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SOUTHERN CALIFORNIA EDISON®

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(U 338-E)

Prepared Testimony in Support of Southern California Edison Company's Application for Approval of its Charge Ready 2 Infrastructure and Market Education Programs

Before the

Public Utilities Commission of the State of California

Rosemead, California
June 26, 2018

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I.

INTRODUCTION

Southern California Edison Company ("SCE") submits the following testimony in support of its Application for Approval of its Charge Ready 2 Infrastructure and Market Education Programs ("Charge Ready 2" or the "Application"). The Application continues the implementation of a transportation electrification pathway that SCE launched in 2014 with its Charge Ready and Market Education Programs ("Programs"), which were developed to support California's policies to reduce greenhouse gas ("GHG") and air pollutant emissions and which also help meet the State's zero-emission vehicle ("ZEV") goals. From their inception, each of these Programs was designed to be implemented in two phases: (1) a smaller-scope Phase 1 ("Phase 1 Pilot"), which would eventually prepare for, and lead to, the deployment of a broader program in (2) the Phase 2 program, which is included in this Application. In 2016, the Commission authorized the Phase 1 Pilot, to deploy "make-ready"[1] infrastructure to support light-duty electric vehicle charging and provide complementary market education about electric vehicles ("EVs") and the benefits of fueling from the grid.[2] The Phase 1 Pilot has successfully deployed 1,003 charge ports at 65 customer sites to date, and in that process met its objectives of informing and refining the design and cost estimates of the originally proposed programs, as well as developing success measures for Charge Ready 2.[3] Building upon the strength of the completed Phase 1 Pilot and recognizing that utilities are a key driving force in the acceleration of transportation electrification, SCE now proposes the broader next step of its transportation electrification program—Charge Ready 2. This request for a $760 million (2018$), four-year program will support and accelerate light-duty EV adoption, in line with California's goals of substantially reducing GHG emissions and criteria pollutants by 2030. Such emission and criteria pollutant reductions are critical to southern California's

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1 Make-ready deployment is the installation of generic concrete pads for mounting charging ports and associated utility- and customer-side infrastructure and components such as: meter, panel, conduit, and wires to the pad. *See* https://www.sce.com/wps/portal/home/business/electric-cars/Charge-Ready/Charge-Ready-Support/.

2 D.16-01-023.

3 *See* Appendix A - SCE, *Charge Ready and Market Education Programs Pilot Report* (April 2018).

communities, several of which are severely impacted by harmful emissions and located in the only two air basins in the country that are in extreme ozone non-attainment.

SCE's Charge Ready 2 expands the Phase 1 Pilot to a multi-year program and scales up elements of the Phase 1 Pilot's original features, while also adding new and innovative program components. Key elements of Charge Ready 2, described further in this testimony, include:

- Supporting and accelerating the adoption of light-duty EVs on a trajectory consistent with SCE's *Clean Power and Electrification Pathway*, which identifies a need for 7 million light-duty EVs by 2030 to reach California's GHG and air quality goals,[4] and at the same time consistent with being able to at least meet the Governor's call for 5 million EVs by 2030,[5] beginning with this four-year effort;
- Installing, operating, and maintaining the "make-ready" infrastructure to support 32,000 charge ports, including direct current fast charging ("DCFC"), with customer rebates to offset a portion of the chargers' costs, and providing an option for site owners to install and own the customer-side infrastructure for which they would receive a rebate of up to 80 percent of the costs;[6]
- Creating new options that provide a range of unique solutions for customers' charging needs in the multi-unit dwelling ("MUD") segment: (i) turnkey option with utility ownership/operation of charging stations;[7] (ii) new construction rebates that will support 16,000 charge ports; and (iii) use of infrastructure to support street-side charging;

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4 *See* Appendix B - Southern California Edison, *The Clean Power and Electrification Pathway* (Nov. 2017).

5 Executive Order B-48-18 (Jan. 26, 2018), *available at* https://www.gov.ca.gov/2018/01/26/governor-brown-takes-action-to-increase-zero-emission-vehicles-fund-new-climate-investments/.

6 *See* D.18-05-040, p. 109, Conclusions of Law (COL) 40. Decision states that customers should be allowed the choice of whether to own, operate, and maintain infrastructure installed behind-the-meter; if the customer chooses ownership, the customer must manage and pay for the installation of the customer-side infrastructure and use qualified and State-licensed labor for which the utility will provide a rebate of up to 80 percent of the installation costs.

7 SCE is also providing the utility ownership/operation of charging station option to governmental entity locations.

- Targeting the needs of low-income and State-designated disadvantaged communities ("DACs"), including a commitment to deploy a minimum of 30 percent of the Charge Ready 2 program's charging infrastructure in DACs;
- Providing a comprehensive marketing, education and outreach ("ME&O") program for all customers over a four-year period; and
- Incorporating lessons learned from the Phase 1 Pilot and extending to a four-year program to provide more market certainty to contractors and suppliers, enabling economies of scale to reduce costs.

With Charge Ready 2, SCE proposes a core program aimed at accelerating light-duty EV adoption by making EV charging available to more customers, addressing barriers to EV adoption, and promoting EV awareness and grid benefits. SCE determined its program size through a bottom-up approach that looked at anticipated incremental market needs and potential customer participation.[8] As was the case in SCE's 2014 Charge Ready Pilot proposal, SCE's proposed Charge Ready 2 program size addresses one-third of the projected, incremental market need during the program duration. The scope and scale of each of the Charge Ready 2 Portfolio programs allow other market players to contribute to infrastructure deployment (e.g., electric vehicle service providers ("EVSPs"), auto manufacturers, Electrify America, other State and local agencies funding infrastructure).[9]

This is truly a decisive moment that requires all stakeholders to work toward a rapid and sustained approach to transform this market. Zero-emission vehicles are critical to California's comprehensive climate and air quality plans. By increasing EV adoption, Charge Ready 2 improves local air quality and reduces GHG emissions broadly. With its proposed scale, Charge Ready 2 will support innovation and the electric transportation market in general with approximately 48,000 charging

[8] *See* Appendix C - SCE Electronic Vehicle Charging Infrastructure Needs Assessment and Appendix D-Program Size and Infrastructures Model.

[9] SCE's program will allow many qualified vendors to participate, so long as they meet the program requirements. Likewise, by addressing only one-third of the need, the program leaves room for, and encourages, other parties to support the growth of necessary EV charging availability. This approach encourages innovation and competition among suppliers. *See* SCE's Prepared Testimony in Support of SCE's Charge Ready Application, Vol 3, pp. 1-4 (October 30, 2014).

port installations. SCE designed the program to provide benefits for the customers and communities we serve. For example, by establishing a minimum target of 30 percent of installations to be in DACs, the program will contribute to removing pollution from the gasoline- and diesel-powered vehicles currently traveling in and through these communities. The program will facilitate access to charging stations during the program and beyond, supporting adoption of light-duty electric vehicles in DACs. Moreover, SCE estimates that over 20 million metric tons of GHG emissions, over 17,000 cumulative tons of nitrogen oxides ("NOx"), and over 51,000 cumulative tons of volatile organic compounds ("VOCs") could be reduced statewide through 2030 from the transportation sector through electric conversion.[10]

Table I-1, below, provides an overview of the Charge Ready 2 Portfolio programs, the focus for each, and which segments they will cover. Table I-2 summarizes the forecasted budget for each program in the Charge Ready 2 Portfolio.

Table I-1
Charge Ready 2 Portfolio

Charge Ready 2 Portfolio Programs	Type of Program	Targeted Number of Ports	Target Customer Segments	Purpose
Make-Ready Expansion	Infrastructure + electric vehicle supply equipment (EVSE) Rebate	32,000	MUD / Workplace / Destination Center / Fleet	A continued focus on away-from-home charging at workplace and public charging locations as well as charging at MUDs.
SCE Own & Operate (ports included in SCE Make-Ready Expansion total)	*Infrastructure*	*up to 4,230*	*MUD / Government*	New solution to address the unique challenges faced by MUDs and government entities. One-third of SCE customers live in MUDs and have limited access to at-home charging options.
New Construction Rebate	Rebate	16,000	MUD	New solution to address the unique challenges faced by MUDs. Rebates to cover all or part of the costs of charging equipment in newly constructed MUDs.
EV Awareness Campaign	Service	N/A	All Customers	A robust marketing, education and outreach program for all customers.
Customer Education Campaign	Service	N/A	Prospective EV owners	
TE Advisory Services	Service	N/A	Business Customers	

[10] *See* Appendix B. Incremental GHG emissions abatement associated with the 5 million vehicles over "economic adoption" scaled to reflect the total 7 million vehicles.

Table I-2
SCE's Charge Ready 2 Portfolio
(2018$, millions, not loaded)

Portfolio Component	Pre-Launch	2020	2021	2022	2023	GRAND TOTAL
Core Programs (including: Charge Ready make-ready expansion, Charge Ready Own and Operate, Charge Ready New Construction)	$2.6	$145.5	$210.3	$210.9	$149.3	**$718.6**
ME&O	$0.0	$10.5	$9.4	$11.3	$10.4	**$41.5**
Total Charge Ready 2 Portfolio	$2.6	$156.0	$219.6	$222.2	$159.7	**$760.1**

II.

TRANSPORTATION ELECTRIFICATION TRANSFORMATION: MOVING FROM PILOT TO SCALE

SCE has long been a supporter of EV adoption. In recent years, SCE has enabled charging station growth through deployment of "make-ready" infrastructure for EV charging stations. In 2014, SCE filed the Charge Ready and Market Education Program Application ("2014 Application"). In the 2014 Application, SCE began to lay the groundwork for the full-scale deployment of EV infrastructure and education programs proposed in this Charge Ready 2 Application. The 2014 Application proposed to implement a phased program: Phase 1, a one-year pilot to deploy infrastructure for up to 1,500 light-duty EV charging stations and complementary market education, and Phase 2, a four-year program to deploy infrastructure for an additional 28,500 light-duty EV charging stations and complementary market education.

Given that the Charge Ready and Market Education Program proposal was the first of its kind for SCE, and one of the first in the nation, SCE and other parties to the proceeding agreed to start with implementing the Phase 1 Pilot, which the Commission ultimately approved.[11] Currently, SCE has deployed infrastructure to support 1,003 charge ports at 65 customer sites, including 496 charge ports at 39 sites located in DACs (nearly 50 percent), significantly exceeding the Phase 1 Pilot's goal of placing 10 percent of charge ports in DACs. The Phase 1 Pilot allowed SCE and others to assess the viability of the make-ready premise, lay the groundwork for Charge Ready 2 with the large-scale deployment of light-duty charging infrastructure, and take full advantage of incorporating the lessons learned through the Phase 1 Pilot into SCE's internal processes and this proposed program expansion. For example, SCE is lowering the minimum port-per-site threshold in Charge Ready 2 in response to customer feedback.[12] SCE is also addressing low adoption in the MUD segment through innovative options, such as new construction rebates, along with street-side charging and turn-key, utility-owned chargers,

[11] *See* D.16-01-023.

[12] *See* Section III.A.3.

identified as desirable in customer feedback. Additionally, SCE has identified major cost drivers and will have more flexibility to minimize these costs with the larger port deployment in the full-scale Charge Ready 2 program. For example, SCE intends to coordinate working sessions with Authorities Having Jurisdiction ("AHJs") to reduce the timing and costs associated with permitting and plan checks. Based on the volume of sites across the various programs, SCE hopes to minimize costs and time by leveraging the State's EV mandates to impact AHJ performance and fees.[13]

With the successful completion of the Phase 1 Pilot and the continuing market need for more EV charging infrastructure, the time has come to implement Charge Ready 2 and move to widescale deployment of EV infrastructure in support of the State's critical GHG and air quality goals.[14] In Charge Ready 2, SCE will deploy electric infrastructure to support light-duty EV charging at customer sites throughout SCE's service area where drivers typically park for two hours or more. California policies, customer demand, urgent environmental and community needs, and technology growth have led us to this juncture. The road has been paved. The time is now to move swiftly with bold action.

The table below summarizes key Phase 1 Pilot lessons learned and how they have been applied in the proposed Charge Ready 2.[15]

[13] *See* Section III.A.3.d.10.

[14] *See* Section II.D.1.

[15] These lessons learned are described further in this testimony and Appendix A.

Table II-3
Key Phase 1 Pilot Lessons Learned and Applied in Charge Ready 2

Lessons Learned	Resolution
Some applicants were not able to participate in the Phase 1 Pilot due to their specific organizational timelines and short Pilot duration.	SCE proposes a four-year program, which will resolve timing issues and allow customers sufficient time to plan appropriately for participation.
The 10-charge-port minimum requirement was a challenge for some customers in non-DACs.	SCE proposes a 2-port minimum requirement.
Charging times for participating EV drivers averaged approximately two hours.	SCE proposes to select sites where vehicles are typically parked 2 hours or more.
The manual processes in application review increased project cycle times.	SCE proposes to automate processes in Charge Ready 2, where appropriate.
SCE experienced delays in starting construction due to delayed or inaccurate submissions of customer requirements.	SCE proposes to optimize processes and cut unnecessary requirements to avoid delays.
Construction delays were experienced due to custom manufacturing of panels for each site.	SCE proposes to bulk order standardized meter panels based on grouped site requirements.
The Phase 1 Pilot did not allow using customers' existing panels and service lines, which, if used, might have reduced costs where sufficient existing capacity was available.	SCE proposes to evaluate the feasibility of using customers' existing panels and service lines in cases where sufficient existing capacity is available.
Customers at governmental locations experienced delays in submitting required procurement documents due to their internal review processes.	SCE proposes a turnkey deployment option where SCE will own and operate charging stations deployed at

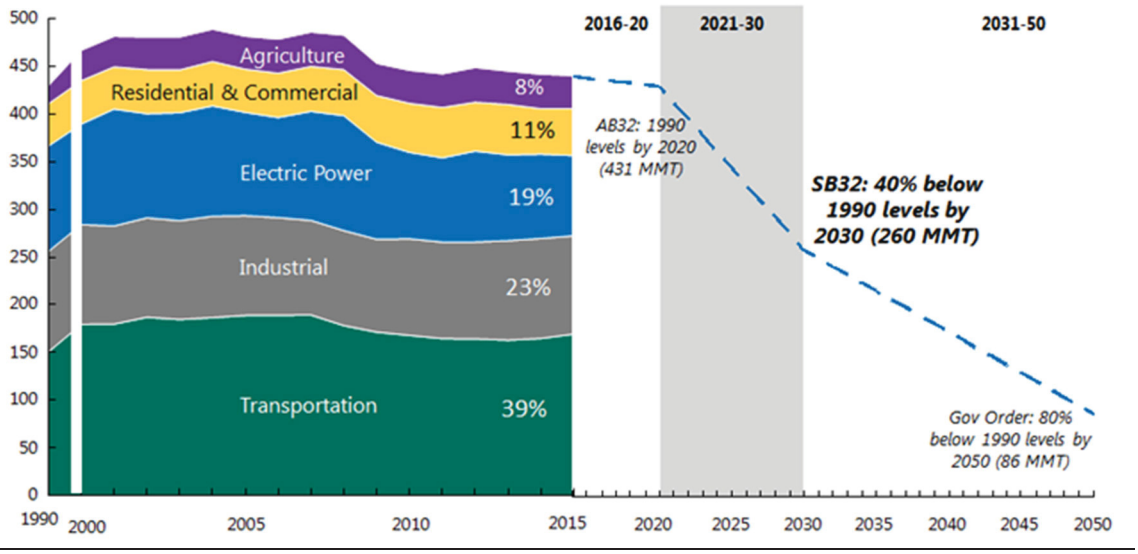
Lessons Learned	Resolution
	governmental locations to eliminate procurement issues at these sites.
The Phase 1 Pilot did not facilitate the use of planned and/or existing infrastructure at new construction sites.	SCE proposes a rebate program for new MUD construction projects.
Multi-Unit Dwelling participation was lower than expected in the Phase 1 Pilot.	SCE proposes reducing the minimum port requirement to two ports to alleviate constraints in existing parking spaces. SCE proposes a rebate program for installations at new MUD construction projects to encourage site owners to go beyond EV-ready to EV-operable. SCE proposes a turnkey deployment option where SCE will own and operate charging stations deployed at MUDs (on premise or curbside) to minimize customer operations and maintenance responsibilities.
Some vendors left the marketplace, which could impact service, maintenance, and data services.	SCE proposes to modify vendor contract language to help protect customer investments and will work on standardizing charging station and networking requirements to make these devices plug-and-play.

A. Transportation Electrification is Crucial to Achieving California's GHG Goals.

Climate change poses serious threats, and climate change effects, such as sea level rise and longer, more intense heat waves, are already escalating. California has taken ownership, within the context of the broader global community, to align its GHG emissions reductions targets with the Paris

Agreement—to limit global warming to well below 2 degrees.[16] California's GHG goals call for a 40 percent reduction in GHG emissions from 1990 levels by 2030 and an 80 percent reduction by 2050.[17] While California reduced its GHG emissions ten percent from their peak in 2004, meeting 2030 requirements and 2050 goals will require California to reduce emissions at more than three times the annual rate achieved between 2004 and 2015. To be successful throughout this three-decade span and beyond, the State must implement fundamental changes across all economic sectors. No individual sector can achieve the emissions goal alone.

Figure II-1
California's GHG Emissions Goals[18]



In November 2017, SCE released *The Clean Power and Electrification Pathway* white paper, a proposed, integrated approach to achieve California's GHG emissions and air pollution reduction goals by taking action in three key economic sectors: electricity, transportation, and buildings. By 2030, SCE

16 *See* CARB, *California's 2017 Climate Change Scoping Plan* (Nov. 2017), *available at* https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf.

17 Executive Order S-3-05 (2005) established a target of reducing GHG emissions 80 percent below 1990 levels by 2050.

18 *See* CARB, *California Greenhouse Gas Inventory for 2000-2015 by Sector and Activity*, last updated June 6, 2017, *available at* https://www.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_sector_sum_2000-15.pdf.

calls for an electric grid supplied by 80 percent carbon-free energy, more than 7 million electric vehicles on California roads, and using electricity to power nearly one-third of space and water heaters in increasingly energy-efficient buildings.[19] Removing any one of these three pillars would make meeting the State's 2030 and 2050 GHG reduction goals exceedingly more costly and would potentially delay meeting the goals established by law. Without significant decarbonization in the transportation sector, the State's 2030 and 2050 GHG reduction goals become impossible.

Multiple paths exist for California to meet its 2030, and ultimately 2050, climate goals with varying levels of difficulty and costs; however, all feasible paths must significantly reduce emissions from the transportation sector. SCE explored several of these scenarios to better understand feasibility, costs, and trajectory to reach California's 2030 and 2050 GHG reduction goals. SCE found the most feasible pathway to reach the State's 2030 goals to be an electric grid supplied by 80 percent carbon-free energy, more than 7 million electric vehicles on California roads, and nearly one-third of space and water heaters powered by electricity.[20] Implementing SCE's *Pathway* would result in 58 million metric tons of CO_2 equivalent abatement in the transportation sector by 2030, representing almost a third of the reductions needed to meet the State's goals. In order to support 7 million electric vehicles and achieve such substantial emission reductions by 2030, a sufficient amount of electric fueling infrastructure needs to be built today, and for years to come, to support both electric vehicle adoption and fueling.

B. Transportation Electrification is a Key Solution to State Environmental Goals.

2030 is just over 11 years away. The average passenger car life is 11.4 years.[21] From this day forward, every time an internal-combustion engine ("ICE") vehicle is purchased and an EV is not, there is a missed opportunity to reduce emissions from the transportation sector. Prior to 2018, everyone could take comfort that, on average, the newly purchased vehicle would retire prior to 2030. Today, this

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[19] *See* Appendix B.

[20] *Id.*

[21] U.S. Department of Transportation, *Average Age of Automobiles and Trucks in Operation in the United States Chart*, *available at* https://www.bts.gov/content/average-age-automobiles-and-trucks-operation-united-states.

is not the case. Every vehicle purchased from this day forward will likely still be on the road in 2030. As a result, there is an urgency to the State's need to focus on the transition to zero-emission vehicles.

Additionally, electric vehicles will become cleaner as the electric sector continues to decarbonize. Current California law requires the electric power sector to meet a 50 percent Renewables Portfolio Standard ("RPS") by 2030. SCE believes the electric power sector needs to achieve an 80 percent carbon-free portfolio by 2030 (including existing large hydro and regional nuclear generating units, which will still provide a portion of California utility customer needs in 2030) to achieve California's GHG reduction goals. Using SCE's vision of an 80 percent carbon-free portfolio, in 2030 nearly 90 percent of GHG tailpipe emissions are abated when a light-duty vehicle is electrified compared to a gasoline-fueled vehicle.[22]

Charge Ready 2 will reduce barriers to EV adoption through deployment of EV charging infrastructure, increasing the availability of charging stations to reduce range anxiety. Charge Ready 2 will also increase customer awareness about the benefits of EVs through broad and targeted education programs. These programs are intended to facilitate widespread adoption of light-duty EVs throughout California, in support of the State's climate goals.

1. Light-duty transportation electrification offers the largest, economical GHG-reduction opportunity.

The electric sector is at the forefront of the fight against climate change in California and today accounts for only 19 percent of the State's GHG emissions. The electric sector reduced its GHG emissions by 27 percent since the height of California's GHG emissions in 2004. In contrast, the transportation sector represents almost 45 percent of California's GHG emissions (including fuel refining), and is the largest GHG-emitting segment in California.[23] Since 2004, the transportation sector

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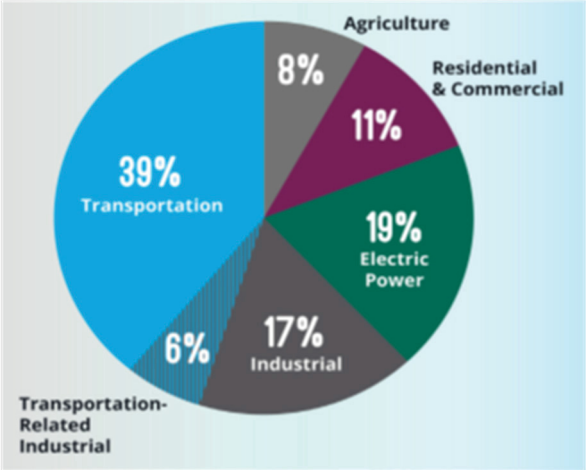
[22] Using CARB's Low Carbon Fuel Standard (LCFS) CARBOB gasoline intensity (101.4 g/MJ) relative to EER adjusted average grid using 80 percent carbon free electricity (12.01 g/MJ).

[23] *See* CARB, *California Greenhouse Gas Inventory 2000-2015 – by Sector and Activity* (June 6, 2017), accessed April 15, 2017, *available at* https://www.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_sector_sum_2000-15.pdf.

has reduced its GHG emissions by only 8 percent. The California Air Resource Board ("CARB") states that the transportation sector will be the largest reduction opportunity in 2030.[24] While internal-combustion cars will become more efficient, they will not decarbonize as quickly as the electric sector. Electrification of light-duty vehicles is the only viable option to progress toward carbon-free and petroleum-free transportation goals over the next 12 years.

Figure II-2
California GHG Emissions by Sector in 2015[25]



Additionally, transportation sector GHG reductions are economical. CARB's 2017 scoping plan assigns mobile sources' abatement costs at less than $50 per metric ton in 2030.[26] The cost of abatement is significantly less than that of using liquid biofuels to comply with California's low carbon fuel standard ("LCFS") carbon reduction intensity target of 18 percent ($150 per metric ton) and meeting the

[24] *See* CARB, *2017 Climate Change Scoping Plan* (Nov. 2017), p. 31, *available at* https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf.

[25] California Air Resources Board, *California Greenhouse Gas Inventory 2000-2015 – by Sector and Activity* (June 6, 2017), *available at* https://www.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_sector_sum_2000-15.pdf.

[26] *Id*., p. 46.

RPS target of 50 percent ($175 per metric ton).[27] SCE's own modeling similarly found transportation electrification to be the largest, economical abatement choice.[28]

2. Transportation electrification reduces air pollution .

The federal Clean Air Act requires states to meet certain health-based ozone and particulate matter requirements by 2023 and 2032.[29] The only two air basins in the nation that are in extreme ozone non-attainment are the South Coast Air Basin and the San Joaquin Valley Air Basin; SCE serves communities in both of these basins.[30] Transportation electrification will help the State meet ground-level ozone and particulate emissions reduction requirements.[31]

NOx and reactive organic gases contribute to the formation of harmful particulate matter in the atmosphere; both pollutants also react with sunlight to form smog (ground-level ozone).[32] The transportation sector emits 80 percent of NOx pollution and is the second highest source of PM2.5.[33] While the medium- and heavy-duty vehicle segments represent the majority of NOx and PM2.5 emissions in the on-road mobile category, light-duty vehicles account for one-third of NOx emissions

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27 *Id.*

28 *See* Appendix B.

29 There are deadlines for attainment of several ambient air quality standards for several pollutants, including the 2032 deadline for ground-level ozone (formed by NOx and organic compounds in the atmosphere). Further adopted standards for ground-level ozone will require additional reductions of NOx by 2037. *See* SCAQMD, *National Ambient Air Quality Standards ("NAAQS") and California Ambient Air Quality Standards ("CAAQS") Attainment Status for South Coast Air Basin*, *available at* http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/naaqs-caaqs-feb2016.pdf.

30 *See* CARB, *Mobile Source Strategy* (May 2016), pp. 6-9. This mobile source strategy requires actions to increase the deployment of zero-emission transportation technologies in order to achieve the 2023 and 2031 air quality standards, on-road GHG emission reduction, and toxic air contaminant exposure reduction. *Available at* https://www.arb.ca.gov/planning/sip/2016sip/2016mobsrc.pdf.

31 *See* SCAQMD, *Final 2016 Air Quality Management Plan* (March 2017), *available at* http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2016-air-quality-management-plan/final-2016-aqmp/final2016aqmp.pdf?sfvrsn=15.

32 *See* U.S. Environmental Protection Agency, *Air Pollution Facts and Figures*, *available at* https://www3.epa.gov/airnow/mediakits/ozone/facts.pdf.

33 *See* CARB, *Statewide 2012 Estimated Annual Average Emissions*, *available at* https://www.arb.ca.gov/app/emsinv/2017/emssumcat_query.php?F_YR=2012&F_DIV=-4&F_SEASON=A&SP=SIP105ADJ&F_AREA=CA

and over 40 percent of PM2.5.[34] Hence, additional transportation electrification of light-duty vehicles will reduce these smog-forming emissions and particulates leading to cleaner air and healthier communities, particularly in disadvantaged communities.

C. Transportation Electrification Provides Additional Customer Benefits

1. Transportation electrification creates downward pressure on rates.

As transportation electrification increases, it has the potential to lower the cost of electric service for electric customers by spreading fixed costs over a larger base of kWh sales. SCE estimates that electrification of the light-duty market could put downward pressure on rates in the long-term. EVs provide incremental, flexible load to the electric grid. By increasing overall system load, the fixed costs of the system will be spread over more kilowatt hours. Additionally, EV load is flexible and could be managed to reduce total system costs further. The combination of these two facts leads to downward pressure on rates.

2. Transportation electrification could improve integration of renewable generation.

Transportation electrification could also improve integration of renewable generation by using time-of-use ("TOU") rates as an incentive for load management.[35],[36] As noted in the recent Proposed Decision in A.16-09-003, which adopts the updated TOU periods proposed by SCE, including shifting the peak period to later in the day and implementing a winter season super-off-peak period during daytime hours, "properly defined TOU periods will provide incentives for customer use and

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[34] Light-duty vehicle subcategories included in calculation: light-duty passenger vehicles, light-duty trucks 1, light-duty trucks 2, light-heavy-duty diesel trucks 1, light-heavy-duty diesel trucks 2, light-heavy-duty gas trucks 1, and light-heavy-duty gas trucks 2. *See* CARB, *Statewide 2012 Estimated Annual Average Emissions*, *available at* https://www.arb.ca.gov/app/emsinv/2017/emssumcat_query.php?F_YR=2012&F_DIV=-4&F_SEASON=A&SP=SIP105ADJ&F_AREA=CA.

[35] The Natural Resources Defense Council's ("NRDC's") report explains how TOU rates for EVs are an important tool to benefit utility customers through improved use of the electric system and integration of renewables. *See* Max Baumhefner & Roland Hwang, *Driving Out Pollution: How Utilities Can Accelerate the Market for Electric Vehicles*, pp. 4-5, 15-16 (June 2016), *available at* https://www.nrdc.org/resources/driving-out-pollution-how-utilities-can-accelerate-market-electric-vehicles.

[36] *See* Environmental Defense Fund, *Time-of-Use Electricity Pricing: Savings When They Matter*, p. 1, *available at* https://www.edf.org/sites/default/files/ca_tou_fact_sheet_091514.pdf.

development of future generation that better reflects the state's electric grid. This, in turn, should assist in reaching state energy goals by minimizing costs, reducing [GHG] emissions, encouraging conservation, and increasing the supply of electricity at times that best serve the needs of the grid."[37]

SCE's Charge Ready 2 portfolio encourages customers to help California use abundant renewable power and improve use of the electric system through TOU price signals and other load management strategies. TOU price signals and load management strategies offer lower prices for EV drivers during non-peak periods of the day in order to shift EV load to hours of the day when there is excess generation on the grid, driven by increased penetration of energy from photovoltaic ("PV") solar, both large-scale and distributed. At these times, load is less costly to serve, providing downward pressure on costs (and eventually rates). For active, daytime grid management to become a reality, southern California needs sufficient away-from-home charging during the day to support meaningful load shifting. As California's so-called "duck curve" imbalance deepens with the significant rise of large-scale and rooftop solar in the overall power mix, SCE expects its net load[38] to peak more sharply and more frequently during the evening hours in 2030 when compared to today, unless significant load management is utilized. The region needs to have the appropriate infrastructure and incentives to help manage load accordingly.

D. Barriers Continue to Impede EV Adoption.

Over 387,000 EVs are registered in California with 123,000 of those EVs residing in SCE territory.[39] EVs represent 5.4 percent of new vehicle sales in California.[40] While this percentage has consistently increased since 2010, the EV share of new sales needs to grow dramatically through 2030

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[37] Proposed Decision issued on May 22, 2018, in A.16-09-003, p. 4.

[38] Net load is the difference between forecasted load and expected electricity production from variable generation resources. *See* CAISO's Fast Facts (2016), *available at* http://www.caiso.com/Documents/Flexibleresourceshelprenewables_FastFacts.pdf.

[39] As of March 2018, data from the Electric Power Research Institute ("EPRI") on annual light-duty vehicle sales in California, based on registration data obtained through RL Polk, measured at the county level.

[40] *Id*.

for California to meet its climate and environmental goals. Barriers continue to impede EV adoption.[41] While the high-level barriers—charging availability, awareness, and affordability—have remained persistent, research[42] is exposing important nuances and a more detailed understanding of these barriers.

1. Charging Availability

In order to increase the light-duty electric vehicle stock nearly 20 times from today's levels to meet the State's ambitious and important GHG and clean air goals, significant and coordinated action is required across multiple fronts to address each of these barriers. Many studies[43] have identified range anxiety as a top barrier to EV adoption, with several facets contributing to the broader sentiment: access to public charging stations, access to home charging and vehicle battery range. An SCE survey found that 69 percent of respondents identified away-from-home charging uncertainty as an important barrier; 66 percent of respondents identified difficulty installing home charging as an important barrier; and 84 percent of respondents identified limited mileage range per charge as an important barrier.[44] Similar results were found in other studies.[45],[46] Within each of these identified sub-barriers, complexities

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41 Zeinab Rezvani, Johan Jansson, Jan Bodin, *Advances in Consumer Electric Vehicle Adoption Research: A Review and Research Agenda* (2015), *available at* https://www.sciencedirect.com/science/article/pii/S1361920914001515.

42 Charles Fleming, *How will I charge my electric vehicle? And where? And how much will it cost?* (Sep. 2016), *available at* http://www.latimes.com/business/autos/la-fi-hy-agenda-ev-charging-20160920-snap-story.html.

43 Chris Mooney, "*Range Anxiety" is Scaring People Away From Electric Cars, but the Fear May be Overblown* (Aug. 2016), *available at* https://www.washingtonpost.com/news/energy-environment/wp/2016/08/15/range-anxiety-scares-people-away-from-electric-cars-why-the-fear-could-be-overblown/?utm_term=.2f2de7104a53.

44 Data from SCE, *Electric Vehicle Marketing Survey*, July 2017. 2,597 invitations sent to SCE Customers Plugged In community members, 31 percent response rate (July 19 through July 25, 2017). The survey participants are customers who have volunteered to participate, have online access and can take surveys in English. This demographic tends to skew somewhat towards having more education and higher home ownership than the general public. Nonetheless, the survey results should appropriately represent the relative importance of concerns customers have about purchasing EVs.

45 *See* Center for Sustainable Energy, *The Clean Vehicle Rebate Project: Summary Documentation of the Electric Vehicle Consumer Survey,* 2013-2015 Edition (June 2017), pp. 24-26, *available at* https://cleanvehiclerebate.org/sites/default/files/attachments/CVRPConsumerSurvey2013-15Reference.pdf.

46 *See* Kenneth Kurani et al., *New Car Buyers' Valuation of Zero-Emission Vehicles: California* (March 2016), pp. 114-119, *available at* https://www.arb.ca.gov/research/apr/past/12-332.pdf.

emerge. For example, the number of away-from-home chargers today is 34 to 55 percent below the level needed to adequately support the number of EVs already on the road in 2017.[47,48] Given that the number of EVs on the road continues to increase, California will have an even wider gap to close if away-from-home infrastructure does not significantly increase its installation pace. This creates issues for both current and future electric vehicle adopters. Current EV owners may not be able to drive their EV to every desired destination. Drivers considering new vehicle options may not choose to purchase an EV because they do not see available charging locations along their frequented routes. Until charging station levels adequately support the level of EVs already adopted (let alone the EVs that need to be adopted to achieve the State's environmental goals), this barrier will continue to persist.

Additionally, for EVs to be truly an option for everyone, all customers, including those who rent their homes or live in MUDs, must have readily available charging stations. Nearly 44 percent of households in SCE's territory rent, and 36 percent of households in SCE's territory are in MUDs.[49] Sufficient away-from-home charging stations enable EVs to be viable options for customers who do not have available residential charging options.

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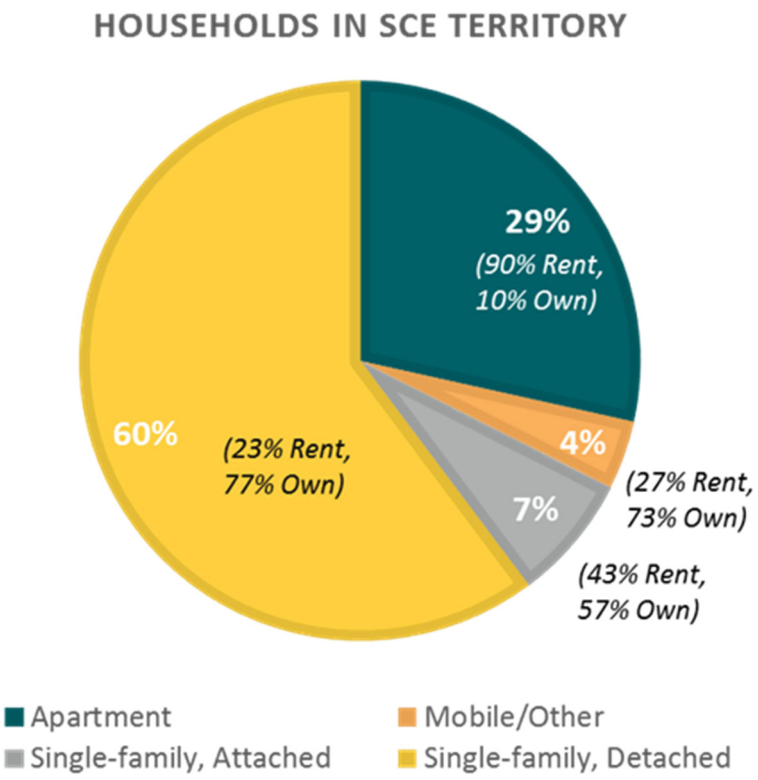
47 *See* California Energy Commission, California Plug-In Electric Vehicle Infrastructure Projections: 2017-2025, p. 5 (March 2018), *available at* http://docketpublic.energy.ca.gov/PublicDocuments/17-ALT-01/TN222986_20180316T143039_Staff_Report__California_PlugIn_Electric_Vehicle_Infrastructure.pdf. Estimated market need in 2017 for L2 destination chargers ranged from 21,502 to 28,702 to support 239,328 plug-in electric vehicles. California has 15,492 public charge points, 1,776 of which are DCFC as of April 25, 2018.

48 *See* U.S. Department of Energy, *Alternative Fuels Data Center, Alternative Fueling Station Locator* (accessed April 25, 2018), *available at* https://www.afdc.energy.gov/stations#/analyze.

49 *See* U.S. Census Bureau, American Community Survey, 2016, https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_16_5YR_DP04&src=pt. SCE applied service territory zip codes to define SCE's geographical representation.

Figure II-3
Occupied Housing Units in SCE Territory (2015)[50]



While away-from-home charging options can help to address range anxiety for people who rent homes or live in MUDs, access to home charging is a top priority for EV drivers. More must be done to reduce barriers and address the unique challenges for charging installations at MUDs.[51] Lessons learned during the Phase 1 Pilot showed that barriers to adoption for MUDs include parking limitations, large complexes wanting to deploy charging stations throughout the grounds (rather than in one central location), and parking structure challenges to meet current State accessibility requirements.[52]

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50 *See* U.S. Census Bureau, American Community Survey, 2016, *available at* https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_16_5YR_DP04&src=pt. SCE applied service territory zip codes to define SCE's geographical representation.

51 *See* CARB, *California's Advanced Clean Cars Midterm Review*, (Jan. 2018), pp. ES 45-49, *available at* https://www.arb.ca.gov/msprog/acc/mtr/acc_mtr_finalreport_full.pdf.

52 *See* Appendix A.

Additionally, MUD property owners often do not see electric vehicle charging as an amenity that can be used to attract tenants.[53] This sub-barrier must be addressed through creative programs to increase the uptake of charging stations at MUDs, which will, in turn, lead to higher electric vehicle adoption.

2. Lack of Awareness

The lack of general awareness about EVs and their benefits remains a major barrier. In a recent national survey, 54 percent of respondents could not name a single plug-in EV, only 13 percent of respondents reported to have ever been in a plug-in EV, and 59 percent of respondents thought battery electric vehicles were not as good as gasoline vehicles.[54] In a California-specific study, CARB found that 49 percent of respondents were aware of federal EV incentives, but only 32 percent were aware of State incentives.[55] Additionally, customers have multiple misconceptions about the performance and reliability of EVs: many assume that gasoline-powered cars are more reliable than battery electric vehicles even though battery electric vehicles require less maintenance and carry comparable 100,000 mile warranties.[56] Respondents also assume gasoline-powered vehicles are safer than battery electric vehicles (despite the fact that there is no evidence to support this misconception).[57] UC Davis examined EV awareness in California and found no increased awareness between 2014 and 2017 despite an almost 40 percent increase of EVs on the road.[58] CARB stated that misunderstanding and lack of knowledge

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[53] *See* UCLA Luskin Center, *Overcoming Barriers to Electric Vehicle Charging in Multi-unit Dwellings* (Nov. 2017), p 19, *available at* http://innovation.luskin.ucla.edu/sites/default/files/Overcoming%20Barriers%20to%20EV%20Charging%20in%20Multi-unit%20Dwellings%20-%20A%20Westside%20Cities%20Case%20Study.pdf.

[54] *See* National Renewable Energy Lab, *Consumer Views on Plug-in Electric Vehicles – National Benchmark Report* (Dec 2016), p. 11, *available at* https://www.nrel.gov/docs/fy17osti/67107.pdf.

[55] *See* Kenneth Kurani et al., *New Car Buyers' Valuation of Zero-Emission Vehicles: California*, CARB Agreement 12-332, (March 2016), *available at* https://www.arb.ca.gov/research/apr/past/12-332.pdf.

[56] *See* U.S. Department of Energy, Alternative Fuels Data Center (visited June 2, 2018), available at https://www.afdc.energy.gov/vehicles/electric_maintenance.html.

[57] *Id*.

[58] *See* Ken Kurani and Scott Hardman, *Automakers and Policymakers May Be on a Path to Electric Vehicles; Consumers Aren't*, (accessed May 2018), *available at* https://its.ucdavis.edu/blog-post/automakers-policymakers-on-path-to-electric-vehicles-consumers-are-not/.

about plug-in hybrid vehicles and battery EVs may be the most important finding of its study.[59] Significant actions need to be taken to address this persistent awareness gap.

E. SCE's Proposed Programs Will Accelerate Transportation Electrification.

SCE supports the State's assessment that transportation electrification will be a large portion of the environmental solution in California, and SCE believes that utilities can be a driving force in making the changes necessary to increase EV adoption. Utilities and other market participants can address many barriers that currently inhibit EV adoption. Electric utilities are especially well suited to address electricity delivery, infrastructure, and integration of EVs with the grid. Utilities are well-versed in developing pricing structures, providing clean electricity, supporting customer adoption of new technologies (e.g., smart thermostats, solar rooftops, electric vehicles), and building infrastructure. In addition, utilities can help the State achieve its clean energy goals while helping to ensure accessibility to the technologies in disadvantaged and low- and moderate-income communities.[60] By focusing in these areas, electric utilities such as SCE, can help accelerate transportation electrification.

- **Opportunity:** In California, transportation electrification represents the largest near-term opportunity to reduce GHG emissions and air pollution. By fueling vehicles with clean electric power instead of fossil fuels, SCE can help meet California's ambitious climate and clean air goals. Because charging at home continues to be the dominant preference for EV drivers, charging options for those who reside in MUDs must be made available. Additionally, workplace charging encourages adoption through increased EV visibility, increased availability of charging stations, and conversation with trusted

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[59] *See* Plug-in Hybrid & Electric Vehicle Center Institute of Transportation Studies, University of California Davis, in partial fulfillment of CARB Agreement 12-332, *New Car Buyers' Valuation of Zero-emission Vehicles: California* (March 2016), *available at* https://www.arb.ca.gov/research/apr/past/12-332.pdf.

[60] For example, see the Governor's Interagency ZEV Action Plan goal to help residents of multi-unit dwellings be able to charge EVs. *See* Office of Governor Edmund G. Brown Jr., "2016 ZEV Action Plan," *available at* https://www.gov.ca.gov/docs/2016_ZEV_Action_Plan.pdf, defining ZEVs to include hydrogen fuel cell electric vehicles (FCEVs) and plug-in electric vehicles (PEVs), which include both pure BEVs and PHEVs. *See also* ACR at Section 3.6.2.

coworkers, while providing the opportunity for more daytime charging to leverage available solar energy and help manage the grid.

