



NUGVE

We Make Electric Vehicles Greener
... and less expensive

California Facts

World's 6th largest economy; Population 39 million; in Bay Area 7 million

Home of Tesla, Google, Facebook, Apple, Twitter

Solar

208 terawatt-hours (TWh) ; 25 TWh from solar PV, with slightly more than 1/3 of that coming from distributed generation. Another 2.4 TWh from concentrating solar power - 13% of the electricity generated in California in 2016.

Wind

13,000 Wind turbines; 5,662 megawatts (MW); 13,500 GWh/year - 6.81% of production

California Facts – Electric Vehicles

		U.S.	California	California as percent of U.S.
General	Population	326 million	39.5 million	12%
	Gross domestic product	\$19.4 trillion	\$2.75 trillion	14%
	Light-duty vehicle sales in 2016	16.2 million	2.0 million	12%
Electric vehicles	New 2017 electric vehicles	193,000	96,000	50%
	Cumulative 2010–2017 electric vehicles	749,000	366,000	49%
Electric vehicle public charging	Level 2 charge points	38,100	12,000	32%
	Fast charge points	6,200	1,600	25%
	Total charge points	44,300	13,600	31%

Population data from U.S. Census; income data from U.S. Bureau of Economic Analysis; vehicle registrations from IHS Automotive; public charging data from Alternative Fuels Data Center.

California has Ambitious Goals

This will in turn help to achieve California's energy goals:

Executive Order B-55-18 - Governor Brown has set a target of reaching **5 million ZEVs** on California roadways by 2030.

Senate bill 350 – Clean Energy and Pollution Act of 2015 (Statutes of 2015) requires among others that the amount electricity generated and sold to retail customers from eligible renewable energy resources be increased by 50% by December 31, 2030.

CPUC Decision 13-10-040, “Decision Adopting Energy Storage Procurement Framework and Design Program” policies and mechanisms for energy storage procurement were established with achieving a target of **1,325 megawatts** of energy storage by 2020.

CEC - Electric Program Investment Charge (EPIC) Program

The Electric Program Investment Charge (EPIC) Program was created by the California Public Utilities Commission (CPUC) in December 2011 to support investments in clean energy technologies that provide benefits to the electricity ratepayers

EPIC funds will provide approximately **\$162 million annually from 2012-2020** primarily to address policy and funding gaps related to the development, deployment, and commercialization of next generation clean energy technologies.

Intelligent Electric Vehicle Integration (INVENT)



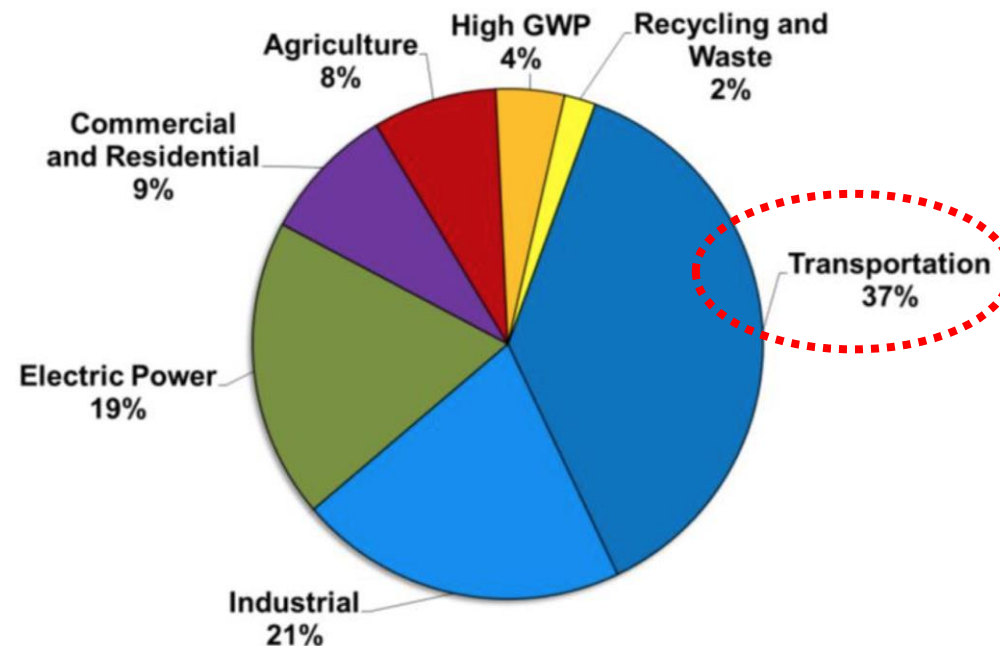
November 27, 2018

INVENT Presentation to Parker

Electrification of Transport Sector is Required for Deep De-carbonization

California CO₂ (in %) from Transport sector almost same as in Denmark

Figure 4. 2015 GHG Emissions by Sector*



Source: EPA - Total Emissions in 2016 = 6,511 [Million Metric Tons of CO₂ equivalent](#)

California – Goal 5 Million Zero-Emission Vehicles by 2030

Impact on Electricity Grid*:

- 300 GWh additional battery capacity
- 50 GW potential extra peak power (same as today's CA peak power of 50 GW)

Impact on Oil industry:

- 2,500,000,000 Gallons of petroleum-derived fuel saved yearly

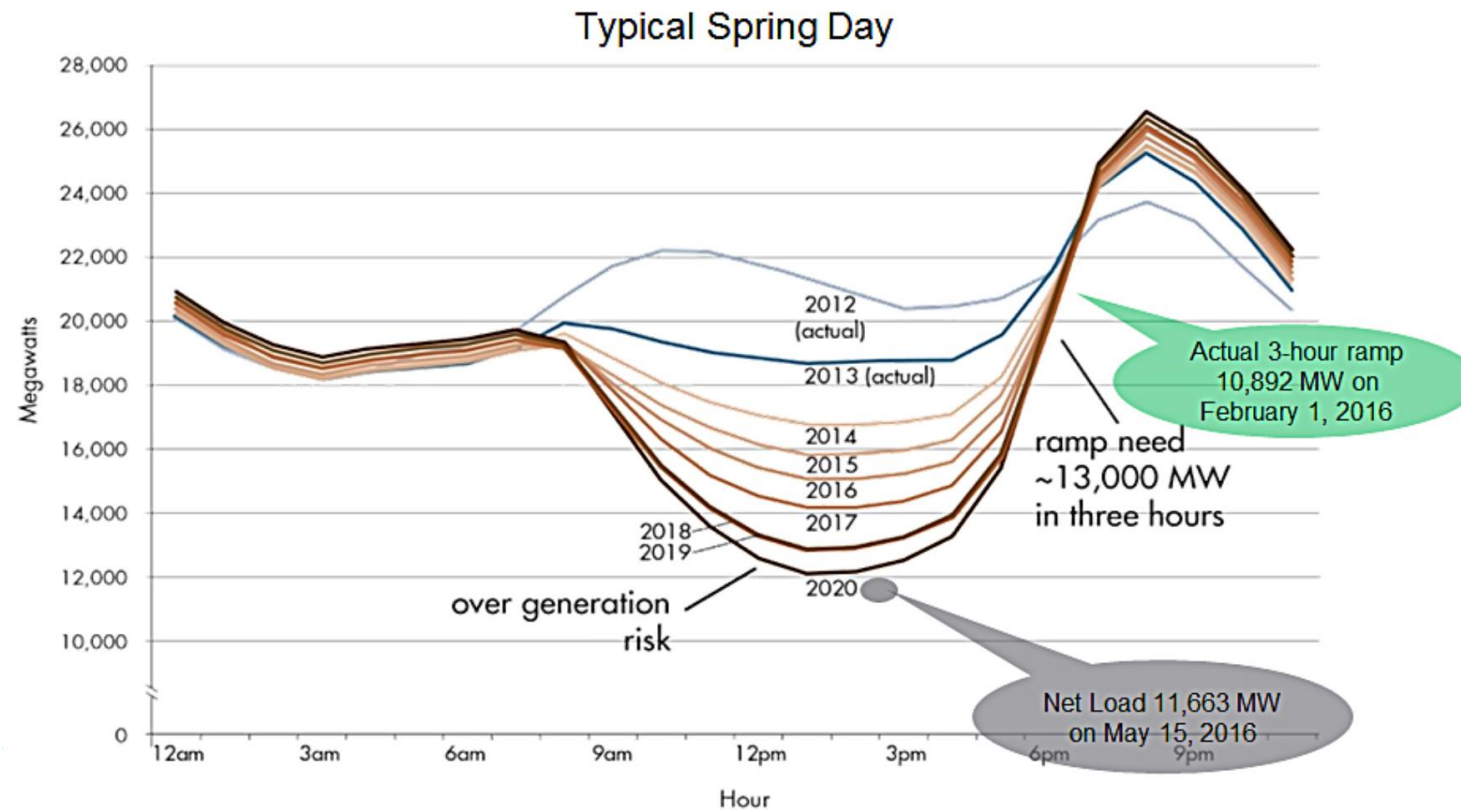
Impact on Environment:

