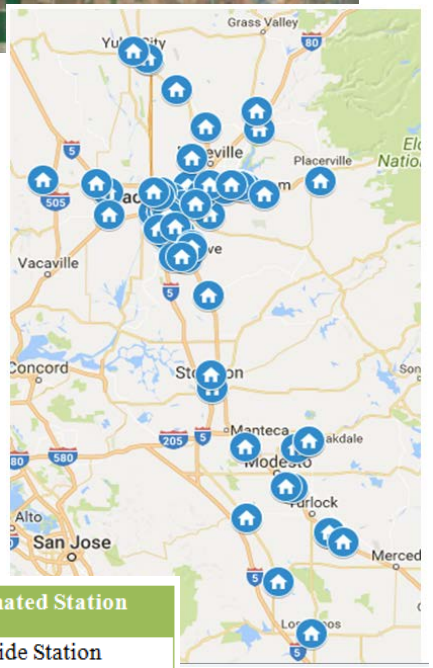
Alternative and Renewable Fuel and Vehicle Technology Program

Innovative Mobility Service Demonstrations with Zero-Emission Vehicles

GFO-16-605
www.energy.ca.gov/contracts/index.html
State of California
California Energy Commission
March 2017







Number of Vehicles	County	Address	Designated Station
5	Riverside	1084 Columbia Ave, Riverside, CA 92507	Riverside Station
2	Riverside	3751 Vine St, Riverside, CA 92507	Riverside Station
8	San Bernardino	1850 Holt Blvd Ontario, CA	Ontario Station

Competitive Targeted Solicitations

- Infrastructure installations specifically for heavy-duty vehicles

- Commercially available systems
  - Charging plazas or charging dedicated to heavy-duty vehicles along key freight travel corridors
    - Similar in concept to West Coast Electric Highway

- Pilot projects located at strategic areas or home-base
  - Existing technologies in a new application
  - New technologies or charging systems out of development but not quite fully commercial – taking it through the “valley of death”
  - Late development/early demonstration technologies
  - Applied research

Charging Plaza Configurations for Light- to Heavy-Duty Vehicles

Example is Tesla charging plaza in Florida. Picture is used to illustrate concept of drive-through, parallel positioning of chargers.

Competitive Targeted Solicitations

Where parking spaces are too valuable to the site host, would valet charging provide a cost effective solution?

Competitive Targeted Solicitations

New technology and applications

- Sidewalk charging systems
- Chargers at lamp posts in parking areas
- Charging at automated garages
- Charging plazas
  - Include EV charging when hydrogen refueling stations are built
  - Retrofit hydrogen refueling stations
  - Retrofit conventional fueling stations
  - New EV charging plazas that include multiple charging levels and connector types
- Autonomous charging for autonomous vehicles
- Off-grid and storage based systems