- **Barriers:** Charging availability is a top barrier: access to public charging stations and access to home charging, especially at MUDs, needs to be resolved. Additionally, lack of consumer education and awareness is pervasive and significant, and contributes to other barriers, including misconceptions regarding the performance, cost and reliability of EVs and the availability of charging stations.
- **Solutions**: SCE proposes the following:
    - Expand the Charge Ready program across workplaces, MUDs, destination centers, and fleets;
    - Offer a turnkey option where SCE will own and operate charging stations deployed in MUDs and at governmental locations;
    - Target MUDs under construction to overcome barriers at these sites;
    - Deploy a ME&O program that contains a broad advertising package describing the benefits of EVs to a general audience;
    - Create a targeted customer education program that exposes customers to the EV experience; and
    - Expand SCE's Transportation Electrification Advisory Services focused on converting customer fleets to zero–emission vehicles.

III.

SCE'S CHARGE READY 2 PORTFOLIO

The Charge Ready 2 Portfolio (the "Portfolio") contains several programs focusing on overcoming barriers to accelerate EV adoption, and to help put California on the path to achieving its GHG goals and air quality requirements. The Portfolio largely follows the infrastructure model developed for the Phase 1 Pilot, where SCE deploys, owns, and maintains the electric infrastructure needed to serve charging equipment for light-duty vehicles (up to and including the make-ready stubs).

The Charge Ready 2 Portfolio incorporates both program design and implementation learnings from the Phase 1 Pilot[61] and the Commission's decision on standard-review projects in D.18-05-040, which includes a customer-ownership option.[62] The Charge Ready 2 Portfolio focuses specifically on providing thoughtful solutions to increase participation at MUDs by eliminating constraints that prevented sites from participating in the Phase 1 Pilot (e.g., minimum charging port requirements, minimum parking lot size). Removing the minimum port requirement enables a greater dispersion of sites throughout SCE's territory; however, it also requires SCE to reduce the assumed average ports per site to 10 from the 26 assumed in SCE's 2014 Charge Ready application.[63] SCE also learned through the Phase 1 Pilot that the average ports per site installed (15 ports per site) did not align with SCE's original assumptions (26 ports per site).[64] The new assumed average ports per site aligns with the lessons learned through the Phase 1 Pilot and the anticipated needs of an expanded program.

The Charge Ready 2 Portfolio contains a robust ME&O program that acknowledges mass market adoption and targets customers at all levels of the purchase funnel—from customers who have no experience with EVs, to those ready to test drive, to businesses that may be interested in updating their internal-combustion engine fleets. Consequently, the Charge Ready 2 Portfolio includes both broad and targeted activities that increase the speed of deployment, expand the scope of eligible customer sites, and extend the scale of engagement that defined the Phase 1 Pilot.

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61 *See* Appendix A.

62 *See* D.18-05-040, COL 40. Decision states that customers participating in SCE's medium- and heavy-duty infrastructure program should be allowed the choice of whether to own, operate, and maintain infrastructure installed behind-the-meter; if the customer chooses ownership, the customer must manage and pay for the installation of the customer-side infrastructure and use qualified, State-licensed labor. The utility will provide a rebate of up to 80 percent of the infrastructure costs.

63 A.14-10-014, SCE Testimony in Support of Application for Approval of its Charge Ready and Market Education Programs, SCE-01 Vol. 02 Pilot, p, 23, Table VI-3: Charge Ready Pilot Capital Cost Breakdown, assuming 1,500 ports at 58 sites or approximately 26 ports per site.

64 The Pilot average cost per port aligns with the original forecast in testimony comparing costs for sites with similar number of ports (26 ports per site). However, with the decrease in average ports per site realized in the Pilot, the average cost per port is higher relative to the assumptions in SCE's 2014 Charge Ready application given the loss of economies of scale.

A. Charge Ready 2 Infrastructure Programs

1. Objectives

SCE projects that 7 million light-duty vehicles must be adopted by 2030 for California to meet its 2030 GHG reduction goals. To realize this magnitude of EVs, we must overcome significant barriers. While many stakeholders can play a role in addressing adoption barriers, the electric utility is especially well-suited to address barriers related to electricity delivery, infrastructure, and integration of EVs with the grid. SCE has created a suite of programs to effectively address the lack of available charging stations and infrastructure cost, through lessons learned[65] from the Phase 1 Pilot and stakeholder feedback, in order to set California on a path to achieve its 2030 climate goals.

2. Infrastructure Programs Description

To address persistent EV adoption barriers, SCE plans to offer three infrastructure programs to customers over four years:

1) Charge Ready Make-Ready Expansion: Install make-ready infrastructure across workplaces, MUDs, destination centers, governmental locations, and fleets capable of supporting 32,000 charging ports (which could represent 3,200 sites, assuming an average of 10 ports per site) in SCE's service territory over a four-year program. Include additional DC fast charging ("DCFC") stations at select sites if certain criteria are satisfied.
2) Charge Ready Own and Operate: Offer a turnkey option where, in addition to the make-ready, SCE will own and operate charging stations deployed in MUDs and at governmental locations. Participation capped at an estimated 4,230 charge ports (35 percent of MUD participation forecasted in the Make-Ready Expansion program).[66]

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[65] *See* Appendix A.

[66] Estimate of 32,000 ports includes both customer-owned ports and utility-owned-and-operated ports.

3) Charge Ready New Construction Rebate: Offer an incentive to MUD sites that exceed mandatory CALGreen and local jurisdiction building code by installing EV charging stations. The rebate is designed to cover the incremental cost to move a site from "EV capable" to full installation of EV charging stations.[67] The rebate program will support an estimated 16,000 additional charging ports at MUDs under construction during the four-year program duration. This program complements, and does not duplicate, the other infrastructure components of the Charge Ready 2 Portfolio by targeting only new construction.[68]

3. Charge Ready Make-Ready Expansion

a) Description

In the Charge Ready Make-Ready Expansion Program, SCE plans to install make-ready infrastructure for MUDs, workplaces, fleets and destination centers to serve approximately 32,000 charging ports for light-duty EVs. Figure 4 shows the components of a make-ready installation. The "behind-the-meter" portion of these installations will include a separately-metered circuit together with utility transformer upgrades, service drop, panel, trenching, wiring, conduit, step-down transformers, and other equipment, as needed. Additional "in-front-of-the-meter" infrastructure may include, but is not limited to, electrical panels, conduit, and wires as well civil construction work in compliance with various regulations including the California Building Code's accessibility requirements for public and common use, and the Americans with Disabilities Act ("ADA"). SCE will offer customers choice to

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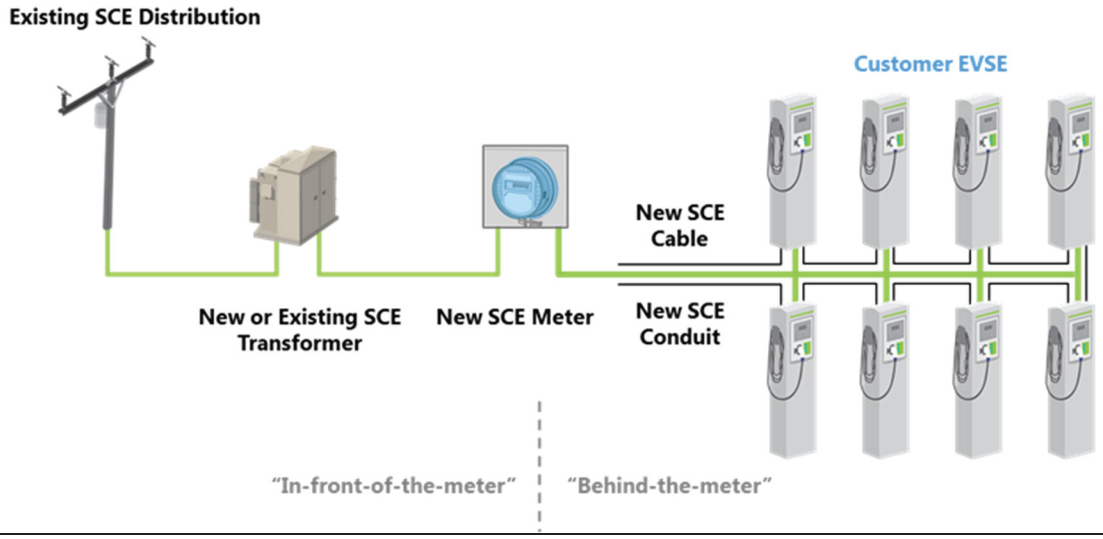
[67] "EV Capable," as defined by CALGreen Section 5.106.5.3: "The service panel or subpanel(s) circuit directory shall identify the reserved overcurrent protective device space(s) for future EV charging… and … the raceway termination location [shall be] permanently and visibly marked EV Capable." CALGreen, *Guide to the 2016 California Green Building Standards Code*, Section 5.106.5.3 (January 2017), *available at* https://www.documents.dgs.ca.gov/bsc/CALGreen/CALGreen-Guide-2016-FINAL.pdf.

[68] Estimate of 16,000 ports at new MUD construction sites is in addition to the 32,000 ports associated with the make-ready program.

manage and pay for the installation of the customer-side infrastructure with a rebate of up to 80 percent of the installation costs.[69]

Figure III-4
Diagram of Make-Ready Infrastructure Components



SCE plans to provide a rebate to cover part of the costs of charging equipment that meets SCE's functional and installation requirements in the Charge Ready Make-Ready Expansion Program. SCE plans to offer a flat rebate to all customers for qualified Level 1 and Level 2 charging stations and a separate, larger rebate on qualified DCFC stations.[70] The charging station rebate amount will be determined at SCE's discretion, up to 100 percent of the cost of the charging stations and their installation, and updated as needed throughout the program, based on market costs for each charging station type. SCE will also offer customers an option to manage and pay for the installation of the customer-side infrastructure and use qualified, State-licensed labor, for which the utility will provide a

[69] *See* D.18-05-040, pp. 149, 160-61. The rebate proposed in Charge Ready 2 aligns with the rebate offered in SCE's medium-duty and heavy-duty program. There, the Commission directed SCE to provide customers who opt to install, own, operate, and maintain the customer side infrastructure, with a rebate of up to 80 percent of the customer-side infrastructure installation cost. SCE would offer the same rebate in this program.

[70] *See* Appendix E – Charging Standards and Definitions. Level 1, Level 2, and DCFC terminology are used generally in this context and are not meant to restrict the technical capability of charging stations which SCE will qualify for the program (e.g., level 3 AC charging).

rebate of up to 80 percent of the installation costs.[71] Participating customers will be responsible for procuring, installing and maintaining charging stations in good working order five years after the initial installation.[72] Customers will also be responsible for any charging station and installation costs exceeding available rebates and for all energy costs.

SCE will leverage the program's infrastructure deployment and offer participating customers the option to install a limited number of DCFC stations, which is more economical than separately deploying DCFC stations at a later date. SCE will work with customers to determine the optimal deployment number and mix of charging stations at their site. Site hosts opting to install a DCFC station will be required to make their DCFC charging station open to the public. Deployment of DCFC stations will increase charging options for customers without access to residential charging and customers needing emergency charging.

SCE's proposed budgeted would accommodate 205 DCFC ports at 170 sites (roughly 5 percent of the anticipated total sites) that could be installed through the Charge Ready Make Ready Expansion Program.[73] DCFC stations have the potential to reduce the number of charging stations deployed at each site while still serving an equal or greater number of EVs throughout each day.[74] Because a significant factor contributing to site costs is civil construction work, installing infrastructure to support DCFC stations at Charge Ready sites that are undergoing construction is a more economical way to deploy DCFC than siting, planning, and constructing stand-alone DCFC sites. By

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[71] SCE modeled the Charge Ready 2 customer infrastructure rebate option after the medium- and heavy-duty program infrastructure rebate designed by the Commission. *See* D.18-05-040, pp. 160-61.

[72] SCE revised the ten-year requirement from the Phase 1 Pilot to a five-year requirement for the Charge Ready Make-Ready Expansion Program based on feedback from participating customers.

[73] Sites with 50 or more employees used as a threshold to estimate sites that may be interested in DCFC. Using census data, 5.4% of business establishments in SCE territory have greater than 50 employees. U.S. Census Bureau, American Community Survey (2015), *available at* https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=BP_2015_00CZ2&prodType=table. SCE applied service territory zip codes to define SCE's geographical representation. All participating DCFC sites assumed to have at least one DCFC port. Twenty percent of participating DCFC sites assumed to have two DCFC ports.

[74] A 50 kW DCFC could fuel seven times as many EVs as a 7 kW level-two charging station.

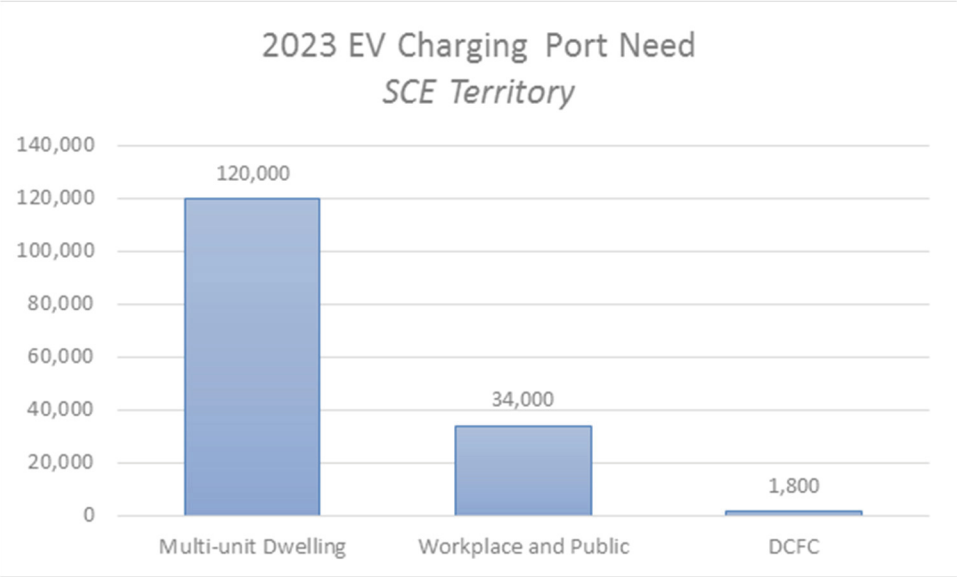
lowering upfront installation costs for charging stations, SCE will encourage broader deployment of DCFC stations and improve access to fast charging, which will ultimately benefit drivers and could foster greater adoption of electric vehicles.

b) Gaps and Customer Charging Needs

SCE's analysis shows that reaching California's GHG goals will require 7 million light-duty EVs on California roads by 2030 with approximately 2.7 million light-duty EVs in SCE's territory. To estimate the charging ports needed to serve these vehicles, SCE used the simulated at-home charging percentage developed in the National Renewable Energy Laboratory's ("NREL") "National Plug-In Electric Vehicle Infrastructure Analysis."[75] Using the results of the NREL analysis and scaling to the total forecasted population of EVs in SCE territory, SCE found that approximately 155,000 additional charging ports would be needed in MUDs, workplaces, and public locations by 2023.

[75] *See* NREL*, National Plug-In Electric Vehicle Infrastructure Analysis* (Sep. 2017), *available at* https://www.nrel.gov/docs/fy17osti/69031.pdf.

Figure III-5
Estimated 2023 EV Charging Port Needs



To determine the away-from-home Level 2 and in-city and inter-city corridor DCFC[76] EV charging infrastructure needs, SCE used the attach rates results (i.e. ports per 1,000 EVs for a variety of types of EVs) from the EVI-Pro model as reported by NREL's 2017 Infrastructure Analysis.[77] SCE modified some of the inputs to develop estimated attach rates that better reflect SCE's internal assumptions about charging behavior and charger distributions. For example, while SCE largely agrees with the NREL assumption that 80 to 88 percent of EV charging currently occurs at home and the remainder occurs away from home, SCE believes that through 2030, more charging will need to be done away from home to minimize the grid impacts of EV charging while maximizing the environmental benefits of EVs and increased solar deployment. As the grid is further decarbonized, primarily with increased solar deployment by 2030, SCE believes that EV load during the day can help facilitate renewable integration by utilizing excess generation from solar energy and helping to mitigate

[76] "In-city DCFC" refers to DCFC ports and stations within city/town limits. "Inter-city corridor DCFC" refers to DCFC ports and stations located along highways and interstates for long distance inter-city travel. *See id.*, p. 18.

[77] *Id.,* p. 14.

generator ramping needs.[78] Away-from-home fueling infrastructure creates an opportunity to charge EVs with low-GHG-intensity energy during the day and use EVs as grid resources. To more effectively manage load and minimize GHG emissions by 2030, SCE estimates that 25 percent or more of charging events need to occur during the day. SCE used NREL's at-home charging sensitivity analysis[79] to estimate the amount of away-from-home ports that are needed to facilitate a gradual shift from residential evening charging to nonresidential daytime charging.[80]

Because customers prefer it, residential charging will likely remain the dominant means of charging EVs. Installing charging stations in or near MUDs will be critical to reaching the number of EVs needed to achieve California's ambitious GHG and air quality goals. As shown in Figure III-5 above, SCE estimates that approximately 120,000 charging stations could be needed in or near MUDs in SCE's territory by 2023. The estimated MUD port need was determined by applying the number of SCE customers that reside in MUDs to the estimated residential chargers needed by 2023 as described above. While there is uncertainty in this estimate stemming from the availability of parking space in and near MUDs to support this level of charger deployment, adoption of EVs relies on developing innovative ways to provide charging services to this segment.

Ensuring that all customers have access to EV charging, and its associated benefits, is of particular importance. This is why the Charge Ready 2 Portfolio pays critical attention to supporting MUD and other publicly accessible charging stations. The creation of publicly accessible charging stations, including DCFC, in neighborhoods close to MUDs is important for meeting these underserved residents. UCLA researchers write that "where MUD inventory is too old, too costly or exempt from owner compliance to upgrades, a strategy of building or encouraging EVSE development

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[78] *See* Jonathan Coignard et al., *Clean Vehicles as an Enabler for a Clean Electricity Grid*, 2018 Environ. Res. Lett. 13 054031 (May 16, 2018), *available at* http://iopscience.iop.org/article/10.1088/1748-9326/aabe97/pdf.

[79] *See* NREL, *National Plug-In Electric Vehicle Infrastructure Analysis* (Sept. 2017), pp. 16-17, *available at* https://www.nrel.gov/docs/fy17osti/69031.pdf.

[80] SCE ports needs analysis assumes that in 2020, residential evening charging makes up 83% while non-residential daytime charging is 17% of total aggregate EV charging. By 2030, SCE assumes that residential charging accounts for 75% and non-residential daytime charging accounts for 25% of total EV charging.

in proximity to clusters of MUD properties may prove successful to the continued development of the EV market."[81] Given that at-home charging is expected to represent the large majority of charging events and almost 30 percent of households reside in apartments in SCE's territory, SCE has estimated that MUD EV drivers will comprise 17 percent of the market need for EV charging.[82]

The proposed SCE programs address the chicken-and-egg dilemma and the upfront cost barrier faced by away-from-home and MUD customer segments, including the cost of charging stations. SCE's programs also address barriers to participation identified in the Phase 1 Pilot to achieve the scale and scope of deployment required to meet the charging station need. Scaling presents an immense challenge that utilities cannot achieve on their own; SCE's proposed program size was determined through an analysis of market potential and only addresses one-third of the incremental market need between 2020 and 2023.[83]

c) Objective

The objective of the Charge Ready Make-Ready Expansion Program is to accelerate adoption of plug-in EVs in SCE territory as needed to meet the State's GHG and air quality goals through deployment of make-ready infrastructure to serve Level 1, Level 2, and DCFC stations and provide charging station rebates to help alleviate a key barrier to EV adoption—charger availability and convenience.

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[81] South Bay Cities Council of Governments and the UCLA Luskin Center for Innovation, *Assessing the Multi-Unit Dwelling Barrier to Plug-in Electric Vehicle Adoption in the South Bay Final Project Report* (Draft), (Jan. 2017), *available at* http://southbaycities.org/sites/default/files/ARV-14-035%20ZEV%20MUD%20-%20Final-Draft%20Rpt_0.pdf.

[82] This assumes 536,000 single-family dwelling ports, 120,000 MUD ports, 34,000 workplace and public ports and 1,800 DCFC by 2023.

[83] Consistent with SCE's Phase 1 Pilot, SCE proposes to deploy up to one-third of the anticipated incremental market need. By supplying only one-third of the need, SCE's program will allow many qualified vendors to participate, so long as they meet the program requirements. This approach encourages innovation and competition among suppliers.

d) Scope and Cost

(1) Customer and Site Eligibility

All eligible participating customers must own, lease, or manage the premises where the charging stations are installed in the Charge Ready Make-Ready Expansion Program.[84] Participating customers, if not the owner of the premises at which the EVSE is to be installed, must obtain written consent from the property owner to participate. Participating customers must provide SCE with the rights-of-way across public or private property (as applicable) and obtain any necessary permits satisfactory to SCE.

Site deployment size will not be constrained by the size of the parking lot, but a minimum of two ports per site will be required to participate in the program. SCE found in the Phase 1 Pilot that, for some customers, the ten-charge-port minimum requirement coupled with the maximum percentage of parking lot that could be converted was a significant barrier to program participation.

To obtain a rebate to offset the charging station costs, participating customers will be required to purchase and install qualified EVSE in the quantity approved by SCE.[85] EVSE, Electric Vehicle Network Service Providers ("EVNSPs"), suppliers, and installation contractors must be approved by SCE. Participating customers must have an Edison SmartConnect® meter or interval data recorder ("IDR") meter dedicated to registering charging site loads. All charging site load must be separately metered from any other load served at the premises or be measured by another equivalent way to verify charging load acceptable to SCE.

The customer of record (e.g., site host, electric vehicle supply provider "EVSP") will be required to take service on one of SCE's time-differentiated rates, but the customer of record will have flexibility to set pricing and parking restrictions for drivers charging at their site. SCE

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[84] Single-family residential customer sites are not eligible for the Charge Ready 2 Program.

[85] SCE will consider Level 2 charging station requirements included in Energy Division reports to the extent that they are relevant and timely for the Charge Ready 2 Portfolio.

will encourage participating customers to pass SCE's TOU rate through directly to drivers, but participating customers may elect to implement their own pricing plans.[86] Regardless of the customer's billing selection, participating customers will be required to participate in a demand response program.[87] SCE will also require participating customers to report prices charged to drivers. SCE will provide aggregate information to its advisory board annually. SCE will work to educate participating customers to ensure that end-use pricing is easy for drivers to understand and provides the opportunity for drivers to access electricity that is less costly than gasoline, consistent with § 740.12(a)(1)(G)[88] and (H), while meeting the needs of participating customers.[89]

(2) Site Prioritization Criteria

In order to achieve the speed and scale required to achieve California's environmental goals, and forecasted through this program, SCE will create a site prioritization methodology in an effort to expedite deployment at high-priority sites. Example criteria used to classify sites may include customer segment, expected number of EVs served, site costs, existing transformer capacity, location in or near DACs, and public accessibility.

(3) DCFC Eligibility

SCE will offer an option for a limited number of sites to install DCFC stations (in addition to the minimum two Level 1 or Level 2 stations) at the time of participation in the make-ready program, and will provide a flat rebate for qualified DCFC stations. SCE will cap the participation at 205 DCFC ports (approximately 5 percent of sites). SCE will develop criteria to

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[86] Custom pricing plans allow participating customers to provide EV charging to patron drivers at no cost, or at a rate that would allow them to recover some of the charging infrastructure's operational costs.

[87] SCE will work with fast charging equipment and network providers as well as customer site hosts to identify opportunities to leverage fast charging infrastructure for grid benefits and demand response.

[88] Cal. Pub. Util. Code § 740.12 (a)(1)(G) states that 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.

[89] Cal Pub. Util. Code § 740.12 (a)(1)(H) states that deploying electric vehicle charging infrastructure should facilitate increased sales of electric vehicles by making charging easily accessible and should provide the opportunity to access electricity as a fuel that is cleaner and less costly than gasoline or other fossil fuels in public and private locations.

determine site eligibility for DCFC, which may include factors such as proximity to customers needing charging, proximity to MUDs, site host agreement for public access, location in DAC, access for low-income customers, cost of charging for drivers, or site size.

(4) Accommodating Future Needs

Based on their predicted EV growth rate, some sites will be permitted to request additional EV charging station capability, but not be required to install charging stations at the time of original program participation. As the EV market continues to grow on a path to 7 million vehicles by 2030, the need for charging stations will also continue to grow. Additionally, many customers have medium- and long-term EV targets or sustainability goals. Through a four-year program, SCE has the potential to account for these factors and significantly reduce the installation cost of future charging stations by planning for and building capacity, so that additional parking spaces are "EV capable"[90] at the time of Charge Ready installation.

SCE will work with customers to plan for future site growth and may install hardware with additional capacity (e.g., panels and transformer pads) and infrastructure to accommodate future charging stations (e.g., trenching, conduit, wire) and electrical needs.[91] Having the infrastructure pre-installed will allow the charging stations to be added easily at a later date. Customers will be required to provide a commitment to install additional charging stations within a defined time period. This will aid in achieving and reducing the cost of Governor Brown's interim goal for infrastructure[92] and SCE's forecasted charging station need, to support California's long-term zero-emission vehicle goals. SCE will work with participating customers and electrical contractors to identify appropriate locations within the participating customer's parking lot to deploy charging stations economically (based on factors such as proximity to transformers, length of trenching, available

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[90] *See* CALGreen, *Guide to the 2016 California Green Building Standards Code*, Section 5.106.5.3 (Jan. 2017), *available at* https://www.documents.dgs.ca.gov/bsc/CALGreen/CALGreen-Guide-2016-FINAL.pdf.

[91] *See* Appendix C – SCE Electric Vehicle Charging Infrastructure Needs Assessment.

[92] Gov. Brown's Zero-Emission Vehicle Executive Order proposes to expand zero-emission vehicle infrastructure throughout California. Exec. Order No. B-48-18. *Available at* https://www.gov.ca.gov/2018/01/26/governor-brown-takes-action-to-increase-zero-emission-vehicles-fund-new-climate-investments/.

transmission and distribution capacity, and ease of access for EV drivers). SCE representatives will also help identify alternative locations, as needed. SCE may deny a customer's request to participate in the Program if the customer and SCE cannot agree upon an installation configuration and location that is reasonably economical, as determined by SCE in its sole discretion.

(5) Qualified Vendors, Products and Services

To promote competition and customer choice, SCE intends to include a broad range of qualified charging station models and network service providers from multiple suppliers as part of the Program offering. SCE will issue a Request for Information ("RFI") to technically capable and financially viable third-party suppliers, including qualified Women Minority Disabled Veteran Business Enterprise ("WMDVBE") suppliers, to cover the provision, installation, operation, networking and maintenance of the charging stations. Prospective suppliers will be asked to submit sample models to supply and install qualified charging stations, based on the RFI's requirements. Suppliers will have to demonstrate capabilities to supply qualified stations in appropriate volumes, and to provide maintenance and network-related services (e.g., charging data collection and management), either through the charging station or through a kiosk or gateway.

To qualify for the program's charging station rebate, equipment and controls will be evaluated against established standards (e.g., SAE J2836, IEEE 2030) and must comply with technical standards and energy efficiency recommendations (e.g., SAE Standards J1772, J2894, J2847, J3068; Title 20) and be listed by a nationally recognized testing laboratory. DCFC charging stations must adhere to the basic requirements of a Direct Current ("DC")-based EVSE, which must use recognized and approved DC standard charging connectors and additionally be capable of charging at power levels of 50 kilowatts ("kW") or greater.[93] If the proposed equipment complies with relevant

[93] Currently approved DC charging connectors are Combined Charging System ("CCS") or CHAdeMO. *See* Appendix E – Charging Standards and Definitions. EV connector specifications and others are defined in the appendix. In the decision on Pacific Gas and Electric's ("PG&E's") standard-review projects, the Commission noted: "While we support the choice of the site host to select their EVSE power level, given the current trends of increasing battery size and higher powered charging stations, it is prudent for PG&E to install the customer-side electric infrastructure necessary to support EVSE of 150 kW or larger at all DCFC sites in the Fast Charge program to account for the possibility that the site host may wish to upgrade to

standards, is listed by a nationally recognized testing laboratory, and is approved by SCE, the charging station would be eligible for the program and receive a rebate. Participating customers would be responsible for any additional cost above the rebate amount of the charging equipment and its installation.[94]

For those applications where charging equipment does not meet the technical requirements, SCE will not provide a rebate, but plans to work with customers and suppliers to evaluate the equipment to ensure safe and reliable operation that meets the functional requirements of the program. If SCE approves equipment that does not meet the technical requirements, the customer may participate in the program and receive the make-ready infrastructure but will not receive a rebate for the charging stations.

In addition, all Level 2 and higher output EVSEs, such as DCFCs,[95] must be demand-response capable (e.g., capable of receiving and executing real-time instructions to reduce and modify end-user pricing of EV charging load) and are encouraged to include additional load management features (e.g., EV charging sequencing or power sharing). EVSE must be controllable by SCE, either directly or through a vendor cloud service (e.g., OpenADR 2.0b), and must have the capabilities for each port to be independently controllable from 0 – 100 percent linear throttling.

Participating customers will be required to maintain charging station operability and communication functionality for five years after installation. Customers will be permitted to change or update their charging stations and networking service provider throughout the useful life of the underlying infrastructure at their own cost.

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higher-powered EVSE in the future." D.18-05-040, p. 74. SCE believes charging at power levels of 50 kW is more appropriate and provides flexibility for mass market vehicles that have smaller batteries and may not have the cooling provisions to be able to support 150 kW charging.

94 Unless customer has chosen for SCE to own and operate charging stations on their site, and SCE has approved this election.

95 *See* Appendix E.

(6) Customer Engagement and Enrollment

Achieving the objectives of the program will require a large-scale and proactive customer recruitment effort. SCE intends to engage and enroll customers by significant education and outreach efforts. Marketing activities will include an increased use of media, a refresh of the existing Charge Ready web content on SCE.com, fact sheet, FAQs, videos, program enrollment portal, and associated collateral and documents. Qualitative and quantitative research will be conducted to guide activities, including the targeting of eligible customers and development of new webpages, instructional videos and email templates. Programs will be promoted and supported by a range of tactics including, but not limited to: social media, segment-specific digital display ads, mobile marketing (e.g., location-based, short message service ("SMS")), and face-to-face interactions at venues like trade shows, direct customer interactions, and events such as ride-and-drives.

SCE will market to customers through mass media. Additionally, decision makers considering installing public and MUD charging stations will learn about the benefits of installing EV charging infrastructure via business publication advertisements and articles in trusted sources of information such as trade journals, as appropriate. Facilities managers will learn about the program via targeted, personalized email campaigns and digital collateral, and interaction with SCE key account managers. All tactics will be informed and optimized by the use of analytics incorporating data from a variety of customer touchpoints including, but not limited to, SCE-owned platforms (e.g., SCE.com, InsideEdison.com), social media (e.g., Facebook, Twitter), and SCE operational channels (e.g., customer contact centers). Input and feedback from customers will be used to produce customer testimonials and inform targeted market segments about the program.

(7) Pre-Deployment Activities

SCE will begin planning and executing pre-deployment activities to ensure that SCE can implement the program within a reasonable timeframe after Commission approval of the Charge Ready Make-Ready Expansion Program. Pre-deployment activities may include:

- Building vendor and supplier awareness of the business opportunities provided by the program;

- Developing and issuing solicitations to identify and qualify potential vendor and product participants;
- Creating and modifying program policies and procedures; and
- Planning and developing participant outreach activities.

(8) Demand Response

Demand Response ("DR") is a tool used by utilities to change a customer's electric load so that it can provide benefits to the grid when needed. The grid can be stressed when generation resources are scarce or abundant, or regional or local grid issues exist. For example, midday EV charging may be served mostly by solar energy. However, as the sun sets, natural-gas-fueled generation may be used to balance electrical supply and demand on the grid.[96] This increases GHG emissions and, depending on the wholesale market generation resources available at the time, may also increase electrical wholesale cost.

Various DR strategies can be utilized to minimize these effects. In addition to load reduction, SCE is testing and developing load shifting strategies for the Charge Ready Phase 1 Pilot sites to encourage charging when there is abundant renewable energy. This provides two benefits: 1) better integration of renewable power and 2) reduced GHG and criteria pollutant emissions as a greater mix of renewable energy is used to charge EVs.

To inform a DR program for Charge Ready 2, SCE developed and is executing a Charge Ready DR pilot. All Level 2 EVSE sites in the Phase 1 Pilot must participate in this DR pilot. During the DR pilot, SCE is testing and developing various types of DR events and issues such as load curtailment, load shifting, and DR messaging; the optimal percentage of load to drop or shift; the best times and event durations to benefit the grid and reduce customer inconvenience; and appropriate incentive amounts to maximize participation.

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[96] *See* Michael Panfil and James Fine, *Putting Demand Response to Work for California*, Environmental Defense Fund (2015), pp. 5-6, *available at* https://www.edf.org/sites/default/files/demand-response-california.pdf.

(9) Data Collection and Reporting

SCE proposes to provide annual status reports to the Commission's Energy Division and other interested stakeholders. The proposed reports will evaluate data across all program activities, including but not limited to: (i) customer enrollment and participation data; (ii) program process information; (iii) program installation costs; and (iv) customer usage data (e.g., EV usage data, transactions per day). The status reports will include updates on program progress, achievements, and lessons learned.

(10) Cost Components

For the proposed Charge Ready 2, SCE incorporated lessons learned from the Phase 1 Pilot to reduce costs. For example:

- Packaged Site Designs: SCE developed threshold site sizes that trigger major equipment size changes. The switchgear and metering panels are a significant cost driver for each site and packaging in various sizes should allow SCE to leverage buying power for multiple panels at once rather than the site-specific, special-order approach used in the Phase 1 Pilot.
- Site Feasibility Reviews: SCE will perform a high-level review of each site prior to engaging a design firm for a formal site assessment, saving on engineering fees for locations that cannot proceed due to site conditions.
- Ability to Use Customer Distribution Facilities: SCE may take a service drop from a customer transformer when there is sufficient existing capacity and it is deemed to be more economical than creating a stand-alone SCE line extension.
- Streamlined Plan Check Processes and Reduced Fees with AHJs: SCE intends to coordinate working sessions with AHJs to reduce the timing and costs associated with permitting and plan checks.

Based on the volume of sites across the various programs, SCE hopes to minimize costs and time by leveraging the State's EV mandates to influence AHJ performance and fees.

- Procurement Strategies: SCE intends to create a bigger pool of vendors to encourage competition, creating downward pressure on pricing (e.g., unit price contracts, eliminating time and material costs where appropriate).

SCE's cost estimates were developed using actual results realized in the Phase 1 Pilot and a detailed analysis of specific activities completed by each organization contributing to the Phase 1 Pilot implementation.

Capitalized Costs

- Utility-Side Costs – SCE developed utility-side cost estimates using actual costs from sites participating in the Phase 1 Pilot. Two installation examples (fixed meter and service, and line extension meter and service) were developed and scaled to five different deployment scenarios. These costs include labor, materials (transformer, cable, duct) and design and permitting costs up to the SCE meter.
- Customer-Side Costs – SCE developed customer-side cost estimates in consultation with internal subject matter experts and request for proposal ("RFP") responses from external electrical contractors participating in the Phase 1 Pilot. These costs include customer site design, planning, engineering, construction (including trenching) labor, and materials from the SCE meter to the stub out.

- Contingency – SCE includes a 10 percent contingency[97] in its utility-side and customer-side infrastructure costs.
- Other Capitalized Costs – Other capitalized costs include back-office software development, easement-related expenses, charging equipment testing to verify that charging stations meet requirements of the program, and all capitalized labor.

O&M Costs

- Rebate – SCE plans to provide a rebate up to $2,000 per charge port for Level 1 or Level 2 charging stations and up to $27,000 for DCFC charging stations at all sites. Rebates will not exceed 100 percent of the total cost of the charging station and installation.
- Labor – Forecasted labor captures all organizations required to implement the significant scale and scope of the Charge Ready 2 programs outside of capitalized labor. Labor estimates were determined by detailing unique implementation activities including, but not limited to, procurement, customer enrollment, infrastructure deployment, program management and post-deployment customer support and operations.
- Other Non-Labor – Other non-labor operation and maintenance ("O&M") expenses include preparation of reports and creation of marketing materials for the program.
- Ongoing O&M costs following the four-year program will be captured in subsequent general rate case requests, incorporating additional lessons learned from this program.[98]

[97] In D.18-05-040, the Commission approved a 10 percent contingency to establish the budget for standard review projects.

[98] D.18-05-040, p. 125.

e) Disadvantaged Communities

SCE will target a minimum of 30 percent of the charging port deployment in DACs in the Charge Ready Make-Ready Expansion Program. These communities are defined using the California Environmental Protection Agency's ("CalEPA's") California Communities Environmental Health Screening Tool 3.0 ("CalEnviroScreen 3.0") or its equivalent.[99] SCE revised its Charge Ready 2 target upwards from the Phase 1 Pilot target of 10 percent to account for the success of the Phase 1 Pilot,[100] which installed approximately 50 percent of charging ports in DACs. Since SCE will reduce its minimum port requirement to two ports per site for all participating customers, SCE does not propose a different minimum port requirement for DACs. SCE will reserve funds to cover 30 percent of the charging port deployment in DACs, with the option to release unused funds to any eligible customer site if there is insufficient DAC demand after two years of program implementation.

SCE will engage with prospective customers (including businesses, governmental institutions, colleges, and MUDs) in DACs to encourage program participation. SCE will also collaborate with various agencies, including but not limited to the California Energy Commission ("CEC"), CARB, the South Coast Air Quality Management District ("SCAQMD"), the San Joaquin Valley Air Pollution Control District and the Southern California Association of Governments ("SCAG"), to encourage more vehicle incentives and related spending authorized by statutes that favor investments in DACs.[101]

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[99] CalEnviroScreen 3.0 is a screening methodology, developed by the CalEPA, which can be used to help identify California communities that are disproportionately burdened by pollution and other socioeconomic factors, *available at* http://oehha.maps.arcgis.com/apps/webappviewer/index.html?id=4560cfbce7c745c299b2d0cbb07044f5.

[100] In the Phase 1 Pilot, the majority of DACs installed less than 10 ports at their sites also additional incentives were offered to increase participation, for example higher EVSE rebates. It is expected for Charge Ready 2 that DACs will continue trend to install fewer charging ports per site.

[101] *See* Cal. SB 535 (2012 Cal. Stats. Ch. 830 § 2); Cal. Assembly Bill (AB) 8 (2013 Cal. Stats. Ch. 401 § 2); Cal. SB 1204 (2014 Cal. Stats. ch. 524); Cal. SB 1275 (2014 Cal. Stats. ch. 530).

f) Advisory Board

SCE will leverage the existing TE Advisory Board comprised of customers and industry stakeholders who provide input, guidance, and suggestions on the execution and ongoing improvement of the Charge Ready Make-Ready Expansion Program. The Advisory Board has been valuable in supporting the implementation and operation of the Phase 1 Pilot by providing insightful feedback, guidance, and suggestions for process improvements, and helping to broaden awareness and promote transparency throughout the program's implementation. SCE will accept new members, and the TE Advisory Board will continue to meet quarterly.

g) Partners and Leveraged Funding

California agencies provide important, limited funds for the purchase of EVs. SCE's proposals provide funding for make-ready infrastructure and, in some cases, charging station and infrastructure rebates, which will complement public funding targeting the incremental cost of EVs and support the acceleration of transportation electrification by mitigating cost barriers. SCE will also encourage participating customers to apply for available third-party funding.

h) Duration

SCE is requesting approval for a four-year, Charge Ready Make-Ready Expansion Program. A four-year program ensures a durable funding signal will be sent vendors to develop products, compete and reduce costs and to the market, helping site hosts who are now engaged and ready to deploy infrastructure, and those that may not be ready for several years. A four-year duration also provides an initial pathway needed to scale up EV adoption to support 2030 GHG reduction goals.

4. Charge Ready Own and Operate

a) Description

For the duration of the four-year Make-Ready Expansion Program, SCE will offer customers in MUDs and governmental locations a turnkey option for SCE to own and operate the charging stations on their sites. SCE will cap this option at 4,230 ports, or approximately 35 percent of

forecasted MUD participation.[102] Under this option, site hosts will be required to meet the contractual needs of the make-ready program (e.g., easement) and pay for all electricity charges, but will not be obligated to purchase or maintain charging stations.

b) Gaps and Customer Needs

MUDs proved to be a difficult market segment to enroll in the Phase 1 Pilot. SCE learned that one of the main challenges for MUDs was the lack of interest from MUD owners to pay for site upgrades. SCE also learned that governmental locations required a long lead-time for charging station procurement.[103] To overcome the unique challenges presented by MUDs and governmental sites experienced during the Phase 1 Pilot, SCE plans to offer a turnkey option for MUD and government customers.

SCE learned that MUD owners are generally hesitant to invest in EV chargers. Their main objective is to provide amenities that will benefit all residents. When asked for interest in spending money to provide charging stations for a subset of residents, there is minimal interest from site hosts.[104] For this reason in particular, offering utility ownership of the charging stations to a portion of the MUD segment would enable EV adoption for residents in those locations.

In the Phase 1 Pilot, SCE learned that some of the delays experienced in project implementation correlated with the market segment being served. For example, government institutions had the longest delays in moving projects forward. Most customers averaged 44 business days to provide the required charging station procurement documents, while federal and university customers took an average of 65 business days. These delays directly impacted the start of construction and other downstream activities. In order to minimize delays and facilitate participation by these customers, SCE

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[102] The Commission has previously acknowledged the difficulties associated with the deployment of charging infrastructure in MUDs. To encourage MUDs to install charging stations, SCE proposes to own up to 35 percent of the electrical vehicle charging stations installed in MUDs, consistent with the Commission's prior decision authorizing PG&E to own up to 35 percent of the total vehicle charging stations in MUDs. *See* D.16-12-065, pp. 38, 83.

[103] *See* Appendix A, pp. 17, 49.

[104] *Id.*, p. 34, Figure 2.22. Reasons for MUDs Declining to Participate in Charge Ready.

is offering governmental entities a model where SCE owns and operates the charging station in Charge Ready 2 at the customer's choosing. Based on Phase 1 Pilot cycle times and feedback from customers, SCE ownership and operation of charging stations at customer sites may save an average of 169 business days to install the charging stations; thus, enabling more customers from this segment to be able to participate in the program.[105]

c) Objective

The objective of the program is to overcome key barriers (e.g., cost, complexity, customer interest) to charging station deployment in MUDs and government locations by offering a turnkey solution for these vital charging segments.

d) Scope and Cost

(1) Customer and Site Eligibility

In addition to previously detailed customer and site eligibility requirements for the make-ready program, SCE-owned-and-operated sites must qualify as a MUD or government-owned or government-leased property.

In addition to traditional parking lots and parking structures, Charge Ready Own and Operate will allow for the economic deployment of charging stations at streetside parking spaces.[106] These sites will be evaluated along with and against other applications for infrastructure in Charge Ready 2. Evaluations will use the site eligibility and prioritization criteria detailed in the Make-Ready Expansion Program description.