- 23,000,000 tons of CO₂ saved yearly

* Assuming 60 kWh EV battery and 10 kW charging

Lots of Solar - The Duck Curve Becomes A Problem

Steep ramping and overgeneration risk



The Duck Curve – 2020 Ramping 13,000 MW in 3 hours

Equivalent to ...

13 Nuclear power plants



4,300 Wind turbines

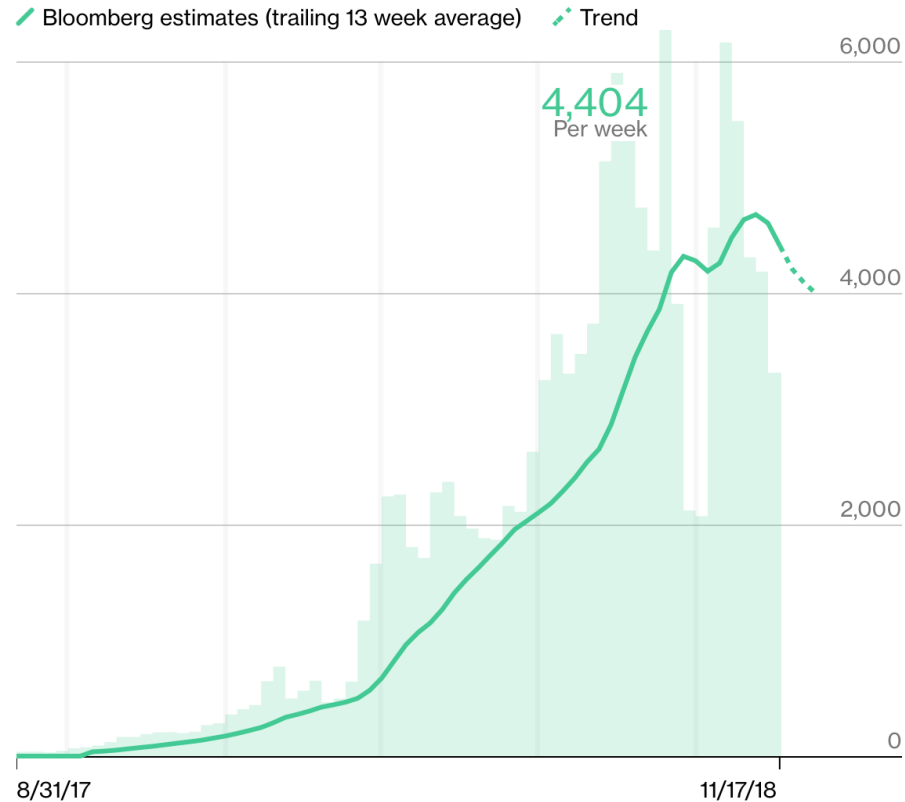


1,300,000 EVs



Something Is Happening In California

Weekly Model 3 Production Rate

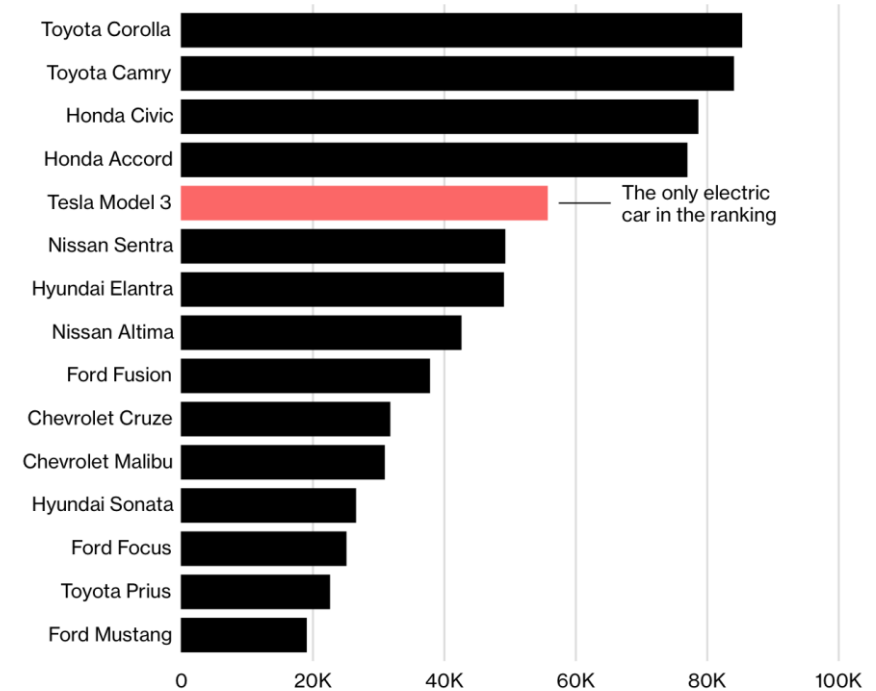


Source: Bloomberg

Tesla Breaks Into America's Top 10

Tesla Breaks Into America's Top 10

The Model 3 electric car ranked among the best-selling sedans of the third quarter