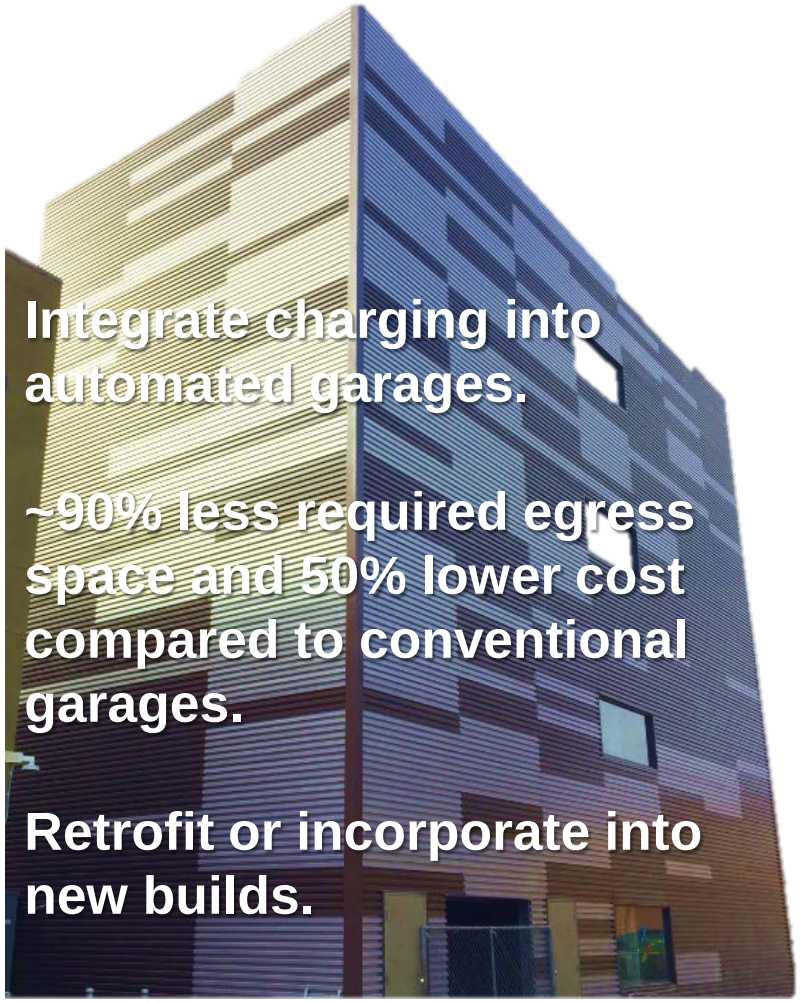
Charging Applications Using Targeted Solicitations

Integrate charging into lamp posts using electricity capacity after LED upgrades.

Example shown is Ebee Smart Technologies (Berlin, Germany).

May also use power pole or traffic signal power.

Innovative applications are too diverse to fit current modeling.



Integrate charging into automated garages.

~90% less required egress space and 50% lower cost compared to conventional garages.

Retrofit or incorporate into new builds.

Charging Applications Using Targeted Solicitations

- Include EV charging when hydrogen refueling stations are built
- Retrofit hydrogen refueling stations

- Retrofit conventional fueling stations

- New EV charging plazas that include multiple charging levels and connector types

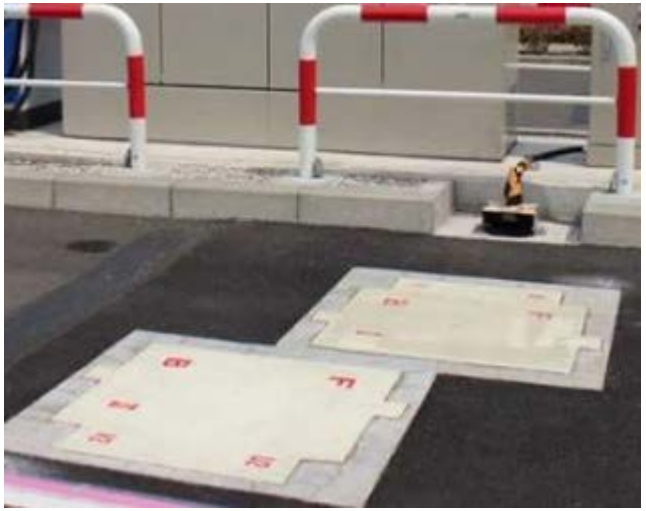
- Provide charging for autonomous vehicles/ride sharing applications

- Provide charging for ride sharing/van pooling/ride hailing and similar services for rural and DACs