As in the Charge Ready Make-Ready Expansion Program, the customer of record (e.g., site host, EVSP) will be required to take service on one of SCE's time-differentiated rates, but customers will have flexibility to set pricing and parking restrictions for drivers charging at their

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[105] The following steps include average times based on the Pilot: (1) Procurement - 59 days; (2) Procurement review and approval by PMO – 11 days (includes back and forth follows up for missing documents); (3) Charging station installation - 46 days; (4) Rebate requirements (includes follow-up and processing) - 34 days; (5) Rebate payment - 19 days.

[106] *See* Jen Kinney, *L.A. Unveils Quicker, Easier EV Charging Station Install* (Dec. 19, 2016).

site. SCE will encourage participating customers to pass SCE's TOU rate through directly to drivers, but participating customers may elect to implement their own pricing plans.[107]

Regardless of the customer's billing selection, participating customers will be required to participate in a demand response program administered by SCE.[108] SCE will also require participating customers to report prices charged to drivers. SCE will provide aggregated information to its advisory board annually. SCE will work to educate participating customers to ensure that end-use pricing is easy for drivers to understand, provides the opportunity for drivers to access electricity that is less costly than gasoline consistent with § 740.12(a)(1)(G)[109] and (H),[110] and meets the needs of the participating customer.

(2) Qualified Vendors, Products, and Services

In addition to all make-ready infrastructure, SCE will select, procure, install, and maintain charging stations for operation on participating customer sites.

(3) Customer Engagement and Enrollment

Achieving the objectives of the program will require a large scale and proactive customer recruitment effort. SCE intends to leverage the customer outreach, enrollment, and education planned for the Charge Ready Make-Ready Expansion Program. Additional information germane to the own-and-operate option will be developed for MUDs and government sites considering installing charging stations.

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[107] Custom pricing plans allow participating customers to provide EV charging to patron drivers at no cost, or at a rate that would allow them to recover some of the charging infrastructure's operational costs.

[108] SCE will work with fast charging equipment and network providers as well as customer site hosts to identify opportunities to leverage fast charging infrastructure for grid benefits and demand response.

[109] Cal. Pub. Util. Code § 740.12(a)(1)(G) states that 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.

[110] Cal. Pub. Util. Code § 740.12(a)(1)(H) states that deploying electric vehicle charging infrastructure should facilitate increased sales of electric vehicles by making charging easily accessible and should provide the opportunity to access electricity as a fuel that is cleaner and less costly than gasoline or other fossil fuels in public and private locations.

(4) Data Collection and Reporting

SCE will provide annual status reports to the Commission's Energy Division and other interested stakeholders. The proposed reports will evaluate data across all program activities, including but not limited to: (i) customer enrollment and participation data; (ii) program process information, (iii) program installation costs; and (iv) customer usage data (e.g., EV usage data, transactions per day). SCE will additionally report on differences between SCE-owned-and-operated sites and make-ready sites. The status reports will also include updates on program progress, achievements, and lessons learned.

(5) Cost Components

SCE's cost estimates were developed using actual results realized in the Phase 1 Pilot and a detailed analysis of specific activities completed by each organization contributing to the Phase 1 Pilot implementation.

- Utility-Side Costs – Utility-side costs are captured in Charge Ready Make-Ready Expansion Program.
- Customer-Side Costs – In addition to the customer-side costs captured by the Charge Ready Make-Ready Expansion Program, charging station costs are estimated based on the average cost of a charging station in the Phase 1 Pilot.
- Contingency – SCE includes a 10 percent contingency in its utility-side and customer-side infrastructure costs.
- Charging Station Operation and Maintenance – O&M costs are derived from actual costs realized in SCE's Workplace Charging Pilot and include Software, ADR functionality, cellular service contract, maintenance contract, back office support, and payment transaction fees.
- Other Capitalized Costs – Other capitalized costs include easement-related expenses, charging equipment testing to verify

that charging stations meet requirements of the program, and all capitalized labor.

- Labor – Forecasted labor captures all organizations required to implement the significant scale and scope of the Charge Ready 2 programs outside of capitalized labor. Labor estimates were determined by detailing many unique implementation activities that overlap between all three infrastructure programs, including but not limited to procurement, customer enrollment, infrastructure deployment, program management and post-deployment customer support and operations.
- Other non-labor – Other non-labor O&M expenses include the development of back-office software to manage the program, preparation of reports, station testing and creation of marketing materials for the program.
- Ongoing O&M costs following the four-year program window will be captured in subsequent general rate cases.

e) Duration

As an offering for customers as part of the Charge Ready Make-Ready Expansion Program, the SCE ownership and operation option will coincide with the launch of Charge Ready 2 and is estimated to run for its full four-year duration.

5. Charge Ready New Construction Rebate

a) Description

The Charge Ready New Construction Rebate provides a rebate to developers of new MUD buildings to exceed local and State CALGreen building code (Part 11 of Title 24) and install EV charging stations. To further address the lack of charging infrastructure in MUDs, SCE plans to offer rebates to new construction MUD developments for the installation of operational charging stations. Current CALGreen building code requires that all new multi-family dwellings "facilitate future

installations and use of EV charges."[111] Specifically, new construction MUDs built in jurisdictions that have adopted the CALGreen building code are required to dedicate a percentage of the planned parking spaces to EV parking and to install a raceway capable of accommodating a 208/240 volt circuit dedicated to EV charging, an electrical system service capacity sufficient to charge all EVs at all required EV spaces. SCE plans to provide rebates to new construction MUD developments for exceeding CALGreen building code by installing the remaining electrical infrastructure and EVSE so that the new building has operational EV charging capabilities upon completion.

This program complements, but does not duplicate, the other infrastructure components of the Charge Ready 2 Portfolio by targeting only new construction. The rebate will provide up to $4,000 per port to help pay the cost of that charging station and the installation of infrastructure components in excess of the most stringent mandatory code for each site's jurisdiction. The rebate will not exceed 100 percent of the installation and charging station costs. Depending on market changes, SCE may reduce the rebate amount. SCE has the discretion to determine the rebate amount in consultation with the TE Advisory Board.

b) Gaps and Customer Needs

Because customers prefer to primarily charge at home and residents of MUDs are a critically underserved population, new strategies must be deployed to increase access to charging and reduce barriers to EV adoption in this segment. The National Academy of Sciences finds that only 27 percent of multifamily dwellings have parking spaces with potential access to charging while 61 percent of single-family houses have potential access to charging.[112] This barrier is beginning to be addressed through mandatory California Building Code, which requires new construction sites to have a defined number of "EV capable" parking stalls.[113] However, current code does not require the installation of

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[111] 2016 California Green Building Standard Code, Part 11, Chapter 4.106.4.

[112] Committee on Overcoming Barriers to Electric-Vehicle Deployment, *Overcoming Barriers to Deployment of Plug-in Electric Vehicles* (2015), *available at* https://www.nap.edu/read/21725/chapter/1.

[113] "EV Capable," as defined by CALGreen Section 5.106.5.3: "The service panel or subpanel(s) circuit directory shall identify the reserved overcurrent protective device space(s) for future EV charging … and … the raceway termination location [must be] permanently and visibly marked EV Capable."

charging stations. Consequently, new MUD sites may remain underserved. With approximately 19,000 new MUD housing units constructed each year in southern California, the opportunity for new construction MUD sites to include operational charging stations is massive. The most economic time to install charging stations at these sites is when they are under construction. To begin to meet the urgent need for charging in the most underserved market segment in the most economical way, SCE's new construction rebate program proposes to support approximately 13 percent of the new MUD construction infrastructure need. This is an essential step to serving MUD customers.

c) Objective

The objective of the New Construction Rebate program is to encourage MUD developers to exceed current CALGreen building code by installing operational charging stations during construction.

d) Scope and Cost

(1) Customer and Site Eligibility

All eligible participating customers must own, lease, or manage the premises where the charging stations are installed. Participating customers, if not the owner of the premises at which the EVSE is to be installed, must obtain written consent from the property owner to participate. Participating customers must provide SCE with the rights-of-way across public or private property (as applicable) and obtain any necessary permits satisfactory to SCE.

Participating properties must be located within SCE service territory and take service from SCE. All EV charging stations must be installed in SCE service territory before receiving a rebate. Eligible customers will receive up to $4,000 for each hardwired (wall-mounted or pedestal-mounted) EV charge port. The EV charging stations must be connected to a separate SCE meter for either revenue or statistical metering, or be measured by another equivalent way to verify charging load acceptable to SCE. Charging stations must be certified by a nationally recognized testing lab and installed by a qualified, licensed contractor in accordance with local codes, permitting and inspection requirements.

Sites will be considered eligible by exceeding the most stringent mandatory building code placed on them (local or State). Sites may exceed code by 1) installing additional infrastructure and operational charging stations on top of required EV Capable requirements as defined in CALGreen or other relevant local requirements or 2) installing additional infrastructure and operational charging stations in excess of the minimum number of required EV spaces defined in CALGreen or other relevant local requirements.

In order to minimize free ridership and maximize the impact of the new construction rebate, only the cost of additional infrastructure and charging stations in excess of the most stringent mandatory code will be applied towards the rebate amount. If, during the duration of the program, local jurisdictions update their code to be stricter than CALGreen or statewide mandatory code, the more stringent, mandatory code of the two will set the new minimum requirement for impacted sites that customers must exceed to qualify for the rebate. If mandatory code requires the full installation of charging stations, then sites would receive the rebate only for additional charging stations installed beyond the minimum required.

Similar to the Make-Ready Expansion Program, the customer of record (e.g., site host, EVSP) will be required to take service on one of SCE's time-differentiated rates, and the customer will have flexibility to set pricing and parking restrictions for drivers charging at its site. SCE will encourage participating customers to pass SCE's TOU rate through directly to drivers, but participating customers may elect to implement their own pricing plans.[114] Regardless of the customer's billing selection, participating customers will be required to participate in a demand response program.[115] SCE will also require participating customers to report prices charged to drivers. SCE will work to educate participating customers to ensure that end-use pricing is easy for drivers to understand, is providing the

[114] Custom pricing plans allow site hosts to provide EV charging to patron drivers at no cost, or at a rate that would allow them to recover some of the charging infrastructure's operational costs.

[115] SCE will work with fast charging equipment and network providers as well as customer site hosts to identify opportunities to leverage fast charging infrastructure for grid benefits and demand response.

opportunity for drivers to access electricity that is less costly than gasoline, consistent with § 740.12(a)(1)(G)[116] and (H),[117] and meets the needs of the participating customer.

(2) Customer Engagement and Enrollment

SCE plans to leverage multiple communication channels to develop customer awareness about the program, including online advertising to target MUD developers. SCE will also coordinate to proactively reach out to developers and capture developers who are communicating with SCE through normal service connection processes. As part of its education and outreach efforts, SCE plans to target sites in State-designated disadvantaged communities to participate in the program.

(3) Data Collection and Reporting

SCE proposes to provide annual status reports to the Commission's Energy Division and other interested stakeholders. The proposed reports will evaluate data across all program activities, including but not limited to: (i) customer enrollment and participation data; (ii) program process information; (iii) program installation costs; and (iv) customer usage data (e.g., EV usage data, transactions per day). SCE will additionally report on differences between sites receiving the new construction rebate and other infrastructure components in the Charge Ready 2 Portfolio. The status reports will also include updates on program progress, achievements, and lessons learned.

(4) Cost Components

SCE's Charge Ready New Construction Rebate cost estimate was developed using relevant components from the same customer-side contractor RFP data used in the Charge Ready Make-Ready Expansion Program estimates. The relevant components include only the

[116] Cal. Pub. Util. Code § 740.12 (a)(1)(G) states that 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.

[117] Cal. Pub. Util. Code § 740.12 (a)(1)(H) states that deploying electric vehicle charging infrastructure should facilitate increased sales of electric vehicles by making charging easily accessible and should provide the opportunity to access electricity as a fuel that is cleaner and less costly than gasoline or other fossil fuels in public and private locations.

materials and labor needed to take a site from "EV Capable" to full installation. Additional costs recorded from Phase 1 Pilot sites for charging station cost and connection were included.

- Rebate – SCE plans to provide a rebate up to $4,000 per port for the completed installation of either Level 1 or Level 2 charging stations at sites. Rebates will not exceed 100 percent of the total cost of the charging station and infrastructure needed to exceed maximum mandatory code.

e) Duration

Launch of the New Construction Rebate will coincide with the launch of the Charge Ready 2 Portfolio and is estimated to run for the four-year duration of the Portfolio.

6. Advancing New Technologies

During Charge Ready 2, technology could change significantly. SCE seeks to balance the immediate need for increased charging infrastructure with measures to promote customer choice and limit the risk of technology obsolescence. The technology described in this section will be incorporated into the broader program. While Charge Ready 2 would serve AC Level 1, Level 2, and DCFC,[118] SCE requests flexibility to accommodate emerging technologies in the program as they become viable. SCE is not seeking additional funds to support this flexibility. Some examples of emerging technologies could be:

- Higher speed AC or DC functionality;
- Wireless inductive EV charging;[119]
- New cellular communication technology such as 5G,[120] which may impact the design of future EVSE and associated services;

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[118] Definitions of charging technologies can be found in Appendix E.

[119] *See* Plugless, *The Ultimate Guide to EVS with Wireless EV Charging (Including Tesla)*, *available at* https://www.pluglesspower.com/learn/wireless-charging-evs-guide-tesla/.

[120] *See* Sascha Segan, *What is 5 G?,* PC MAG (March 20, 2018), *available at* https://www.pcmag.com/article/345387/what-is-5g.

- EV Original Equipment Manufacturer ("OEM") Cloud platforms that would allow participation in Demand Response directly by the EV and bypass the EVSE;[121] and/or
- EVSE that integrates storage capabilities to reduce grid stress during high charging periods.[122]

SCE plans to integrate new technologies and processes into the program with the following criteria:

- **New EVSE Technologies:** SCE will fund only core EVSE features such as charging, connectors, DR, and networking in the Charge Ready 2 programs. However, SCE will not preclude new potential hardware features, such as integrated storage or wireless charging, from evaluation and participation in the program.
- **Site-Based Load Management:** New technologies that may be evaluated include, but are not limited to, solutions that minimize impact on the electric grid through compliance with power quality standards and load management, such as time-of-use pricing, power sharing, or power sequencing.
- **Networking and Usage Data Management:** Networking, sensors, metering and payment technologies facilitating access to usage data, data transfer, payment methods or reducing networking costs may be evaluated.
- **Annual Reporting:** SCE **will** provide annual reporting on the incorporation of any new economical technology as part of the annual Charge Ready 2 program

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121 *See* Taas News, *Ford Acquires Autonomic and Transloc to Help with its New Mobility Business*, TAAS MAGAZINE (January 29, 2018), *available at* https://taas.news/article/103299/Ford_Acquires_Autonomic_And_Transloc_To_Help_With_Its_New_Mobility_Business.

122 *See* Amit Katwala, *A Fluke Breakthrough Could be the Missing Link for an Electric Car Age,* WIRED (March 1, 2018)*, available at* http://www.wired.co.uk/article/superdielectrics-supercapacitor-electric-car-battery.

report. SCE will incorporate the data collection and reporting requirements outlined in D.18-01-024.

Allowing flexibility to incorporate new technologies in the Charge Ready 2 program maintains the program's relevancy and enhances the attractiveness of the program for future customers.

B. Marketing, Education and Outreach

In addition to the Charge Ready 2 education and outreach efforts described above, SCE proposes a comprehensive ME&O initiative to tackle key adoption barriers and address customer needs as described in Section II.D. Many of these activities align with programs SCE is already delivering, making them a natural role for the utility. The Portfolio's objective is to help the EV market resolve significant barriers broadly, such as availability of charging stations and EV awareness, and specifically, enabling more charging station deployment in MUDs.

In response to these barriers and customer needs, SCE proposes three discrete, related efforts to develop awareness about TE and the benefits of fueling from the electric grid, and to assist residential and business customers as they consider adopting EVs:

1. **EV Awareness Campaign** leveraging mass media channels, a web content refresh, and the launch of a new EV Ambassador network;
2. **Customer Education Program** with new online self-service tools, ride-and-drive events, and education and training materials for industry stakeholders (e.g., dealerships, architects and developers); and
3. **TE Advisory Services Expansion** building on TE Advisory Services deployed concurrently with the Phase 1 Pilot.

The EV Awareness Campaign and the Customer Education Program will primarily target potential individual/residential adopters of light-duty EVs. The TE Advisory Services will serve business customers adopting light-, medium-, or heavy-duty EVs, or provide EV charging services to their constituents (tenants, employees, visitors, customers, or fleets). In addition, all three ME&O efforts will include specific engagement of DAC customers who face additional socioeconomic barriers

and live or work with a concentrated amount of air pollution, largely caused by fossil-fueled vehicles.[123] ME&O will familiarize customers with available EV incentives and rebates that make EVs more affordable, including special State incentives available to customers in DACs.

In D.16-01-023,[124] the Commission found that "SCE intends to invest $3 million in education and outreach for Phase 1, which represents a significant commitment to education and outreach that can be enhanced and improved in [Charge Ready 2]." The proposed second phase of SCE's ME&O effort builds on SCE's learnings from the Phase 1 Pilot and expands SCE's initial efforts to promote transportation electricification and the benefits of fueling from the grid.

Below, SCE outlines specific information for each effort including: descriptions of the effort, how the effort addresses different customer needs, and the effort's objectives. There are certain implementation aspects that will be the same across all ME&O activities, which are described beginning in Section III.B.4**.**

1. EV Awareness Campaign

a) Description

In order to increase EV adoption, SCE will implement a broad EV awareness campaign through mass media, direct marketing, outreach through local community organizations, and a new EV Ambassador network.

(1) Mass Media

SCE plans to reach a broad audience with key messages to create general awareness through a mix of channels and tactics including social media, display ads, search engine marketing, mobile marketing, content marketing, radio, video, print ads and outdoor advertising. In addition, SCE will target specific customer segments (e.g., DACs, multi-unit dwellings) with tailored messaging. Each channel will serve to encourage customers to learn more about EVs at SCE's website, which will contain information to dispel myths and elaborate upon the benefits of EVs, and to provide

[123] California Public Utilities Commission, Zero-Emission Vehicles Fast Facts, *available at* http://www.cpuc.ca.gov/zev/.

[124] D.16-01-023, p. 54.

key information to further engage and learn more about the benefits of EVs. SCE will ensure adequate coverage among its diverse customer base by developing its campaign in key languages spoken in its service territory, including Spanish and Asian languages.

(2) Direct Marketing

SCE will use direct marketing channels (e.g., email newsletters) for a more personalized message. Through external research and internal customer data, SCE can identify customer populations, such as those that will be more likely to adopt EVs, or those facing specific adoption barriers (e.g., MUD residents). Because the nature of direct marketing is to target specific audiences with specialized messaging, SCE can address these populations with direct and ongoing messages to help speak to each audiences' unique barriers.

(3) Outreach through Local Community Organizations

SCE plans to conduct outreach to build awareness through its extensive network of agencies and partners,[125] such as community- and faith-based organizations. These organizations can help communicate through their established relationships with customers in disadvantaged and low- or moderate-income communities, which may include Hispanic, Asian-Pacific Islander, or African American communities. By working with these organizations, SCE will connect with hard-to-reach audiences, using trusted community resources. Additionally, SCE proposes a greater presence at industry and automotive events, including sponsorships and speaking opportunities, all with the purpose of providing a trusted voice to attendees and to continue to increase engagement.

(4) EV Ambassador Network

Recognizing the value of personal endorsements and word of mouth, SCE plans to build a network of EV "Ambassadors." This network, comprised of EV drivers and enthusiasts, may include SCE customers, employees, and retirees, to participate in ride-and-drive events, provide testimonials, and answer questions about EVs and EV operation at events and in their daily lives. EV drivers who are highly satisfied with their vehicle are often the best advocates for the technology. SCE

[125] *See* Appendix G, which includes a list of community-based organizations ("CBOs").

will use social media, both paid and organic, for storytelling, driver blogs and videos to allow EV Ambassadors to share their experiences and engage with customers.

b) Gaps & Customer Needs

Various interlinked barriers prevent wider adoption of EVs,[126] including a general lack of awareness about EVs, the differences between internal-combustion engine vehicles, battery electric vehicles ("BEVs") and plug-in hybrid electric vehicles ("PHEVs"),[127] and the benefits EVs provide (individual, societal, and environmental), suggesting a need for large-scale education to support EV adoption.[128] Customers also lack an understanding of the cost of EV ownership over the lifetime of a vehicle, including purchase/resale, fueling, maintenance, and repair. Without this understanding, potential buyers may face sticker shock when comparing only upfront acquisition costs, even as EV prices are dropping. Similarly, the lack of understanding of the cost of deploying and operating charging infrastructure at premises other than single-family homes is a barrier to EV adoption. Property owners and managers may not have the time or motivation to gain an understanding of a new and potentially confusing market. Finally, EV drivers state that access to charging at home and away from home, in particular at work, is a primary concern. The UC Davis survey shows that while doubling of away-from-home charging may have occurred, away-from-home infrastructure has not kept pace with EV adoption.[129]

c) Objective

The objective of the EV awareness campaign is to develop awareness about EVs, benefits of EV adoption, and fueling from the grid through mass media, direct marketing, outreach

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[126] *See* Section II.D for description of barriers to EV adoption.

[127] *See* NREL Report*, Consumer Views on Plug-in Electric Vehicles-National Benchmark Report*, *available at* https://www.afdc.energy.gov/uploads/publication/consumer_views_pev_benchmark.pdf.

[128] *See*, *e.g.*, Mark Singer, National Renewable Energy Laboratory, *The Barriers to Acceptance of Plug-in Electric Vehicles: 2017 Update*, p. 11 (Nov. 2017), *available at* https://www.nrel.gov/docs/fy18osti/70371.pdf.

[129] *See* Ken Kurani and Scott Hardman, *Automakers and Policymakers may be on a Path to Electric Vehicles; Consumers Aren't* (accessed May 2018), *available at* https://its.ucdavis.edu/blog-post/automakers-policymakers-on-path-to-electric-vehicles-consumers-are-not/.

through local community organizations, and a new EV Ambassador network. The purpose of increased EV awareness is to increase EV adoption.

2. Customer Education Program

a) Description

The Customer Education Program will build on the proposed EV Awareness Campaign to provide further education on EVs through new, online self-service tools, enhanced education and training materials, hands-on ride-and-drive events and experiential events. SCE intends to develop improved, mobile-optimized tools and customer materials to help potential EV adopters develop an informed opinion and determine if EVs are a right fit for their needs and budget. Through these mobile-optimized customer tools, SCE will provide customers with information to assist in overcoming barriers to adoption, for example: understanding the total cost of ownership and finding ways to locate charging away from home.

In spite of rebates available to assist with purchasing or leasing an EV, the upfront cost of an EV is typically higher than a similar-in-class conventional vehicle. However, when factoring all costs over the lifetime of a vehicle, including fueling, maintenance, and repair (total cost of ownership), EVs will often offer a similar or more financially attractive option as compared to ICE vehicles. An important component of cost of ownership is fueling, both at home and on the road, and where that charging can occur. Understanding and locating home and away-from-home fueling options, and seeing how charging behavior influences costs, will help customers to be more open to EV adoption. Providing this holistic view of the total cost of ownership to potential EV drivers is important as a way to help them make an informed evaluation in their decision to adopt.

(1) Enhanced Education and Training Materials

In addition to online tools, SCE plans to develop educational and training materials in collaboration with original equipment manufacturers, local dealerships, and other stakeholders to help customers identify and select an EV that matches their needs. A study from UC Davis identified some of the challenges that EV buyers face at car dealerships such as product knowledge of sales staff, a longer sales process to explain product features, and the desire for greater

support around EV ownership after the sale.[130] Unfortunately, a more recent survey confirmed that these challenges still exist, with much room for improvement in the dealership experience.[131] SCE plans to develop enhanced educational tools and materials to lead customers to become educated consumers equipped with EV knowledge to enjoy a more satisfying purchase experience. In turn, these materials, as well as specialized EV training developed with industry partners, can be provided to dealer sales staff to ensure critical EV ownership questions, such as cost to charge, special EV rates, or utility rebate and incentive programs are included in the sales presentation.

(2) Experiential Events

Hands-on experience with an EV is viewed as a key enabler to educating drivers on the performance benefits of an EV. Simply getting behind the wheel of an EV to touch, see and feel how an EV operates is important to helping the public gain a greater understanding and familiarity with the technology. SCE plans to expand upon this concept, through experiential events such as ride and drives or hands-on EV showcases, to allow drivers a pressure-free environment to test drive EVs, ask questions of trained staff, and meet other EV drivers. For example, the "GO FORTH Electric Showcase"[132] in Portland, Oregon, which includes trained staff and a variety of EVs for potential drivers to interact with, provides an excellent model for the type of enhanced experience SCE can develop under the proposed program.

b) Gaps & Customer Needs

Advancing drivers through the EV journey is critical to ensuring EV adoption. Once stakeholders are aware of EVs, there is still work to be done to increase their intent and consideration in order to move closer to actual purchase. The more stakeholders learn and understand the nuances of EVs, the more comfortable they will become. Currently, a range of websites,

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[130] *See* Eric Cahill, Jamie Davies-Shawhyde and Thomas S. Turrentine, *New Car Dealers and Retail Innovation in California's Plug-In Electric Vehicle Market* (Oct. 2014), *available at* https://itspubs.ucdavis.edu/wp-content/themes/ucdavis/pubs/download_pdf.php?id=2353.

[131] Press Release, Ipsos, *Ipsos RDA Study Finds U.S. Dealerships not Prepared for the EV Invasion* (November 15, 2017), *available at* https://www.ipsos.com/sites/default/files/ct/news/documents/2017-11/rda-finds-dealership-not-prepared-ev-invasion-2017-11-15-v1.pdf.

[132] Information on Go Forth Electric Showcase Event *available at* https://forthmobility.org/showcase.

organizations, and sources exist to educate the public on key EV concerns, such as cost to own, performance, or where and how to charge. Providing education through a single source such as a self-service tool or through hands-on experiences through a trusted advisor such as SCE will be important to advancing consumers through their EV journey.

c) Objective

The objective of the Customer Education Program is to build on the proposed EV Awareness Campaign to provide further education on EVs by combining new online self-service tools, enhanced education and training materials for stakeholders, and hands-on ride-and-drive events and experiential events. This will help to increase EV adoption.

3. TE Advisory Services Expansion

a) Description

SCE proposes to expand the Phase 1 Pilot TE Advisory Services to include new services for more business customers. These services will primarily focus on technical education and support commercial, governmental and fleet-operating customers from initial awareness to training, hands-on experiences, and TE-related assessments performed by SCE or its vendors. These efforts will target business customers including small, medium and large commercial fleet operators, school districts, transit agencies, cities and counties (including their various departments with fleet vehicles such as public works, emergency response, permitting and inspection agencies, and parking enforcement), workplaces and public charging locations with employee/visitor parking, and multi-unit dwelling owners, managers, and homeowners' association representatives.

(1) Educational Events at SCE's Energy Education Centers

SCE's Energy Education Centers in Irwindale and Tulare educate customers and the community on key energy-related technologies and programs. They serve as technical and scientific centers of expertise where customers and the local community go to connect with and learn from experts on a variety of energy-related topics. SCE plans to bring electric vehicles to customers via Energy Education Center demonstrations, driver training classes, and ride-and-drive events to showcase the benefits of EVs, provide access to vehicle manufacturers and technical experts,

and create a venue for customer cross-pollination and idea-sharing. For example, customers interested in Charge Ready 2 may be exposed to quarterly medium- and heavy-duty ride-and-drive events, highlighting a potentially unfamiliar vehicles class such as school buses or delivery vehicles. Industry experts will provide classroom training (including any tie-ins with applicable utility incentive programs) and OEMs may demonstrate their vehicles and answer questions. Classroom-based driver training and safety education training will provide fleet operators with greater confidence in their drivers' ability to maximize range of EVs and ensure employee and public safety.

(2) Fleet Assessments and Site Feasibility Assessments

SCE has successfully provided a limited number of high-level fleet analyses and site feasibility assessments to help customers prepare for potential deployment of charging stations. These efforts support customer consideration of TE technologies. These services, provided by trained SCE personnel, have allowed SCE to refine its methodology and evaluate customer interest in EV adoption. SCE plans to continue offering these services to more customers over the four-year program period.

SCE has also identified that its businesses customers with large fleets have sophisticated fleet operations requiring granular duty-cycle data and analysis to evaluate fleet conversion beyond the high-level fleet analyses SCE has been piloting. For qualified customers,[133] SCE intends to develop an enhanced service to help gather relevant data and conduct investment-grade fleet analyses to support their fleet management needs and decision-making process through the development of a comprehensive business case for TE investment.

(3) Grant Writing Services/Support

SCE has learned that many customers with fleet operations do not have available budget to participate in or create EV demonstrations or deployments. Grants are critical to initiating adoption in new segments lacking high EV penetration. While significant funding is available for TE conversion and demonstrations (e.g., Carl Moyer Program or Hybrid and Zero-Emission Truck

[133] Based on the number of fleet vehicles for which commercially available EV alternatives exist.

and Bus Voucher Incentive Project ("HVIP")), many customers do not have the resources available to apply for these grants. For example, school districts or distribution centers may not take advantage of grant funding opportunities to acquire electric buses or electric refrigerated truck units ("RTUs") that could be combined with available utility infrastructure programs to install the necessary charging equipment. SCE will offer grant writing services and support to customers and identify and assist in applying for appropriate grants. SCE will track the participating customers' applications and whether they received grants.

b) Gaps & Customer Needs

Business customers have expressed to SCE the need for more technical assistance from a neutral voice as they consider electric vehicles for their operations. Business customers without sufficient support are frequently faced with inertia that prevents them from evaluating and planning adoption of TE technologies. Alternatively, customers without the proper expertise could make costly decisions that will hinder future adoption efforts.

SCE has found that business customers, like their residential counterparts, are often unfamiliar with the range of TE options available to replace their fleet of fossil-fueled vehicles. They are unprepared to assess the feasibility of adding EVs to their fleets and developing a reliable business case to support a conversion. These customers, including local governments, may be unfamiliar with writing grants to access the many available State and federal TE incentives.

c) Objective

The objective of the education events and site and feasibility assessments is to expose business customers to electric vehicle options for commercial and fleet vehicles. These education and demonstration events will provide hands-on exposure and access to a variety of electric vehicle models applicable to fleet operations. Additionally, fleet and site feasibility assessments will allow business customers to understand how adoption of EVs will specifically impact and work with their operations.

The objective of the grant writing service is to assist customers in applying for grants that fund acquisition of EVs for fleet conversion or for demonstration and evaluation purposes.

SCE intends to provide technical writing assistance and to leverage industry expertise to help customers prepare their applications.

4. ME&O Implementation

While SCE is proposing three discrete, related efforts to develop awareness about TE that have specific descriptions, address different customer needs, and have different objectives, there are certain implementation pieces that will be the same across all ME&O activities. These include collaboration and partnerships, creative agencies and vendors, data collection and reporting, TE Advisory Board, duration, cost, and benefits.

a) Collaboration and Partnerships

SCE proposes to coordinate its market education efforts closely with industry and government stakeholders at the local, regional, State, and national levels. From local vehicle dealerships to OEMs, from cities and communities to regional air districts, the CEC or CARB, SCE has demonstrated its experience and willingness to work with stakeholders to educate residential and business customers about EVs. Through the proposed new efforts, SCE intends to continue and expand these collaborations.

b) Creative Agencies and Vendors

SCE plans to implement the proposed efforts with a combination of in-house resources, third-party creative agencies and other vendors. When SCE procures these services from third parties, SCE utilizes a consistent set of professional service vendors which support all SCE ME&O programs. These vendors are awarded contracts based on SCE Procurement policies and procedures including a competitive RFP process, subject to SCE's WMDVBE requirements.

c) Data Collection and Reporting

SCE proposes to provide annual status reports to the Commission's Energy Division and other interested stakeholders. The proposed reports will evaluate data across all program activities. SCE will use and report on a variety of metrics to evaluate success and effectiveness of each effort, in particular for awareness, intent, and engagement. SCE intends to monitor these metrics and make changes in approach or to shift the mix of one channel over another to ensure program objectives

are reached. For instance, to determine awareness and intent, SCE will conduct surveys to develop baselines and continuously evaluate its efforts. SCE will also measure media impressions, reach, frequency, and website traffic. For engagement, SCE will measure click-through and open rates, video views, and likes/shares in social media.

Evaluation metrics will also include class and event attendance metrics and pre- and post-event survey data to measure increased interest in procurement of electric vehicles or participation in utility incentive programs.

d) Advisory Board

SCE intends to work closely with the TE Advisory Board and its members as SCE develops and implements its ME&O activities. SCE will also provide updates to the Board about its progress and discuss any adjustments needed.

e) Duration

SCE proposes to conduct its ME&O efforts for a period of four years following approval by the Commission.

f) Costs

The table below summarizes the costs for the proposed marketing, education and outreach efforts.

Table III-4
ME&O Costs
(Millions, 2018 $, not loaded)

ME&O	Year 0	Year 1	Year 2	Year 3	Year 4	GRAND TOTAL
Broad EV Awareness	$0.0	$7.3	$6.7	$7.6	$7.2	**$28.7**
Customer Education	$0.0	$2.2	$1.8	$2.2	$1.8	**$8.0**
TE Advisory Services	$0.0	$1.0	$0.9	$1.5	$1.4	**$4.8**
TOTAL	**$0.0**	**$10.5**	**$9.4**	**$11.3**	**$10.4**	**$41.5**

g) Benefits

With any new technology, building awareness is critical to success. SCE believes that increasing awareness of EVs and their benefits will lead to greater consideration in the vehicle purchase cycle. More customers must become aware of EVs and their benefits to think of them when buying or leasing a new vehicle. SCE intends to build on its prior efforts to amplify EV awareness building as our customers' trusted energy advisor. SCE's message about the benefits of EVs is consistent with SCE's *Clean Power and Electrification Pathway* white paper. Customers are looking to SCE to help provide a modern grid, facilitate higher levels of renewables, improve air quality, and help make EVs more affordable.[134]

By addressing one of the most significant barriers to EV adoption, awareness, SCE's ME&O proposal will, first and foremost, seek to accelerate greater adoption of EVs. Additionally, the multiple components of the ME&O strategy will improve customer awareness of the value of charging off-peak and increase utilization of off-peak charging.

SCE's education and outreach campaigns have a history of success. For example, SCE created a multi-channel, multi-language public safety campaign, addressing what to do in

[134] SCE conducted a focus group on November 27, 2017, with Unisearch Partners to explore reactions to the communication ideas about SCE leading California toward a clean energy future.

dangerous electrical situations. These efforts have been in-market with a strong media presence for several years. Over time, and with an ongoing and significant investment in advertising, awareness of SCE's safety messaging increased from a low of 31 percent to over 60 percent over a period of six years.[135] Additionally, educating residential customers about available time-of-use rate options using broad channels has also proven to be successful. In 2016, a mass media campaign about rate choices increased awareness of options, including time-of-use plans, from 40 to 46 percent.[136]

The proposed ME&O activities are designed to generate several benefits for SCE's customers. ME&O will help customers understand that EVs are a highly viable and effective transportation option for many, through a combination of self-service tools and in-person services on a scale commensurate with the adoption goals set forth by California. These efforts will promote off-peak charging when grid capacity is high and integration with renewable energy generation through the newly approved EV rates.[137] While the scope of these ME&O activities are on par with other successful broad education and outreach efforts conducted by SCE,[138] the requested funding for the Market Education represents a significant contribution to lower critical adoption barriers and accelerate widespread TE. ME&O aims to develop awareness about EVs and the benefits of fueling from the electric grid for both residential and business customers.

C. Portfolio Costs and Benefits

1. Charge Ready 2 Portfolio Costs

Table III-5, below, summarizes the annual direct costs for Charge Ready 2 programs.

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[135] SCE conducts a "Customer Attitude Tracking Survey" every quarter. This survey is designed to assess and track attitudes towards marketing issues and SCE marketing campaign among SCE residential and small business customers.

[136] SCE conducted multiple "Rate Reform/TOU Transition ME&O Tracking Surveys." The purpose of these surveys is to determine residential customers' awareness of different rates.

[137] *See* D.18-05-040, approving SCE's new EV rates.

[138] *See SCE Surveys*, fn. 135-137.

Table III-5
Charge Ready 2 Portfolio Summary Cost
(Million, 2018 $, excludes escalation and loaders)

Charge Ready 2 Portfolio	**Total Cost**
Make-Ready Expansion	$596.2
Ownership and Operation	$28.0
Program Labor/Non-labor	$28.3
New Construction Rebate	$66.1
Marking, Education, Outreach	$41.5
TOTAL	**$760.1**

Table III-6
Charge Ready 2 Infrastructure Programs Capital Cost
(Million, 2018 $, excludes escalation and loaders)

Capital Cost	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**GRAND TOTAL**
Utility-side Costs	$0.0	$26.1	$39.1	$39.1	$26.1	**$130.5**
Customer Site Cost	$0.0	$79.1	$118.6	$118.6	$79.1	**$395.3**
Ownership Station Cost	$0.0	$3.2	$4.8	$4.8	$3.2	**$16.2**
Non-labor (Capital)	$1.1	$0.3	$0.3	$0.3	$0.1	**$2.1**
Labor (Capital)	$0.0	$3.4	$5.1	$5.1	$3.4	**$17.0**
TOTAL	**$1.2**	**$112.0**	**$167.9**	**$167.9**	**$111.9**	**$560.9**

Table III-7
Charge Ready 2 Infrastructure Programs O&M Cost
(Million, 2018 $, excludes escalation and loaders)

Program O&M	Year 0	Year 1	Year 2	Year 3	Year 4	GRAND TOTAL
Non-labor (Expense)	$0.1	$0.1	$0.1	$0.1	$0.2	**$0.6**
Labor (Expense)	$0.3	$2.0	$2.9	$3.1	$2.5	**$10.9**
Ownership and Operation O&M	$0.0	$0.9	$2.4	$3.8	$4.7	**$11.8**
Rebate (Level 2)	$0.0	$11.0	$16.5	$16.5	$11.0	**$55.1**
Rebate (DCFC)	$0.0	$1.1	$1.7	$1.7	$1.1	**$5.5**
New Construction Rebate	$0.0	$16.0	$16.0	$16.0	$16.0	**$64.0**
Charge Ready 2 Marketing	$1.0	$2.3	$2.7	$1.8	$1.9	**$9.7**
ME&O	$0.0	$10.5	$9.4	$11.3	$10.4	**$41.5**
TOTAL	**$1.4**	**$44.0**	**$51.7**	**$54.3**	**$47.8**	**$199.2**

2. Portfolio Benefits

The Charge Ready 2 Portfolio supports the acceleration of widespread TE by deploying critical electric infrastructure for government, commercial, and some residential customers, providing incentives that accelerate the adoption of TE technologies within the proposed Portfolio duration, rather than in a more distant future. The Portfolio will help increase adoption of electric vehicles across the service territory by overcoming the two most significant barriers to adoption – availability of charging stations and customer EV awareness. By increasing EV adoption, the program contributes to improved air quality in SCE territory and reduces GHG emissions broadly.

With the proposed scale, the Portfolio will support innovation and the TE market, while remaining able to adapt to market and technology developments. SCE designed the Portfolio to provide benefits for the customers and communities we serve.

These benefits include:

- *Improved safety* – Charge Ready 2 will follow standard SCE practices and procedures and will be performed safely, and to code, by SCE employees or by certified and licensed contractors. SCE make-ready infrastructure in Charge Ready 2 will be installed by SCE employees or IBEW signatory contractors.
- *Benefits accrue to disadvantaged communities* – By targeting a minimum of 30 percent of the program installations to be in DACs, Charge Ready 2 will contribute to removing pollution from the gasoline- and diesel-powered vehicles traveling through these local communities. Additionally, SCE is committed to the deployment of needed infrastructure in DACs to facilitate access to charging stations during the program and beyond, supporting adoption of light-duty electric vehicles.
- *Innovation* – SCE's proposed approach supports the Commission's interest in innovation[139] and enables numerous third-party charging equipment suppliers to provide qualified charging equipment and services to participating customers. This approach will encourage the charging market to innovate hardware, propose new business models and allow SCE to collect valuable data around customer usage, needs, and load requirements. SCE will also offer customers an option to manage and pay for the installation of the customer-side infrastructure with a rebate for up to 80 percent of the costs.[140]
- *Environmental and other air quality benefits* – Increased EV adoption and fueling from the grid will benefit the entire southern California region by reducing GHGs and contributing to improved air quality. Based on SCE's vehicle forecast, SCE

[139] *See* D.16-12-065, Finding of Fact (FOF) 27, p. 75.

[140] *See* D.18-05-040, pp. 149, 160-61. The rebate proposed in Charge Ready 2 aligns with the rebate offered in the medium- and heavy-duty program. There, the Commission directed SCE to provide customers who opt to install, own, operate, and maintain the customer-side infrastructure with a rebate of up to 80 percent of the customer-side infrastructure cost. SCE proposes to offer the same rebate option in this program.

estimates that over 20 million metric tons of GHG, over 17,000 cumulative tons of NOx, and over 51,000 cumulative tons of VOCs could be reduced through 2030 statewide from the transportation sector through electric conversion.[141]

- *Integrates renewables and minimizes costs to the grid* – Charge Ready 2 provides new charging options for EV drivers, while encouraging participating customers to pass through TOU rates to drivers and requiring participation in a DR program. Each of these options limits grid impacts and helps to integrate renewables onto the electrical system.
- *Increases customer charging options* – Providing DCFC as an option for select sites, Charge Ready 2 will increase the dispersion of this needed technology and help alleviate some of the challenges around charging availability in MUDs and DACs. By increasing access to both slow and fast charging, SCE is helping to overcome key adoption barriers and will help accelerate adoption of EVs.

[141] *See* Appendix B. Incremental GHG emissions abatement associated with the 5 million vehicles over "economic adoption" scaled to reflect the total 7 million vehicles.

IV.

CHARGE READY 2 SATISFIES STATUTORY AND REGULATORY GUIDELINES

As discussed above, the transportation sector is the most significant emitter of GHG in California, accounting for 39 percent of in-State emissions, which increases to about 45 percent when including emissions from refineries.[142] Direct emissions from the transportation sector are also the largest contributor to the formation of ozone and emissions of small particulate matter and diesel particulate matter, accounting for nearly 80 percent of nitrogen oxide emissions and 90 percent of diesel particulate matter emissions in the State.[143] To meet California's aggressive climate change goals and to protect public health and the environment, the State will need to dramatically reduce these emissions in the coming years by, among other things, approving the Charge Ready 2 Program proposal. Numerous policy drivers and programs are now in place that, if successful, will help achieve these goals.[144]

A. Charge Ready 2 Follows the ACR's Guidelines

As demonstrated below, Charge Ready Phase 2 conforms to the guidelines established in Commissioner Peterman's September 14, 2016 ACR.[145]

1. Charge Ready 2 fits with IOU core competencies and capabilities.

SCE's portfolio focuses on the Company's core competencies — safely delivering reliable, affordable, and clean electricity to customers and managing effective customer programs. SCE will work closely with customers, creating safe, economical interconnection with the distribution grid, testing technologies and new grid strategies. The ACR encourages projects that would accelerate the adoption of TE. The ACR also acknowledges that "the Legislature recognizes in Pub. Util. Code §

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142 CARB, *California Greenhouse Gas Emission Inventory*, June 6, 2017, *available at* https://www.arb.ca.gov/cc/inventory/data/data.htm.