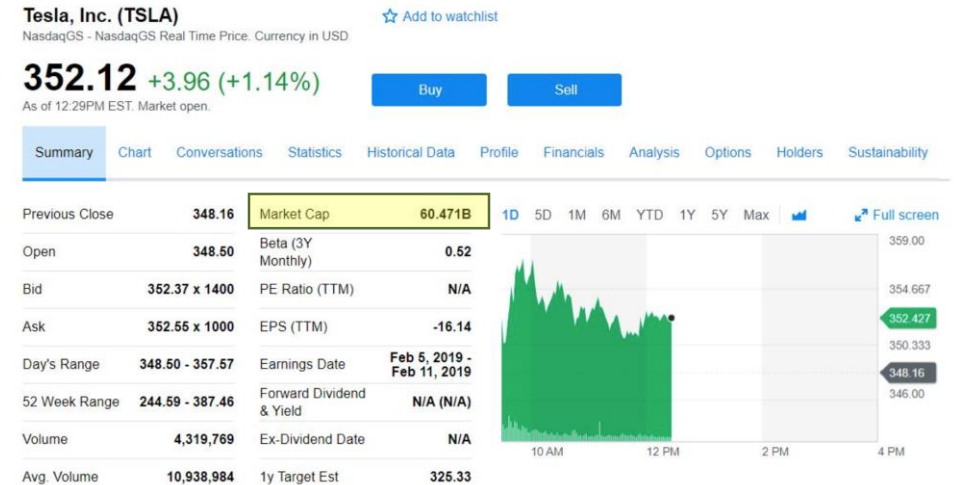
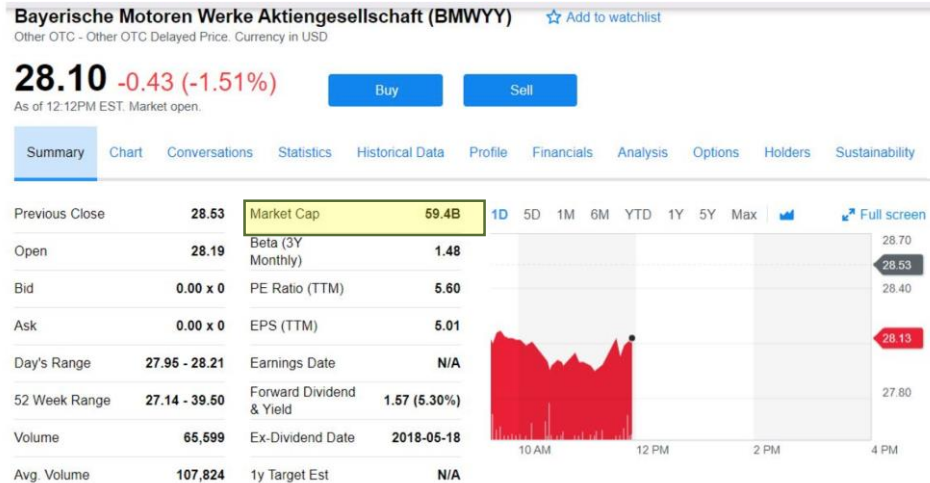


Source: Bloomberg, company filings

Note: Tesla's Model 3 tally includes some deliveries in Canada

Something is happening In California

Tesla now has a higher market cap than BMW



INVENT Project Overview

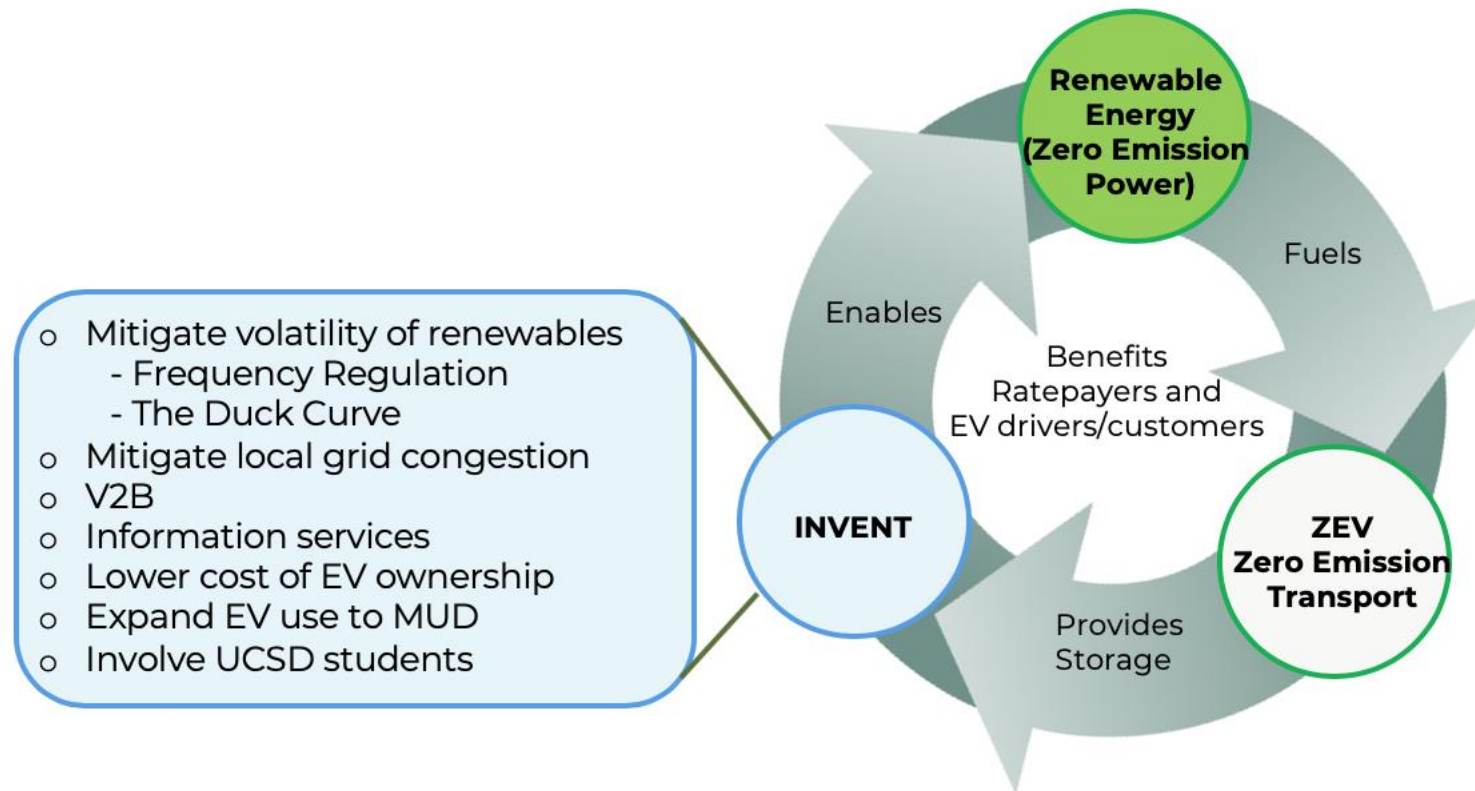
Timeframe	October 2017 to December 2020
Total budget:	\$7,897,744
CEC Funds:	\$ 4,200,000
Match Funds:	\$ 3,697,744

INVENT Project Goals

Demonstrate solutions that yield and quantify
multiple real-world benefits of advanced
vehicle-grid integration **(VGI)** applications for
electric vehicle fleets
and

Pave the way for commercial deployments in California

INVENT



INVENT Project - Overview

Project Lead



Launching Platform



Partners



Infrastructure Partners

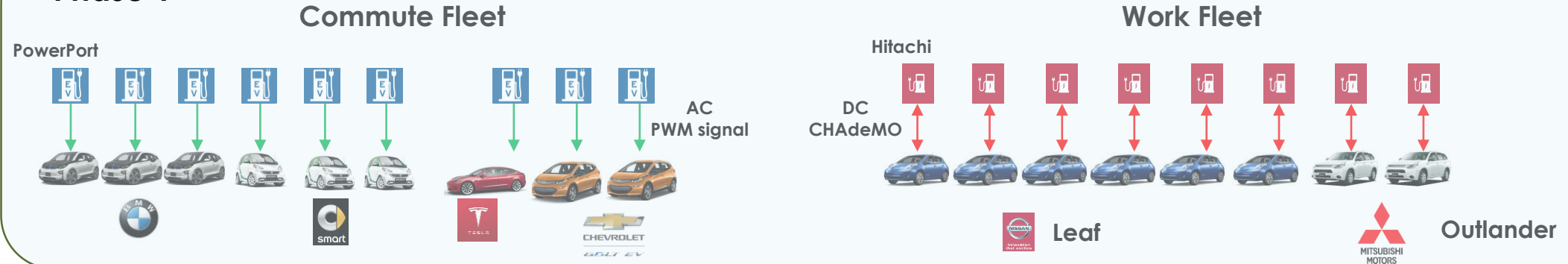


EV OEMs



INVENT Phase 1-3 Fleet Configuration

Phase 1



Phase 2 & 3

+ up to 30 EVSEs/EVs
+ MUD + Car-sharing

Construction

Phase 1 Start: February 2018



Phase 1 Construction Completion: June 2018

The UCSD Campus – Host For The INVENT Project



Commonly Held View of Cape Canaveral As a Single Launch Pad



Actual Aerial of Cape Canaveral With Multiple Launch Pads

**UCSD Microgrid serves as
launching pad for
multiple California projects**



The Grid Taxonomy

UCSD Microgrid



69kV



CA Electric Grid



Electricity, heating, and cooling for 1,200 Acres campus with a daily population of 45,000.