Charging Applications Using Targeted Solicitations

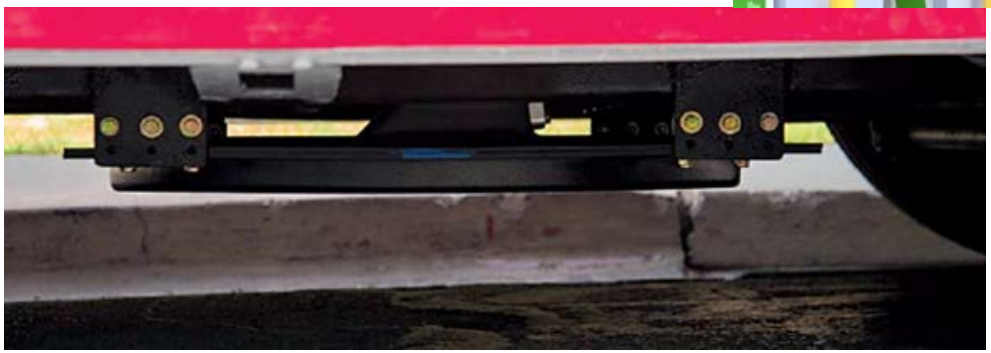
Wireless systems used in transit applications

Toshiba



Proterra Pantograph

Wave



Directed Projects

- Provide electric school bus chargers to support Proposition 39 School Bus Replacement Program

- Pilot Projects
  - “problematic” applications
  - mix of charging systems and vehicle types within a bounded area

- Support for specific ZEV readiness planning efforts

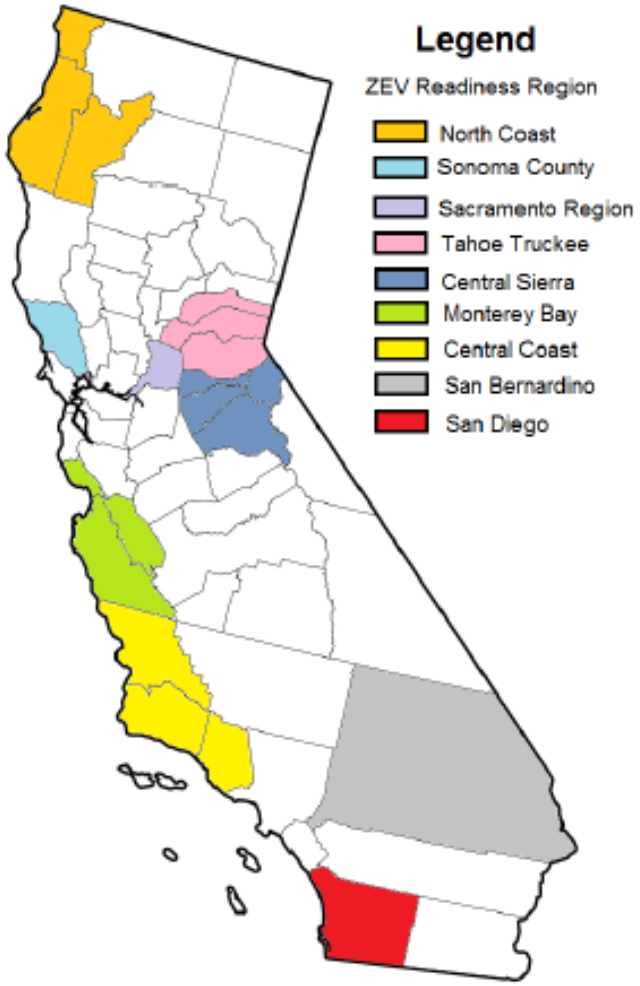
Directed Projects may be conducted using CALeVIP or targeted solicitations as the mechanism for funding.

Directed Projects




- Directed projects will require infrastructure funding commitments to be successful.
- Examples include the School Bus Replacement Program under Proposition 39 – successful deployment of electric school buses require charging infrastructure to be deployed ahead of or along with the buses.
- Electric school buses deployed under other funding programs may be underfunded for charging infrastructure.

Directed Projects



Support for ZEV readiness plans and the EV Ready Communities Challenge

I

GRANT FUNDING OPPORTUNITY

Alternative and Renewable Fuel and Vehicle Technology Program

Electric Vehicle (EV) Ready Communities Challenge Phase I – Blueprint Plan Development

GFO-17-604
www.energy.ca.gov/contracts/index.html
State of California
California Energy Commission
December 2017

Public Discussion

Adjournment

#18-HYD-01

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