143 CARB, *Mobile Source Strategy*, May 2016, *available at* https://www.arb.ca.gov/planning/sip/2016sip/2016mobsrc.pdf.

144 California Energy Commission, *2017 Integrated Energy Policy Report*, Publication Number: CEC-100-2017-001-CMF.

145 ACR, pp. 15-16.

740.12 that the electric utilities have *a lead role in promoting widespread TE*."[146] California's goals to reduce the State's total GHG emissions by 40 percent from 1990 levels by 2030 and 80 percent by 2050, as well as its air quality goals, are some of the most ambitious in the world and will be difficult to meet. Given the short amount of time to build infrastructure and change consumer behavior, acceleration of TE is critically important. Accordingly, SCE should continue to install, own, and maintain the make-ready infrastructure—except where customers elect to install and own the portion of the infrastructure on their side of the meter and receive a partial rebate—to ensure the prompt development of these needed make-readies to broaden access to EV charging.

2. Charge Ready 2 addresses the multiple goals of widespread TE.

Charge Ready 2 will achieve the multiple objectives outlined in SB 350, namely to reduce dependence on petroleum, meet air quality standards, lower GHG emissions, and achieve the goals set forth in the Charge Ahead California Initiative in California's Health and Safety Code.[147] As described above, SCE targets critical barriers to widespread adoption of EVs through this program. Removing or reducing these barriers, and in turn increasing the amount of EVs on the road, serves the SB 350 environmental and other EV-related objectives.

3. Charge Ready 2 aligns with local, regional, and broader State policies.

Charge Ready 2 aligns with and supports local, regional, and broader State policies for reducing petroleum use, air pollutants, and GHG emissions because transportation electrification is necessary to achieve these goals. Examples of the major policies and electrification initiatives that Charge Ready 2 supports include:

- Executive Order B-48-18,[148] which calls for 5 million EVs in California by 2030,

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[146] ACR, p. 29 (emphasis added).

[147] Cal. Pub. Util. Code § 740.12(a)(1)(A) – (B); Cal. Health & Safety Code § 44258.

[148] *See* Exec. Order No. B-48-18 (Jan. 26, 2018), *available at* https://www.gov.ca.gov/2018/01/26/governor-brown-takes-action-to-increase-zero-emission-vehicles-fund-new-climate-investments/.https://www.gov.ca.gov/2018/01/26/governor-brown-takes-action-to-increase-zero-emission-vehicles-fund-new-climate-investments/.

- Executive Order B-16-2012,[149] which calls for an 80 percent reduction in GHG emissions from the transportation sector by 2050, infrastructure in place to support one million zero-emission vehicles by 2020, 1.5 million zero-emission vehicles on California roads by 2025, and implementation of an Interagency ZEV Action Plan[150] (updated in 2016) for agencies such as the CPUC, CARB, and the CEC,
- California's efforts to meet National Ambient Air Quality Standard deadlines and the California Clean Air Act,[151]
- The State Alternative Fuels Plan adopted by the CEC and CARB, which sets a goal of increasing non-petroleum fuel to 20 percent of on-road demand by 2020 and 30 percent in 2030, adopted pursuant to AB 1007,[152]
- SB 1274 "California Charge Ahead Initiative," which increases customer access to EVs by creating vehicle rebates and financing for low- and moderate-income consumers.[153]

To ensure alignment and support, SCE actively sought feedback from public agencies (federal, State, regional, and local) and stakeholders from the private and non-profit sectors prior to finalizing this proposed program. On March 16, 2018, SCE invited over 140 participants to a workshop

[149] *See* Exec. Order No. B-16-2012 (Mar. 23, 2012), *available at* http://gov.ca.gov/news.php?id=17472.http://gov.ca.gov/news.php?id=17472.

[150] *See* Office of Governor Edmund G. Brown Jr., *2016 ZEV Action Plan*, *available at* https://www.gov.ca.gov/docs/2016_ZEV_Action_Plan.pdf, defining ZEVs to include hydrogen FCEVs and PEVs, which include both pure BEVs and PHEVs.

[151] *See* SCAQMD, *National Ambient Air Quality Standards (NAAQS) and California Ambient Air Quality Standards (CAAQS) Attainment Status for South Coast Air Basin*, available at http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/naaqs-caaqsfeb2016.pdf?sfvrsn=2. See also CARB, Mobile Source Strategy (May 2016), pp. 20-23, *available at* https://www.arb.ca.gov/planning/sip/2016sip/2016mobsrc.pdf.

[152] *See* CARB & CEC, *State Alternative Fuels Plan*, p. 36 (Dec. 2007), *available at* http://www.energy.ca.gov/2007publications/CEC-600-2007-011/CEC-600-2007-011-CMF.PDF.http://www.energy.ca.gov/2007publications/CEC-600-2007-011/CEC-600-2007-011-CMF.PDF.

[153] Cal. SB 1275 (2014 Cal. Stats. ch. 530).

to share details about SCE's Charge Ready 2 plans.[154] In addition to engaging with industry representatives interested in transportation electrification, SCE held multiple additional meetings where the Company engaged with and solicited feedback from a wide variety of stakeholders, including small and large business customers, community leaders and organizations that represent the diverse customer base, environmental and environmental justice advocates, faith-based organizations, local government officials and representatives from community choice aggregators.

4. Charge Ready 2 promotes safety.

SCE is committed to the safety of the public and its employees. SCE's Charge Ready 2 Portfolio promotes customer and worker safety. For instance, the proposed program provides financial incentives to pay for make-ready infrastructure installed by licensed electrical contractors and for the applicable permits, which promote safety practices. SCE make-ready infrastructure in Charge Ready 2 will be installed by SCE employees or IBEW signatory contractors. SCE will also leverage the expertise of its Advanced Technology Lab to test new charging technologies and coordinate with external testing agencies to evaluate charging equipment for eligibility in the programs in order to ensure safe connection to and use on the grid.

5. Charge Ready 2 leverages non-utility funding.

SCE's program provides funding for make-ready infrastructure and charging station rebates, which will complement public funding targeting the incremental cost of electrifying vehicles and support acceleration of transportation electrification by mitigating cost barriers to adoption. SCE will also encourage participating customers to apply for available third-party funding.[155] For example, SCE will be providing grant writing services to assist customers in applying for grants that fund acquisition of EVs for fleet conversion or for demonstration and evaluation purposes. SCE intends to provide technical writing assistance and to leverage industry expertise to help qualified customers prepare such applications.

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[154] Over 140 participants registered, representing over 90 different private, non-profit, and public sector entities.

[155] *See* Section III.B.3.

6. Charge Ready 2 provides anonymous and aggregated data for evaluation.

SCE plans to report anonymous and aggregated data to the Commission and interested stakeholders annually. SCE also proposes to provide a final close-out report once Charge Ready 2 concludes. These annual reports and final close-out report will inform future Commission policy and help guide the design of future utility EV-related programs.

B. SCE's Charge Ready 2 Portfolio Meets the Requirements of Appendix A in the Assigned Commissioner Ruling ("ACR")

The ACR requires the utility applications to comply with statutory guidelines.[156] California's goals to reduce the State's total GHG emissions 40 percent below 1990 levels by 2030 and 80 percent below 1990 levels by 2050 are some of the most ambitious in the world and will be difficult to achieve.[157] SB 350 states that "[i]t is the policy of the state and the intent of the Legislature to encourage transportation electrification as a means to achieve ambient air quality standards and the state's climate goals."[158] SB 350 found that "widespread transportation electrification requires electrical corporations to increase access to the use of electricity as a transportation fuel,"[159] and directs the Commission to "approve, or modify and approve, programs and investments in transportation electrification, including those that deploy charging infrastructure," if they accelerate widespread TE, do not unfairly compete with nonutility enterprises, include performance accountability measures, and are in the interests of ratepayers.[160] SB 350 makes several findings about the need for and benefits that will arise from widespread TE, and the Commission, like other agencies tasked with implementing the State's directives, should consider these findings in its review of the Charge Ready 2 application.[161]

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156 ACR, pp. 13-14.

157 Cal. Pub. Util. Code § 740.12(a)(2).

158 Cal. Pub. Util. Code § 740.12(a)(1)(E).

159 Cal. Pub. Util. Code § 740.12(a)(1)(E).

160 Cal. Pub. Util. Code § 740.12(b).

161 *See* Cal. Pub. Util. Code § 740.12(a)(2), stating that "[a]gencies designing and implementing regulations, guidelines, plans, and funding programs to reduce greenhouse gas emissions shall take the findings described in paragraph (1) into account."

SCE's Charge Ready 2 Portfolio meets the ACR's requirements because it:

1. Fulfills the Legislature's Findings and Declarations in §740.12(a)(1)

Section 740.12(a)(1) describes "widespread transportation electrification" as including the following:

- Advancing clean vehicles and fuels to reduce petroleum use, to meet air quality standards, to improve public health, and to achieve greenhouse gas emissions reduction goals;
- Achieving the goals of the Charge Ahead California Initiative;
- Requiring increased access for disadvantaged communities, low and moderate income communities, and other consumers of zero-emission and near-zero emission vehicles and increased use of those vehicles;
- Reducing emissions of GHGs to 40 percent below 1990 levels by 2030 and to 80 percent below 1990 levels by 2050 will require widespread transportation electrification;
- Requiring electrical corporations to increase access to the use of electricity as a transportation fuel; and
- Stimulating 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.[162]

Section 740.12(a)(1) also finds that "[d]eploying 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."[163] Further, it finds that "[d]eploying electric vehicle charging infrastructure should facilitate increased sales of electric

[162] *See* Cal. Pub. Util. Code § 740.12(a)(1).

[163] *Id.*

vehicles by making charging easily accessible and should provide the opportunity to access electricity as a fuel that is cleaner and less costly than gasoline or other fossil fuels in public and private locations."[164]

Charge Ready 2 is consistent with the findings in §740.12(a)(1) because:

a) Charge Ready 2 Benefits Local Communities

Charge Ready 2 benefits local communities by improving air quality and reducing GHG emissions, consistent with the new, more stringent State standards.[165] SCE serves two districts in the most extreme air quality non-attainment zones.[166] The air quality benefits of Charge Ready 2 increase when charging is managed to optimize grid utilization or integrate renewable energy generation, and will increase over time as the grid becomes cleaner with more renewable generation coming online in the future. The GHG reduction and energy security benefits of light-duty EVs, when monetized, are conservatively estimated to be over $2,000 per EV over its lifetime.[167] The Commission and State legislature have recognized these additional customer benefits.[168]

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[164] *Id.*

[165] The CEC and CARB, in response to AB 2076 and AB 1007, adopted the goal of increasing non-petroleum fuel to 20% of on-road demand by 2020 and 30% in 2030. *See* CARB & CEC, *State Alternative Fuels Plan, Commission Report*, p. 6 (Dec. 2007), *available at* http://www.energy.ca.gov/2007publications/CEC-600-2007-011/CEC-600-2007-011-CMF.PDF.

[166] *See*, *e.g.*, R.13-11-007, Comments of SCAQMD Staff in Response to Order Instituting Rulemaking and Scoping Memo, filed September 4, 2014, pp. 3-5. *See also* CARB, *California Local Air District Directory*, *available at* http://www.arb.ca.gov/capcoa/roster.htm (identifying SCAQMD, San Joaquin Valley Unified Air Pollution Control District (APCD), Antelope Valley Air Quality Management District (AQMD), Eastern Kern APCD, Great Basin Unified APCD, Mojave Desert AQMD, Santa Barbara County APCD, and Ventura County APCD).

[167] *See* ICF International & Energy & Environmental Economics, *California Transportation Electrification Assessment, Phase 2: Grid Impacts*, Figure 20, for information on the net benefits of reducing greenhouse gases and petroleum, and Section 5, pp. 46-54, for inputs to Figure 20. *Available at* http://www.caletc.com/wpcontent/uploads/2016/08/CalETC_TEA_Phase_2_Final_10-23-14.pdf. Alternatively, LCFS prices (April 2018 average) are trading near $129 per metric ton. With EVs receiving an LCFS award at two metric tons over a ten-year life, the GHG reduction benefits of EVs are currently valued at $2,580.

[168] D.11-07-29, p. 68 (discussing that it is essential to accelerate EV adoption to support reduction of greenhouse gas emissions and meet other State and national goals); EV programs and policies must be in the ratepayer's interests as defined in Cal. Pub. Util. Code § 740.8: "direct benefits that are specific to ratepayers in the form of safer, more reliable, or less costly … electrical service … and activities that benefit ratepayers and that promote energy efficiency, reduction of health and environmental impacts from air pollution, and greenhouse

b) Charge Ready 2 Creates Jobs in the Community and Provides Opportunities for SCE's Suppliers, Including Diverse Business Enterprises

SCE anticipates Charge Ready 2 will create many jobs for electricians, engineers, and construction workers.[169] SCE plans to contract for many required services, potentially including engineering, design, and construction. SCE participates in the Commission's voluntary supplier diversity program (Commission General Order 156), which sets a goal of procuring 21.5 percent of the company's annual spend on goods and services from WMDVBEs.[170][171]

c) Charge Ready 2 Supports Reliable Electric Service by Addressing Current and Future Grid Problems

Charge Ready 2 focuses on providing reliable electric service, enhanced resource utilization, and optimized grid operation. In conjunction with SCE's planning processes, Charge Ready 2 also ensures that the neighborhood grid and the customer infrastructure are evaluated for all EV customers. Charge Ready 2 can also promote grid stability by requiring all participating customers to take service on a TOU rate schedule for the EV charging at their sites.[172] Daytime charging of EVs

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gas emissions related to electricity … production and use, and increased use of alternative fuels." D.11-07-029, p. 67, n. 37 (citing Cal. Pub. Util. Code § 740.8).

169 Studies have found light duty EVs result in net job and economic benefits to California. *See* David Roland-Holst, *Plug-in Electric Vehicle Deployment in California: An Economic Assessment* (Sept 2012), *available at* https://are.berkeley.edu/~dwrh/CERES_Web/Docs/ETC_PEV_RH_Final120920.pdf. *See also* Marc Melaina et al., *National Economic Value Assessment of Plug-in Electric Vehicles*, National Renewable Energy Laboratory (Dec. 2016), *available at* http://www.nrel.gov/docs/fy17osti/66980.pdf.

170 *See* SCE's General Order (GO) 156 Report, *Supplier Diversity 2015 Annual Report/2016 Annual Plan* (May 2016), *available at* http://www.cpuc.ca.gov/uploadedFiles/CPUC_Website/Content/About_Us/Business_and_Community_Outreach/GO_156_Reports/2014(1)/R0907027%20OIR%20to%20Amend%20GO156%20-%20SCE%202015%20Annual%20WMDVBE%20Rpt%20and%202016%20Annual%20Plan%20-%20Southern%20California%20Edison%20Company.pdf.

171 *See* Sections III.A.3.d.(5), III.B.4.

172 *See* ICF International & Energy & Environmental Economics, *California Transportation Electrification Assessment, Phase 2: Grid Impacts*, p. 19 (Oct. 23, 2014), *available at* http://www.caletc.com/wp-content/uploads/2016/08/CalETC_TEA_Phase_2_Final_10-23-14.pdf.

(e.g., workplaces, fleet vehicles) may absorb excess solar generation and reduce the evening ramp of residential load. SCE's TOU price signals incentivize this daytime charging.

d) Charge Ready 2 Is Designed to Increase Access to Charging Infrastructure

Charge Ready 2 is designed to address existing barriers that currently limit EV adoption. SCE's proposed programs specifically target barriers, such as insufficient away-from-home EV charging infrastructure and cost of charging infrastructure. Eliminating these barriers should help improve access to charging infrastructure and support more EV adoption.[173]

e) Charge Ready 2 Contains Measurable Monitoring and Evaluation Criteria

The proposed Charge Ready 2 Portfolio contains the following elements for each program, as described in the program-specific testimony: objective, scope, cost, estimated duration, and anticipated benefits. These elements provide the foundation for measurable monitoring and evaluation criteria. In addition, SCE also proposes to report on a number of metrics related to implementation and execution. For further details on reporting, see the subsections on data collection and reporting for each of the projects and programs.

2. Charge Ready 2 Seeks to Minimize Costs and Maximize Benefits

As described in cost-related testimony, SCE has applied lessons learned from the Phase 1 Pilot in the Charge Ready 2 design to help contain costs, such as: packaged site designs; site feasibility reviews; use of customer distribution facilities where appropriate; streamlined processes; and enlarging contractor pools in procurement.[174] For example, SCE proposes to source relevant products and services through a competitive RFP process to select vendors and contractors. The program will maximize benefits from EVs by requiring that customers participating in the proposed program take service on a TOU rate plan, which incentivizes charging in a manner consistent with grid conditions. As noted in the recent Proposed Decision in A.16-09-003, which adopts the updated TOU periods proposed by SCE (including shifting the peak period to later in the day and implementing a winter season super-off-peak

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[173] *See* Sections II.D, III.A.1, III.A.3.b, III.A.4.b, III.A.5.b.
[174] *See* Section III.A.3.d.(10).

period during daytime hours), "properly defined TOU periods will provide incentives for customer use and development of future generation that better reflects the state's electric grid. This, in turn, should assist in reaching state energy goals by minimizing costs, reducing [GHG] emissions, encouraging conservation, and increasing the supply of electricity at times that best serve the needs of the grid."[175] Customer benefits are described in further detail in Section III.C.2, including committing to the deployment of needed infrastructure in DACs to facilitate access to charging stations, environmental and other air quality benefits, and increased customer charging options.

3. Charge Ready 2 Contains A Specified Cost Recovery Mechanism

SCE proposes that if the Charge Ready 2 actual direct capital and O&M expenditures, including Market Education expenses, are consistent with the scope and within the cost levels adopted by the Commission, then those expenditures should be deemed to be reasonable and no further after-the fact reasonableness review would be required. Pursuant to the Commission-adopted process for reviewing other SCE balancing accounts, including the Charge Ready Program Balancing Account ("CRPBA") for the Phase 1 Pilot[176] and the Transportation Electrification Portfolio Balancing Account ("TEPBA"),[177] SCE proposes that the recorded operation of the CRPBA Phase 2 subaccount be reviewed by the Commission in SCE's annual Energy Resource Recovery Account ("ERRA") Review Application. This continuing review of the CRPBA for Charge Ready 2 activity in the ERRA Review proceeding will ensure that all entries to the account are stated correctly and are consistent with Commission decisions. Commission review procedures for Charge Ready 2 costs should be limited to ensuring that all recorded costs are associated with activities as defined and adopted by the Commission in this Charge Ready 2 proceeding. Additional cost recovery details are provided in Section V.

4. Charge Ready 2 Fairly Competes with Non-Utility Enterprises

SCE intends to follow the same market-neutral approach demonstrated with the Phase 1 Pilot, while balancing customer needs for flexibility. This approach consists of deploying electric

[175] Proposed Decision issued on May 22, 2018, in A.16-09-003, p. 4.

[176] *See*, *e.g.*, Advice Letter 3502-E.

[177] *See*, *e.g.*, Advice Letter 3734-E.

infrastructure that the utility owns and maintains--or at participating customers' election, they may construct and own the portion of the infrastructure on their premises--while site hosts select, own, operate, and maintain qualified charging equipment (except in the case of a MUD or governmental entity that selects SCE ownership and operation of the charging equipment). When qualifying charging equipment, SCE plans to rely on adopted efficiency and safety standards to define its requirements and accept a large number of vendors and charging equipment models. SCE also proposes the option to evaluate new and emerging technologies and incorporate them into the program, if appropriate.

5. Charge Ready 2 Contains Trackable Performance Accountability Measures

SCE proposes to prepare annual reports to provide status updates on implementation to the Commission and interested stakeholders. The annual reports will provide a high-level summary, the amount of funds expended to date, and the status of each program. SCE will provide aggregated data of customer participant profiles (e.g., market segment, located in a DAC); operational metrics such as average times to complete milestones in the installation cycle (e.g., average customer "end-to-end" cycle time by segment, number of completed installations); marketing materials (e.g., expended funds, description of materials, media outreach, published articles); and outreach events (e.g., outreach type, location, estimated number of customer interactions).[178] In addition to providing an annual report, SCE also proposes to provide a final report on the completed program, which will provide a comprehensive description of the completed initiative, including findings, lessons learned, and metrics.

6. Charge Ready 2 is in the Interests of Ratepayers Per §740.8

SB 350 modified Public Utilities Code §740.8 to require demonstration of both of the following types of ratepayer benefits:

- Safer, more reliable, or less costly gas or electrical service, consistent with §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.

[178] *See* Appendix A.

- And any one of the following:
    - Improvement in energy efficiency of travel.
    - Reduction of health and environmental impacts from air pollution
    - Reduction of greenhouse gas emissions related to electricity and natural gas production and use.
    - Increased use of alternative fuels.
    - Creating high-quality jobs or other economic benefits, including in disadvantaged communities identified pursuant to §39711 of the Health and Safety Code.[179]

Charge Ready 2 meets these requirements for both types of ratepayer benefits identified in §740.8. Charge Ready 2 contributes to safer, more reliable, or less costly gas or electrical service[180] through (i) improved use of the electric system and potential downward pressure on rates, and (ii) improved integration of renewable energy generation.[181] In addition, the proposed initiatives contribute to supporting EV adoption and will help displace diesel or gasoline petroleum usage with electricity, resulting in environmental and societal benefits consistent with §740.8, such as substantially reducing GHG, NOx, and particulate matter emissions.[182]

7. Charge Ready 2 Avoids Long-Term Stranded Assets

SCE will seek to avoid long-term stranded assets by requiring customers to utilize and maintain charging equipment deployed through Charge Ready 2. Risk of stranded assets is minimized through program design. SCE's program limits the risk of technology obsolescence by deploying make-ready infrastructure that can support a variety of current or future charging technologies. Additionally,

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179 Cal. Pub. Util. Code § 740.8.

180 The Natural Resources Defense Council's report shows how well-managed EVs benefit all utility customers through improved use of the electric system and integration of renewables. *See* Max Baumhefner & Roland Hwang, *Driving Out Pollution: How Utilities Can Accelerate the Market for Electric Vehicles* (June 16, 2016), *available at* https://www.nrdc.org/resources/driving-out-pollution-how-utilities-canaccelerate-market-electric-vehicles.

181 *See* Section II.C.

182 *See* Section II.B.

SCE plans to monitor the load for the electric infrastructure deployed through the program. Lastly, SCE intends to require participating customers who do not comply with the five-year participation requirement to reimburse the prorated cost of infrastructure deployed through the program. The portion of the costs subject to recovery will be prorated over the required five-year participation period.

V.

COST RECOVERY

This section presents SCE's ratemaking proposal for the Charge Ready 2 Portfolio. SCE requests approval to recover the revenue requirements associated with no more than $760.1 million (2018$) in direct capital expenditures and O&M expenses related to Charge Ready 2, including marketing, education, and outreach. SCE also proposes to separately record the Charge Ready 2 incremental revenue requirements in its existing Charge Ready Program Balancing Account ("CRPBA") to provide for the recovery of Charge Ready 2 revenue requirements associated with all recorded Charge Ready 2 related costs, effective upon a Commission decision in this Application proceeding. Because the Commission will perform a full review of the scope of Charge Ready 2 activities and the forecast costs in this proceeding, reasonableness review of the CRPBA should be limited to a review to ensure that all entries to the account are stated correctly and are associated with Phase 2 activities as defined and approved by the Commission. In addition to a detailed description of the CRPBA and proposed reasonableness standards, this chapter also presents a four-year forecast of Charge Ready 2 revenue requirements.

Table V-8
Forecast 2019-2023 Charge Ready 2 Direct Costs
(Millions, 2018 $, excludes escalation and loaders)

Capital Cost	**2019**	**2020**	**2021**	**2022**	**2023**	**TOTAL**
Utility-side Costs	$0.0	$26.1	$39.1	$39.1	$26.1	**$130.5**
Customer-Site Cost	$0.0	$79.1	$118.6	$118.6	$79.1	**$395.3**
Ownership Station Cost	$0.0	$3.2	$4.8	$4.8	$3.2	**$16.2**
Non-labor	$1.1	$0.3	$0.3	$0.3	$0.1	**$2.1**
Labor	$0.0	$3.4	$5.1	$5.1	$3.4	**$17.0**
Program O&M						
Non-labor	$0.1	$0.1	$0.1	$0.1	$0.2	**$0.6**
Labor	$0.3	$2.0	$2.9	$3.1	$2.5	**$10.9**
Ownership and Operation	$0.0	$0.9	$2.4	$3.8	$4.7	**$11.8**
Rebate (L2)	$0.0	$11.0	$16.5	$16.5	$11.0	**$55.1**
Rebate (DCFC)	$0.0	$1.1	$1.7	$1.7	$1.1	**$5.5**
New Construction Rebate	$0.0	$16.0	$16.0	$16.0	$16.0	**$64.0**
CR2 Marketing	$1.0	$2.3	$2.7	$1.8	$1.9	**$9.7**
ME&O	$0.0	$10.5	$9.4	$11.3	$10.4	**$41.5**
TOTAL	**$2.6**	**$156.0**	**$219.6**	**$222.2**	**$159.7**	**$760.1**

A. Description of Charge Ready Program Balancing Account

On January 14, 2016, the Commission issued D.16-01-023,[183] which adopted SCE's proposal to establish a Charge Ready Program balancing account to recover the revenue requirements associated with up to $22 million (in 2014 dollars) in direct capital and O&M costs to implement the Phase 1 Pilot. On March 5, 2018, SCE filed a Petition for Modification of D.16-01-023 to allow SCE to recover an additional $22 million in Phase 1 bridge funding.

SCE herein requests Commission authorization to record the actual Charge Ready 2 revenue requirement each month in a separate subaccount in the CRPBA. SCE will record the actual O&M, payroll taxes, and capital-related revenue requirement (*e.g.*, depreciation, return on rate base, property taxes, and income taxes) in the CRPBA Charge Ready 2 subaccount.

To ensure timely recovery, SCE requests authorization to transfer the revenue requirement recorded in the CRPBA to the distribution sub-account of the Base Revenue Requirement Balancing

[183] Advice Letter 3362-E, which established the CRPBA, was made effective by the Energy Division on February 11, 2016.

Account ("BRRBA") at the end of each year. All revenue requirements associated with expenditures related to Charge Ready 2 below the cap of $760.1 million (2018$, direct spend) that are recorded in the BRRBA as of year-end will be recovered from customers through distribution rates in the subsequent year. SCE will not record any revenue requirements related to Charge Ready 2 expenditures exceeding the $760.1 million (2018$, direct spend) cap in the CRPBA.

Each month, SCE will record in the CRPBA Charge Ready 2 subaccount:

- Capital-related revenue requirements (debit), including depreciation, return on rate base, property taxes, and income taxes based on recorded capital additions and rate base;
- Recorded incremental O&M costs (debit);
- Charge Ready 2-related marketing and education costs; and
- Broad EV awareness and marketing expenses.

Included in the $760.1 million (2018$, direct spend) Charge Ready 2 cap, SCE proposes to record O&M expense of $157.7 million in the CRPBA related to SCE program office labor, customer service labor, vendors, ownership and operation O&M, rebates and Charge Ready 2 marketing expense as well as $41.5 million in Market Education and Outreach costs.

All recorded incremental costs will include provisions for overhead loadings on direct labor dollars, to account for items such as benefits and payroll taxes.[184] In addition, interest expense will accrue each month in the CRPBA at the three-month commercial paper rate until the year-end transfer of the CRPBA balance to the BRRBA.

B. Proposed Reasonableness Review of Phase 2 Expenditures

SCE proposes that if the Charge Ready 2 actual direct capital and O&M expenditures, including Market Education expenses, are both consistent with the scope and within the cost levels adopted by the

[184] Overhead loading factors will be based on authorized rates. The revenue requirements presented herein reflect all SCE labor loadings. However, to the extent a particular labor loading is currently accounted for in another balancing account (e.g., Pensions, Post-Employment Benefits Other Than Pensions ("PBOPS"), Medical, Dental and Vision), SCE will not include these labor loadings in the recorded operation of the CRPBA.

Commission, then those expenditures will be deemed to be reasonable and therefore no further after-the-fact reasonableness review will be required.

Pursuant to the Commission-adopted process for reviewing other SCE balancing accounts, including the CRPBA for the Phase 1 Pilot and the Transportation Electrification Portfolio Balancing Account ("TEPBA"), SCE proposes that the recorded operation of the CRPBA Charge Ready 2 subaccount be reviewed by the Commission in SCE's annual April 1 ERRA Review Application. This continuing review of the CRPBA for Charge Ready 2 activity in the ERRA Review proceeding will ensure that all entries to the account are stated correctly and are consistent with Commission decisions. Commission review procedures for Charge Ready 2 costs should be limited to ensuring that all recorded costs are associated with activities as defined and adopted by the Commission in the Charge Ready 2 proceeding.

C. Cost Deflation and Reasonableness Determination

Because actual O&M expenses and direct capital expenditures[185] will be recorded in nominal dollars over four years of program spend (plus start-up costs in 2019, prior to implementation of the four-year program), these costs will have to be deflated for price inflation between 2018 and later years. SCE proposes to accomplish this by deflating the recorded capital and O&M costs by the same inflation indexes used to escalate costs from 2018 levels to nominal dollars used in forecasting. SCE proposes to use two deflation factors: the Handy-Whitman Capital Cost Index for capital and IHS Markit (formerly IHS Global Insight) Electric O&M A&G cost index for O&M. In the annual April 1 ERRA Review proceeding, SCE will seek review of the operation of the CRPBA, and, following completion of the fourth and final year of Charge Ready 2, SCE will include testimony demonstrating that Charge Ready 2 expenditures did not exceed authorized amounts. SCE will use the actual, published inflation indexes to deflate recorded costs back to 2018 dollar levels to compare actual O&M expenses and direct capital expenditures to the forecast spend.

[185] Direct capital expenditures refers to project-related spend, controllable by program managers, and does not include AFUDC or corporate overheads.

D. Forecast of SCE's Charge Ready Program 2 Revenue Requirements

9 below presents SCE's forecast 2019-2023 revenue requirements for Charge Ready 2 Program and Market Education efforts.

Table V-9
Forecast 2019-2023 Charge Ready 2 Revenue Requirements
(in Millions of Nominal Dollars)

Revenue Requirement (in Millions of Nominal Dollars)						
	2019	2020	2021	2022	2023	Total
1. O&M	$ 1.6	$ 47.9	$ 57.9	$ 62.1	$ 55.9	$ 225.4
2. Franchise Fees and Uncollectibles	$ 0.0	$ 0.7	$ 1.0	$ 1.4	$ 1.6	$ 4.8
3. Depreciation	$ 0.1	$ 2.9	$ 9.7	$ 18.1	$ 25.3	$ 56.2
4. Taxes	$ 0.0	$ 1.4	$ 5.2	$ 10.9	$ 16.4	$ 34.0
5. Return	$ 0.0	$ 4.8	$ 16.7	$ 30.8	$ 42.1	$ 94.5
6. Total Revenue Requirement	$ 1.8	$ 57.8	$ 90.5	$ 123.4	$ 141.3	$ 414.8

Beginning in 2019, SCE requests to include in distribution rates a forecast Charge Ready 2 revenue requirement for each year up until the time the Charge Ready 2 revenue requirements are included in SCE's General Rate Case ("GRC") request (*e.g.*, the 2024 or 2028 GRC).

SCE currently files an advice letter each year to determine the Charge Ready Phase 1 Pilot revenue requirement to be included in distribution rates the following year. SCE proposes to include the Charge Ready 2 forecast revenue requirement in this same advice letter [186] to be filed in November of each year beginning in November 2019. In the annual advice letters, SCE will update the Charge Ready 2 revenue requirement to reflect the prior year recorded capital expenditures, any forecast capital expenditure changes in the following year, and also the most recently adopted rate of return on rate base, franchise fees and uncollectible rates, and tax rates. SCE will then consolidate the changes in its distribution rates to reflect these updated Charge Ready 2 revenue requirements in conjunction with

[186] In one advice letter, SCE intends to seek approval to include in rates for the following year a forecast of revenue requirements for both Charge Ready Phase 1 Pilot and Charge Ready 2, as well as the revenue requirements for the Transportation Electrification Program Priority Review Projects and the Standard Review Project consistent with Section 6.4 in D.18-01-024 approving SCE's Priority Review Projects and Section 8.4 of D.18-05-040 approving SCE's Standard Review Project.

other authorized rate level changes in its January 1 consolidated revenue requirement and rate change advice letter.

1. Capital Expenditures and Additions

SCE's forecasted revenue requirements as shown in Table V-9, above were derived based on estimated direct capital expenditures of $560.9 million (2018$), as supported in Section III.C.1, above. Table V-10, below shows estimated direct capital expenditures escalated for each calendar year. The total estimated nominal expenditures of $625.4 million are forecast to close to plant-in-service as the assets are placed in service.SCE's forecasted revenue requirement as shown in 9, above were derived based on estimated direct capital expenditures of $560.9 million (2018$), as supported in Section III.C.1, above. **Error! Reference source not found.**10, below shows estimated direct capital expenditures escalated for each calendar year. The total estimated nominal expenditures of $625.4 million are forecast to close to plant-in-service as the assets are placed in service.

Table V-10
Forecast 2019-2023 Charge Ready 2 Direct Capital Expenditures
(in Millions of Nominal Dollars)

Capital Expenditures (Millions of Nominal Dollars)						
	2019	2020	2021	2022	2023	Total
Utility-side Infrastructure	$ 0.6	$ 27.2	$ 42.0	$ 43.3	$ 29.7	$ 142.8
Contingency	$ -	$ 2.5	$ 3.9	$ 4.0	$ 2.8	$ 13.2
Customer-side Infrastructure	$ 0.6	$ 81.9	$ 126.6	$ 130.5	$ 89.7	$ 429.3
Contingency	$ -	$ 7.6	$ 11.8	$ 12.2	$ 8.4	$ 40.1
Total Capital	**$ 1.2**	**$ 119.2**	**$ 184.3**	**$ 190.1**	**$ 130.6**	**$ 625.4**

a) Capital Additions and Plant-In-Service

Capital expenditures are not included in rate base until the assets are ready for service. The accounting for this is prescribed by the Federal Energy Regulatory Commission ("FERC") Uniform System of Accounts ("USoA"). When incurred, capital expenditures record to FERC Account 107, Construction Work In Progress ("CWIP"). While in CWIP, costs typically accrue capitalized financing costs (known as Allowance for Funds Used During Construction ("AFUDC") at rates based on a prescribed formula in the FERC USoA. Once ready for service, cumulative costs, including AFUDC,

are transferred from CWIP to Plant-In-Service[187] as Capital Additions. At this same time, AFUDC accruals are stopped, the cumulative balance is included in rate base, and depreciation expense begins.

For purposes of forecasting capital in Charge Ready 2, SCE has assumed that AFUDC accruals will be zero. However, on a recorded basis, the CRPBA will reflect actual recorded revenue requirements, including all applicable overheads and AFUDC to the extent that they are incurred.

b) Depreciation Expense and Accumulated Depreciation

Line 3 of Table V-9, above shows forecast total annual depreciation expense of $56.2 million over the 2019 – 2023 period. To estimate annual depreciation expense capital additions were divided into 1) utility-side infrastructure including line transformers, services, meters, and easements and 2) customer-side infrastructure that includes the panel, conduit, wiring, and "make-ready" stub. Depreciation for utility-side infrastructure uses a composite[188] 3.40 percent rate as authorized in SCE's 2015 GRC. Depreciation rates for customer-side infrastructure are estimated using the 4.44 percent authorized rate approved in the decision authorizing SCE's Phase 1 Pilot.[189]

On a recorded basis, SCE will utilize depreciation rates adopted in its Final 2018 GRC Decision. To the extent that certain charging sites are no longer used after the program period, capital recovery for the investment will continue under normal group depreciation procedures.[190]

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[187] Plant-In-Service includes FERC Accounts 106 (Completed Construction Not Classified) and 101 (Electric Plant-In-Service.

[188] This composite is based on recorded plant balances in the Charge Ready Program Balancing Account as of April 2018.

[189] D.16-01-023.

[190] SCE's assets are depreciated using broad group procedure. Generally, a broad group is defined by FERC plant account, with some exceptions. Assets within a broad group are expected to retire before and after the average service life, and by convention, are fully depreciated when retired. Under CPUC Standard Practice U4, the depreciation rate is recalculated on a periodic basis (currently in GRCs) determining the annual accruals necessary to allocate the net book value less future net salvage over the average remaining life of the group. Thus, any over- or under-allocation is addressed in future periods.

2. Rate of Return

SCE calculated the return on rate base using SCE's current authorized rate of return of 7.61 percent established in D.17-07-005 and subsequently approved in Advice Letter 3665-E. On a recorded basis, SCE will update its rate of return on rate base to be consistent with the then-currently authorized rate of return.

3. O&M Expenses

SCE's forecasted revenue requirements were derived based on the O&M expenses supported in Chapter III.C.1, and summarized in Table V-9, above. O&M labor expenses include all applicable overheads.[191]

4. Income Taxes

SCE estimates income taxes by following the rules and methods adopted in the Company's GRCs. Specifically, in computing tax depreciation, on property owned by SCE, SCE uses the twenty year MACRS ("Modified Accelerated Cost Recovery System") tax life for federal purposes and a thirty-year life, straight-line method, for computing state tax depreciation. Deferred taxes are estimated as required by the normalization rules of the Internal Revenue Code ("IRC") for property owned by SCE that are subject to the MACRS under IRC Section 168. SCE will use flow-through tax treatment on book and state tax depreciation differences, as required by this Commission. SCE computes tax basis by removing any recorded AFUDC and replacing it with the tax capitalized interest following the rules of IRC Section 263A. SCE computes tax expense using the applicable federal corporate tax rate of 21 percent for each year and an apportioned state corporate tax rate as applicable.

[191] The forecast revenue requirements as presented in Table V-9 include a composite benefit loader of 36.91%.

Appendix A

Charge Ready Pilot Report

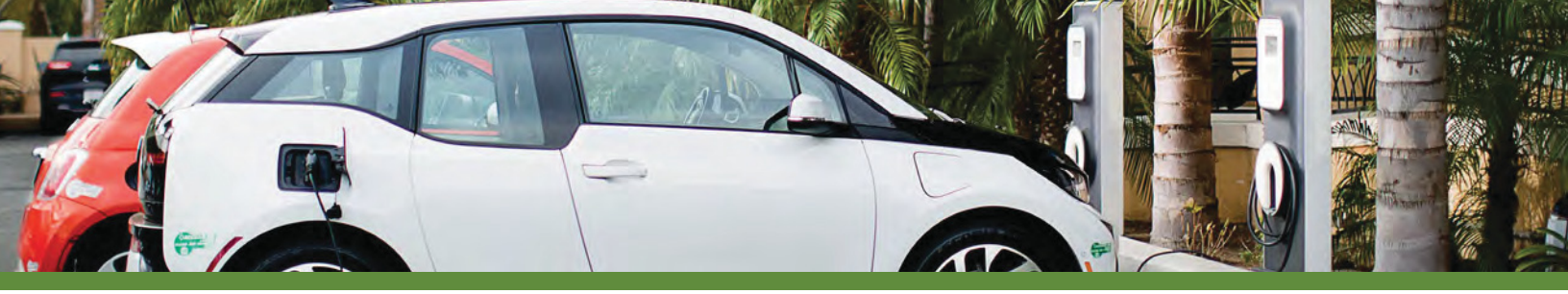
Charge Ready and Market Education Programs

Pilot Report

May 2016 – March 2018
Submitted April 2, 2018

SOUTHERN CALIFORNIA EDISON®
Energy for What's Ahead℠

Get Started



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1 Executive Summary

The Charge Ready and Market Education programs were developed to support California's policies to reduce greenhouse gas (GHG) and air pollutant emissions and to help meet the state's zero-emission vehicle (ZEV) goals. The Charge Ready program deploys electric infrastructure to support light-duty electric vehicle (EV) charging at customer sites throughout Southern California Edison's (SCE's) service area. At the time of this report, SCE has deployed infrastructure to support 941 charge ports at 60 customer sites, including 462 charge ports (50%) at 36 sites located in Disadvantaged Communities (DACs),[1] significantly exceeding the Pilot's goal of placing 10% of charge ports in DACs. Additionally, the Pilot exceeded SCE's Diversified Business Enterprise 40% spending goal. The architecture and engineering firm and the general contractors selected for Charge Ready were all Diversified Business Enterprises (DBEs).

The Market Education program targets car buyers to help them gain awareness of EVs and the benefits of fueling from the grid. The Market Education program also includes SCE's advisory services, providing education and support related to electrifying fleets, EV charging, reducing GHG footprints, and other transportation electrification (TE) areas for business customers. Each program was designed in two phases, with a smaller-scope Phase 1 Pilot to prepare for a broader Phase 2. This report covers Phase 1 of each program, and demonstrates that the Pilots have achieved their objectives. Based on successfully meeting its objectives for the Pilot, SCE will request California Public Utilities Commission (CPUC) approval of the second phase of these programs. Moving forward with the broader Phase 2 is particularly important in light of the adoption by California Governor Brown of a target of 5 million EVs by 2030[2].

The Charge Ready and Market Education programs support California's GHG- and air-pollution-reduction goals by addressing the following issues resulting from insufficient EV infrastructure, especially in certain market segments.