Supplying 85% of campus electricity needs, 95% of its heating, and 95% of its cooling.

UCSD Microgrid – Sandbox As Small Version Of CA Grid

UCSD Microgrid



~45 MW



1000 X 45 MW

CA Electric Grid

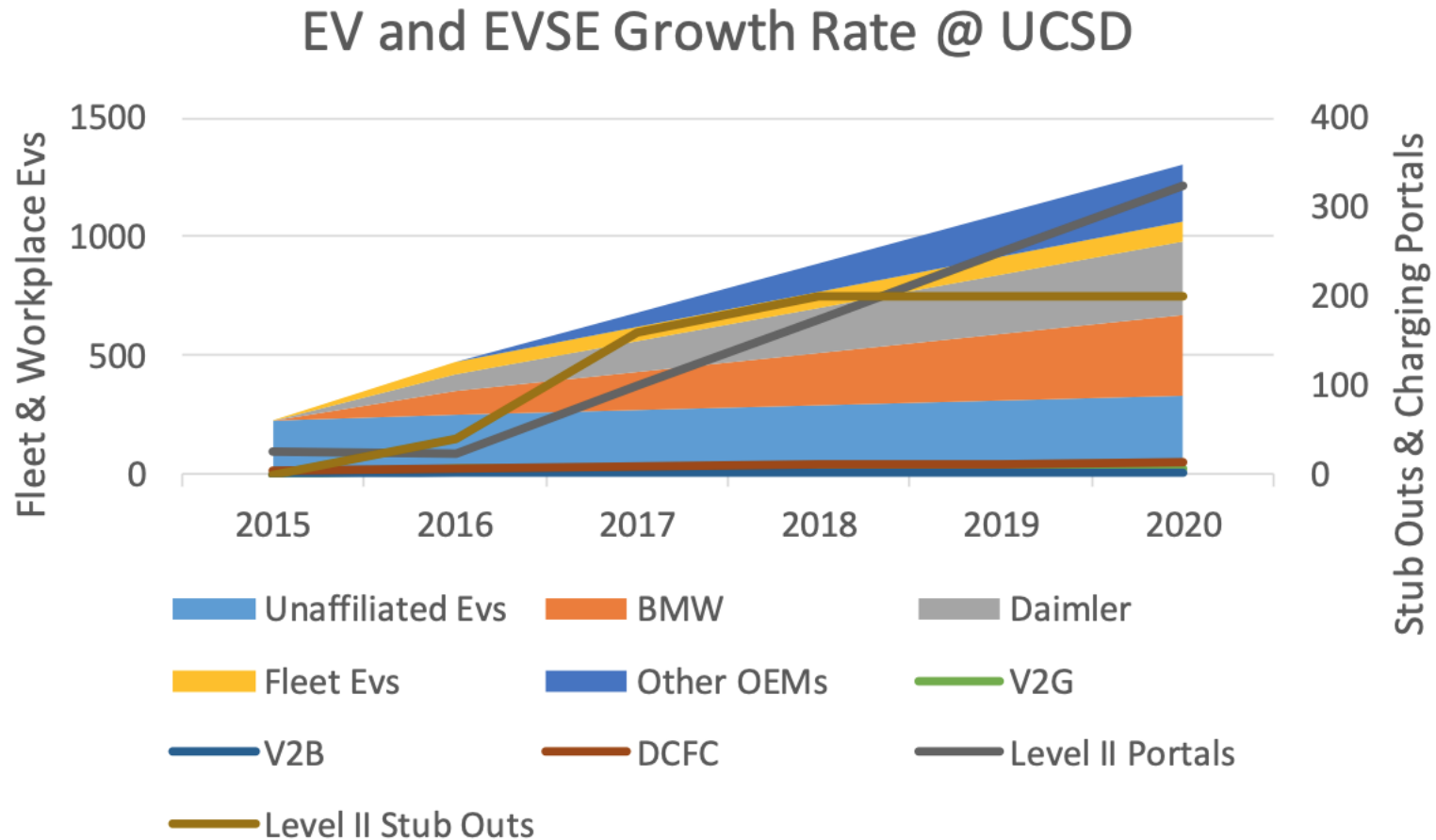


California ISO Peak Load History
1998 through 2017

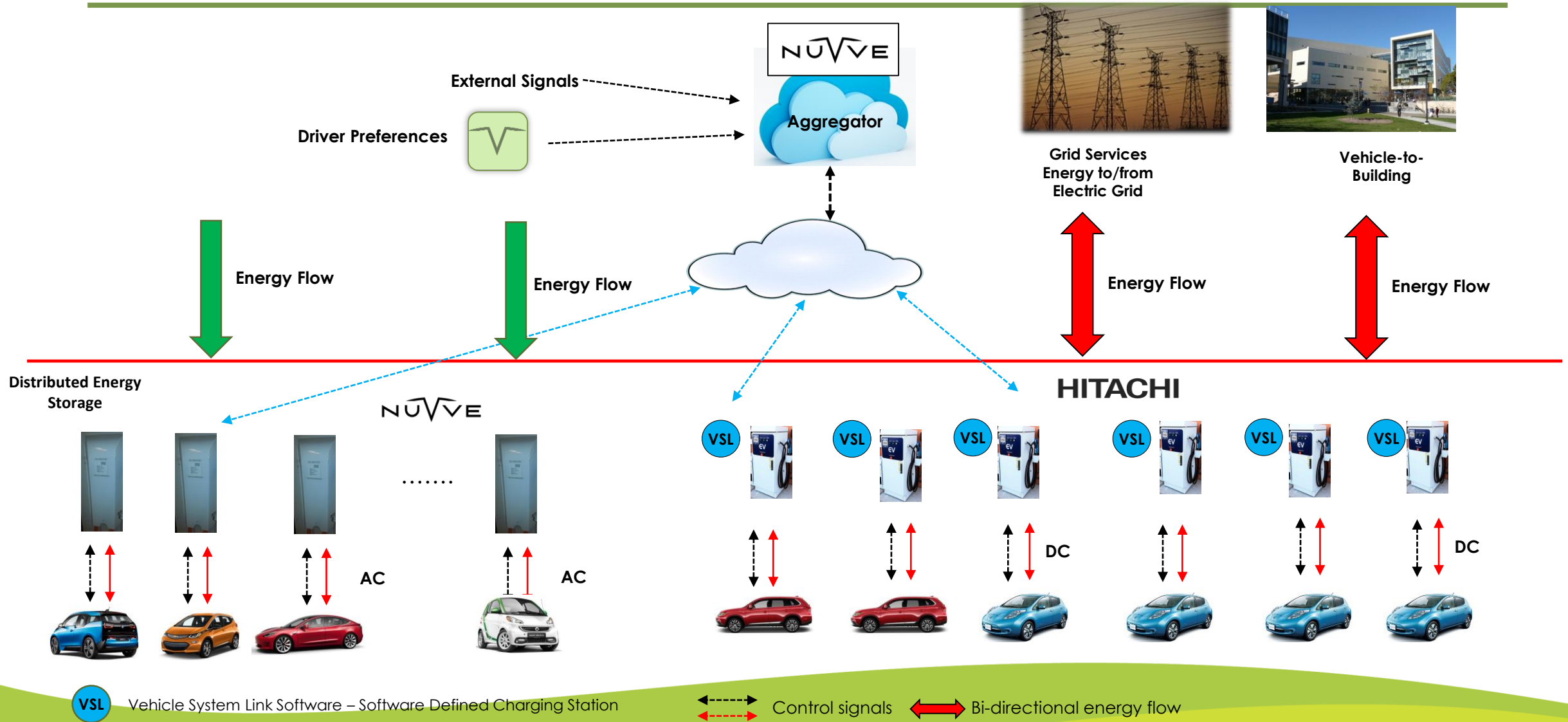
Year	Megawatts at Peak Load*	Date	Time
1998	44,659	August 12	14:30
1999	45,884	July 12	16:52
2000	43,784	August 16	15:17
2001	41,419	August 7	16:17
2002	42,441	July 10	15:01
2003	42,689	July 17	15:22
2004	45,597	September 8	16:00
2005	45,431	July 20	15:22
2006	50,270	July 24	14:44
2007	48,615	August 31	15:27
2008	46,897	June 20	16:21
2009	46,042	September 3	16:17
2010	47,350	August 25	16:20
2011	45,545	September 7	16:30
2012	46,846	August 13	15:53
2013	45,097	June 28	16:54
2014	45,089	September 15	16:53
2015	46,519	September 10	15:38
2016	46,232	July 27	16:51
2017	50,116	September 1	15:58