- Range anxiety continues to be a key roadblock to expediting EV adoption. Access to charging at both home and work is a top priority for EV drivers with workplace charging serving a dual-role: 1) to advance adoption through consumer assurance on available away-from-home charging locations, and 2) to increase electric vehicle miles traveled.[3] SCE's Pilot helps to accelerate EV adoption by meeting a large portion of charging needs at long-dwell-time locations.
- The cost and complexity of deploying charging infrastructure at premises other than single-family homes is another major barrier to EV adoption.[4] For example, while customers with parking facilities may understand the benefits of offering EV charging to their tenants, they may not envision an obvious return on investment. Property owners and managers who provide parking may not have the time or motivation to gain an understanding of a new, complex, and potentially confusing market.
- Developing driver awareness of EVs and their benefits is one of the most important factors for increasing EV adoption and significantly growing the market. Not understanding EV benefits (individual, societal, and environmental) or the differences between internal combustion vehicles, battery EVs (BEVs) and plug-in hybrid EVs (PHEVs) significantly hinders EV adoption[5,6]. Federal, state, and local governments may attempt to address this issue, but only a small amount of public funding is designated to raising consumer awareness.[7] We, SCE, as a utility, together with other stakeholders, is uniquely equipped to meet the need for greater market education focused on the needs and interests of

1 DACs were identified using the California Environmental Protection Agency's (CalEPA) California Communities Environmental Health Screening Tool (CalEnviroScreen 2.0).
2 Executive Order B-48-18.
3 California Air Resources Board, "California's Advanced Clean Cars Midterm Review", January 2017, p. B64, B84-B86, available at https://www.arb.ca.gov/msprog/acc/mtr/acc_mtr_finalreport_full.pdf
4 See "California Transportation Electrification Assessment; Phase 1: Final Report," prepared by ICG International and E3, September 2014, Section 5.2, pp. 46-50, available at http://www.caletc.com/wpcontent/uploads/2014/09/CalETC_TEA_Phase_1-FINAL_Updated_092014.pdf [as of October 27, 2014]. Installing charging stations at businesses involves many more factors than home charging, and also includes a more expensive setup. Commercial Level 2 charging station installation costs are an average of $2,500, compared with residential Level 2 costs of $1,300 and residential Level 1 costs of only $200. See "Electric Vehicle Supply Equipment Installed Cost Analysis: 2013 Technical Report," Electric Power Research Institute (EPRI), December 6, 2013, pp. 18, 33, abstract available at http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002000577 [as of October 27, 2014]. As with businesses, charging station installation cost at multi-unit dwellings far exceeds that of single-family residences. Id., pp. 3-5, 3-6.
5 National Renewable Energy Laboratory, "Consumer Views on Plug-in Electric Vehicles – National Benchmark Report", January 2017, p. 11, available at https://www.afdc.energy.gov/uploads/publication/consumer_views_pev_benchmark.pdf
6 International Council on Clean Transportation, "Literature review of electric vehicle consumer awareness and outreach activities", March 2017, p. 2, available at https://www.theicct.org/sites/default/files/publications/Consumer-EV-Awareness_ICCT_Working-Paper_23032017_vF.pdf
7 CEC has funded less than $5 million in consumer education on EVs since 2009 with Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP) funds, out of more than $400 million between 2009 and 2013. See California Energy Commission, DRIVE: California's Alternative & Renewable Fuel & Vehicle Technology Program, Reports, as of June 30, 2013, available at http://www.energy.ca.gov/drive/investing/reports.html [as of October 27, 2014].

customers and drivers within the SCE service territory with a population of 15 million people.

- DACs face additional socioeconomic barriers as well as a concentrated amount of air pollution, mostly caused by petroleum-powered vehicles.[8] Education and outreach will help familiarize customers with available EV incentives and rebates that make EVs more affordable, including special state incentives available to residents of DACs. Providing EV charging infrastructure plus education and outreach in these communities will help increase EV adoption and reduce harmful emissions.

1.1 Charge Ready Pilot Program Description

Charge Ready was developed to reduce barriers to EV adoption by deploying electric infrastructure to support installation of EV charging stations (EV supply equipment, or EVSE)[9] at locations where EVs are usually parked for at least four hours (i.e. long dwell-time locations). These locations provide adequate time for most EV drivers to fully recharge their vehicles with Level 1 and Level 2 charging stations.

The Pilot was open to non-residential customers in the following long dwell-time location market segments:

- Workplaces
- Multi-Unit Dwellings (MUDs), such as apartment buildings
- Fleets
- Destination centers, such as sports arenas or malls

Through Charge Ready, SCE installed and paid all costs for make-ready stubs serving EVSE, and will continue to own and maintain that infrastructure, including:

- Electric distribution infrastructure, such as transformers, service lines, and meters dedicated to EV charging equipment deployed under the program.
- Customer-side infrastructure, such as panels, step-down transformers, wiring and conduits, and stub outs, to allow for EVSE installations.

Participating customers were responsible for procuring, installing, and maintaining qualified EVSEs, including electrical energy and networking costs, but received rebates to reduce the EVSE and installation costs.

To efficiently execute the Pilot and inform stakeholders of progress achieved, SCE established an Advisory Board comprised of customers, industry stakeholders, and representatives of disadvantaged communities (DACs). The board provided useful input and guidance to SCE during the Pilot implementation and execution.

1.2 Objectives

The objectives of the Charge Ready Phase 1 Pilot were to inform and refine the design and cost estimates of the program, and to develop success measures for Phase 2.[10] Charge Ready objectives included evaluating:

- Processes, including: 1) qualifying charging stations (for example, availability of Level 2 charging stations with load management and demand response (DR) capabilities); 2) procuring deployment-related services (such as sourcing qualified electrical contractors); and 3) assumptions about time and costs to deploy EV charging infrastructure at participating customer sites.
- Post-deployment impacts, including assumptions about load expected from installed charging stations.

As this report demonstrates, the Pilot successfully achieved its objectives in accordance with the key guiding principles[11] that drove its implementation and execution.

1.3 Implementation

SCE launched the Charge Ready Pilot in May of 2016. The Pilot immediately generated significant interest, with 190 applications received within the first month. SCE stopped accepting new applications in January 2017 as all program funding was reserved for approved sites at that time.

Participating customers were able to select EVSE from different approved models. At the time of this report, there are 61 approved models offered by twelve SCE-qualified vendors, demonstrating SCE's commitment to offering a broad range of charging equipment options to participating customers.

8 California Public Utility Commission, Zero-Emission Vehicles Fast Facts, available at http://www.cpuc.ca.gov/zev/
9 An EVSE may typically include one, two, or four charge ports, with varying costs and demand (kW), SCE uses charge port (rather than EVSE) as the preferred unit to provide detailed reporting about Charge Ready.
10 Testimony In Support Of Southern California Edison Company's Charge Ready Application, Vol. 02 – Phase 1 Charge Ready And Market Education Pilot, p. 3.
11 See Section **2.2.2** of this report.

SCE completed its first deployment in February 2017, in the City of Lynwood. It included six charge ports to support the City's new EV fleet.

As of the date of this report, SCE has deployed infrastructure to support 941 charge ports at 60 customer sites, including 462 charge ports (50%) at 36 sites located in DACs, significantly exceeding the Pilot's goal of placing 10% of charge ports in DACs. On March 9, 2018, SCE released unused funds reserved for completed sites and re-opened the Pilot to new applications. SCE expects to add approximately 175 additional ports with the recently released funding.

1.4 Market Education

SCE developed a Market Education campaign to generate awareness about EVs and the benefits of fueling from the grid, delivered to a broad audience of potential car buyers through a variety of complementary channels, including paid media (for example, radio) and direct messaging (such as email). SCE developed specific efforts to target customers residing in DACs, including outreach events. With limited funding, SCE's Market Education campaign successfully achieved a 15% recall rate.

SCE also launched new TE Advisory Services[12] online content in September 2017 to assist business customers in considering and planning for TE deployment through self-service online tools (for example, Charge Port Estimator), fact sheets (on topics such as managed charging through **vehicle-grid integration**). Since the launch of updated web pages with content specific to Workplace Charging, Public Charging, Fleet, and MUDs, we have seen a significant increase in unique site visitors (a nearly 300% increase in Q4 2017 over Q3 2017) and page views (a nearly 200% increase in Q4 2017 over Q3 2017). Additionally, as part of TE Advisory Services, SCE launched in-person services in January 2018.

1.5 Conclusions

Phase 1 of the Charge Ready program successfully achieved its objectives. With infrastructure to support 941 charge ports deployed thus far, the Pilot allowed SCE to develop and improve processes to qualify a broad range of charging stations with DR capabilities from multiple vendors. It also provided real-life data about the time and costs to deploy EV charging infrastructure at participating customer sites, and helped SCE refine some of the assumptions included in its initial plans.

In addition, the Pilot confirmed customer interest in a program to deploy utility-owned infrastructure on the customer side of the meter to serve customer-owned charging equipment while maintaining market and technology neutrality, with high satisfaction expressed by participating customers.[13]

Phase 1 of the Market Education program demonstrated the need for greater public education about EVs and the benefits of fueling from the grid. The initial response to TE Advisory Services also confirmed a business customer interest for more technical assistance from a trusted energy advisor to help navigate the complexities of adopting and deploying TE technologies.

SCE plans to file an application in the second quarter of 2018 to seek approval of Phase 2, with changes based on the lessons learned documented in this report.

12 Sce.com/TE
13 Overall satisfaction of participating customers surveyed by SCE averaged 9.1 out of 10, with 100% of customers rating the program between 8 and 10.

2 Charge Ready Pilot

2.1 Pilot Design

The Charge Ready program was designed to offer customers a key solution for the electrical infrastructure necessary to support EV charging. To remove barriers to deploying EV charging, as part of the Pilot, SCE constructed the electric infrastructure needed to serve EVSE at participating customer locations, and will continue to own and maintain that infrastructure. The Pilot also offered customer participants a rebate to reduce the cost of acquiring and installing qualified EVSE. The rebates were calculated as a percentage of the EVSE base cost, as shown in the table below:

Table 2.1 Pilot Rebate Levels by Market Segment

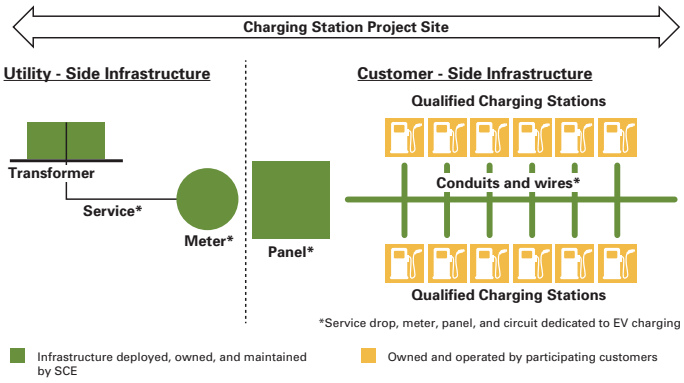
Market Segment	Rebate (% Base Cost)[14]
All segments in DACs	100%
MUDs	50%
All other segments (workplaces, fleets, and destination centers)	25%

Customer participants must procure, operate, and maintain the charging stations in accordance with the terms and conditions of the Pilot.

Customer participants established their own policies about charging station use (for example, access to charging stations and financial contributions from EV drivers). However, customers with Level 2 charging stations must participate in a Charge Ready DR Pilot.

SCE deployed electric infrastructure, on both the customer and utility sides of the electrical meter, to serve the charging stations at participating customer locations, up to and including the "make ready" stub.[15] Figure 2.1 shows a diagram of a Charge Ready Project Site.

Figure 2.1 Charge Ready Model



SCE established a clear end-to-end process and aimed to support efficient charging station deployment while minimizing disruption for participating customers. SCE established procedures to determine the number of charging stations approved at each site, and deployed supporting infrastructure based on existing and anticipated EV adoption at each participating site. The customer participants, together with SCE, approved the final site plan. To participate in SCE's program, most sites had to support a minimum of ten charge ports. A minimum of five ports was required for sites in DACs.[16] Participating customers had to procure qualifying charging stations and their installation directly from qualified suppliers for interconnection to SCE's supporting infrastructure. SCE offered a rebate for the procurement and installation of qualified charging stations, in an amount that reflected a percentage of the base cost[17] for functionalities established by SCE.

14 Charge Ready rebates, combined with other rebates or programs, cannot cover more than 100% of the charging station costs.
15 Includes customer-side and utility-side infrastructure.
16 DACs were identified using the California Environmental Protection Agency's (CalEPA) California Communities Environmental Health Screening Tool (CalEnviroScreen 2.0).
17 SCE defined the base cost as "The amount representing the best value for a Charging Station and its installation, as determined by SCE through primary or secondary market research." (Schedule CRPP). The base cost was determined by conducting an analysis for each of the charging station level categories using pricing information submitted by approved Charge Ready vendors. SCE evaluated several combinations to develop a fair comparison among single- and multiple- connector EVSEs. SCE determined a price per port for each of the qualified models and configurations, and used the lowest price per port within each EVSE category, to determine the base costs.

2.1.1 Customer and Site Eligibility

The program was open to SCE customers who met the following criteria:

Customer Eligibility

- Qualified as non-residential customers (business, government)
- Met the program's guidelines for EV adoption
- Owned, leased, or operated a long-dwell-time parking site (4+ hours)
- Provided a grant of easement from the property owner
- Delivered proof of purchase of qualified charging equipment

Site Approval

- Granted by SCE on a first-come, first-served basis that meet Pilot cost thresholds
- Required agreement from customers on the number of charging stations and their site locations (as proposed by SCE)
- Required a minimum of ten charging stations (reduced to five in DACs) in up to 4% of parking spaces (unless existing adoption demonstrated higher demand)

In addition, program participants were required to own and operate qualified charging stations for at least 10 years, pay for operating costs (such as energy, maintenance, repairs, and the EV network), and also provide non-Personally Identifiable Information (PII). Customers with Level 2 charging stations must also participate in a Charge Ready DR Pilot and any future DR program.

SCE focused its efforts on DACs, which are disproportionately affected by low EV adoption and the negative environmental impacts of gasoline- and diesel-powered vehicles. SCE managed the Pilot to ensure a minimum of 10% of all charge port installations were deployed in DACs. At the time of this report, out of the 1,066 charge ports funded through the program, 50% are located in DACs.

2.1.2 Pilot Objectives

The CPUC approved guiding principles for the Charge Ready Pilot.[18] These principles are listed below as a reference, and the body of this report will describe how each of these requirements was successfully met.

Table 2.2 Pilot Objectives

Pilot Objective	Pilot Summary	Pilot Report Section
	Guiding Principles	
1. Support the Governor's and California state goals, including: A. Achieve installation of grid-integrated infrastructure to support 1 million ZEVs by 2020[19]. B. Accelerate the adoption of 1.5 million ZEVs by 2025[20]. C. Support clean air and climate change objectives.	The 941 charge ports deployed thus far in the Pilot provide grid-integrated infrastructure and support the acceleration and adoption of ZEVs. Based on meter data from participating customers, 214.7 metric tons (MT) of carbon dioxide equivalent (CO_2e) was reduced from the charging stations installed from February 2017 through January 2018. The Pilot will likely further reduced GHG emissions through indirect benefits of the Pilot, such as accelerated EV adoption.	Section **2.3** Section **2.7.4**
2. Support the acceleration of a competitive EV charging market and encourage innovation, while maintaining market-neutral customer engagement.	SCE developed a Request for Information (RFI) to find and approve charging stations that meet the Pilot's requirements, reduce barriers for Pilot participants in procuring charging stations, and promote competition in the EV charging market.	Section **2.6.1**
3. Maintain customer choice.	At the time of this report, the Pilot offered 61 models from 12 vendors, maintaining customer choice and market-neutral customer engagement.	Section **2.6.1**
4. Remove barriers to deploying EV charging.	SCE constructs, owns, and maintains the electric infrastructure needed to serve EVSE at participating customer locations. The Pilot also offered customer participants a rebate to reduce the cost of acquiring and installing qualified EVSE.	Section **2.2**
5. Ensure the customer participant site infrastructure is installed and maintained in safe working order.	The Pilot required SCE employees and subcontractors installing make-ready infrastructure to follow safety requirements. For infrastructure safety, all site plans were submitted to the appropriate Authority Having Jurisdiction (AHJ) for approval and permitting. Some AHJs required approval from multiple agencies, such as Building and Safety, Electrical, and Fire Department Planning. For charging station safety, all installations were per AHJ-approved plans, and were inspected by AHJ inspectors.	Section **2.5.2**
6. Enable EV load management to support the grid in a manner that delivers benefits to all SCE customers.	SCE required DR capabilities for Level 2 charging stations and required customers selecting those charging stations to participate in a DR program.	Section **2.6.1** and Section **4**
7. Evaluate customer participant strategies that give EV drivers the opportunity to maximize fuel cost savings relative to conventional transportation fuels.	Based on initial analysis of the load profiles from the different segments, Destination Centers and Workplaces appear to be good candidates for load shifting strategies, while Destination Centers and Fleets are better candidates for a traditional DR strategy. DR concepts that will be tested are based on incentives. Through participation in future DR programs, our customers will have reduced fuel costs.	Section **2.7.3**

18 D.16-01-023, p. 7.
19 Executive Order B-48-18 established a goal to put 5 million ZEVs in California by 2030.
20 Executive Order B-48-18 established a goal to install 250,000 vehicle charging stations in California by 2025.

Pilot Objective	Pilot Summary	Pilot Report Section
8. Manage program costs.	Establishing cost thresholds[21] for various segments to manage program costs and to fulfill demographic goals of 10% of infrastructure installed in DACs.	Section **2.11**
9. Provide representative data (by different market segments, and across DACs, load management strategies, and pricing models) to allow for meaningful evaluation and comparisons, and to inform Phase 2 and future EV policy.	As Charge Ready installations were completed, detailed analyses were conducted, to understand the utilization of EVSE and track growth in terms of the number of Charge Ready sites, charging ports, charging sessions, average connection times, average charge times, and the amount of kWh consumed. SCE will continue to analyze submitted charging data, and expects to gain significant learnings as the users mature and develop more consistent charging patterns and behavior.	Section **2.7.3** Section **2.8** Section **4**
10. Identify and incorporate best practices for future EV infrastructure deployment.	SCE identified and recorded lessons learned, issue resolutions, and recommendations for a future program phase.	Section **2.4**
11. Support SCE's company-wide Diversified Business Enterprise (DBE) spending goal of 40%.	The architecture and engineering firm and general contractors selected for Charge Ready are all DBEs.	Section **2.5.1**
12. Provide services in line with legislative goals (Senate Bill [SB] 535 [de León, 2013] and SB 1275 [de León, 2014]) to serve DACs and increase access to clean transportation.	SCE focused on DACs, which are disproportionately affected by low EV adoption and negative environmental impacts of gasoline- and diesel-powered vehicles. At the time of this report, of the 1,066 charge ports funded, 50% or 535 charge ports are located in DACs.	Section **2.8**
13. Complement other utility clean energy programs and other non-utility programs, such as those being implemented pursuant to the Charge Ahead California Initiative established by SB 1275, which will build consumer demand for clean energy and clean vehicles.	In addition to the Charge Ready demand response Pilot, Charge Ready also complemented other clean-energy programs, such as the Clean Fuel Rewards Program in which EV drivers may be eligible to receive a $450 rebate.	Section **2.3**

21 Using estimated costs.

Pilot Objective	Pilot Summary	Pilot Report Section
	Settlement Agreement[22]	
1. Utilization for Level 1 and Level 2 EVSEs by Market Segment, including DACs.	As Charge Ready installations were completed, SCE analyzed the utilization of EVSE, including information about charging sessions, average connection times, average charge times, and kWh consumed. SCE will continue to analyze charging data, and expects to gain significant learnings as the users mature and develop more consistent charging patterns and behavior.	Section **2.7.3**
2. Comparisons of different customer participant load profiles and load management strategies, including the use of price signals by customer participants to charging station users.	SCE's analysis of the load profiles from the different segments indicates that Destination Centers and Workplaces are potential candidates for the load shifting strategies, while Destination Centers and Fleets are likely candidates for traditional DR strategies. MUD load profiles will need to be analyzed when more sites are available to determine the load management strategies that work best for that segment. In the DR Pilot (see Section 4.0) load management will be utilized in all of the traditional and load shifting DR events.	Section **2.7.3**
3. Information about charging station costs, levels and types of preferred features, and rebate amounts reserved or paid to date.	At the time of this report, 70 customers with 1,066 charge ports have submitted their charging station procurement documents. The majority of customers selected Level 2B charge ports and dual-port connectors.	Section **2.6**
4. Conversion of EV charging hours into avoided GHGs and identification of other grid benefits and implications, as appropriate.	Based on meter data for participating customers, 214.7 metric tons (MT) of carbon dioxide equivalent (CO_2e) was reduced from the charging stations installed from February 2017 through January 2018. Further GHG reductions can be attributed to the Pilot's indirect benefits, such as accelerated EV adoption.	Section **2.7.4**
5. Insights learned by SCE about the effect of the program on the EVSE and EV market.	The 941 charge ports deployed thus far in the Pilot support the acceleration and adoption of ZEVs. As an example of increased EV adoption, Mr. Kenny Tang of Cathay Bank in El Monte observed that several employees started driving EVs after the site installed charging stations with 17 ports through the Charge Ready pilot.[23]	Section **2.3**

22 Application 14-10-014, Motion for Approval of Settlement Agreement, p. A-1.
23 Shared with permission from customer participant.

2.2 Pilot Operations

2.2.1 Enrollment and Deployment Status

At the time of this report, SCE has committed funds for a total of 1,066 charge ports, with 50% located in DACs. **Appendix A** shows a breakdown of the 1,066 charge ports by city and zip code. On March 9, 2018, SCE released unused funds reserved for completed projects and re-opened the Pilot to new applications. SCE expects to add approximately 175 additional ports with the recently released funding. The following two figures provide the charge port distribution by market segment and customer type for the 1,066 charge ports:

Figure 2.2 Charge Ports by Market Segments

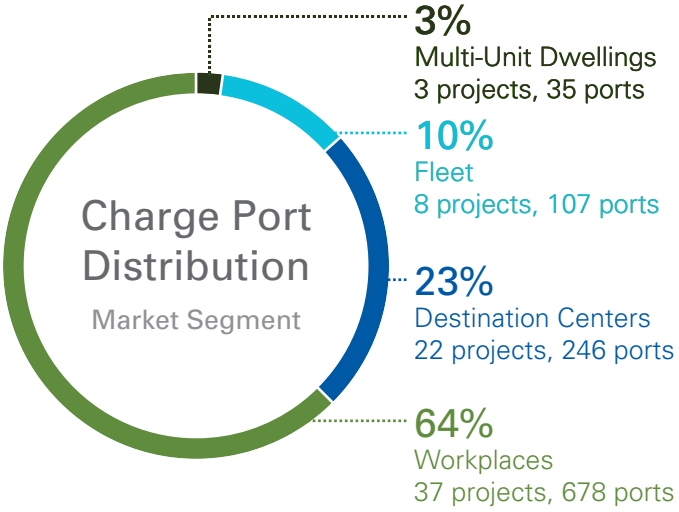
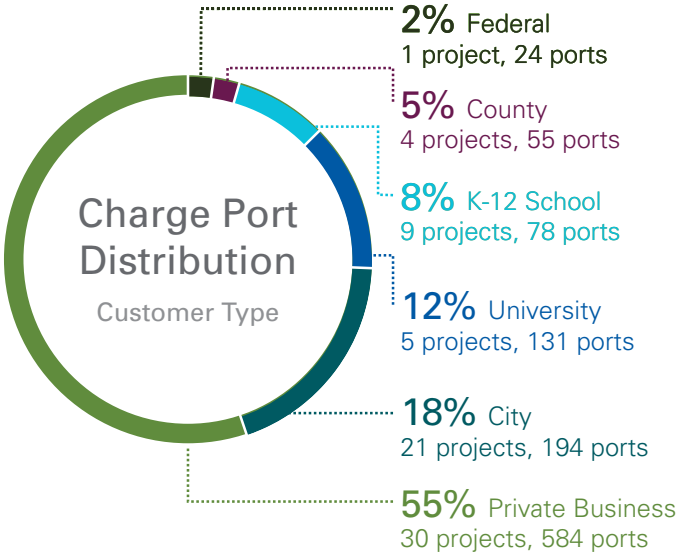


Figure 2.3 Charge Ports by Customer Type



2.2.2 Application Process

The Pilot's application process was designed to accommodate customer needs and promote customer choice. The process can be described in six stages: Engagement, Evaluation, Confirmation, Planning and Design, Construction, and Verification.

Process Overview

- **Engagement** began with a customer submitting an application indicating their interest in participating in the Pilot. This application is called **Step 1 – Notice of Intent**.
- **Evaluation** followed the application submission. SCE conducted on-site assessments to evaluate the feasibility of deploying charging stations through the Pilot.
- **Confirmation** of the customer's participation, including the customer's approval of the number of charging stations and deployment locations at each site (as proposed by SCE). SCE reserved funding (if available) upon receipt of **Step 2 – Agreement**, signed by the customer and property owner.[24]
- SCE then conducted **Planning and Design** for the approved site, while the customer participant procured qualified charging stations. At the end of the procurement period, customer participants had to provide the required proof of purchase using **Step 3 – Certification**[25]. In addition, customers who applied for charging stations for fleet EVs were also required to provide their DMV registrations, or evidence of vehicle purchase or lease.
- SCE then conducted **Construction** for the approved site. Before construction began, SCE held a pre-construction meeting with the customer participant. Once the infrastructure was completed and passed inspection, the customer participant's selected charging station vendor installed the charging stations.
- Finally, **Verification** took place, to ensure the electric infrastructure and charging systems were deployed in accordance with approved plans (using **Step 4 – Walk-Through Report** and **Step 5 – Rebate Confirmation**); SCE then issued the rebate.

Waitlist Process

SCE established a waitlist for customers that did not meet program timelines, or whose applications exceeded funding availability. Waitlisted projects can move forward in the process if other projects with reserved funding drop out of the program or if funding becomes available.

2.3 Successes

The Pilot was met with enthusiasm by the marketplace. SCE's initial outreach resulted in 334 applications totaling 2,043 charge ports. The Pilot was fully subscribed by January 2017 based on estimated costs. As described in section 2.4.1 below, evaluation of applications resulted in a smaller number of sites and associated charge ports being deployed within the available Phase 1 Pilot funding. At the time of this report, the Pilot has deployed infrastructure to support 941 charge ports with additional 62 charge ports in construction. SCE expects to deploy infrastructure to support up to 1,250 charge ports by the Pilot's completion. The infrastructure supports EV acceleration and adoption. As an example of increased EV adoption, Mr. Kenny Tang of Cathay Bank in El Monte observed that several employees started driving EVs after the site installed charging stations with 17 ports through the Charge Ready pilot. Charge Ready also complements other clean-energy programs outside of Charge Ready, such as the Clean Fuel Rewards Program,[26] in which EV drivers may be eligible to receive a $450 rebate.

24 Charging stations were procured by customers only after the Step 2 Agreement was signed and SCE reserved funding.
25 The Step 3 procurement and preliminary site design period began once customers executed their Step 2 agreements and funds were reserved for the customers' applications. This period allowed 30 calendar days from fund reservation, and customers were provided an additional 15 days if they submitted extension requests. SCE also offered, at its discretion, additional extensions if the customers were actively procuring charging stations. Customers who did not meet these timelines were subject to being placed onto a waitlist. SCE Account Managers encouraged customers to begin this process early to comply with the Pilot's timelines.
26 https://www.scecleanfuel.com/

2.4 Pilot Operations Lessons Learned and Potential Improvements

2.4.1 Customer Engagement and Evaluation

SCE reviewed customer applications and conducted on-site assessments to determine the feasibility of deploying charging stations. The following table shows lessons learned and recommendations to improve the customer engagement and evaluation stage of the Pilot.

Table 2.3 Customer Engagement and Evaluation Lessons Learned and Recommendations

Program Phase	Lessons Learned	Resolution/Recommendation
Site Assessment	Program Timing: Several schools were not able to conduct the program's EV survey (to help identify existing and future EV adoption at the site) during the summer months when they were not in session. Also, the Pilot was launched in late May, and many businesses had already set their budget plans for the following year, creating a challenge for those interested in the program.	SCE will propose a five-year program which will resolve any seasonal/annual timing issues and will allow customers sufficient time to plan appropriately for participation.
Eligibility Requirement	SCE proposed deploying a maximum number of customer-site charging stations, to meet anticipated use. For some DACs, maximum use supports the minimum program requirement of five charge ports. This presents a challenge for customers who prefer dual-port stations.	In DACs, customers who were approved for a maximum of five ports but selected dual-port stations were allowed to deploy six ports.
	The 10-charge port minimum requirement was a challenge for some customers in non-DACs.	In the future phase, SCE may reduce the minimum port requirement fewer than 10 to support increased adoption across all targeted segments.
	Some customer sites were not viable in the Charge Ready program due to high costs. Customers who are willing to pay excess costs were unable to do so.	SCE will consider submitting a proposal that allows customer cost-sharing in future programs.
Application Support	Another challenge during the Pilot was the lack of automation in processing applications. Follow-up e-mails and notifications to customers and their selected vendors were drafted and sent manually for each project.	SCE will evaluate automation in processing applications where appropriate.

2.4.2 Application Process

SCE assisted customers through the Pilot application process. After customers signed the Step 2 agreement and SCE reserved funding, customers submitted their Step 3 certification. The following table shows lessons learned and recommendations to improve the application process of the Pilot.

Table 2.4 Application Process Lessons Learned and Recommendations

Program Phase	Lessons Learned	Resolution/Recommendation
Step 2 - Agreement	The Pilot experienced varied and at times lengthy customer delays to execute the Step 2 Agreement. The average cycle time from site assessment completion to Step 2 Agreement completion was 72 business days.	Our solution to minimize these delays was to have a continuous dialogue between SCE Account Managers and customers. In the future phase, SCE may establish different timelines for customers in different market segments.
	Some customers withdrew from the Pilot after SCE incurred design costs for these withdrawn projects, which reduced the funding available to other customers who wanted to participate in the program.	SCE will improve the Pilot processes and future program design to minimize the design costs incurred before customers confirm their charging station procurement. In the future phase, SCE may require a deposit from the customers and will focus on communicating termination fees and how they are applied, before customers sign their agreements, to help ensure mutual customer and SCE commitment.
Step 3 - Procurement	Customers experienced difficulty contacting the approved charging station vendors on SCE's Approved Package List.	SCE gathered and published detailed contact information for approved vendors, including direct contacts to the vendors' sales departments.
	After signing their program agreements, customers were required to provide proof of purchase of their charging stations within 30 calendar days. SCE found a majority of submissions to be incomplete or inaccurate.	SCE made changes to improve document completeness and accuracy. Customer form instructions were updated, charging station vendors were reminded of the requirements, and SCE's project management organization worked closely with customers to submit accurate documents.
	Most customers require more than 30 calendar days to procure the EVSE. Customers who submitted proof of purchase averaged 44 business days. Federal, university, and municipal customers took longer than average, while business, school, and county customers were faster than average (see Appendix for additional information on market segments). Most customers requested two extensions, with some needing additional extensions. As a result, SCE experienced delays in starting construction at these customers' sites.	SCE waitlisted customers who exceeded procurement deadlines, including extension deadlines. SCE may recommend different program requirements for government and institution customers to accommodate their unique internal processes.

Program Phase	Lessons Learned	Resolution/Recommendation
Step 3 - Procurement	A number of customers submitted incomplete procurement documents, which delayed deployment design completion and construction start.	For a future phase, SCE will change materials to add an in-depth requirements overview at the initial customer meeting. The procurement requirements could also be included in educational materials. Vendors could be trained and responsible for ensuring their supporting documents include the necessary elements. Additionally, a Step 3 requirements meeting, in which the Account Manager reviews all Step 3 requirements, may be added to the process.

2.4.3 Pre-Construction Process

While the customers procured the charging stations, SCE completed and presented the deployment design to the customers. Once the customers approved the design and SCE received all supporting documents required with Step 3 - Certification, SCE completed other pre-construction requirements such as applying for permits and ordering materials. The following table shows lessons learned and recommendations to improve the pre-construction stage of the Pilot.

Table 2.5 Pre-Construction Lessons Learned and Recommendations

Program Phase	Lessons Learned	Resolution/Recommendation
Requirements	Initially, SCE required a two-step process to obtain easements. First, property owners were asked to sign contingent easements that provided "blanket" easements over their entire properties. The intent of contingent easements was to move applications through the design and construction processes. Once the final design was complete and accepted by the customer participants, SCE amended the contingent easements to encompass only the charging station infrastructure locations. Several customers were resistant to executing contingent easements over their entire properties. Additionally, the contingent easements caused delays in receiving the customers' signed program agreements, due to additional time needed for customers' legal review.	In Q1 2016, as a process improvement, SCE bypassed the contingent easement and only required execution of the final easement. The final easement reflected the final charging station design and location.
	SCE experienced delays in executing final easements. Average cycle time was 59 business days; 37% of projects took more than 59 business days, and some took up to 234 business days, causing construction delays. For some customers, more time was needed for management and legal easement document review.	While the easement process was mentioned in the Charge Ready participation package and at Account Manager meetings with customers, for the future phase, SCE will ensure customers thoroughly understand the easement process during the early application stages and will recommend customers' management and legal team review easements early in the process.

Program Phase	Lessons Learned	Resolution/Recommendation
Site Design	Customer-requested re-designs for alternate charging station locations caused delays at a small number of sites, including some of the Pilot's highest port sites.	SCE will explore limiting or defining the number of customer re-design requests allowed, and deadlines for such requests.
Pre-Construction	The Pilot required a separate panel and separate service for the charging stations. This is more costly than using an existing panel and service line at the customer site.	For a future phase, SCE will evaluate the feasibility of using customers' existing panels and service lines. This approach would be limited to customers with existing panels that can support new charging station load.
	Program requirements in the Charge Ready Pilot did not facilitate use of planned and/or existing infrastructure at new construction sites. Capitalizing on construction already underway could reduce program costs significant but coordination and contractual obligation agreements with developers will be key.	SCE will evaluate program requirements and offerings to determine the most feasible and cost-effective way to deploy charging stations at new construction sites. These offerings may include but are not limited to rebates for sites that exceed CalGreen building code and early coordination with project developers to plan and deploy charging stations.
	Construction delays in meter panel manufacturing and delivery occurred early in the Pilot. Panels were custom-ordered for each site, and for warranty purposes, the manufacturers had to build and fully test the panels. These meter panel delays caused initial site construction delays.	SCE started ordering meter panels early in the design process to avoid construction delays. SCE also expanded the number of meter panel manufacturers to ensure all sites could be supported. The SCE team also began awarding projects earlier in the scheduling and construction coordination process to mitigate this delay. The SCE team and Charge Ready general contractors also identified alternate sources for panel procurement, reducing material lead time. For a future program phase, SCE may bulk order standardized meter panels based on grouped site requirements to eliminate construction delays.

2.4.4 Construction

By March 2018, utility- and customer-side infrastructure construction was completed for 60 projects with a total of 941 ports. Based on these projects, the overall average cycle time for infrastructure construction was 44 business days, not including charging station installation. Destination centers had an average cycle time of 54 days for infrastructure construction, workplace sites took 38 days, fleet sites 37 days, and MUD sites 43 days. The following table shows lessons learned and recommendations to improve the construction stage of the Pilot.

Table 2.6 Construction Lessons Learned and Recommendations

Program Phase	Lessons Learned	Resolution/Recommendation
Resources	General contractor resource issues contributed to delays in SCE's ability to award construction projects.	In Q2 2017, SCE added an additional general contractor, for a total of three contractors, to support construction through the remainder of the Pilot.
Construction	SCE experienced construction delays due to a handful of customer requests for specific outage dates or construction start delays at their sites.	In a future phase, SCE will work with customers to commit to pre-scheduled outages earlier in the process.
Charging Station Installation	A charging station vendor challenged the infrastructure completed by SCE as it does not include the mounting fixture.	Standard charging station footprints could accommodate standardized make-ready infrastructure and mounting fixtures, which would lower overall costs.

2.4.5 Post-Construction

SCE conducted post-installation verification to confirm equipment installation and operability are consistent with approved plans. Once verified, SCE provided rebate checks to customers. The following table shows lessons learned and recommendations to improve the post-construction stage of the Pilot.

Table 2.7 Post-Construction Lessons Learned and Recommendations

Program Phase	Lessons Learned	Resolution/Recommendation
Charging Station Maintenance	Some vendors left the marketplace post-purchase. Service and maintenance may not be available for the products offered by these vendors. Charge port data and cloud services may be impacted.	SCE will modify contract language to help protect customer investments.
Rebate	Delays were experienced in receiving the required final documentation from charging station vendors and customers.	SCE continually followed up with customers and their selected vendors on their missing documentation before releasing their charging station rebates.

2.4.6 MUDs

As expected, a prerequisite to working with MUDs is gaining support by the local Homeowner Associations (HOAs). However MUDs also had other unique challenges charge port installation Charge Ready pilot. Identified challenges are listed below:

Table 2.8 MUDs Lessons Learned and Recommendations

Lessons Learned	Resolution/Recommendation
Parking limitations were the most pervasive constraint for MUDs. Because most spaces were already assigned to residents; it was difficult for the owners or property managers to allocate sections of parking stalls for charging station installations.	Allowing parking lots adjacent to the MUD property to be eligible for the program if they can serve those MUD residents. However, this will require increased coordination with different site hosts and may add cost and complexity to the program. SCE may also lower port minimum requirement to address parking constraints.

Lessons Learned	Resolution/Recommendation
For customer convenience, large MUD complexes often wanted to deploy charging stations throughout the grounds, rather than in single, defined areas. This required multiple service connections and exclusive infrastructure components resulting in high costs that exceeded Pilot thresholds.	SCE will work with site hosts to learn more about customers parking management best practices and incorporate learnings earlier in process to help address deployment location concerns.
MUDs with parking structures faced challenges in meeting current state accessibility requirements, which required more work. In some cases, AHJ s required MUDs to update all parking areas to current codes.	Allowing parking lots adjacent to the MUD property to be eligible for the program if they can serve those MUD residents. However, this will require increased coordination with different site hosts and may add cost and complexity to the program.
Due to space constraints, it could be difficult to find viable locations for switchgear, transformers, and other necessary equipment for charging station deployment.	Capitalizing on construction already underway could address space constraints but coordination and contractual obligation agreements with developers will be key.

2.5 Contractors

2.5.1 Supplier Diversity

The architecture and engineering firm, as well as the general contractors selected for Charge Ready, were all Diversified Business Enterprises (DBEs). This exceeded SCE's Diversified Business Enterprise 40% spending goal.

2.5.2 Training and Safety

SCE values safety, and ensured the utility and the customer participant site infrastructures were installed and maintained in safe working order. The Pilot required SCE employees and subcontractors installing the make-ready infrastructure to follow these safety requirements:

- All general contractors must prepare and adhere to a job-specific Job Hazard Analysis (JHA).
- All general contractors must have a dedicated safety officer or manager who regularly visits the job site.
- Safety tailboards must be held daily to discuss the work to be performed and any potential risks.
- All general contractors must submit a monthly safety report to SCE.
- SCE personnel must follow all site safety regulations, including wearing appropriate personal protection equipment.
- Subcontractor electricians must hold valid California C-10 licenses.
- Electricians installing the make-ready infrastructure must be EV Infrastructure Training Program (EVITP) certified.

For infrastructure safety, all site plans were submitted to their AHJs for approval and permitting. Some AHJs required multi-agency (for example, Building & Safety, Electrical, and Fire Department Planning) approval. For charging station safety, all installations were completed per AHJ-approved plans, and inspected by AHJ inspectors.

2.6 Charging Stations

2.6.1 Overview

In accordance with our testimony,[27] the Pilot installed charging stations at long-dwell-time locations. The three types of charging stations that met those needs were:

1. Level 1 charging system, without network capability.
2. Level 2 "A" charging system, with network capability integrated into the EVSE.
3. Level 2 "B" charging system, with network capability provided by an external device (such as a kiosk or gateway) shared among multiple stations.

SCE required DR capabilities for Level 2 charging stations, and customers selecting those stations are required to participate in a future DR program. SCE developed an RFI to find charging stations with these capabilities and qualify them for the Pilot to reduce customer participant barriers in procuring charging stations and to promote competition in the EV charging market. The Approved Package List[28] summarizes the vendors and EVSE models available to customers. At the time of this report, the Pilot offers 61 models from twelve vendors, maintaining customer choice and market-neutral customer engagement. **Appendix C** provides a summary of the different charging system types.

To further reduce barriers to adoption, SCE provided a rebate to reduce charge port cost and installation (the base cost, defined in Section 2.2). The base cost values at the time of this report are shown in the following table. These values were updated once during the Pilot.

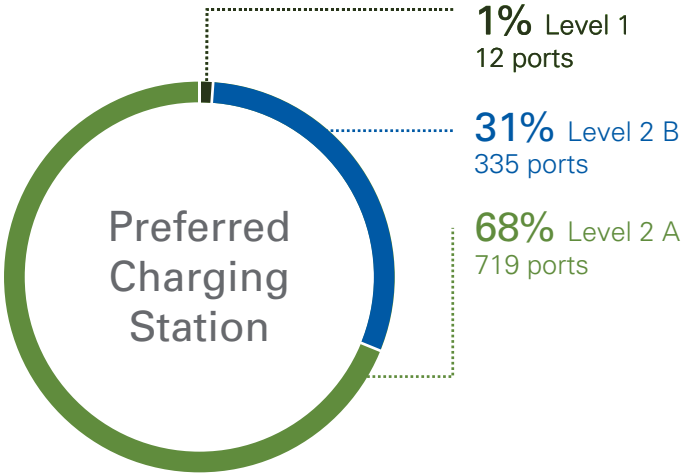
Table 2.9 Charging Stations Base Cost

Charging System Type	Base Cost ($ per port)
Level 1	$1,396
Level 2 "A"	$2,188
Level 2 "B"	$1,611

2.6.2 Customer Charging Stations

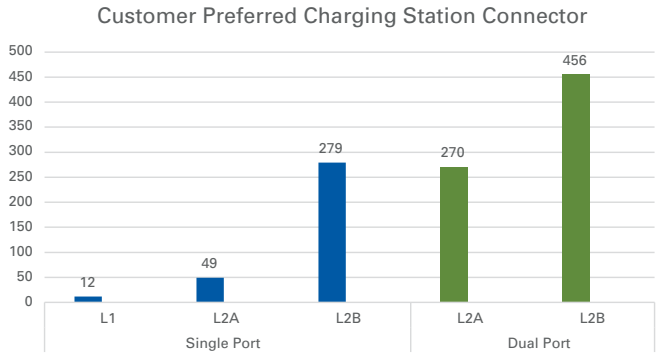
At the time of this report, 70 customers with 1,066 charge ports had submitted their procurement documents for the charging stations. The following chart displays customer charging station selection.

Figure 2.4 Customer Preferred Charging Station Type



The following graph shows that more customers preferred dual-port connectors for both Level 2A and Level 2B charge ports.

Figure 2.5 Customer Preferred Charging Station Connector



27 Testimony In Support Of Southern California Edison Company's Charge Ready Application, Vol. 03 – Phase 1 Charge Ready And Market Education Pilot, p. 10.
28 The Pilot's Approved Package List can be found on the landing page at https://on.sce.com/chargeready.

2.6.3 Rebate

By the end of February 2018, 35 rebate payments were released.

The following table provides a summary of charging station requests and rebates.