*This value is an instantaneous MW value at the time specified in the Time column

UCSD – Growth of EVs and EVSEs

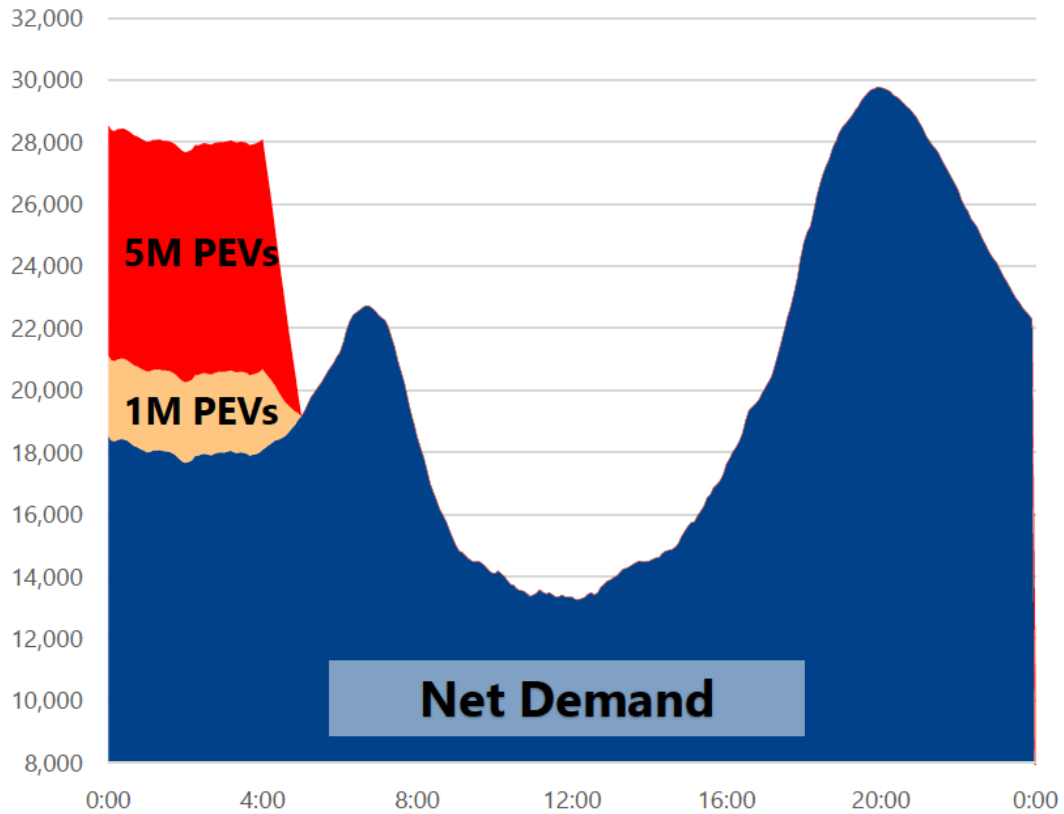


INVENT Architecture

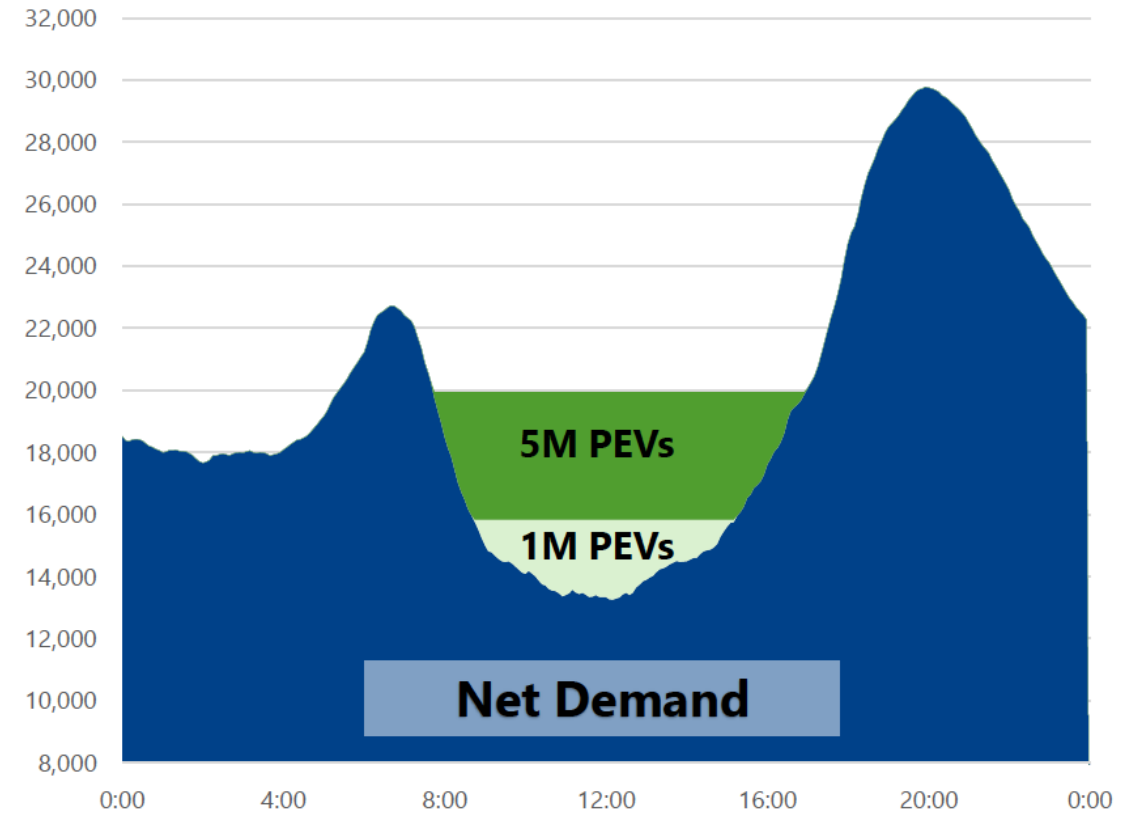


The Case for Workplace Charging

100% Home Charging

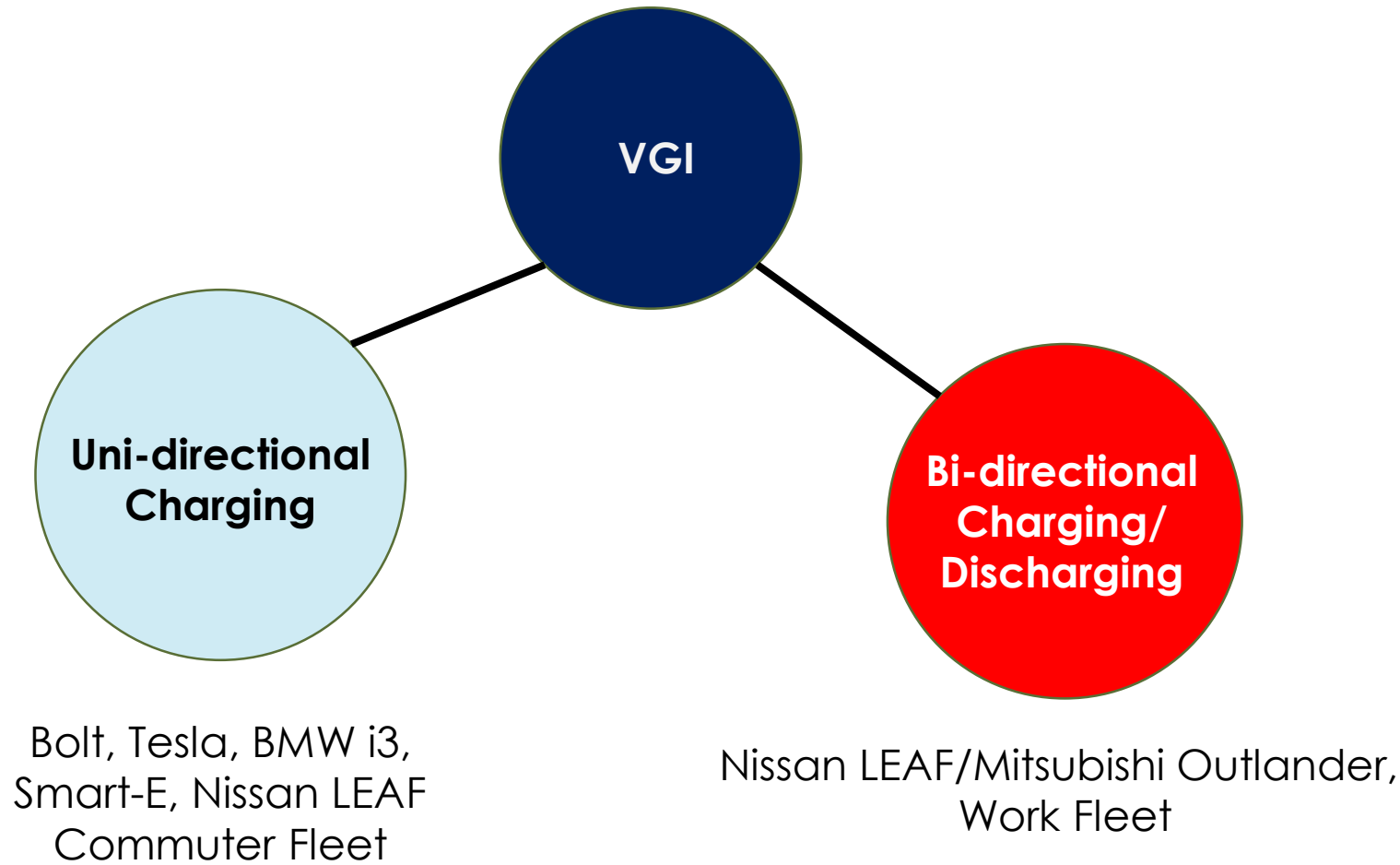


100% Work Charging



Source: EDF RE

Service Taxonomy



VGI Services & Evaluation



Demand Response

Distribution-level
(SDG&E Reduce
Your Use Events)

Transmission-level
(CAISO Flex
Alerts)