Table 2.10 Charging Station Rebate Update

Charging Station Rebates	
Rebate amount reserved for Level 1 ports	$19,356
Rebate amount reserved for Level 2A ports	$358,993
Rebate amount reserved for Level 2B ports	$774,318
Rebate amount paid for Level 1 ports	$-
Rebate amount paid for Level 2A ports	$237,642
Rebate amount paid for Level 2B ports	$243,289

2.6.4 Charging Stations Lessons Learned and Recommendations

Through an RFI process, the Charge Ready team identified challenges and recommends potential improvements for a future phase of the program, as described below:

- Through the Pilot, **SCE learned the importance of testing charging stations and approving the EVSE into the program**. Some EVSE did not pass evaluation, for reasons such as failing to pass the momentary outage test, failing to stop the charge session even when charging has been completed, unknown charging interruptions, missing OpenADR 2.0b or UL certifications, ventilation and other safety issues. In a future phase, SCE may continue testing EVSE directly or through a third party to be approved in the program and ensure safe, reliable charging stations.
- **Several EVSE vendors were not ready for the program upon enrolling**. Even though the RFI describes the technical requirements, some vendors submitted packages but were still in the process of receiving UL or OpenADR certification, or receiving other updates. This delayed the RFI process and kept them "on hold" in our testing queue for a good deal of time. It also required significant back-and-forth communication to follow up on missing requirements. During Q4 2017, for the equipment still in the testing queue from previous RFI submissions, the Charge Ready team started setting firm deadlines to receive equipment, and recommends the same approach in a future program phase. The average cycle time for equipment testing was 127 days.
- **New vendors submitted RFIs for equipment that was already approved for the program**. In these cases, SCE conducted the entire RFI process, testing, and building out new pricing analyses. The team learned it is important to establish a procedure for accepting and approving re-sellers for pre-approved charging stations.
- **SCE encountered vendors changing model numbers during the testing process, and submitted different model numbers than originally listed in the RFI response**. This made it challenging to match models with the RFI response, manuals, pricing templates, and nameplate labels on the test equipment, making some parts of the testing process more difficult. Some information is not requested in the RFI, such as gateway model numbers, differentiation between L2A and L2B, and firmware version number, and needs to be acquired from the vendor prior to approval. This requires extensive coordination with the vendor. For a future phase, SCE intends to create a supplemental document that the vendor signs and submits at the end of testing. This document would capture all the information that may have changed during testing, and also a method to consolidate all the emails that go back and forth between SCE and the vendor to acquire this information.
- Energy management systems, which are considered a new technology, are encouraged by vendors in their RFI introductions. **SCE does not yet have a procedure to test energy management systems**. Also, the RFIs do not cover compliance standards, such as NEC Article 750 or UL 916, for these systems. In the Pilot, there were two vendors who submitted these systems and made it through the RFI review, and specific procedures were drafted to accommodate these vendors. For a future phase, SCE will develop a standard procedure for testing and approving energy management systems to be used in the Charge Ready program.
- Although OpenADR 2.0 and network communication were requirements for EVSE to be approved for the Charge Ready Pilot, preparation for the Charge Ready DR Pilot discovered that actual implementations varied by EVSE vendor. For example, at least one vendor does not support the ability for chargers to "throttle" to a lower capacity of charging, but only turn chargers off or

on. Some vendor systems also do not require an e-mail address or phone number from drivers using their chargers, making it difficult to notify drivers when events are called that could impact their charging. In the future, SCE may need to be more specific in EVSE vendor capabilities to ensure uniform capabilities for program participation.

2.7 Charging Station Operation

2.7.1 Rate Schedules

Customers with low load factors are more costly to serve because their utilization is volatile. Therefore, utilities must size transmission and distribution systems accordingly. Under current CPUC-approved tariffs, some of these costs are passed on to customers via demand charges, which are measured in kW. These are different from energy consumption charges, which are measured in kWh.

Charge Ready customer participants who had general service accounts located at their premises could select available EV rates with Facilities-Related Demand (FRD) charge offset options.

For Rate Schedules TOU-EV-3-B, TOU-EV-4, and TOU-EV-6, FRD charges are determined using the FRD in excess of the primary account located at the same premises (the customer of record must be the same for both accounts). If the FRD from EV charging is less than the FRD of the primary service account (within any given monthly billing period), no separate FRD charge is due for the qualifying EV account. This is also known as demand neutralization.

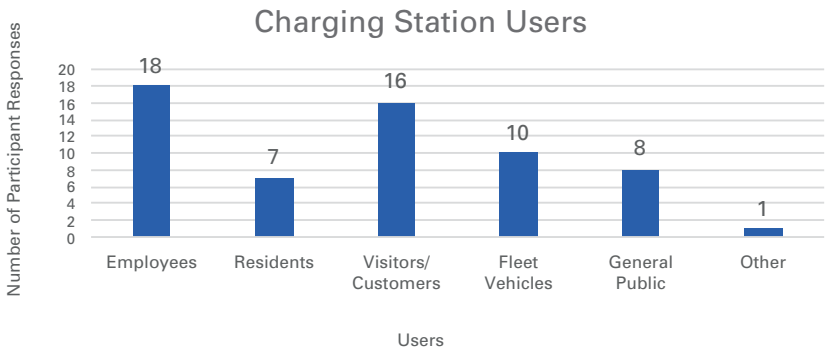
The majority of Pilot participants are selecting TOU-EV-4.

2.7.2 Charging Station Access and Use

As customer participants own and operate their charging stations, they determine charging station access and pricing policies.

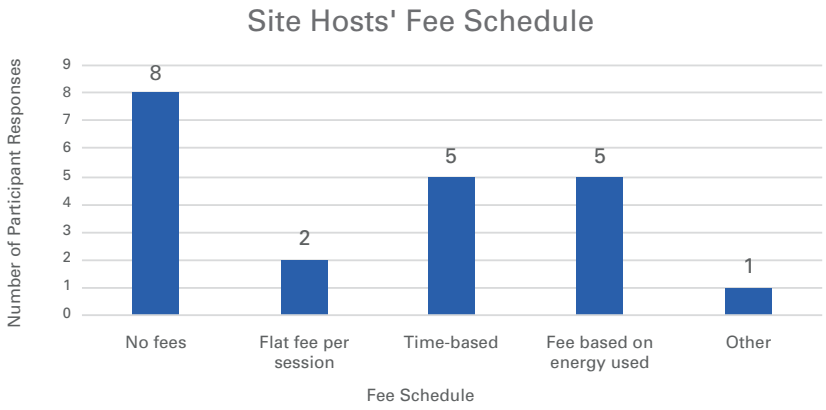
Charge Ready invited participants to complete customer satisfaction surveys to determine how the program met expectations. The survey methodology is described in Section 5. The survey asked participants questions related to charging station accessibility and how end-user fees were assessed, if any. By the end of January 2018, survey invitations were sent to 25 participants, representing 34 sites. SCE received responses from 20 participants. The following chart shows charging station accessibility at their sites.

Figure 2.6 Charging Station Users



The chart below shows charging station fee schedule set by the site hosts according to the survey responses.

Figure 2.7 Site Hosts Fee Schedule



2.7.3 Charging Station Utilization and Customer Participant Load Profiles

As Charge Ready installations were completed, SCE analyzed EVSE utilization and tracked the number of Charge Ready sites, charging ports, and kWh consumed. SCE collected and analyzed meter data at each Charge Ready program Pilot site. At each site, the bank of charging stations was connected to a single meter, allowing SCE to measure the aggregated load and determine its grid impact. The charts below show the average usage per port by month for each market segment from June 2017 to February 2018.

Figure 2.8 Workplaces Monthly Average Usage per Port

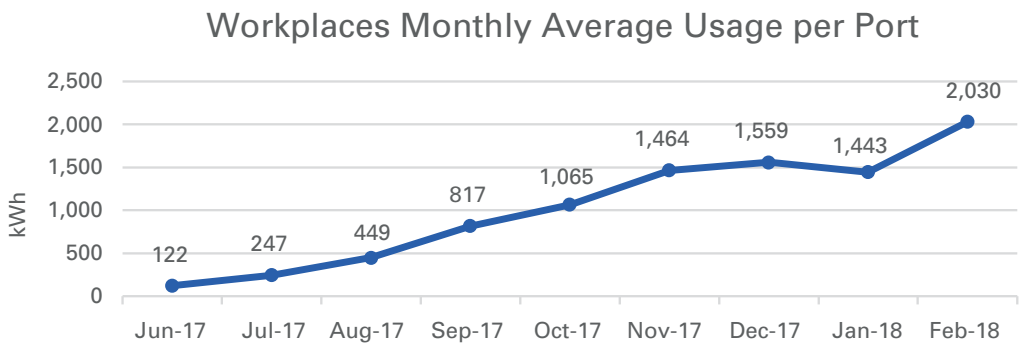


Figure 2.9 Destinations Center Monthly Average Usage per Port

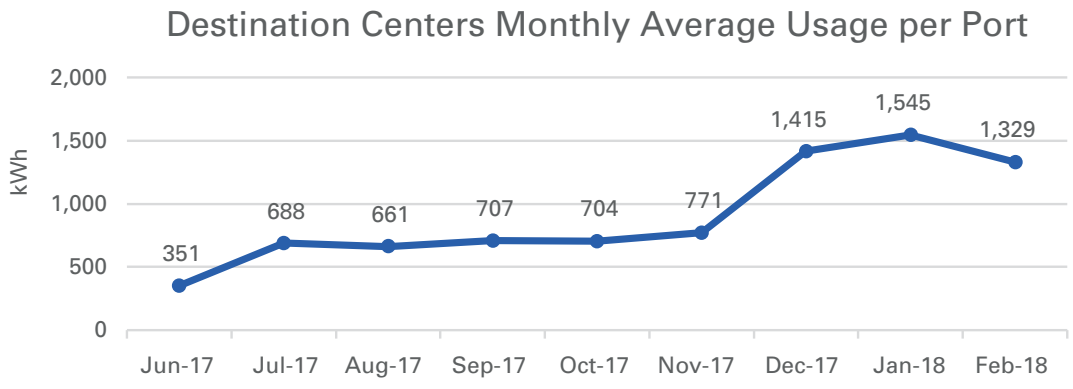


Figure 2.10 Fleets Monthly Average Usage per Port

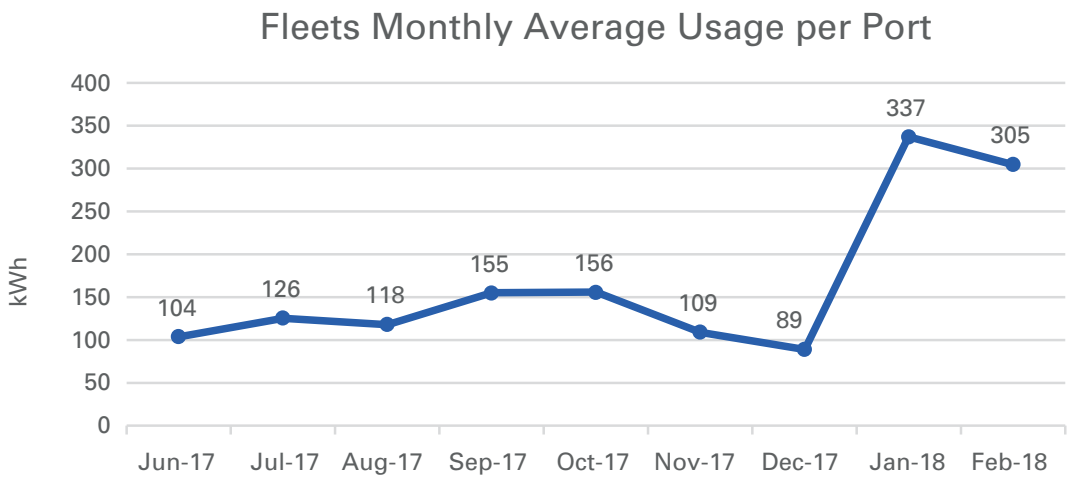
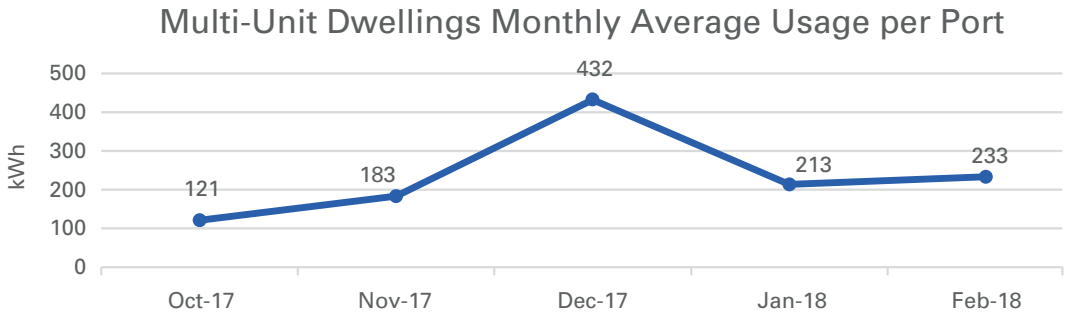


Figure 2.11 MUDs Monthly Average Usage per Port



SCE also analyzed the charging station load profiles to design the DR Pilot. The following charts show February 2018 usage data from workplaces, destination centers, fleets, and multi-unit dwellings. Based on analysis of the load profiles from the different segments, Destination Centers and Workplaces may be good candidates for load shifting strategies, while Destination Centers and Fleets may be the best candidates for traditional DR strategies. MUD load profiles should be analyzed when more sites are available to determine the best strategies for DR in that segment. The Charge Ready DR Pilot (see Section 4.0) will include both traditional DR and load shifting events, but will most likely only reduce charging capacity by throttling to 50%. However, communication to customers and end users (either through the customer or the EVSE/EVSP vendor) will be utilized for all events.

Figure 2.12 Workplaces – Weekday Average Usage

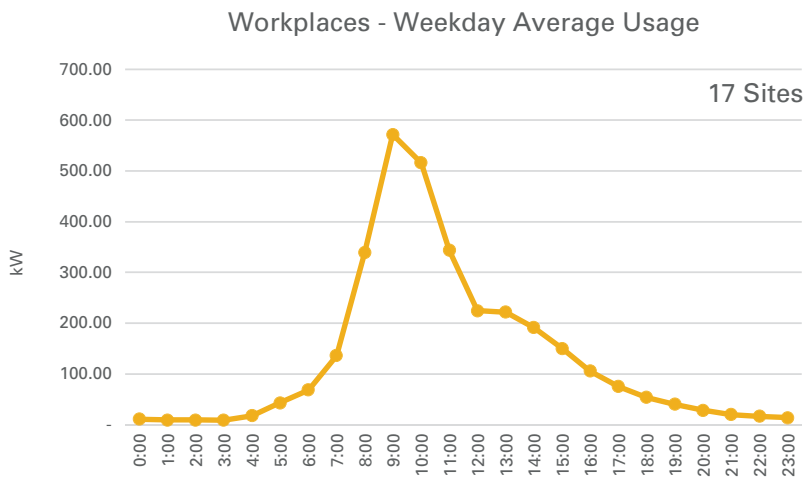


Figure 2.13 Workplaces – Weekend Average Usage

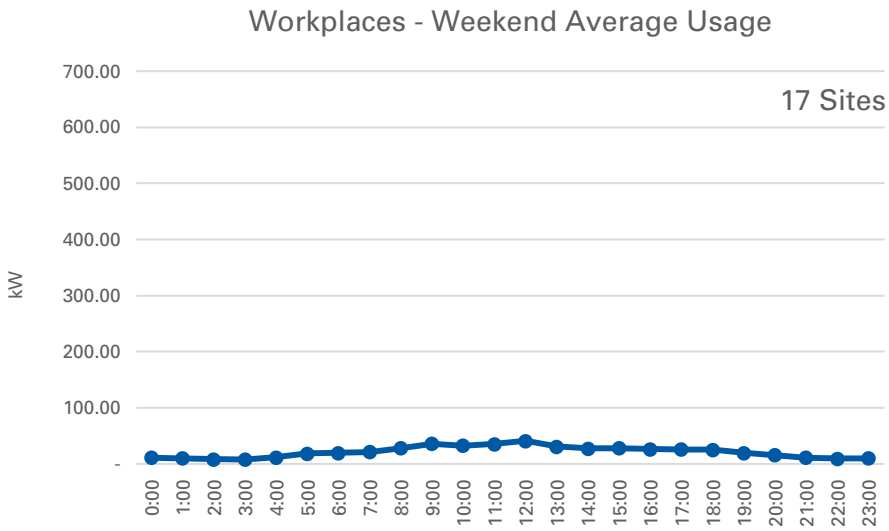


Figure 2.14 Destination Centers - Weekday Average Usage

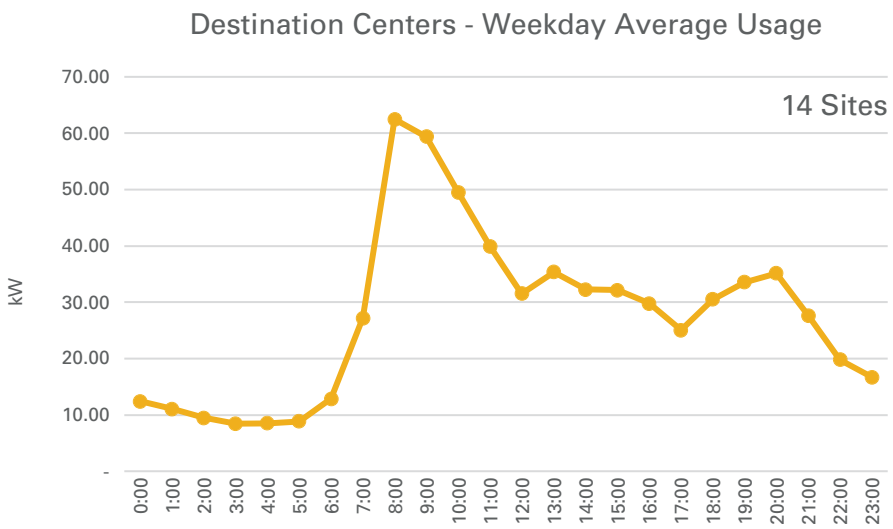


Figure 2.15 Destination Centers - Weekend Average Usage

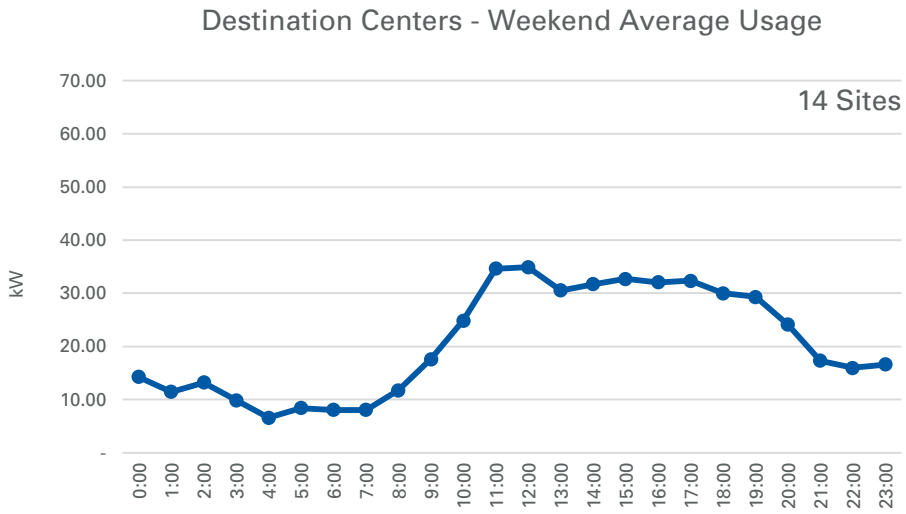


Figure 2.16 Fleets - Weekday Average Usage

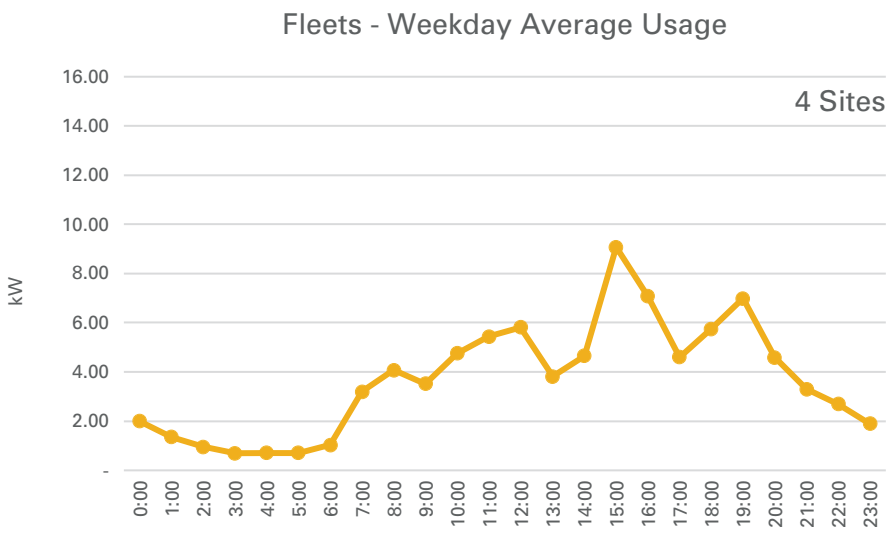


Figure 2.17 Fleets - Weekend Average Usage

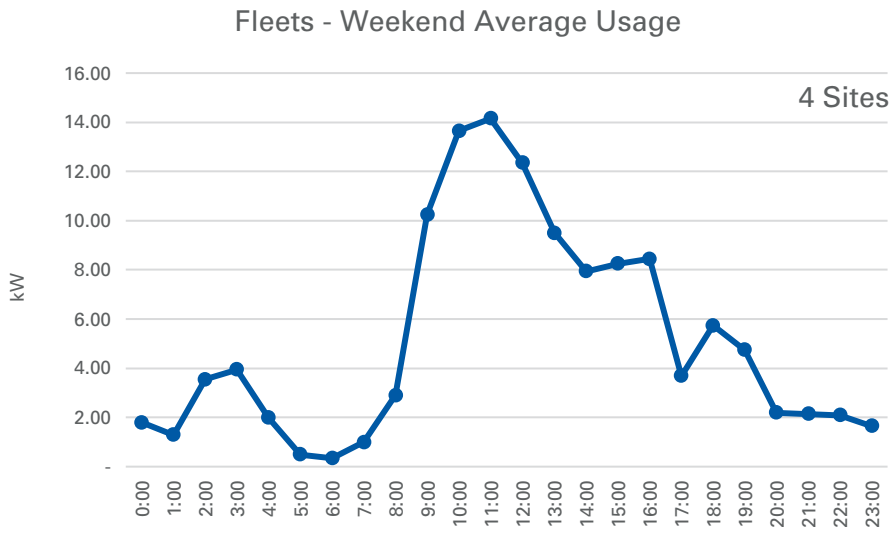


Figure 2.18 MUDs - Weekday Average Usage

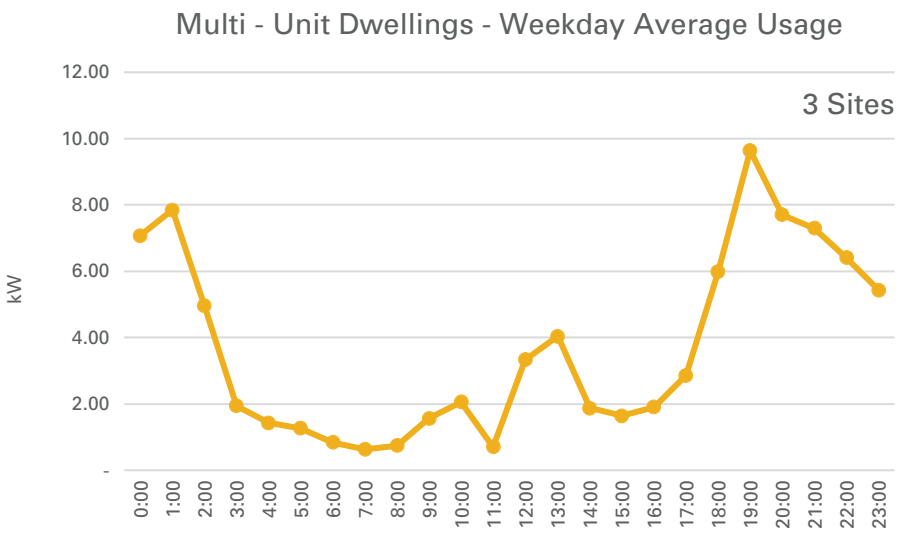
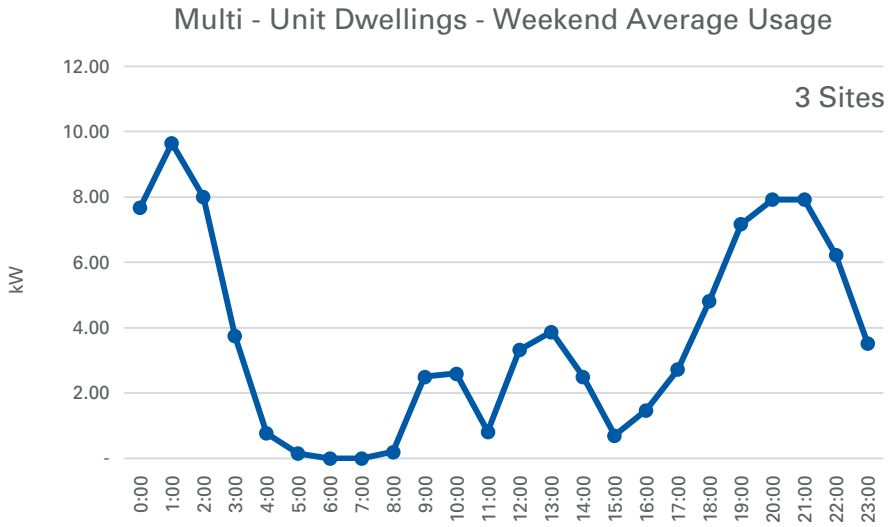


Figure 2.19 MUDs - Weekend Average Usage



The figures above indicate that, on average, workplaces experience a higher level of charging on weekday mornings and consistent level of charging during weekdays. Destination centers, on average, experience higher levels of charging in the morning with usage on weekend afternoons. Fleet sites, on average, experience higher levels of charging on weekday afternoons and during mid-day on weekends. Finally, MUDs, on average, experience similar patterns of charging with higher usage at night on weekdays and weekends. SCE will continue to analyze submitted charging data, and expects to gain significant learnings as the users mature and develop more consistent charging patterns and behaviors.

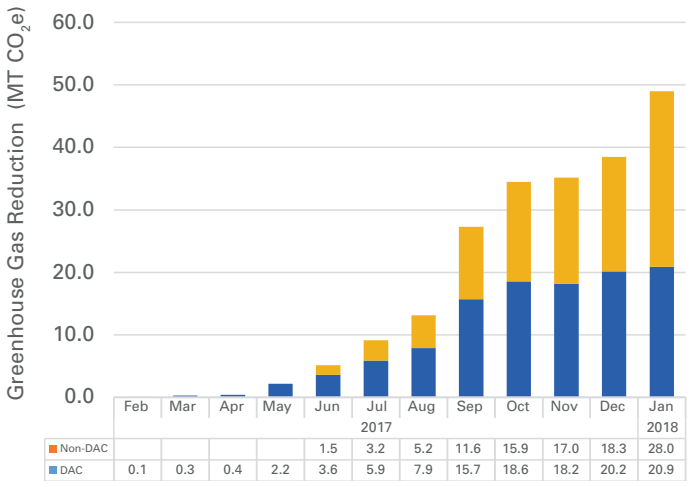
2.7.4 Avoided Greenhouse Gases

A total of 214.7 metric tons (MT) of carbon dioxide equivalent (CO_2e) was reduced from the charging stations installed from February 2017 through January 2018. For comparison, reducing 214.7 MT CO_2e emissions equates to planting over 5,500 coniferous trees in an urban setting and allowing them to grow for 10 years.[29]

These GHG emissions reductions are direct emissions reductions based on displacing conventional gasoline-powered vehicles with electric vehicles. SCE used participating customer meter data to calculate displacement of gasoline-powered vehicle miles. Actual GHG emission reductions are likely even greater than those presented in this report due to indirect benefits of the Charge Ready Pilot program. For example, the increased presence of charging stations enhances public awareness of EV technology; it also decreases range anxiety in both current EV drivers and potential EV drivers, which can encourage EV adoption and increase electric vehicle miles driven.

Figure 2.16 presents a summary of the estimated GHG emissions avoided per month attributed to the Charge Ready Pilot charging stations (based on electricity throughput) for both DAC and non-DAC sites.

Figure 2.20 Greenhouse Gas Emissions Reductions from the Pilot



Methodology: For the purposes of calculating avoided GHG emissions, SCE used the California Air Resources Board's (CARB's) Low Carbon Fuel Standard regulation guidance. SCE calculated metric tons (MT) of carbon dioxide equivalent (CO_2e) using the following equation:

$$MT\ CO_2e = (CI_{gasoline} - CI_{electricity}/EER) \times Energy\ Density \times EER \times kWh \times 10^{-6}$$

Carbon intensity (CI) is the measure of GHG emissions associated with producing and consuming a fuel throughout its lifecycle, which is measured in grams of CO_2e per megajoule (MJ). The CI of gasoline is 99.78 g CO_2e/MJ.[30] The CI of SCE electricity delivered in 2016 is 66.65 g CO_2e/MJ.[31]

The Energy Economy Ratio (EER) is a dimensionless value that represents the efficiency of a fuel as used in a powertrain as compared to a reference fuel. EERs are often a comparison of miles per gasoline gallon equivalent (mpge) between two fuels. EER for light- and medium-duty EVs is 3.4.[32]

The Energy Density of electricity is 3.6 MJ/kWh.[33] SCE collected meter data to determine the amount of electricity used each month of the Pilot program, starting in February 2017 and continuing through January 2018.

2.8 Disadvantaged Communities

SCE focused its efforts on DACs, which are disproportionately affected by low EV adoption and the negative environmental impacts of gasoline- and diesel-powered vehicles. SCE managed the Pilot to ensure a minimum of 10% of all charge port installations were accorded in DACs.

As a general rule, to participate in SCE's program, each site had to support a minimum of ten charge ports. However, in DACs, SCE reduced the minimum number of ports required to five, with a 100% rebate toward the charging station base cost.

The Pilot was a success in DACs. Of the 1,066 charge ports with reserved funding to date, 50% (535 charge ports) are located in

29 USEPA. Greenhouse Gases Equivalencies Calculator - Calculations and References. Available at: https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references. Accessed: November 2017

30 Based on CARB's Low Carbon Fuel Standard, Table 6: Carbon Intensity Lookup Table for Gasoline and Fuels that Substitute for Gasoline. CARBOB - based on the average crude oil supplied to California refineries and average California refinery efficiencies. Available at: https://www.arb.ca.gov/regact/2015/lcfs2015/lcfsfinalregorder.pdf. Accessed: February, 2018.

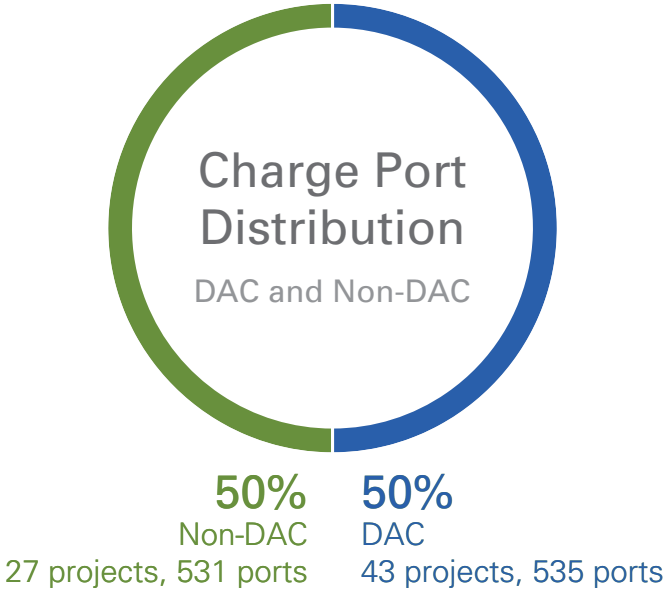
31 Based on SCE's CO2e emissions from delivered electricity in 2016. Available at: https://www.edison.com/content/dam/eix/documents/investors/corporate_responsibility/2016-eix-corporate-responsibility-and-sustainability-report.pdf. Accessed: November, 2017.

32 Based on information available in ARB's Low Carbon Fuel Standard. Available at: https://www.arb.ca.gov/regact/2015/lcfs2015/lcfsfinalregorder.pdf. Accessed: February, 2018.

33 Based on information available in ARB's Low Carbon Fuel Standard. Available at: https://www.arb.ca.gov/regact/2015/lcfs2015/lcfsfinalregorder.pdf. Accessed: February, 2018.

DACs, which greatly exceeds the Pilot's requirement to deploy 10% of charge ports in DACs.

Figure 2.21 Charge Ports in DACs and Non-DACs



During the Pilot, SCE conducted six outreach events in DACs to support program enrollment. SCE employees who attended the events provided an estimated 1,900 customer interactions. A full list of the outreach events can be found in **Appendix D**.

2.9 Customer Satisfaction

Charge Ready invited its participants to complete customer satisfaction surveys to determine how the program met expectations. SCE used third-party online software to deploy these surveys. SCE sent invitations to each customer, with unique links so they could be identified in the analysis. The survey invitation was sent to customer participants approximately 10 to 12 weeks after their charging stations were installed and verified by SCE to allow customers ample time to use the charging stations.

Areas of questioning included overall satisfaction levels with the Charge Ready program (1 – very dissatisfied to 10 – very satisfied) and satisfaction levels for the different areas of the program. By the end of January 2018, SCE sent survey invitations to 25 participants representing 34 sites. SCE received responses from 20 customers. The program received an average satisfaction score of 9.25

Based on feedback from these completed projects, customers are highly satisfied with the overall program and application process. The lowest average score of 8.30 was rated for charging station pricing from SCE-approved vendors.

In addition, SCE hosted a vendor conference for charging station vendors participating in the Pilot on February 26, 2018. The session was attended by 12 vendors. The following day, SCE hosted customer session for Pilot customers and was attended by 20 customers. The objective of both sessions was to learn about the vendors' and customers' experience in the Pilot and gather feedback for future programs. The following table summarizes the feedback received from both sessions. Feedback will be used to improve requirements and processes of future programs.

Table 2.11 Summary of Feedback Received from Pilot Approved Vendors and Customer Participants

Area of Focus	Vendor Feedback	Customer Feedback
Program Design	• Marketing was done very well • Customers liked SCE covering make-ready infrastructure costs • Easement process was long, recommends moving it up in the process • Heard concerns about customers not being able to add more ports in the future (infrastructure not sized up)	• Marketing was done very well • Easement process was long, recommends moving it up in the process • Concerns about long-term commitment and stations becoming obsolete • Minimum port count was a challenge at some sites • Would be easier if SCE offered package of make-ready infrastructure options including charging stations
Base Cost and Rebate	• Some customers confused the base cost with the rebate amount • Would prefer set rebate levels vs base cost calculation • Feels that utility is "getting in their business" by requiring pricing information	• Had full understanding of what base cost and rebate mean • 100% rebate for Disadvantaged Communities is great.
Charging Station and RFI	• There is interest in Level 3 stations • Recommends not re-testing stations once primary vendor is approved	• There is interest in Level 3 stations
Site Design and Construction	• Pre-construction meeting is great • Some stub-outs did not match charging station templates	• Pre-construction meeting is great • Appreciates SCE's attention to detail and customer service
General	• Time it took from application to completion is long • Recommends using API for monthly data pulls versus Excel-based submissions	• Overwhelming positive feedback for all SCE employees and general contractor interaction • Application process and enrollment portal was easy • Time to complete was long but customers do not see SCE as the reason for any delays

2.10 Charge Ready Education and Outreach

2.10.1 Overview

Charge Ready education and outreach efforts were designed to promote the Pilot to SCE customers. SCE also tested marketing channels in preparation for a subsequent phase of Charge Ready, including email, website, social media, collateral, and account manager interaction. SCE developed content to communicate to potential customer participants about the Pilot, and highlighted key areas such as eligible rates, bill impact analyses, metering options, EV infrastructure, access to subject matter expert resources, and EVSE information. SCE also developed marketing materials to provide relevant program information and help customers through the application process. The Charge Ready program landing page[34] is the main resource for customers to learn about the Pilot and submit their applications. A full list of the Charge Ready marketing materials, along with their descriptions, can be found in **Appendix E**.

34 https://on.sce.com/chargeready

2.10.2 Outreach Events

SCE conducted 38 outreach events during the Pilot to support program enrollment. SCE employees who attended the events provided an estimated 6,281 customer interactions. A full list of the outreach events can be found in **Appendix D**.

2.10.3 Multi-Unit Dwelling Outreach

In Q3 2016, SCE focused some of its Charge Ready marketing efforts toward the MUD market segment. To increase MUD customer enrollment in Charge Ready, SCE developed a customer outreach and engagement plan, including:

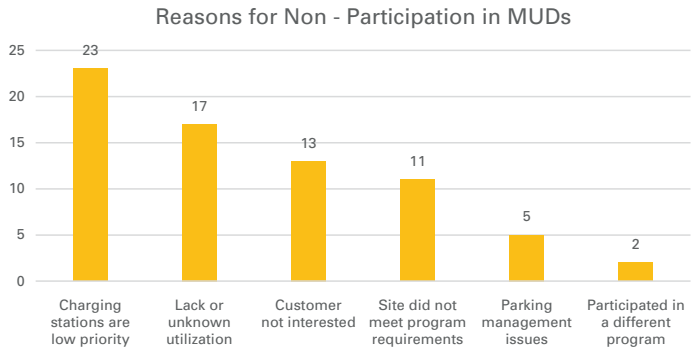
- Direct Engagement: SCE Account Managers individually reached out to a list of MUD customers that had been screened as potential Charge Ready participants. During the Pilot, there were 147 Account Manager interactions with MUD customers.
- Targeted Marketing Collateral: SCE developed a MUD Customer Fact Sheet articulating the value proposition for MUDs to deploy EV charging, in general, and through Charge Ready, in particular.
- MUD Customer Outreach Events: SCE conducted an in-person meeting at SCE's Energy Education Center on August 30, 2016. SCE presented a program overview and organized a meet-and-greet with the program's charging station vendors. Participating MUD customers also learned about complementary financing opportunities from representatives from CARB and the California State Treasurer's office (CPCFA/CalCAP).

SCE also started weekly MUD Virtual Workshops in Q4 2016 to educate MUDs about the Charge Ready program and other available complementary EV programs. During the meetings, SCE shared the MUD fact sheet and other targeted marketing materials developed during Q3 2016.

SCE learned about the MUD customer segment through its marketing and outreach approach. Low customer attendance at the first two MUD Virtual Workshops changed the outreach strategy from a mass message approach to a targeted, direct engagement approach. SCE intended to reach large numbers of MUD customers through the virtual workshops, but later found direct engagement to be more effective in educating customers about the program.

SCE discontinued the weekly MUD Virtual Workshops and, instead, focused efforts on direct engagement with customers. SCE's direct interactions (phone, email, and in-person meetings) with MUD customers revealed customers interested in charging stations and also uncovered reasons why some MUD customers were not interested in the program. For the customers interested in the program, SCE focused resources to support these customers during in the enrollment process. For customers not interested in the program, SCE gathered customer feedback to inform a future Phase 2 MUD outreach strategy. The following chart summarizes the feedback from 71 MUD customers who indicated their reasons for not participating in the program.

Figure 2.22 Reasons for MUDs Declining to Participate in Charge Ready



2.10.4 Successes

Charge Ready Pilot marketing created overwhelming customer and vendor interest, exceeding all expectations. SCE communicated the details of a complex, months-long project in a simple, easy-to-follow manner. The effectiveness of the multi-media marketing was proven two weeks after launch; the program had already received 183 applications. Due to significant interest in the program, SCE stopped accepting new applications seven months after launch. 334 customers had submitted applications to have 2,043 EV charging stations installed on their property when SCE stopped accepting new applications. SCE expects to add approximately 175 additional ports with the recently released funds previously reserved for completed sites.

2.10.5 Charge Ready Education and Outreach Lessons Learned and Potential Improvements

During the Pilot, SCE learned that there is no "one-size-fits-all" marketing campaign or outreach that works for all segments of the Charge Ready program. Especially with MUDs, SCE learned that much more education is required for both residents and MUD owners. SCE will take a more holistic approach in educating these customers, combining messages on safety, EVs, charging, and EVSE education.

2.11 Pilot Costs

Through the execution of the Charge Ready pilot SCE discovered several ways to manage the cost of delivering electric vehicle charging infrastructure to the customer such as:

- Executing concurrent steps to reduce overall timeline and example is obtaining SCE and GC permits in parallel
- Scheduling site inspections strategically to reduce drive time and onsite presence to reduce design costs and inspector hours that are billed to the program
- New messaging was developed to improve efforts to educate the customers and suggest installations in parking areas that have the greatest chance of qualifying on the original site visit resulting in the reduction of follow-up site visits and associated costs
- Establishing cost thresholds[35] for various segments to manage program costs and to fulfill demographic goals of 10% of infrastructure installed in DACs
  - DAC charge ports are by nature more expensive due to the 5 port minimum – forcing fixed costs to be shared amongst a smaller number of ports – initially $30,000 was allocated per port for this segment
  - Non-DAC (and DAC after 10% achieved) threshold allocated remaining capital to Non-DAC ports – threshold was set at approximately $15,000 per port

The CPUC approved SCE's proposal to establish a Charge Ready Program balancing account to recover the revenue requirements associated with up to $22 million in direct capital and O&M costs to implement Phase 1 of the Charge Ready and Market Education Programs.[36] The following table summarizes the Pilot's spend at the time of this report.

Table 2.12 Pilot Costs

Variables	Authorized/Planning Assumptions[37]	2/28/18 Inception-to-date[38]	Remaining[39]	Percentage Remaining
Capital				
Utility-Side Infrastructure Costs	$3,353,532	$1,225,388	$2,128,144	63%
Customer-Side Infrastructure Costs	$7,586,387	$8,352,551	($766,164)	-10%
Easement	$115,942	$120,425	($4,483)	-4%
Station Testing	$30,000	$60,393	($30,393)	-101%
BCD Labor	$103,500	$108,776	($5,276)	-5%
PMO Labor	$460,003	$686,212	($226,209)	-49%
Total Capital	**$11,649,364**	**$10,553,746**	**$1,095,618**	**9%**
Operations & Maintenance				
Rebate	$5,850,000	$480,931	$5,369,070	92%
BCD Labor	$51,750	$57,099	($5,349)	-10%
Transportation Electrification Advisory Services	$316,800	$265,019	$51,781	16%

35 Using estimated costs.
36 D.16-01-023, p. 59.
37 In 2014 dollars.
38 In nominal dollars.
39 In comparison to Authorized/Planning Assumptions.

Variables	Authorized/Planning Assumptions[37]	2/28/18 Inception-to-date[38]	Remaining[39]	Percentage Remaining
PMO Labor & Non-Labor	$232,340	$222,496	$9,844	4%
Charge Ready ME&O, Market Reporting, SAP	$665,000	$492,919	$172,081	26%
EV Awareness	$2,830,600	$1,701,757	$1,128,843	40%
Other O&M[40]		$832,410	($832,410)	0%
Total Operations & Maintenance	**$9,946,490**	**$4,052,631**	**$5,893,859**	**59%**
Total Program	**$21,595,854**	**$ 14,606,378**	**$6,989,476**	**32%**

2.11.1 Data Analysis and Insights

SCE's estimated budget for infrastructure (utility- and customer-side) and rebates was $16.8 million to deploy up to 1,500 charge ports. Customer-side infrastructure deployment costs were higher than estimated in SCE's testimony. The Pilot average cost per port is $13,731. The table below shows the cost breakdown.