Vehicle-to-Building

Demand Response

Peak Shaving

Multi-Unit Dwelling
Application



CAISO AGC Signal Simulation

LA AFB Historical
Signal Dispatch

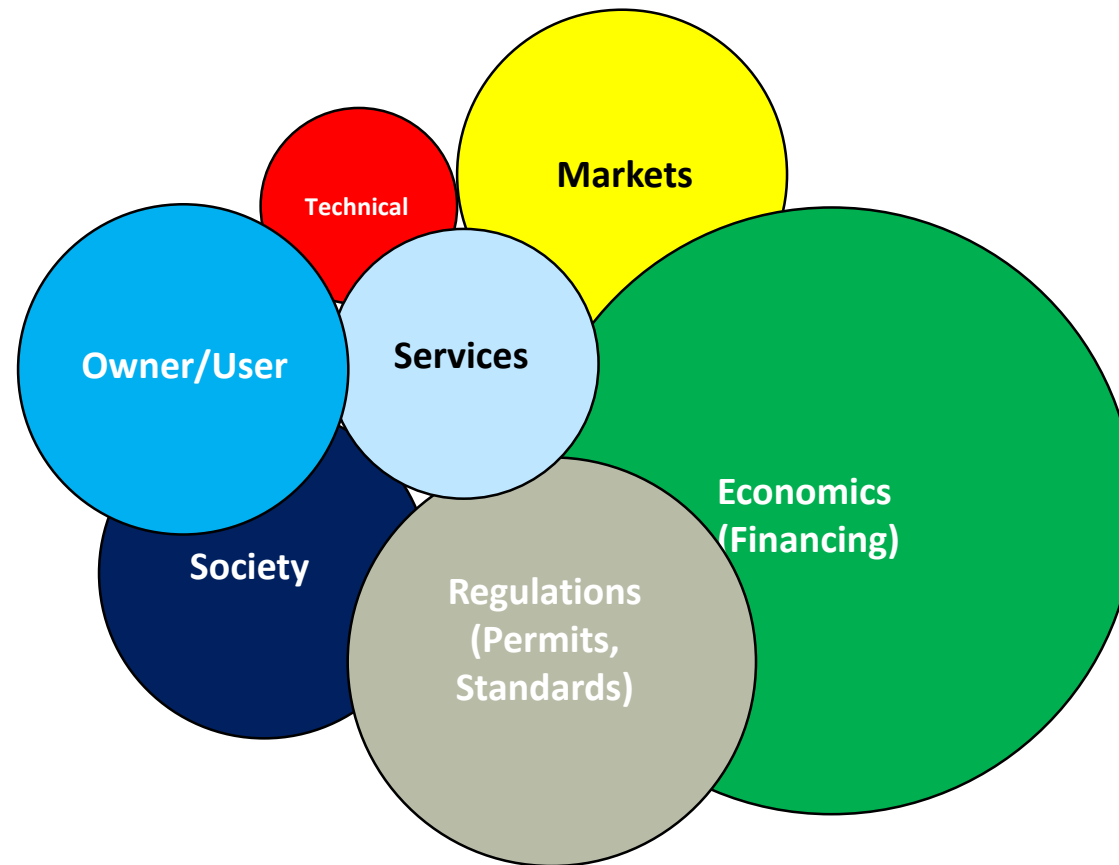


Renewable Energy Time Shifting

Real-time

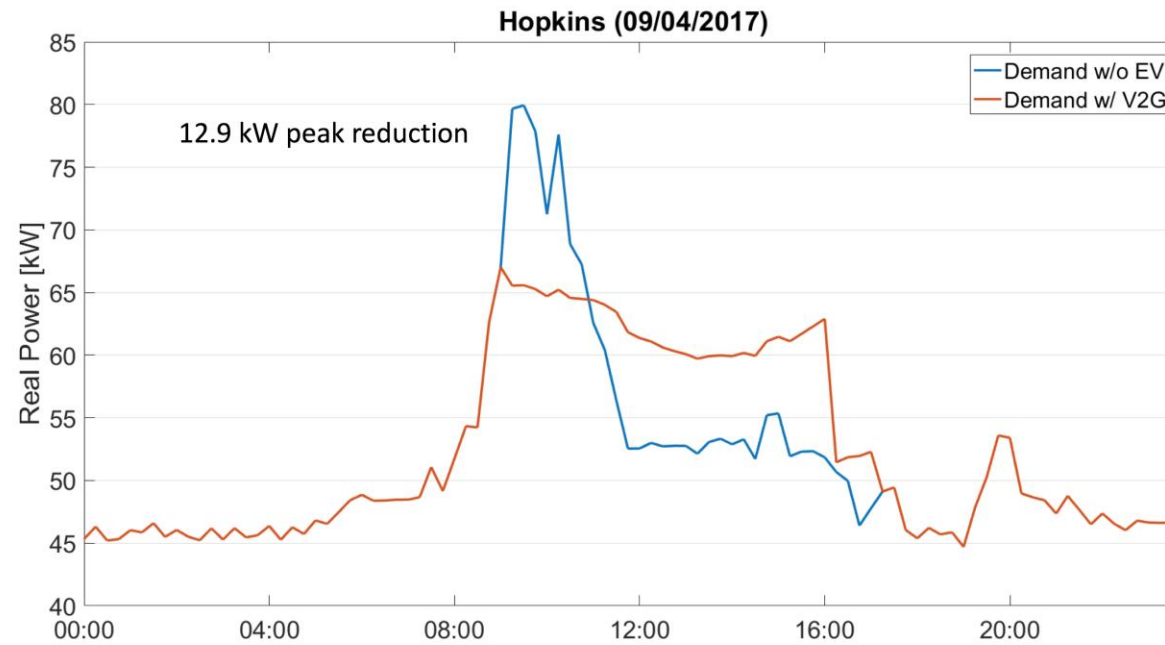
Forecast

Services evaluation In 6 dimensions



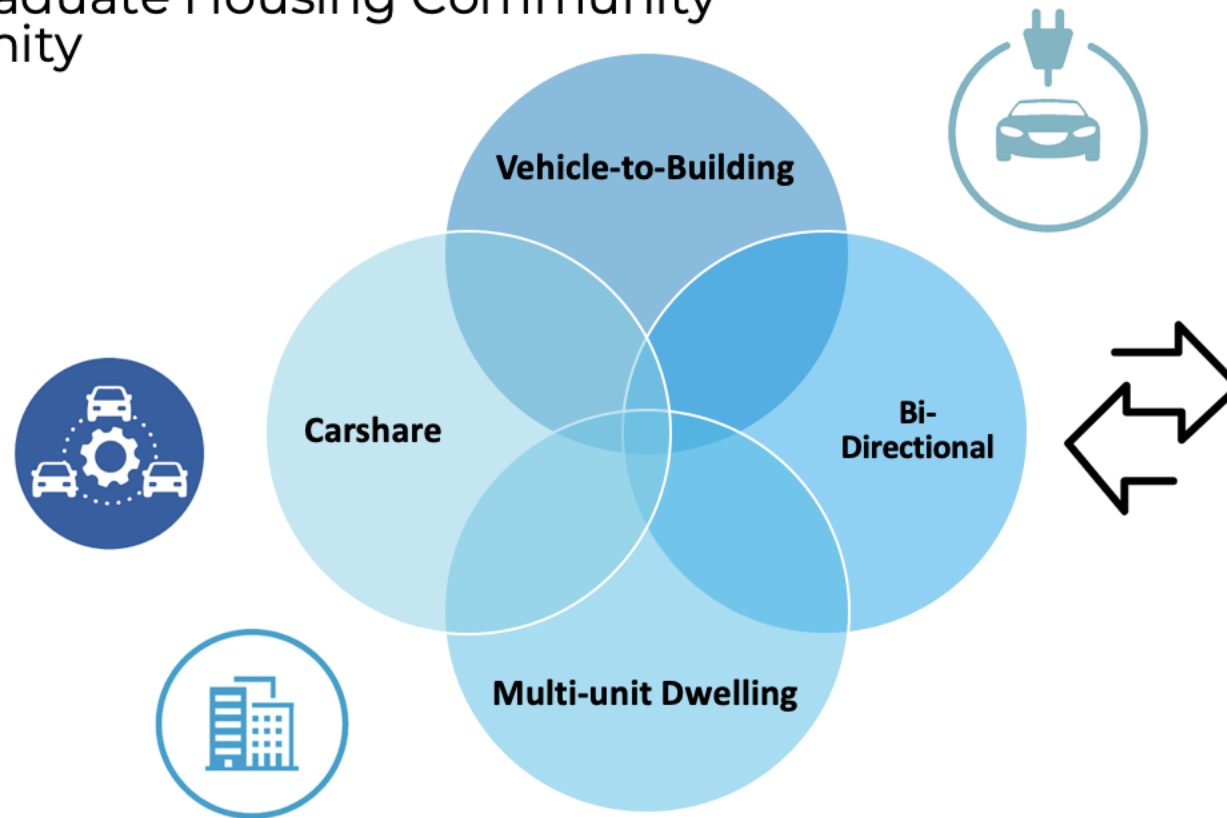
UCSD – Demand Charge Simulation

Demand Reduction



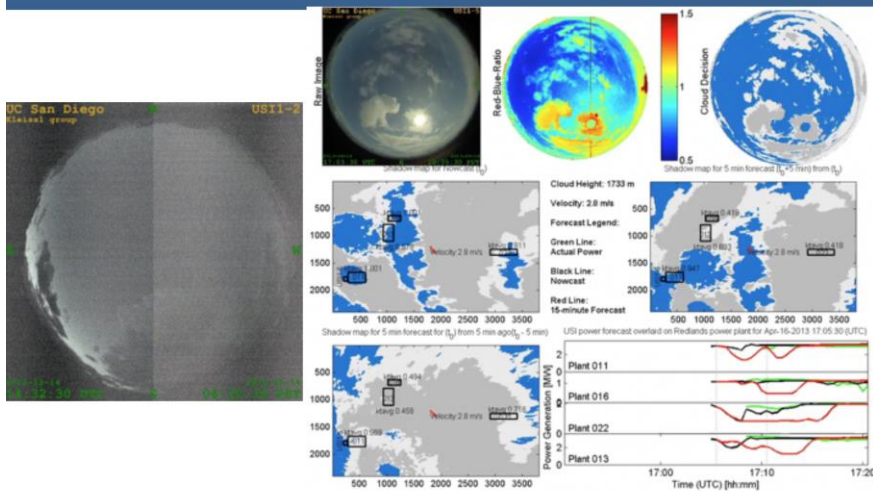
Vehicle-to-Building

UCSD Graduate Housing Community Opportunity

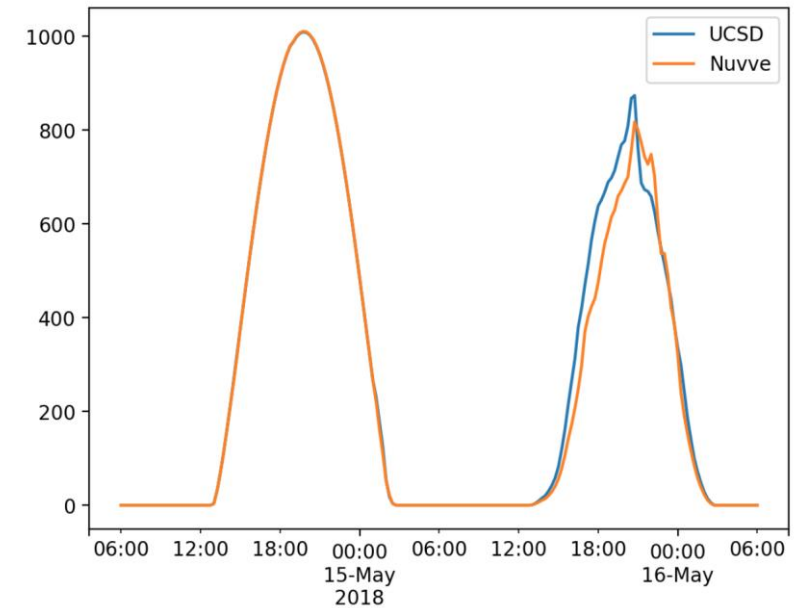


Working in Harmony With UCSD Solar Forecasting

Short term solar forecasting using sky imagery



Working in Harmony with UCSD Solar Forecasting 48 Hours Solar Forecast



Demand Response – Functional Tests

Flex-Alert (CAISO) and Reduce-your-Use (SDG&E)



NOTICE: 201802356 POSTED: 2018-07-23 09:12:00

The California ISO has issued a Flex Alert for the CAISO Grid due to high temperatures across the western U.S., high fire risk and tight gas supplies in Southern California effective Wednesday, July 25, 2018. Californians are urged to conserve electricity from July 25 at 5:00 PM to July 25 at 9:00 PM to avoid power disruptions.

A news release is pending. The ISO media hotline is (888)516-NEWS.

NOTICE: 201802355 POSTED: 2018-07-23 09:10:00