Table 2.13 Average Cost per Port

Cost per Port	Filing	Estimated Average Cost per Port[41]
Utility-Side Infrastructure	$2,237	$2,129
Customer-Side Infrastructure	$5,058	$10,397
Rebate	$3,900	$1,206
Total	**$11,195**	**$13,731**

2.11.2 Pilot Costs – Lessons Learned and Recommendations

The average cost[42] per port in the Pilot is $13,731 (2014$) at an average of 14 ports per site based on the 1,066 charge ports in progress. Most applicants requested the program minimum of 10 ports (or five ports if located in DACs). Sites with the minimum number of ports are significantly more costly to deploy, especially if they require new transformers to serve the incremental EV load. SCE's testimony forecast average cost per port to be $11,195, assuming an average of 26 ports per site. The Pilot actual average recorded costs per port were higher than forecast because SCE deployed an average of 14 ports per site. When comparing deployments with approximately 26 ports per site, the average costs per port aligned with SCE's forecast for deployments of that size. It is important to note, however, that the average rebate paid is lower than SCE's forecast (because SCE originally proposed to provide all participating customers with a rebate for 100% of base cost) and customer-side infrastructure is higher than filing assumptions.

Other infrastructure cost drivers include:

- Sites that were primary metered were not approved in the program. SCE found it too costly to bring power to proposed charging station location in these sites. This would require creating a parallel line extension from upstream SCE facilities to feed the proposed charging site.
- AHJ constraints – the costs associated with municipality fee requirements or other jurisdictional constraints varied by jurisdiction, and influenced site viability. Permitting can be variable if the AHJ charges based on site value rather than fixed-plan-review pricing.
- The cost assumptions in SCE's testimony did not account for the updated state accessibility statues, which have necessitated more construction work at some customer sites to ensure compliance with the new requirements.
- Site assessment and design are generally fixed costs regardless of size, making sites with fewer charge ports more expensive per port, all other factors equal.
- K-12 school sites requiring Division of the State Architect

40 Includes other O&M (e.g. site assessments, design, permits, and easements on withdrawn projects).
41 Based on recorded costs of projects completed and estimated costs of projects in progress or not yet invoiced.
42 Includes infrastructure costs and rebate.

(DSA) inspection incur an additional $5,000 to $6,000 per site in inspection fees.

- Underground parking garages presented challenges, such as non-level grades, space constraints, and height restrictions, to serve power primarily due to AHJ requirements that required significant civil work to bring sites into compliance.
- Non-fleet sites require ADA improvements, which can add significant costs depending on the existing site conditions.
- Parking structures and sites that may accommodate surface-mounted conduits represent significant savings since there is minimal site restoration work following installation.
    - However, older parking structures present difficulties with current ADA code and may be too costly.
- Trenching and pavement work in public Right of Way (ROW) is significantly more expensive than installation on private property or parking areas out of ROW.
- Site conditions and construction complexity – in some cases, SCE found site conditions added significant costs. Examples included:
    - Older buildings with parking lots that would require large investment to conform to AHJ requirements, such as ADA and state accessibility statutes.
    - Poor customer parking lot conditions required restoring the entire parking lot.
    - Proximity – longer distances from charging station sites to existing transformers increased trenching and boring costs.

2.12 Pilot Summary

Charge Ready Phase 1 successfully met its objectives. SCE deployed infrastructure to support 941 charge ports to date, half of this total in DACs, and expects to deploy infrastructure to support approximately 1,250 charge ports by the Pilot's completion. SCE also developed and improved processes to qualify a wide range of charging stations and vendors. The Pilot produced real-life data on the time and costs to deploy EV charging infrastructure.

The Pilot proved customers are interested in utility-owned EV charging infrastructure, and confirmed their satisfaction with the program.

The Market Education program revealed that enhanced public EV education is necessary to help customers understand program benefits. SCE also discovered that business customers need additional assistance from their trusted energy advisors.

SCE plans to file an application for Phase 2 approval. In that phase, SCE will propose changes based on lessons learned during Phase 1.

3 Market Education

3.1 Overview

Separately from its education and outreach efforts to support enrollment in the Charge Ready Pilot, SCE also communicated about EVs and the benefits of fueling from the grid to a broad audience, through a variety of complementary channels. These channels include:

- Paid Media: Digital banners, video ads, Search Engine Marketing (SEM), paid social media, radio (local booth sponsorship at EV-related events).
- Direct Messaging: Direct mail or email to targeted customer populations.
- Other channels: bill onserts, messaging on SCE.com, and organic social media.

Customers exposed to these channels are directed to relevant information on the updated SCE.com EV website, which includes content in English, Spanish, Korean, Chinese, and Vietnamese. SCE tracked customer site interactions to improve and optimize the experience. While the digital ads and radio sponsorships concluded at the end of Q2 2017, SCE continued marketing activities including paid social media to support market education efforts, as well as sponsorship and participation in several National Drive Electric Week events. As a result of these efforts, SCE observed increased web traffic.

The following table includes metrics capturing traffic for key campaign pages within the site.

Table 3.1 Electric Vehicle Awareness Website Metrics

EV Awareness	Q4 2017
Electric Vehicle Overview Page on SCE.com[43]	
Unique Visitor Count	7,986
Repeat Visitor Count	2,851
Page Views	11,526
Bounce Rate[44]	41.46%
Multi-page Visits	6,674
Electric Vehicle Campaign Landing Page on SCE.com[45]	
Unique Visitor Count	8,518
Repeat Visitor Count	743
Page Views	10,944
Bounce Rate	87.08%
Multi-page Visits	1,277

Additionally, through a 12-month digital and radio campaign launched in July 2016, SCE delivered more than 65 million digital and 6,000 radio spots, and observed monthly increases in website page views. Customer engagement in online ads was in line with industry benchmarks, with video ads performing above benchmarks for completion rates. The following table provides metrics around the digital campaign, from July 2016 – June 2017.

Table 3.2 Digital Campaign Metrics

Channel	Impressions	Clicks	CTR[46]	VCR[47]
Display Ads	23,187,350	10,436	0.04%	
Mobile Ads	30,646,251	63,080	0.10%	
Video Ads	9,955,511	6,975	0.10%	80.79%
SEM	1,448,875	9,963	0.71%	

43 https://www.sce.com/wps/portal/home/residential/electric-cars/ This page provides an overview of the EV-related content for residential customers on the website, and includes links to Pilots (Submeter, Charge Ready) and EV content for businesses. Customers can navigate to this site without a vanity URL.
44 Bounce rate is the percentage of single page visits.
45 https://www.sce.com/wps/portal/home/residential/electric-cars/EV-Assessment-Campaign-Page/ This page was visible only by clicking through on digital and social media ads, or by using a vanity URL provided in radio ads.
46 Click-through rate. The utility benchmark for CTR is 0.13%.
47 Video completion rate. The utility benchmark for VCR is 57.3%.

For SCE's Market Education efforts, customer awareness of EV benefits and messaging were tracked using SCE's Customer Attitude Tracking (CAT) survey, a quarterly phone survey designed to assess and track customer attitudes toward relevant marketing issues and marketing campaigns. This survey was conducted by an independent marketing research firm, contacting 450 randomly-selected SCE households. SCE collected baseline data in Q2 2016. For EV awareness, customers were asked to recall messaging about the benefits of EVs and preparing to buy or lease an EV, as well as SCE's role in supporting and advancing electric transportation. Quarterly measures of awareness were compared to the baseline to determine lift,[48] as well as the impact of the media mix on awareness levels. The following table summarizes the CAT Survey's quarterly data. Respondents were asked, "In the past three months, do you recall seeing, hearing, or reading any ads about SCE and the benefits of electric vehicles?" The results continued to show levels of EV awareness close to the baseline.

Table 3.3 Customer Attitude Tracking Survey Metrics

Response	Baseline	Q4 2016	Q1 2017	Q2 2017	Q3 2017	Q4 2017
Total Respondents	1,354	450	450	450	600	600
Yes	189 14%	58 13%	57 13%	54 12%	92 15%	92 15%
No	1,147 85%	383 85%	384 85%	378 84%	489 82%	476 79%
No Response	18 1%	9 2%	8 2%	18 4%	19 3%	32 5%

3.2 TE Advisory Services

SCE created TE Advisory Services (TEAS) to provide business customers with a dedicated "one-stop shop" for specialized education, awareness, and support on such issues as federal, state, and local incentives, vehicle and charging equipment financing opportunities, vehicle types, and charging installation programs.

TE Advisory Services includes:

Updated web content on SCE.com business section, which includes information on:

- Vehicle types
- Charging Infrastructure
- SCE's EV Rates
- Information specific to MUDs, Fleets, Workplaces, and Public sites
- Links to additional tools, resources and fact sheets
- Calls to action to reach out to SCE for more information and support (Account Manager or 800#)

Self-service online tools to assist customers:

- The Charge Port Estimator, which estimates the number of charge ports customers may need at their sites
- A Rate Analysis Tool, based on customers' numbers of estimated charge ports and segment types
- A customer self-administered EV survey for workplaces and MUDs

Fact Sheets: Customer-facing PDFs covering the following TE topics, including links to additional resources:

- Transportation Electrification Overview
- Fleet Conversion
- MUDs
- Vehicle to Grid Integration
- Planning for Charging Infrastructure
- Understanding GHG Emissions from Transportation
- Overview of Fleet Segments and available EV alternatives

48 Improvement in response.

In addition to the above, TE Advisory Services launched an in-person services study for approximately 25 business customers in Q1 2018 with the following services:

- An initial fleet assessment (including GHG savings calculations) to help customers evaluate business cases for converting fleets of vehicles to TE technology
- Infrastructure Assessments to assist customers in evaluating a potential deployment of charging equipment

SCE is tracking web traffic and has established the following baselines presented in the table below to compare against as more outreach is conducted.

Table 3.4 TEAS web traffic

Q4 2017: Baseline

Metric	Workplace	Public	Fleet	MUD
Unique Visitor Count	292	121	138	69
Page Views	507	188	281	162
Multi-Page	346	143	165	111

3.3 Market Education Lessons Learned and Recommendations

The EV Market Education and Outreach effort was designed to raise awareness and provide education on the benefits of EVs and fueling from the grid. The campaign was not developed as an enrollment campaign.

The EV awareness campaign cost $1.5 million, and was in the market for 12 months.

This limited spending and time in the market was not enough to build momentum for large gains in awareness. SCE maintained awareness levels at or around 14%; however, to increase awareness, a larger media spend level should be implemented over a longer duration.

Future media campaigns would also benefit from additional channels to enable a broader reach, such as out-of-home (billboards), television, or print.

4 Demand Response Pilot

4.1 Demand Response Pilot Overview

SCE required all customer participants with Level 2 charging stations to participate in future DR programs designed in connection with the Program and approved by the Commission.[49] SCE also required all Level 2 charging stations to be DR-capable (i.e., capable of receiving and executing real-time instructions to throttle, and/or modify the end-user pricing of EV charging load) and encouraged those charging stations to include additional load management features (e.g., EV charging sequencing or sharing). All Level 2 charging stations qualified for the Pilot have DR communication capabilities built directly into the charging station (Type A) or communication through a gateway device to the charging station (Type B). The different types of charging stations installed as part of the Pilot have gone through rigorous testing by SCE's ATO, and the communication capabilities will be tested further during the Charge Ready DR Pilot that will launch in Q2 2018.

To participate in the Charge Ready Pilot, customers must, at their own expense, procure, own, install, operate, and maintain the charging stations in working order at their originally-installed locations for the entire 10-year term of participation, in accordance with Schedule CRPP. Based on charging station procurement documents submitted by customers during the Step 3 process, some customers chose to pay for maintenance packages and extended warranty coverage from the EVSE suppliers.

With the rapid increase of renewable energy sources in California, an imbalance of load-to-energy is emerging. To mitigate the impacts of this "duck curve,"[50] SCE's Charge Ready DR Pilot events will attempt to shift load to periods of high solar generation during spring and winter months, and decrease load during steep ramping periods that occur in late afternoons and evenings during summer months. In addition, SCE has proposed new time-of-use (TOU) rates that better align with the needs of the electric grid, with on-peak time periods beginning in the evening hours when solar generation is decreasing and typical net customer electricity use is highest. These new TOU rates also shift off-peak time periods to morning and afternoon hours when solar generation is maximized. Although the DR Charge Ready Pilot will begin before these new TOU rates are in place, the program was designed in consideration of these potential new rates in an effort to limit the need for future major program modifications.

4.2 Pricing Model Overview

All Level 2 Charge Ready customers will participate in a DR Pilot beginning in the spring of 2018. Customers will be incented based on participating in two different types of test events:

1. Load Shift events, in which customers receive a discounted rate for charging during a time of high solar generation and potential negative prices by shifting charging from early morning to midday.
2. Traditional DR events, in which customers receive incentives for consuming less electricity during peak times, or during periods of steep ramping of electricity demand.

The Charge Ready DR Pilot plans to test both incentives and controls to influence charging behavior of EV drivers. A more detailed description can be found in SCE's Charge Ready DR Advice letter.[51]

49 Schedule CRPP.
50 https://www.caiso.com/Documents/FlexibleResourcesHelpRenewables_FastFacts.pdf
51 Advice Letter 3773-E, "Southern California Edison Company's Charge Ready Demand Response Pilot Plan, Pursuant to Decisions 16-01-023 and 17-12-003".

5 Appendices

Appendix A. Pilot Customer Participants

Table 5.1 Summary by Market Segment in Disadvantaged Communities

Disadvantaged Communities

Segment	# of Ports	# of Applications
Destination Center	80	12
Fleet	28	4
Multi-Unit Dwelling	12	1
Workplace	415	26
Grand Total	**535**	**43**

Table 5.2 Summary by Market Segment in Non-Disadvantaged Communities

Non-Disadvantaged Communities

Segment	# of Ports	# of Applications
Destination Center	166	10
Fleet	79	4
Multi-Unit Dwelling	23	2
Workplace	263	11
Grand Total	**531**	**27**

Table 5.3 Summary by City of Installation in Disadvantaged Communities

Disadvantaged Communities

City of Installation	# of Ports	# of Applications
Barstow	6	1
Carson	13	2
Chino	7	1
El Monte	39	4
Fontana	21	3
Hanford	16	2
Hawthorne	80	1
Irwindale	30	2
Loma Linda	5	1
Los Angeles	10	1
Lynwood	14	2
Maywood	9	1
Montclair	6	1
Norwalk	12	1
Ontario	35	6
Orange	20	1
Porterville	6	1
Rancho Cucamonga	18	1
Rosemead	67	2
S El Monte	10	1
Santa Ana	16	1
Santa Fe Spgs	12	1
South Gate	20	2
Torrance	24	1
Visalia	6	1
West Covina	9	1
Whittier	24	1
Grand Total	**535**	**43**

Table 5.4 Summary by City of Installation in Non-Disadvantaged Communities

Non-Disadvantaged Communities

City of Installation	# of Ports	# of Applications
Alhambra	14	1
Aliso Viejo	10	1
Camarillo	19	1
Fountain Vly	73	1
Fullerton	33	2
Hermosa Beach	10	1
Inglewood	32	1
Irvine	68	2
Lancaster	12	1
Long Beach	51	3
Malibu	24	1
Monrovia	13	1
Ontario	22	2
Orange	20	1
Palm Desert	38	2
Palmdale	12	1
Rllng Hls Est	10	1
Santa Barbara	10	1
Santa Monica	44	2
Thousand Oaks	16	1
Grand Total	**531**	**27**

Table 5.5 Summary by Zip code in Disadvantaged Communities

Disadvantaged Communities

Zip Code of Installation	# of Ports	# of Applications
90022	10	1
90250	80	1
90262	14	2
90270	9	1
90280	20	2
90502	24	1
90601	24	1
90650	12	1
90670	12	1
90745	8	1
90746	5	1
91706	30	2
91710	7	1
91730	18	1
91731	25	2
91732	14	2
91733	10	1
91761	13	2
91762	6	1
91763	6	1
91764	16	3
91770	67	2
91790	9	1
92311	6	1
92335	14	2
92337	7	1
92354	5	1
92707	16	1
92868	20	1
93230	16	2
93257	6	1
93292	6	1
Grand Total	**535**	**43**

Table 5.6 Summary by Zip code in Non-Disadvantaged Communities

Non-Disadvantaged Communities

Zip Code of Installation	# of Ports	# of Applications
90254	10	1
90265	24	1
90274	10	1
90303	32	1
90401	31	1
90405	13	1
90802	27	2
90822	24	1
91016	13	1
91320	16	1
91764	22	2
91803	14	1
92260	38	2
92606	18	1
92656	10	1
92697	50	1
92708	73	1
92831	23	1
92832	10	1
92868	20	1
93012	19	1
93108	10	1
93534	12	1
93550	12	1
Grand Total	**531**	**27**

Table 5.7 Multi-Unit Dwelling Summary by City of Installation

Multi-Unit Dwelling

City of Installation	Number of Charge Ready Ports	Number of Charge Ready Applications	Disadvantaged Community	Property Type
Rolling Hills Estates	10	1	No	Condominiums
Santa Fe Springs	12	1	Yes	Town homes
Santa Monica	13	1	No	Apartments
Total	**35**	**3**		

Appendix B. Pilot Operational Metrics

Table 5.8 Pilot Cycle Times[52]

Pilot Cycle Times	
Average customer "end-to-end" cycle time, by segment	337[53]
Minimum customer "end-to-end" cycle time, by segment	211[54]
Maximum customer "end-to-end" cycle time, by segment	432[55]
Average time for Application Received to Initial Qualification	37
Average time for Initial Qualification to Site Assessment Completion	43
Average time for Site Assessment Completion to Program Agreement Complete	72
Average time to complete base map	9
Average time to complete preliminary design	35
Average time from Preliminary Design Sent to customer to Preliminary Design Approved	11
Average time to complete T&D final design	17
Average time for Final Design Received to Permit Requested	9
Average time for Permit Requested to Permit Approved	36
Average time for Permit Approved to Ready to Break Ground	27
Average time from Ready to Break Ground to Final Inspection Completed	66
Average time from Final Inspection Completed to Rebate Check Issued	45

52 Business Days.
53 Based on 35 projects with rebate paid.
54 Based on 35 projects with rebate paid.
55 Based on 35 projects with rebate paid.

Table 5.9 Pilot Applications

	Planning Assumptions	Inception-to-Date Actual	Percentage to Planning Assumptions
Total number of applications received	58 projects, 1,500 charge ports	334 projects, 2,043 charge ports	576%, 136%
Percentage of total applications received for Disadvantaged Communities	N/A	47%	N/A
Percentage of applications received for Destination Centers	N/A	24%	N/A
Percentage of applications received for Workplaces	N/A	65%	N/A
Percentage of applications received for Fleet	N/A	5%	N/A
Percentage of applications received for MUDs	N/A	6%	N/A
Percentage of charging stations requested for Disadvantaged Communities	10%	38%	377%
Percentage of charging stations requested for Destination Centers	N/A	27%	N/A
Percentage of charging stations requested for Workplaces	N/A	59%	N/A
Percentage of charging stations requested for Fleet	N/A	8%	N/A
Percentage of charging stations requested for MUDs	N/A	6%	N/A
Number of approved and confirmed projects (Step 2 Agreement signed)	58 projects, 1,500 charge ports	70 projects, 1,066 charge ports	121%, 71%
Number of approved and confirmed projects for Disadvantaged Communities (Step 2 Agreement signed)	N/A	43 projects, 535 charge ports	N/A
Number of approved and confirmed projects for Destination Centers (Step 2 Agreement signed)	N/A	22 projects, 246 charge ports	N/A
Number of approved and confirmed projects for Workplaces (Step 2 Agreement signed)	N/A	37 projects, 678 charge ports	N/A
Number of approved and confirmed projects for Fleet (Step 2 Agreement signed)	N/A	8 projects, 107 charge ports	N/A
Number of approved and confirmed projects for MUDs (Step 2 Agreement signed)	N/A	3 projects, 35 charge ports	N/A
Number of applicants rejected	N/A	94 projects, 392 requested charge ports	N/A
Percentage of applicants rejected for Disadvantaged Communities	N/A	40%	N/A
Percentage of applicants rejected for Destination Centers	N/A	23%	N/A
Percentage of applicants rejected for Workplaces	N/A	69%	N/A

	Planning Assumptions	Inception-to-Date Actual	Percentage to Planning Assumptions
Percentage of applicants rejected for Fleets	N/A	0%	N/A
Percentage of applicants rejected for MUDs	N/A	7%	N/A
Number of applicants withdrawn	N/A	143 projects, 630 charge ports	N/A
Percentage of applicants withdrawn for Disadvantaged Communities	N/A	46%	N/A
Percentage of applicants withdrawn for Destination Centers	N/A	19%	N/A
Percentage of applicants withdrawn for Workplaces	N/A	69%	N/A
Percentage of applicants withdrawn for Fleets	N/A	6%	N/A
Percentage of applicants withdrawn for MUDs	N/A	7%	N/A
Number of applicants withdrawn after signing Step 2 - Agreement	N/A	11	N/A
Number of applicants withdrawn after signing Step 2 – Agreement for Disadvantaged Communities	N/A	5	N/A
Number of applicants withdrawn after signing Step 2 – Agreement for Destination Centers	N/A	4	N/A
Number of applicants withdrawn after signing Step 2 – Agreement for Workplaces	N/A	7	N/A
Number of applicants withdrawn after signing Step 2 – Agreement for Fleets	N/A	0	N/A
Number of applicants withdrawn after signing Step 2 – Agreement for MUDs	N/A	0	N/A
Total number of charge ports installed	N/A	578	N/A
Total number of charge ports installed for Disadvantaged Communities	N/A	247	N/A
Total number of charge ports installed for Destination Centers	N/A	191	N/A
Total number of charge ports installed for Workplaces	N/A	320	N/A
Total number of charge ports installed for Fleets	N/A	32	N/A
Total number of charge ports installed for MUDs	N/A	35	N/A
Average number of charge ports installed per site	N/A	14	N/A
Average number of charge ports installed per site for Disadvantaged Communities	N/A	10	N/A

	Planning Assumptions	Inception-to-Date Actual	Percentage to Planning Assumptions
Average number of charge ports installed per site for Destination Centers	N/A	11	N/A
Average number of charge ports installed per site for Workplaces	N/A	20	N/A
Average number of charge ports installed per site for Fleets	N/A	8	N/A
Average number of charge ports installed per site for MUDs	N/A	12	N/A
Total number of completed projects	58 projects, 1,500 charge ports	41 projects, 578 charge ports	N/A
Percentage of completed projects for Disadvantaged Communities	N/A	61%	N/A
Percentage of completed projects for Destination Centers	N/A	44%	N/A
Percentage of completed projects for Workplaces	N/A	39%	N/A
Percentage of completed projects for Fleets	N/A	10%	N/A
Percentage of completed projects for MUDs	N/A	7%	N/A

Table 5.10 Customer Participant Request

	Planning Assumptions	Inception-to-Date Actual
Average number of total parking spaces per site	N/A	621 parking spaces/site
Average number of total parking spaces per site for Disadvantaged Communities	N/A	377 parking spaces/site
Average number of total parking spaces per site for Destination Centers	N/A	931 parking spaces/site
Average number of total parking spaces per site for Workplaces	N/A	523 parking spaces/site
Average number of total parking spaces per site for Fleets	N/A	404 parking spaces/site
Average number of total parking spaces per site for MUDs	N/A	636 parking spaces/site
Percentage of total number of parking spaces located in parking structures	N/A	12%
Total number of parking spaces located in parking structures for Disadvantaged Communities	N/A	1,660
Total number of parking spaces located in parking structures for Destination Centers	N/A	7,560
Total number of parking spaces located in parking structures for Workplaces	N/A	23,332
Total number of parking spaces located in parking structures for Fleets	N/A	1,882

	Planning Assumptions	Inception-to-Date Actual
Total number of parking spaces located in parking structures for MUDs	N/A	2,978
Average fleet size[56]	N/A	6 (Fleet Segment Only) 4 (All Segments)
Percentage of applications received with charging systems already installed at the site	N/A	15%
Average number of charging systems already installed at the site	N/A	10
Average number of charge ports requested per site	26	7.6
Average number of charge ports requested per site for Disadvantaged Communities	N/A	8.3
Average number of charge ports requested per site for Destination Centers	N/A	9.2
Average number of charge ports requested per site for Workplaces	N/A	9.8
Average number of charge ports requested per site for Fleet	N/A	13.1
Average number of charge ports requested per site for MUDs	N/A	8

Table 5.11 Average EVSE Procurement Period

Organization	Average Business Days
Business	36
K-12 School	54
University	62
City	50
County	15
Federal	69

Table 5.12 Charging Station Procurement Submission Issues

Issue	No. of Projects
Missing delivery date	30 projects, 497 charge ports
Incorrect vendor name	4 projects, 118 charge ports
Missing equipment and installation cost breakdown	4 projects, 100 charge ports
Missing model #	5 projects, 138 charge ports
Missing fleet documentation	4 projects, 71 charge ports
Quote signed after expiration date / missing signature / missing quote	14 projects, 166 charge ports
Missing installer information / missing installation cost	8 projects, 111 charge ports

56 Applicants from all segment categories may indicate the number of fleet vehicles at their site (All Segments). Applicants in the fleet category intend to use the new charging station for their EV fleet (Fleet Segment Only).

Table 5.13 Number of Approved Charging System Models

Charging System Type	Total Number of Approved Models
Level 1	4
Level 2 "A"	17
Level 2 "B"	41
Total	**62**

Table 5.14 EVSE Model Summary

Average number of ports per EVSE	1.4
Average number of circuits per EVSE	1.3
Average number of ports per circuit	1.1
Number of wall EVSE units	18
Number of pedestal units	31
Number of both wall and pedestal units	13

Table 5.15 Charging Station Request and Rebate

Charging Station Requests & Rebates[57]	
Number of Level 1 charge ports requested[58]	13
Number of Level 2 charge ports requested[59]	1,053
Number of total charge ports approved	1,066
Average Number of Level 1 charge ports approved per Level 1 site	6.5
Average Number of Level 2 charge ports approved per Level 2 site	15.3
Number of Level 1 EVSE bought	12
Average number of ports per Level 1 EVSE	1.0
Number of Level 2A EVSE bought	184
Average number of ports per Level 2A EVSE	1.7
Number of Level 2B EVSE bought	512
Average number of ports per Level 2B EVSE	1.4
Number of Level 1 EVSE installed	12
Number of Level 2A EVSE installed	135
Number of Level 2B EVSE installed	219
Rebate amount reserved for Level 1 ports	$19,356
Rebate amount reserved for Level 2A ports	$358,993
Rebate amount reserved for Level 2B ports	$774,318
Rebate amount paid for Level 1 ports	$-
Rebate amount paid for Level 2A ports	$237,642
Rebate amount paid for Level 2B ports	$243,289

57 Data as of February 2018.
58 In the Step 2 Agreement, the applicant indicates the requested number of Level 1 EVSE to be approved and installed under the Program. The number of installed Level 1 EVSE must match the number of Level 1 EVSE requested in Step 2 Agreement.
59 In the Step 2 Agreement, the applicant indicates the requested number of Level 2 EVSE to be approved and installed under the Program. The number of installed Level 2 EVSE must match the number of Level 2 EVSE requested in Step 2 Agreement.

Appendix D. Outreach Events

Table 5.16 Outreach Events

Event Date	Event Name	Outreach Type	Location	Estimated Customer Interactions
4/2/2016	Formula E – ePrix	Market Education & TE Advisory Services	Long Beach	300
5/18/2016	Charge Ready Pilot Kick-Off	Charge Ready Education & Outreach	Irwindale	300
5/26/2016	AT&T/PEVC Ride and Drive	Market Education & TE Advisory Services	El Segundo	84
5/31/2016	Uptown Whittier Association Meeting	Disadvantaged Community Outreach	Whittier	1
6/10/2016	California Association of Community Managers, Inc. (CACM) CEO Business Forum	Charge Ready Education & Outreach	San Diego	100
6/16/2016	CBS Eye on the Environment Event	Charge Ready Education & Outreach	Studio City	100
6/23/2016	Faith-Based Business Summit	Charge Ready Education & Outreach	Los Angeles	75
6/29/2016	CA Higher Ed Summit	Charge Ready Education & Outreach	Fullerton	50
7/2016	Connecting Women to Power Business Conference	Disadvantaged Community Outreach	Carson	5
7/29/2016	Environmental Justice Advisory Group meeting at AQMD	Charge Ready Collaboration Efforts with Complementary EV Programs	SCAQMD Headquarters - Diamond Bar	15
8/4/2016	Filipino American Chamber of Commerce of Orange County	Charge Ready Education & Outreach	Anaheim	100
8/24/2016	EV Virtual Summit	Charge Ready Education & Outreach	Webex	75
8/30/2016	SCE MUD Workshop	Charge Ready Education & Outreach	Irwindale/Skype	20
9/10/2016	National Drive Electric Week - SCAQMD/Diamond Bar	Market Education & Charge Ready	SCAQMD/Diamond Bar	80
9/11/2016	National Drive Electric Week - Los Angeles	Market Education & Charge Ready	Los Angeles	118
6/2/16 & 6/29/16	CA Hotel & Lodging Association	Disadvantaged Community Outreach	Multiple cities	17
9/16-9/17/2016	AltCar Expo	Market Education & Charge Ready	Santa Monica	142
9/21/2016	Apartment Association of Greater Los Angeles (AAGLA) [12-2pm]	Charge Ready Education & Outreach	AAGLA Headquarters - 621 South Westmoreland Avenue, Los Angeles, CA 90005	45
9/28/2016	Apartment Association of Orange County - Reverse Trade Show (20 MUD Property Managers)	Charge Ready Education & Outreach	Costa Mesa	45
10/6/2016	League of Cities	Charge Ready Education & Outreach	Long Beach	50
10/25/2016	County of Ventura	Charge Ready Education & Outreach	Westminster	25
11/4/2016	Optima presentation	Charge Ready Education & Outreach	Torrance	2
11/8/2016	Charge Ready Weekly MUD Virtual Workshop (collaboration with CalCAP)	Charge Ready Education & Outreach	Rosemead	0

Event Date	Event Name	Outreach Type	Location	Estimated Customer Interactions
11/15/2016	Charge Ready Weekly MUD Virtual Workshop (collaboration with CalCAP)	Charge Ready Education & Outreach	Rosemead	0
12/2/2016	Consumer Advisory Panel Brainstorming Session (hosted by SCE)	Charge Ready Education & Outreach	Rosemead	50
12/13/2016	SCAG EV Charging Stations and Multi-Family Housing: Overcoming the Obstacles	Charge Ready Education & Outreach	Los Angeles	20
2/24/2017	San Joaquin Valley EV Partnership - Workplace Charging Workshop	Charge Ready Education & Outreach	Bakersfield	50
2/24/2017	San Joaquin Valley EV Partnership - Workplace Charging Workshop	Disadvantaged Community Outreach	Bakersfield	50
3/1/2017	Local Government Kickoff Workshop	Charge Ready Education & Outreach	Downey	200
3/9/2017	Apartment Association of Orange County Trade Show	Disadvantaged Community Outreach	Costa Mesa Orange County	1200
3/17/2017	California Association of Community Managers Trade Show (for Property	Disadvantaged Community Outreach	Anaheim	625
4/22/2017	Earth Day Festival	Charge Ready and Market Education	City of Lynwood	600
9/10/2017	National Drive Electric Week	Market Education	South Pasadena	70
9/15-16/2017	AltCar Expo	Market Education	Santa Monica	350
9/16/2017	National Drive Electric Week	Market Education	Los Angeles	267
9/16/2017	National Drive Electric Week	Market Education	Gardena	150
9/16/2017	National Drive Electric Week	Market Education	Tehachapi	50
9/26/2017	Transportation Electrification	Market Education	Rosemead	850
			Total Estimated Customer Interactions	**6,281**

Appendix E. Charge Ready Marketing Materials

Table 5.17 Charge Ready Marketing Materials

Marketing Materials	Description
Charge Ready Landing Page	Website SCE.com Landing Page - Provides resources that enable customers and EVSE vendors to learn more about Charge Ready
Charge Ready Enrollment Portal[60]	Website - A seamless interface that allows customers to apply for participation in the Pilot and provide the required information throughout the enrollment and deployment process
Frequently Asked Questions[61]	Website - Addresses many of the most common questions and concerns customers may have when considering the Pilot
Participation Package	Collateral (Interactive PDF) - An intuitive document designed to walk interested customers through the Pilot process from start to finish

60 https://chargeready.sce.com
61 https://www.sce.com/wps/portal/home/business/electric-cars/Charge-Ready/Charge-Ready-Supports

Marketing Materials	Description
Pilot Fact Sheet	Collateral - A high-level overview of the Pilot that should give customers an idea of what to expect
Demand Charges Overview	Collateral - Provides definitions of demand charges and solutions for customers to mitigate demand charges, such as load management and SCE's available rates
Electric Vehicle Supply Equipment Vendor Fact Sheet	Collateral - Provides information to prospective vendors to apply for qualification as a Charge Ready charging station vendor
Pilot Email Invitations	Promotional Emails - Sent directly to customers to spark interest and drive traffic to landing page; message is crafted specifically for four segments: MUDs, workplaces, fleet, and destination centers
Customer Video	Video Vignette - Quick and easy way for people to learn more about the Pilot
Charge Ready Twitter Page	Social Media - Provides followers the latest news and developments from within the Charge Ready Program

Appendix F. Media Outreach and Published Articles

SCE, City of Ontario Partner in 'Charge Ready' Program
EEI Delivering the Future, October 2017

California utilities plot ways to prep grid for coming EV boom
Utility Dive, August 22, 2017

California buses are going electric, and that's good for our environment
Los Angeles Daily News, August 4, 2017 (This opinion piece by President Ron Nichols, which prominently mentions Charge Ready, also ran in the Los Angeles Daily Breeze, Long Beach Press-Telegram, the San Bernardino Sun, San Gabriel Valley Tribune, the Inland Valley Daily Bulletin, Pasadena Star-News, Whittier Daily News, and Redlands Daily Facts.)

Santa Monica Poised To Approve Contract Adding 29 Electric Vehicle Charging Stations. (LOOKOUT)
Santa Monica Lookout, July 27, 2017

Charging stations for electric vehicles nearly open
Porterville Record - Friday, June 23, 2017

Charging station goes online in Lynwood on Earth Day
KPCC-FM, April 21, 2017

SCE brings EV charging stations to Lynwood
KFI-AM, April 21, 2017

SCE President Ron Nichols talks about electrifying transportation on Earth Day
Chung T'ien Television, May 3

Edison installs first electric-car charging stations in low-income community
San Gabriel Valley Tribune, February 16, 2017. This article is also provided by the **Pasadena (CA) Star-News** and the **Long Beach (CA) Press-Telegram**.

SoCal Edison to install 1,500 electric-car charging sites; what's your electric utility doing?
Green Car Reports, June 1, 2016

How Southern California Edison might help you charge your electric car at work
L.A. Daily News/Long Beach Press-Telegram/San Gabriel Valley Tribune/Pasadena Star, May 25, 2016

Southern California Edison plugging into electric-vehicle charging market
L.A. Daily News/Long Beach Press-Telegram/San Gabriel Valley Tribune/Pasadena Star, May 14, 2016

SCE to add electric vehicle charging stations
KNBC-TV, May 16, 2016

So Cal Edison looking to install 1,500 new electric vehicle charging stations
KNX News Radio, May 16, 2016

Plugging EVs: Program by SoCal Edison will add 1,500 charging stations
Los Angeles Business Journal, March 27, 2016

CA EV Infrastructure: Platform for innovation or simple utility service?
SmartGridNews, April 25, 2016

EV charging pilot takes off in Southern California
Green Transit News, May 16, 2016

SCE Launches Charge Ready Electric Vehicle Charging Pilot Program
The Street, May 24, 2016

SCE launching $22M Charge Ready EV charging pilot
Green Car Congress, May 17, 2016

SDG&E kicks off $52.5 million EV charger installation and customer education pilot
Utility Dive, May 23, 2016

Electric vehicle charging station pilot
World Journal, May 19, 2016

SCE Ramps Up Electric Vehicle Charging Program
socalTECH, May 17, 2016

SCE Launches Charge Ready Electric Vehicle Charging Pilot Program
Electric Cars Report, May 17, 2016

Southern California Edison to start electric car charging pilot program
Korea Herald Biz, May 17, 2016

SCE Launches Charge Ready Electric Vehicle Charging Pilot Program
Transmission & Distribution World, May 18, 2016

SCE electric vehicle charging facilities expansion plan
Korea Daily, May 19, 2016

SCE encourages participation in charging station pilot program
Singtao Daily, May 17, 2016

Plugging EVs: Program by SoCal Edison will add 1,500 charging stations.
Los Angeles Business Journal, March 27, 2016

You Know Electric Cars Are Poised to Take Off When the Koch Brothers Plan the Technology's Demise
Huffington Post, February 26, 2016

So Cal Edison gets green light to install 1,500 charging stations
CBS2, Jan. 15, 2016

So Cal Edison to Install Charging Stations
KCAL9, Jan. 15, 2016

Edison to install 1,500 electric vehicle charging stations
KNBC-TV, Jan 22, 2016

Edison will be installing 1,500 Charging Stations
KABC-TV, Jan. 15, 2016

State regulators approve electric vehicle charging station pilot program
Los Angeles Times, Jan. 15, 2016

Editorial: The right way to charge electric cars
Los Angeles Times, Jan. 27, 2016

EV drivers get more spark from Edison
L.A. Daily News/Long Beach Press-Telegram/San Gabriel Valley Tribune/Pasadena Star, Jan. 20, 2016

Southern California Edison to install 1,500 charging station
Orange County Register, March 29, 2016

Commentary: We'll all pay to charge others' electric cars
Orange County Register, Feb. 4, 2016

Utility to roll out more electric vehicle charging stations
San Jose Mercury News, Jan. 20, 2016

Electric vehicle charging stations will be installed around the area by Southern California Edison
KNX Radio, Jan. 15, 2016

SCE is getting ready to roll out a $22 million pilot program for EV charging stations
KPCC Radio, Jan. 20, 2016

Southern California pilot program to install 1,500 car charging stations
KPCC Website, Jan. 15, 2016

Edison to Install 1,500 Charging Stations
Los Angeles Business Journal, Jan. 15, 2016

Tesla's Cheaper Model 3 Could Strain Charging Infrastructure
MIT Technology Review, March 29, 2016

California Invites Power Utilities into the Car-Charging Market
Bloomberg, May 5, 2016

SCE Electric Car Initiative
KCOY-TV, Jan. 15, 2016

So Cal Edison will install 1,500 new charging stations for electric vehicles
KESQ-TV, Jan. 15, 2016

So Cal Edison says it will help to pay for the installation of 1,500 new electric car chargers
KFI Radio, Jan. 15, 2016

SCE receives green light from state regulators to begin vehicle charging pilot project
KCEP-FM, Las Vegas, Jan. 15, 2016

SoCal Edison to Add 1,500 new stations for a pilot project to install 1,500 EV charging stations
KFSN-TV, Fresno

Today CPUC gave SCE Green Light to Install As Many As 1,500 Charging Stations
KCRW Radio, Jan 22, 2016

$22 Million EV Charging Pilot Launched In Southern California
CleanTechnica, Jan. 27, 2016

Gov't Regulators To Break Out Subsidy For EV Charging Stations
Daily Caller, Jan. 19, 2016

Two California Utilities Get Creative with EV Charging
Energy Efficient Markets, Feb. 1, 2016

Southern California Utilities to Deploy 5,000 EV Chargers in First-of-Their Kind Pilots
Green Tech Media, Feb. 1, 2016

How Utilities Are Planning Electric-Vehicle Infrastructure in California and Beyond
Green Tech Media, Feb. 25, 2016

To Lead Nation in EVs, California Should Encourage Charging Station Competition
GovTech, April 27, 2016

You Know Electric Cars Are Poised to Take Off When the Koch Brothers Plan the Technology's Demise
Huffington Post, Feb. 26, 2016

Proposal to Charge Electric Cars in Southern California Gets the Green Light
NRDC Switchboard, Jan. 14, 2016

Electric Charging Station Coming Your Way
Los Alamitos-Seal Beach Patch, Jan. 14, 2016

California Regulators Approve Pilot EV Charging Program for Southern California Edison
Renewable Energy World, Jan. 15, 2016

Proposal to Charge Electric Cars in Southern California Gets the Green Light
NRDC, Jan. 14, 2016

Utility to roll out more electric vehicle charging stations
San Jose Mercury News, Jan. 20, 2016

California legislature not happy with PG&E EV proposal
SmartGridNews, April 21, 2016

California regulators approve SCE pilot to build 1,500 EV charging stations
Utility Dive, Jan. 19, 2016

California Regulators Approve Pilot EV Charging Program for Southern California Edison
Renewable Energy World, Jan. 19, 2016

SCE Inside Edison/Newsroom Stories

Hyundai Employees Can Now Charge Their EVs at Work
September 22, 2017

Charge Ready: Ontario Gets Charged Up in Time for National Drive Electric Week
September 11, 2017

Southern California Cities Plug Into Charge Ready EV Program
March 29, 2017

SCE Charge Ready Among Electric Vehicle Programs Recognized by White House
July 21, 2016

SCE launches Charge Ready Electric Vehicle Charging Pilot Program
May 16, 2016

State Commission Ruling Allows Electric Utilities to Invest in Electric Car Charging
January 22, 2015

Appendix G. Rejected and Withdrawn Applications

Figure 5.1 Withdrawn Application Reasons

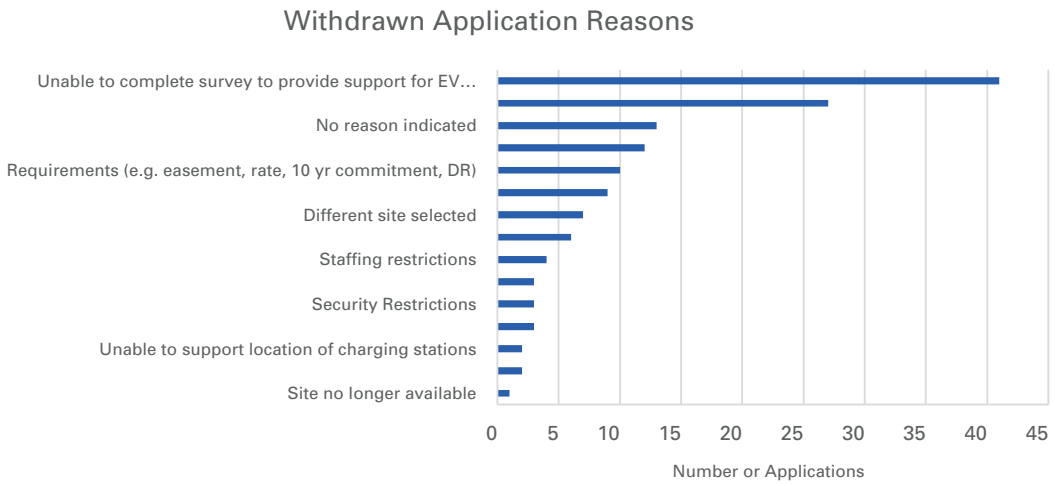
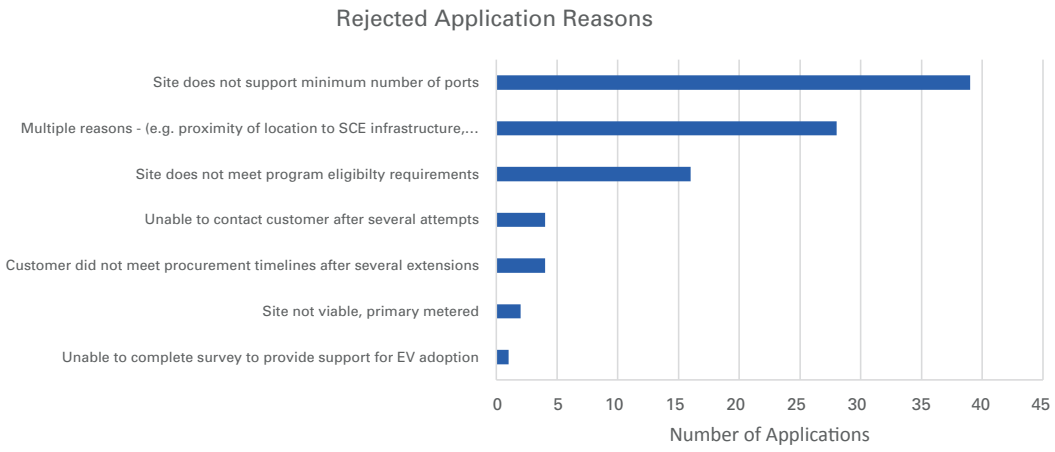


Figure 5.2 Rejected Application Reasons



Appendix B

SCE Clean Power and Electrification Pathway White Paper

SOUTHERN CALIFORNIA EDISON®
Energy for What's Ahead℠

THE CLEAN POWER AND ELECTRIFICATION PATHWAY

Realizing California's Environmental Goals

November 2017

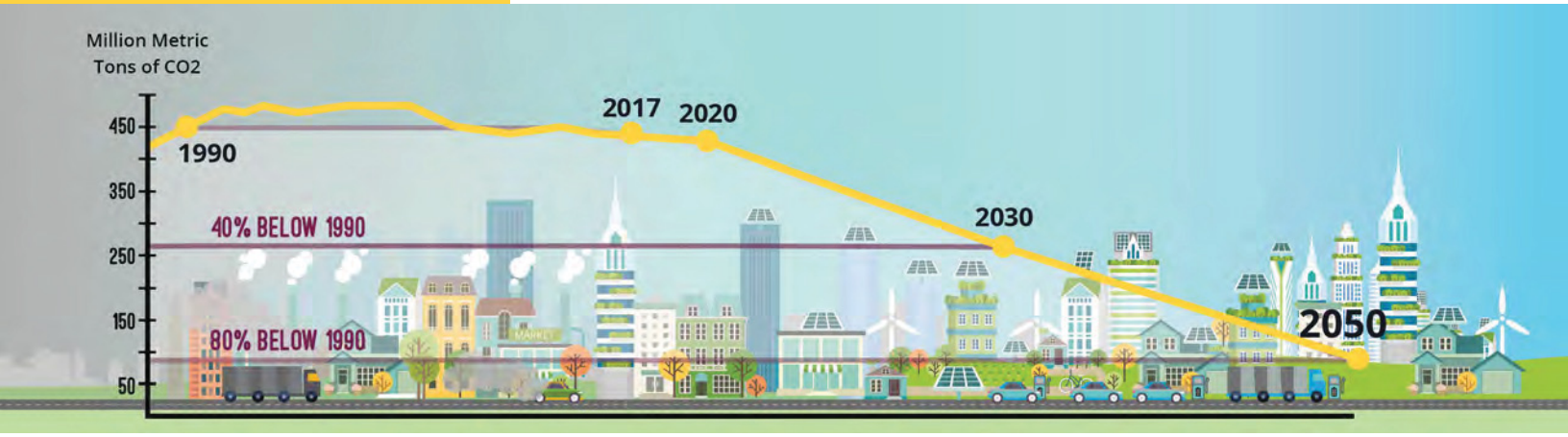


Figure 1: Meeting California's GHG Reduction Goals *(Source: California Air Resources Board [CARB])*

This paper presents Southern California Edison's integrated blueprint for California to reduce greenhouse gas emissions and air pollutants. Realizing the blueprint will reduce the threat of climate change and improve public health related to air quality. It is a systematic approach and each measure is integrated with — and depends upon — the success of the others. To be successful, California must approach implementation as an integrated package, applying resources across the board where most effective.