The California ISO has issued a Flex Alert for the CAISO Grid due to high temperatures across the western U.S., high fire risk and tight gas supplies in Southern California effective Tuesday, July 24, 2018. Californians are urged to conserve electricity from July 24 at 5:00 PM to July 24 at 9:00 PM to avoid power disruptions.

SDG&E triggers Reduce Your Use program amid high temperatures

BY: Jermaine Ong
POSTED: 8:03 AM, Aug 6, 2018
UPDATED: 9:20 AM, Aug 7, 2018



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SAN DIEGO (KGTV) - San Diego Gas & Electric is urging its customers to save energy as temperatures increase across the county.

The utility is activating its “Reduce Your Use” program from 2 p.m. to 6 p.m. on Tuesday. In a tweet, SDG&E said the activation was due to “forecasted record temperatures expected to drive up demand on the power grid.”

Additional Reduce Your Use days could be added later in the week.

According to SDG&E, customers who are enrolled in the program can earn a bill credit of 75 cents per kilowatt hour saved or \$1.25 credit per kilowatt hour saved with enabling technology like a smart thermostat.

Customers can reduce power consumption by using fans or ceiling fans instead of running air conditioning systems, or by setting the AC at 78 degrees, running the AC in the morning to pre-cool a residence, closing drapes and blinds, running major appliances and pool pumps outside of peak-usage hours, and either unplugging televisions, cable boxes and gaming devices or hooking them up to a smart power strip.

[Click here to learn more about SDG&E's Reduce Your Use program](#)

As of Monday morning, officials have not issued a [statewide Flex Alert](#).

During a Flex Alert, Californians are asked to conserve power if state utility officials determine there could be a potential energy supply shortage.

Demand Response – Active Participation

3 X Participation in Demand Response Alerts

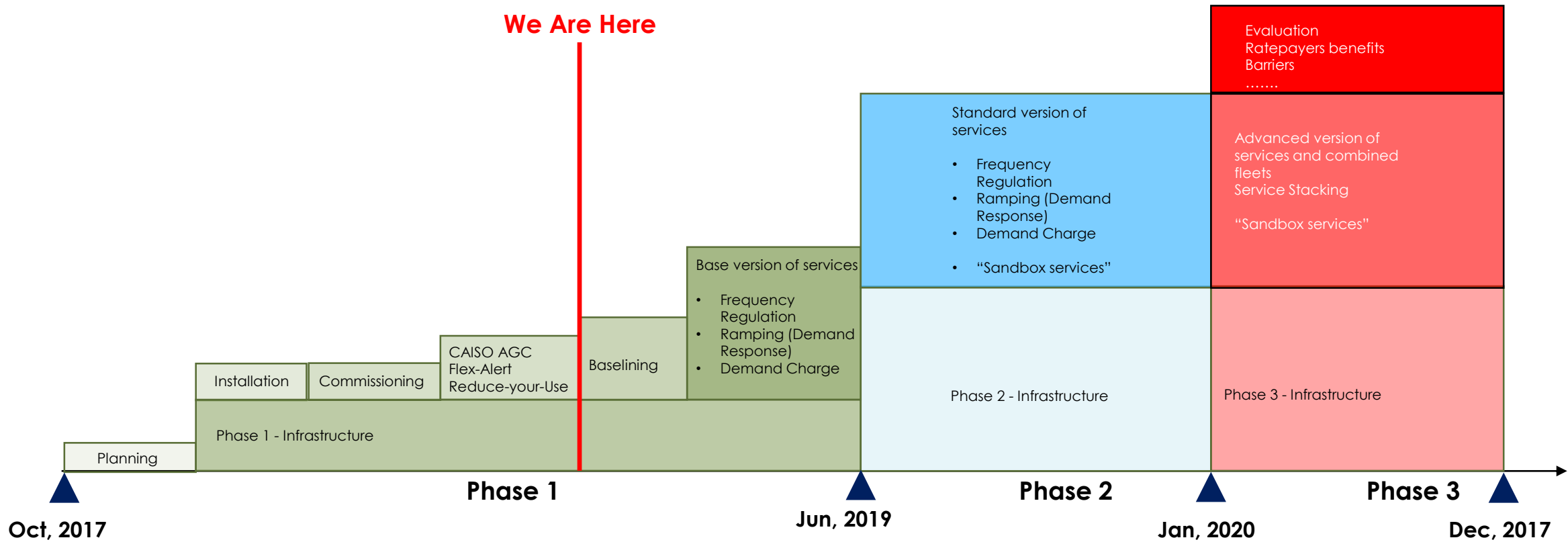
INVENT-REDUCE = (Ride the Duck Curve)

Energy was returned to the grid:

Date	Alert Type	Time	Energy	Potential Revenues*
July 24 th , 2018	Flex-Alert	17:00-21:00	63 kWh	
July 25 th , 2018	Flex-Alert	17:00-21:00	76 kWh	
August 7 th , 2018	Reduce-your-Use	17:00-21:00	75 kWh	\$93.80

* Potential revenues for participation in alert with 7 EVs. Discharged energy must be resupplied adding a cost factor

Ramping Up the INVENT Project



Winner of ESNA 2018 Mobility Award – Pasadena Nov 7, 2018



NUVVE CORPORATION, INVENT (INTELLIGENT
ELECTRIC VEHICLE INTEGRATION):
#ESNA_NUVVE
La Jolla, CA