EXECUTIVE SUMMARY

Climate change and air pollution pose serious threats. Climate change effects, such as sea level rise and longer, more intense heat waves, are now occurring. In California, while significant progress has been made, too many communities continue to experience asthma and other air-quality-related health issues.

California continues its leadership in addressing climate change and air pollution. The state's greenhouse gas (GHG) goals call for a 40 percent reduction in GHG emissions from 1990 levels by 2030 and an 80 percent reduction by 2050 (Figure 1). Air quality goals include a 90 percent reduction in emissions of nitrogen oxides from 2010 levels in some of the state's most polluted areas by 2032. Meeting these ambitious clean energy and clean air goals requires fundamental changes over the next 12 years and beyond.

The electric sector is at the forefront of the fight against climate change in California and today accounts for only 19 percent of the state's GHG emissions. The transportation sector (including fuel refining) and fossil fuels used in space and water heating now produce almost three times as many GHG emissions as the electric sector and more than 80 percent of the air pollution in California.

The Clean Power and Electrification Pathway is an integrated approach to reduce GHG emissions and air pollution by taking action in three California economic sectors: electricity, transportation and buildings. It builds on existing state policies and uses a combination of measures to produce the most cost-effective and feasible path forward among the options studied.

The Pathway will help California achieve its climate goals and significantly reduce today's health-harming air pollution in local communities. It also has strong potential to create highly-skilled, middle-income jobs.

By 2030, it calls for:

- an electric grid supplied by 80 percent carbon-free energy;
- more than 7 million electric vehicles on California roads; and
- using electricity to power nearly one-third of space and water heaters, in increasingly energy-efficient buildings.

(Continued)

(Continued - Executive Summary)

These electrified technologies will use zero-emission resources like solar and wind to provide most of their power, and can in turn support the electric grid by balancing electricity demand with supply.

The private and public sectors must work together to support customer adoption, while ensuring electricity remains reliable and affordable, and that end-use technologies are increasingly energy efficient. Public policy can enable the Clean Power and Electrification Pathway through comprehensive integrated resource planning that includes consideration of end uses of fossil fuels, through investing cap-and-trade revenues thoughtfully, and through supporting electrification in transportation, homes and businesses.

Southern California Edison is proud to be a long-standing partner with the state, customers and our communities on important climate change and air quality efforts. We look forward to continuing this broad-based partnership to pursue practical, cost-effective approaches to achieving a bold, clean energy future.

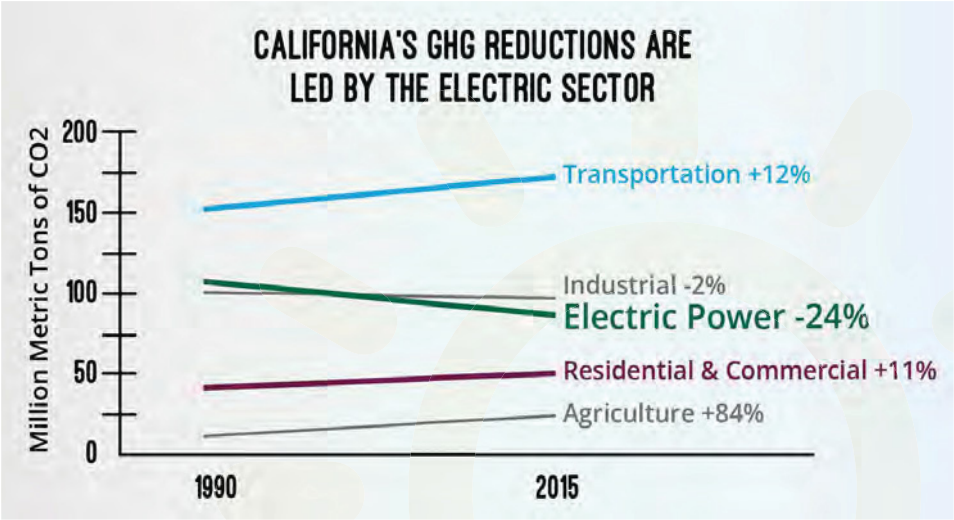


Figure 2: Change in California GHG Emissions *(Source: CARB)*

Successive California policies supporting GHG emissions reductions[1]

1. **SB 1078 (2002), SB 107 (2006), and SB X1-2 (2011)** established a Renewables Portfolio Standard (RPS), 20% by 2010 and then 33% by 2020.
2. **Executive Order S-3-05 (2005)** established a target of reducing GHG emissions 80% below 1990 levels by 2050.
3. **AB 32 (2006)** codified a GHG emissions target of 1990 levels by 2020 and created an economy-wide cap-and-trade program.
4. **SB 350 (2015)** established an RPS of 50% by 2030 and added new requirements for doubling energy efficiency and for wide scale transportation electrification deployment.
5. **SB 32 (2016)** codified a GHG target of reducing emissions 40% below 1990 levels by 2030.
6. **AB 398 (2017)** extended cap-and-trade program to 2030 and defined new offset levels.
7. **CARB Proposed Scoping Plan (2017)** identifies policies and tools to achieve the 2030 GHG target.

Additional major policy measures include the Low Carbon Fuel Standard, the Zero Emission Vehicle Program and Sustainable Community Planning.

A systematic approach that integrates these programs and market activities provides the best chance of achieving shared goals at the lowest cost to customers and the economy.

INTRODUCTION

California is committed to reducing its greenhouse gas (GHG) emissions, improving local air quality and supporting continued economic growth. The state set goals to reduce GHG emissions by 40 percent from 1990 levels by 2030 and 80 percent from the same baseline by 2050 (Figure 1).[2] State and local air quality plans call for substantial improvements, such as reducing smog-causing nitrogen oxides (NOx) 90 percent below 2010 levels by 2032 in the most polluted areas of the state.[3] Meeting environmental goals of this magnitude will require fundamental changes to infrastructure and transportation and, at the same time, can help the California economy by creating jobs. These policy goals cannot be achieved by the electric sector alone.[4]

The Urgency of Meeting Climate Change and Air Quality Goals

Meeting California's pressing 2030 climate and air quality goals requires timely, proactive decision-making by policymakers and leaders throughout the state. Stakeholders must quickly align on the near-term programs and market transformation activities required to meet this ambitious schedule. A systematic approach that integrates these programs and market activities provides the best chance of achieving shared goals at the lowest cost to customers and the economy.

The electric sector has provided the majority of emissions reductions in California (Figure 2) through energy efficiency, the phasing out of coal, and integration of new renewable resources. We are ahead of pace to reach a 50 percent renewables portfolio standard (RPS) by 2030.[5]

For California to meet its 2030 GHG target, significant emission reductions will be required from consumers of liquid and gas fuels — primarily in the transportation and building sectors. The transportation sector contributes nearly 40 percent of California's GHG emissions (approximately 45 percent when oil refining is included) and 80 percent of California's smog-forming NOx emissions.[6] The residential, commercial, and industrial sectors combined contribute approximately 30 percent of the state's GHG emissions (Figure 3). These emissions, as opposed to the emissions from the electric sector, have risen by more than 10 percent since 1990.[7]

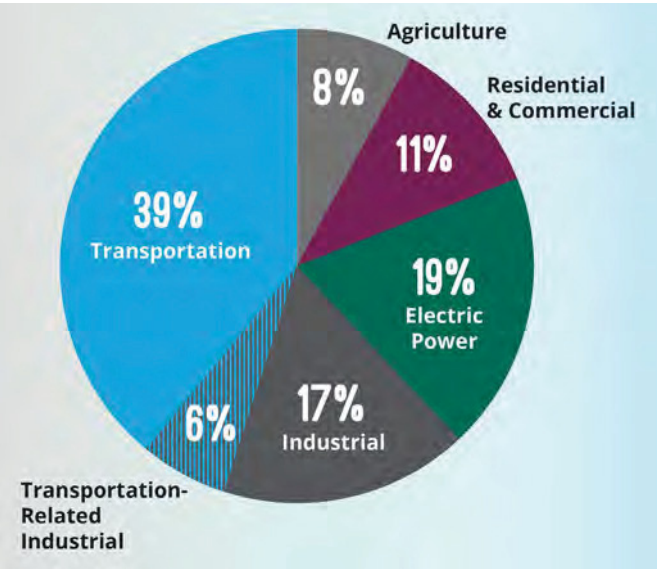


Figure 3: California GHG Emissions by Sector in 2015 *(Source: CARB)*

CLEAN POWER AND ELECTRIFICATION PATHWAY

California has taken concrete steps to move toward a clean energy future. Market-based policies such as the GHG cap-and-trade program and the low-carbon fuel standard provide a solid foundation by putting a price on carbon to encourage the most cost-effective actions to reduce or avoid GHGs. There are multiple pathways to meet California's 2030 climate goals, with varying levels of difficulty and costs. Some pathways are better than others in positioning the state to achieve 2050's deeper carbon reduction goals. SCE explored three alternatives (Table 1) and found that a clean power and electrification path is the most affordable and feasible approach to reaching California's climate and air quality goals. This pathway also will contribute to a strong state economy and can be an engine for creating highly-skilled, middle-income jobs.[8]

Table 1: Comparing 2030 Decarbonization Pathways *(Source: SCE Internal Analysis using E3 Pathways Model. Available at sce.com/pathwayto2030)*

PREFERRED PATHWAY CLEAN POWER AND ELECTRIFICATION	RENEWABLE NATURAL GAS (RNG)	HYDROGEN (H2)
• **80%** carbon-free electricity supported by energy storage • At least **24%** of light-duty vehicles are EVs (7MM) • **15%** of medium-duty and **6%** of heavy-duty vehicles are electrified • **Up to 30%** efficient electrification of commercial and residential space and water heating	• **60%** carbon-free electricity • **24%** of light-duty vehicles are EVs (7MM) • **12%** of medium- and heavy-duty vehicles use compressed natural gas • **42%** of natural gas replaced by RNG	• **80%** carbon-free electricity • **22%** zero-emission light-duty vehicles (4MM H2, 2MM EV) • **4%** of heavy-duty vehicles use H2 • **7%** natural gas replaced by hydrogen
• Dependent on broad adoption of electrified technologies • Most feasible pathway because technology already exists	• Power-to-gas not yet commercially available • A large biogas market requires expensive imports	• Most expensive pathway • Requires significant H2 adoption outside of CA • Lack of sufficient delivery infrastructure
Incremental abatement cost (last 36 MMT)* $79/ton	**Incremental abatement cost (last 36 MMT) $137/ton**	**Incremental abatement cost (last 36 MMT) $262/ton**

*The pathways analyzed include measures to achieve the full 2030 GHG abatement (180 MMT), such as existing state policies and programs included in CARB's Proposed Scoping Plan and additional measures. 36 MMT represents the last 20 percent of GHG abatement needed to meet the 2030 target after offsets are used. This incremental abatement is incentivized by the cap-and-trade market.

THE VISION FOR CLEAN POWER AND ELECTRIFICATION

The Clean Power and Electrification Pathway…builds on existing state programs and policies to achieve California's climate and air quality goals…

The Clean Power and Electrification Pathway is an integrated approach that builds on existing state programs and policies to achieve California's climate and air quality goals, while ensuring that an economy-wide transformation happens in an efficient and — importantly — affordable way. Using existing technologies, the Pathway calls for an electric grid with more carbon-free energy, which is used to clean other sectors of the economy. As the electric supply becomes cleaner, every electric vehicle and electric space or water heater becomes cleaner over its lifespan.

The Clean Power and Electrification Pathway to 2030 is defined by three measures. Each measure is integrated with — and depends upon — the success of the other and should be pursued in concert:

1. **Continue carbon reduction in the electric sector:** increase energy efficiency, provide 80 percent carbon-free energy through large-scale resources and use distributed solar.
2. **Accelerate electrification of the transportation sector**, including placing at least 7 million light-duty passenger vehicles on the roads and supporting a transition to zero-emission trucks and transit.
3. **Increase electrification of buildings:** electrify nearly one-third of residential and commercial space and water heaters.

Continue Carbon Reduction in the Electric Sector

Electric sector measures, including providing 80 percent carbon-free energy from large-scale resources, and leveraging energy efficiency and distributed solar will lower GHG emissions from 84 to 28 million metric tons (MMT)/year (Figure 4). This represents 31 percent of the 2030 GHG reduction goal and aligns with California's pillars for carbon reduction and decades of state energy policy.[9]

Large-scale renewable energy is likely to be the most significant and affordable means of decarbonizing the electric supply. The transmission grid can provide 80 percent carbon-free energy from a combination of renewable resources including wind, solar and large hydroelectric

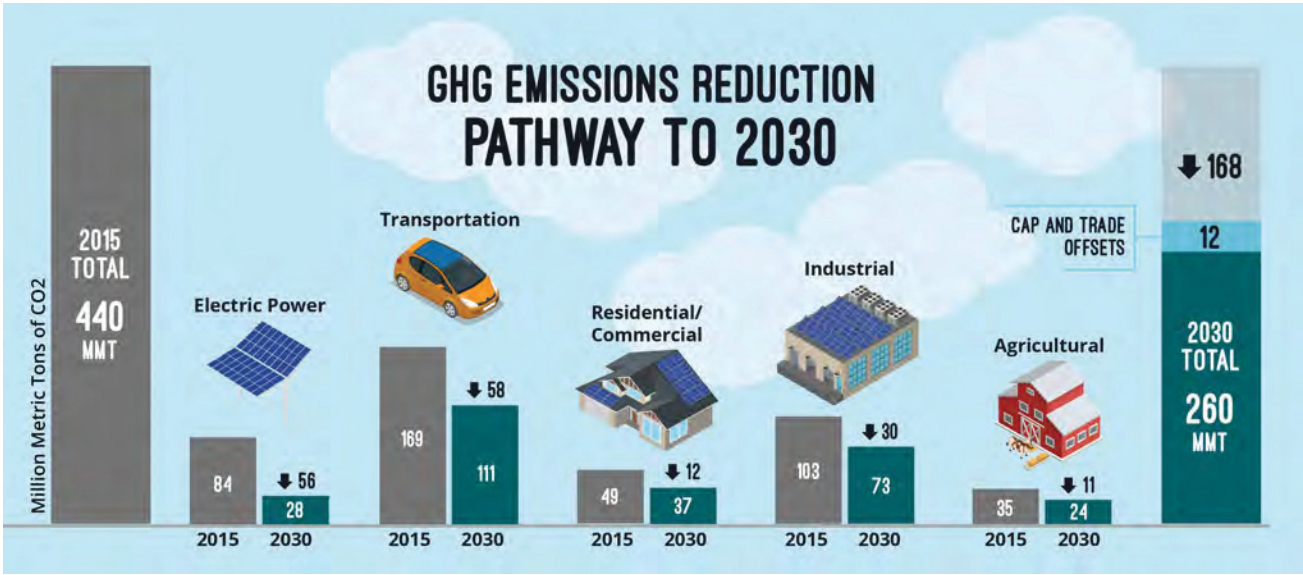


Figure 4: GHG Reductions Across Sectors to Reach 2030 Goals

generators. This will require the development of up to 30 gigawatts (GW) of additional renewable capacity.

California's electric system can incorporate a high penetration of large-scale renewable resources by having a renewables portfolio that is diverse in geography and resource availability, increasing transmission capacity, and enhancing integration across the western grid.

Using a system that relies so heavily on variable resources like wind and solar will require up to 10 additional GW of energy storage from fixed and mobile sources to even out hourly, daily and seasonal energy imbalances (the differences between energy supply and usage).

Even at today's levels of renewables, these energy imbalances can result in California's infamous "duck curve" — the timing imbalance that exists between solar generation and daily peak load.[10] This creates two significant problems for today's electric grid:

- the excess supply of solar at midday, which can lead to shutting down large-scale renewable resources or paying other states to take our power; and
- the significant fast ramp-up in generation to reliably cover the late afternoon and evening electricity need as the sun sets, solar generation fades and customer energy demands peak.

The extremes of the duck curve can be mitigated by the addition of energy storage at scale. Flexible electric vehicle charging could also provide beneficial load shifting — effectively a form of mobile energy storage — that could make electric fueling more affordable. Nonetheless, the magnitude of the duck curve issues is expected to increase as more renewables are added to the system, and some amount of gas-fired generation will be needed for service reliability.

Modernizing the distribution grid with available and evolving technologies will...support our customers' desire to participate in the clean energy future by making their own energy choices.

Reducing or avoiding carbon in the electric sector also requires advances to integrate the clean energy resources that customers are adopting. These resources on the distribution grid are expected to include increased energy efficiency (consistent with SB350's mandate to double energy efficiency), rooftop and community solar, and electric vehicles. Modernizing the distribution grid with available and evolving technologies will allow these distributed energy resources to be better integrated and optimized, will improve system reliability and safety, and will support our customers' desire to participate in the clean energy future by making their own energy choices.

Accelerate Electrification of the Transportation Sector

The GHG reduction potential of the Clean Power and Electrification Pathway hinges on aggressive electrification of light-duty vehicles, i.e., the passenger cars, SUVs and pickup trucks that currently contribute one-quarter of California's GHG emissions.[11] The Pathway calls for at least 24 percent of these vehicles — 7 million — to be electrified by 2030. EVs charging from an increasingly clean electric grid can help reduce transportation sector GHG emissions from 169 to 111 MMT/year, one-third of the 2030 goal. Reduced gasoline demand will also provide the benefit of reducing industrial emissions from refineries.

Electrification of the transportation sector will greatly improve local air quality — an urgent community need across California and particularly

Expanding transportation electrification will require sustainable policies and collaboration between vehicle manufacturers, charging companies, policymakers and electric utilities on issues such as charging standards and consumer awareness.

in Southern California. Many communities, particularly DACs*, are situated near heavily traveled freight corridors, where the concentration of air pollutants often exceeds health-based standards.†

Medium- and heavy-duty vehicles contribute to GHG emissions and are the largest mobile source of smog-forming emissions across the state. The Pathway calls for electrifying 15 percent of medium-duty and 6 percent of heavy-duty vehicles in the state by 2030, supporting needed GHG reductions and improvements in air quality. This will help California position itself for the 2050 GHG goal, which will require the elimination of virtually all vehicle emissions from fossil fuels.[12]

While these vehicle growth targets are ambitious, they are not far outside forecasts of rapid growth in the EV market.[13] Growing customer interest, increasing availability and variety of EV models (Figure 5), and the favorable economics of using EVs for ridesharing and autonomous vehicles have made a high-EV future more plausible than ever. Nations such as the United Kingdom, France, Norway, India and China have announced plans to phase out internal combustion vehicles within coming decades. Manufacturers are responding; GM recently indicated that it expects the company's entire model lineup to run on electricity in the future, and Volvo committed to eliminating traditional internal combustion engines in favor of an electric and hybrid fleet as early as 2019.[14]

Expanding transportation electrification will require sustainable policies and collaboration between vehicle manufacturers, charging companies, policymakers and electric utilities on issues such as charging standards and consumer awareness.[15]

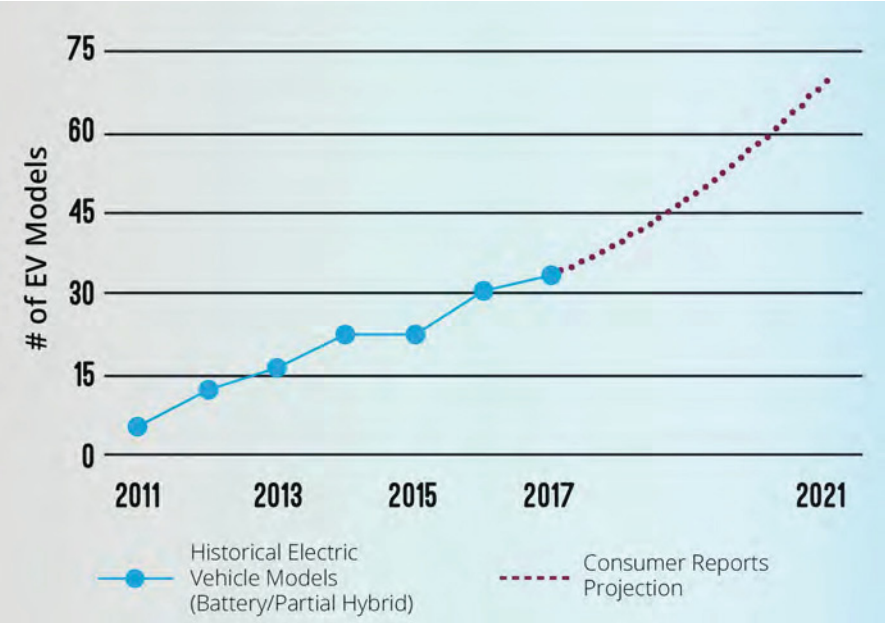


Figure 5: Battery/Partial Hybrid Electric Vehicle Models
(Sources: U.S. Department of Energy/Consumer Reports)

*CalEPA uses the designation Disadvantaged Community (DAC); DACs represent the 25% highest scoring census tracts in CalEnviroScreen 3.0, along with other areas with high amounts of pollution and low-income populations.
†Electrification in areas such as the I-710 corridor between Long Beach and Los Angeles promotes environmental justice by insuring that climate investments provide near-term air quality benefits to a broad set of communities.

Current codes and standards are based on the 20th century power-generation supply framework dominated by fossil fuels.

Continued price incentives, funded by the cap-and-trade and low carbon fuel standard programs, help to lower up-front purchase costs and will help drive additional adoption, as will increased selection and EV availability.

In order to support at least 7 million electric cars by 2030, California will need to have over one million away-from-home charging ports.[16] The state's investor-owned and public utilities have initiated charging infrastructure pilots*[17], but these pilots alone will not meet the expected scale of light-duty EV adoption. Funding will be needed to enable utilities and charging companies to rapidly deploy more infrastructure and chargers.

For medium- and heavy-duty vehicles in urban areas with lower daily mileage, such as buses, delivery vehicles and intermodal freight trucks, electrification is already being deployed and can significantly reduce GHG emissions and improve air quality. Larger plug-in electric and plug-in hybrid electric trucks are in development[18] and will play a greater role in achieving California's 2050 climate and air quality goals. Early deployments must coincide with the development of adequate charging infrastructure to support this critical clean-transportation opportunity.

Increase Electrification of Buildings

Space and water heating currently contributes more than two-thirds of total residential and commercial building GHG emissions. Electrifying nearly one-third of residential and commercial space and water heaters, in addition to increased energy efficiency and strong building codes and standards, could reduce GHG emissions from this sector from 49 to 37 MMT/year, or 7 percent of the 2030 goal.

Expanding electrification of residential and commercial buildings will require new policies and support. Collaboration between manufacturers, repair service providers and policymakers is needed to raise awareness and increase availability of clean, efficient options for electric space and water heating in new building construction and retrofits. Current building codes and standards are based on the 20th-century framework of power generation supply dominated by fossil fuels. This framework should be updated to account for an increasingly decarbonized electric grid.

Updated codes and standards can advance the use of clean electric appliances in new buildings, and incentives can encourage adoption of clean technologies through appliance replacement. For instance, controllable electric space and water heating, which draws from carbon-free electricity powered by solar in the middle of the day, could be an evolution of the Zero Net Energy (ZNE) framework toward more carbon-focused principles for new home construction.[19]

REACHING OUR GOALS WITHIN 12 YEARS

While the Clean Energy and Electrification Pathway is feasible, meeting the 2030 climate goal and also achieving significant improvements in air quality is an urgent challenge, requiring focused efforts and purposeful actions across multiple sectors of the economy (Figure 6). Many of the needed approvals, programs, and market transformations require compromise and consensus among stakeholders with diverse agendas and priorities. Customer adoption is also key to success — and that adoption requires that electricity remains an affordable alternative to fossil fuels.

*For instance, SCE's Charge Ready program is a $22 million pilot to increase charging infrastructure throughout the SCE service territory. The program provides the electrical infrastructure necessary for EV charging, as well as rebates to help pay for charging stations.

SCE's Clean Power and Electrification Pathway calls for integrated actions, programs and policies across all sectors of the economy and strongly links grid decarbonization with electrification right from the start. Planning for 2030 reduction targets now provides a starting point for important, necessary policies, programs and actions needed to meet the even more transformational 2050 climate goals.

Putting millions of electric vehicles on California's roads requires overcoming current barriers, such as vehicle affordability, customer awareness and EV charging accessibility. Durable, predictable incentives that lower EV purchase prices will encourage buyers to choose plug-in models at the end of their gasoline-powered vehicles' 11- year life cycles. Healthier incentives will also be needed to encourage commercial enterprises to switch to electricity as a fuel for buses and delivery and intermodal trucks with 18-year average life spans. In addition, charging station networks will need to expand rapidly to ensure availability at workplaces, multifamily units and along heavily traveled corridors.

An electric system upgrade can take as long as a decade to site, license, build and commission. Planning often involves a consensus-driven process that rarely results in a quick decision. Given this timeline, for the majority of electric power in California to come from renewable and distributed energy resources by 2030, the planning process for additional transmission capacity, new renewable energy development projects, grid modernization and large-scale energy storage investments must start now.

California's Building Energy Efficiency Standards are updated every three years, at the culmination of a multi-year planning process. Development of the 2019 standards is nearing completion, and planning for 2022 standards is an opportunity for strategic discussions. Waiting until the 2025 cycle could cost California the opportunity to decarbonize hundreds of thousands of new homes through electrified space and water heating, at a lower cost than later retrofits.

SUPPORTING THE PATHWAY THROUGH CALIFORNIA POLICY

Integrated Resource Planning

California has begun integrated resource planning — a comprehensive planning process to meet forecasted electricity needs and GHG targets for the electricity sector. Planning a decarbonized grid in a cost-effective manner requires strong coordination and balanced trade-offs for the good of the overall system. Provided that its scope includes consideration of

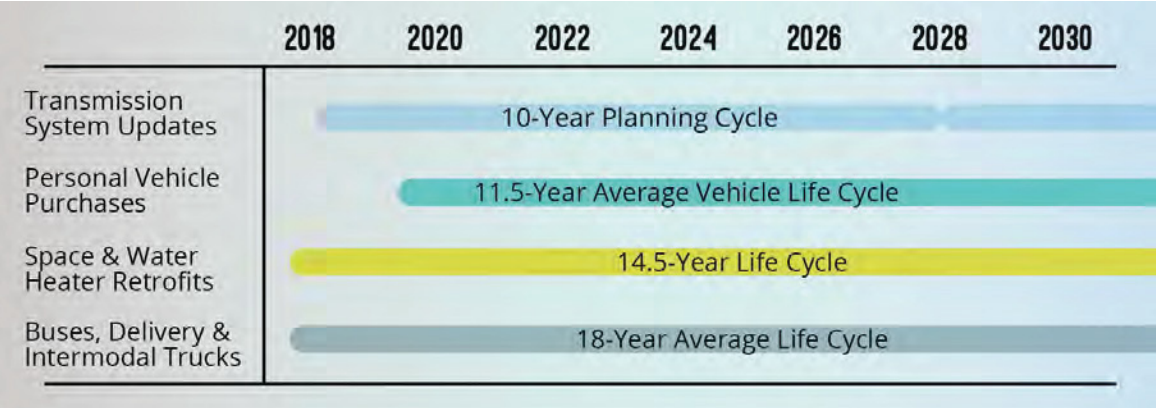


Figure 6: Planning and Life Cycle Timeline *(Source: SCE Internal Analysis)*

Planning a decarbonized grid in a cost-effective manner requires strong central coordination and balanced trade-offs across many parties for the good of the overall system.

the end uses of fossil fuels, this new process has the potential for more efficient planning decisions across economic sectors and electric sector technologies. This kind of planning would include large-scale and customer-sited renewable resources, energy efficiency, electric vehicles, energy storage and more.

GHG Cap-and-Trade
California's market-based, GHG cap-and-trade program is a critical enabler of the Clean Power and Electrification Pathway. Setting a price on GHG emissions with limited offsets creates opportunities to optimize spending in areas that most cost-effectively reduce or avoid GHG emissions. The continued, direct allocation of emissions allowances to utilities helps ensure electricity remains affordable and competitive with fossil fuels during the transition to the clean energy future.

Market-based programs could be bolstered by new flexible policy tools and significant funding to spur customer choice for clean electrification. California policymakers should allocate additional cap-and-trade revenues to programs that encourage consumers to adopt transportation and building electrification.

Transportation Electrification
New or refreshed policies could be enacted to smooth the pathway to broad customer adoption of electric vehicles. These policies could include support for continued and expanded consumer education, continued incentives for EV purchases, adequate charging infrastructure, and pricing that keeps electric fueling costs competitive with gasoline and diesel. Efforts are also needed to ensure the affordability of, and access to EVs for mid- and low-income Californians.

Building Electrification
California's 2022 Building Energy Efficiency Standards could include establishing new building standards to promote the clean electrification of space and water heating in homes and businesses, as well as to require collecting more data on fossil fuel end uses. In addition, energy efficiency programs could be optimized to include a focus on their ability to support GHG emissions reductions.

Keeping Clean Electricity Affordable
A key consideration for many consumers is, and will remain, the cost of electricity. The success of the Clean Power and Electrification Pathway rests on implementing an integrated package of measures that contribute to a strong California economy and maintain affordable electricity for all customers.

The price of electricity and who pays the costs must reflect the services provided to customers. All users of the electric grid must pay their share to support a reliable and increasingly clean electric system. Policies that ensure this fairness will help to keep electricity affordable, which will support customer adoption of the electrified solutions in the transportation and building sectors.

Creating Jobs That Support the Clean Energy Economy
A clean energy future benefits the California economy. Many studies suggest that the clean energy and electrification measures described in the Pathway will lead to higher statewide gross product, real output, state revenue and employment.[20] Highly skilled, middle-income jobs will be created to introduce and service new technologies. The Clean Power and Electrification Pathway can be a double win — both more prosperous and healthier — for California's residents.

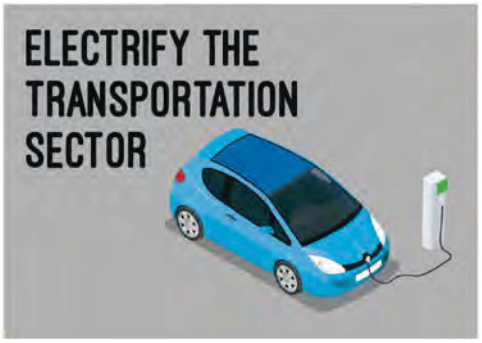
CONCLUSION

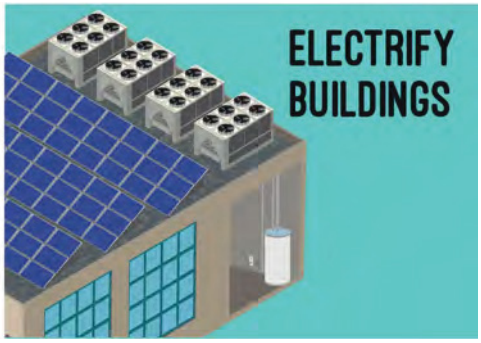
Broad decarbonization and electrification of the economy requires comprehensive policy to guide the transformations across our economy — not just in the electric sector.

Because of California's size and economic complexity, it will be a major undertaking for the state to meet its GHG goal in just 12 years. It is similarly difficult to meet our air quality targets. As the world's sixth largest economy, California has a unique opportunity to create a blueprint that others can follow for an affordable clean energy economy that improves air quality for our communities and mitigates impacts of climate change through greenhouse gas reductions across all energy sectors: electricity, fuels and gases.

Electric utilities are uniquely positioned to facilitate the transformation to a clean energy economy. They have the size, scope and infrastructure assets to deliver clean energy and support electrification for all customers. They also have the capacity to finance prudent investments to maintain and modernize the grid, with regulatory approval. But, they cannot do it alone. Broad decarbonization and electrification of the economy require comprehensive policy to guide the transformations across our economy — not just in the electric sector.

Everyone who lives, works, drives or invests in California is a stakeholder in this effort. The results will be a new energy paradigm that will address the enormous challenge of global climate change through the reduction of GHG emissions, improved air quality and human health — providing access to clean energy for all consumers.





ACRONYMS

AB	Assembly bill (California State Assembly)
BEV	battery-powered electric vehicle
CAISO	California Independent System Operator
CARB	California Air Resources Board
CNG	compressed natural gas
EV	electric vehicle
GHG	greenhouse gas
GW	gigawatt
H2	hydrogen
HDV	heavy-duty vehicle
MDV	medium-duty vehicle
MM	million
MMT	million metric tons
NOx	nitrogen oxide
PHEV	plug-in hybrid electric vehicle
RNG	renewable natural gas
RPS	Renewables Portfolio Standard
SB	Senate bill (California State Senate)
SCE	Southern California Edison
ZNE	zero net energy

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Electronic copies of this white paper and its appendices are available at sce.com/pathwayto2030

The Clean Power and Electrification Pathway

Realizing California's Environmental Goals

Appendices

November 2017

Contents

APPENDIX I: Pathway Analysis

Development Approach

The scope of the SCE Pathways Analysis was to identify the most feasible and economical pathway to realizing California's greenhouse gas (GHG) policy target in 2030, reducing emissions from all economic sectors by 180 million metric tons (MMT) — from 440 MMT in 2015 to 260 MMT in 2030 — and reducing air pollution to support achievement of health-based air quality standards.

The analysis resulted in the development of the Clean Power and Electrification Pathway. The Pathway includes the 132 MMT[1] of GHG abatement from the California Air Resources Board (CARB) Proposed Scoping Plan, in addition to 12 MMT of abatement obligations projected to be met by cap-and-trade offsets (4 percent of CARB's allotment for 2030). (See **Table 1.**) The GHG abatement from most of the current and expected policies identified in the CARB Proposed Scoping Plan are listed in **Table 2**.

Table 1. California GHG Accounting from CARB Policy

	GHG Accounting
2015 California Emissions (Economy Wide)	**440 MMT**
CARB Scoping Plan Update 2017	(132 MMT)
Cap-and-Trade Offsets	(12 MMT)
Cap-and-Trade Market / Incremental Abatement	(36 MMT)
2030 Emissions Target (40% below 1990 levels)	**260 MMT**

SCE used four criteria to select the GHG abatement measures for the Clean Power and Electrification Pathway (see **Table 3**) to abate the remaining 36 MMT needed to reach the 2030 GHG goal:

1. GHG abatement potential;
2. Marginal abatement costs[2];
3. Measure feasibility (availability of technology, infrastructure requirements, economies of scale, consumer preference, timing of deployment); and
4. Technologies that will continue to support GHG reductions beyond 2030 and help California achieve the 2050 GHG target (i.e., technologies with low risk of stranded investment by 2050).

The analysis to develop the Clean Power and Electrification Pathway, and alternative pathways, details the combination of measures (**see Table 4**) that could be implemented to achieve the 36 MMT of incremental abatement, incented by cap-and-trade.

This analysis used the Energy + Environmental Economics (E3) PATHWAYS model for deep decarbonization scenarios (https://www.ethree.com/tools/pathways-model/), as well as internally-developed economic adoption and renewable generation optimization models. These models produced an economy-wide view of the expected GHG abatement from existing and expected policies and forecasted economic adoption of low-carbon technologies and fuels. Results are in **Table 5**.

[1] The CARB Proposed Scoping Plan calls for a number of initiatives and policies that would achieve 135 MMT of GHG abatement. However, AB 398 (2017) removed refinery efficiency improvements, accounting for 3 MMT of abatement. AB 398 also authorized the use of offsets to account for up to 12 MMT of emissions abatement.

[2] Marginal abatement costs refer to the cost of an additional unit of abatement, whereas incremental costs in this appendix refer to the cost of abating the final 36 MMT of GHG to meet California's 2030 climate goals.

Table 2. CARB-Identified Policy Impacts by Sector

Sectors	Initiatives and Policies	High-Level Description of Key Elements
Transportation	Low Carbon Fuel Standard	- 18% reduction in carbon intensity in fuel by 2030
	Mobile Source Strategy	- 1.5 million light-duty Zero Emission Vehicles (ZEV*) and Plug-in Hybrid Electric Vehicles (PHEV) by 2025 and 4.2 million ZEVs by 2030 - Medium- and heavy-duty GHG Phase 1 and 2 to reduce new vehicle emissions by 4 to 5% per year starting 2014 - Advanced Clean Transit: starting in 2018, 20% of new buses sold must be zero emission, increasing to 100% in 2030 - Last Mile Delivery: requirement to purchase low-NOx engines and phase-in zero emission trucks starting in 2020
	SB 375 Sustainable Community Strategies and Climate Protection Act of 2008	- Reduce Vehicle Miles Traveled (VMT) through greater access to alternative forms of transportation
	California Sustainable Freight Action Plan	- Improve freight system efficiency by 25% by 2030 - Deploy >100,000 freight vehicles and equipment capable of zero emission operation and maximize near-zero emission freight vehicles and equipment powered by renewable energy by 2030
	CARB Advanced Clean Cars	- By 2025, new vehicles will emit 75% less smog-forming pollutants and about one-half the GHG of the average new car sold today - Beyond 2025, 5% additional GHG emissions reductions are projected through new vehicle emissions standards - Zero Emission Vehicle Regulation requires ~15% of new cars sold in CA in 2025 to be PHEV, battery electric vehicles (BEV) or fuel cell vehicles
	Alternative Transportation	- Large Scale High Speed Rail
	Caltrans Complete Streets Implementation Action Plan	- Sustainable transportation facility for all users in rural, suburban, and urban areas
Electric Power	SB 350	- Increase the Renewables Portfolio Standard (RPS) to 50% by 2030 - Double additional achievable energy efficiency in electricity and natural gas end uses by 2030
	CPUC Rulemaking 13-09-011	- Improve Demand Response reliability and utility, in order to replace quick-start fossil-fueled generation
	AB 2514 and AB 2868	- AB 2514 requires investor-owned utilities (IOUs) to procure 1325 MW of energy storage by 2024, and AB 2868 requires an additional 500 MW
	SB 338	- Utilities are to identify carbon-free alternatives to gas generation for meeting peak demand in their integrated resources plans
Industrial	Governor Brown's Clean Energy Jobs Plan	- 6,500 MW of additional capacity from combined heat and power systems by 2030
Residential / Commercial	CPUC Long-term Energy Efficiency Strategic Plan	- Set policy goals to achieve zero net energy building (ZNE) in all new residential buildings by 2020, and all new commercial buildings by 2030
	Executive Order B-18-12	- State agencies to reduce grid-based energy purchases by at least 20% by 2018 - State agencies to reduce the GHG emissions associated with the operating functions of their buildings by 20% by 2020
	AB 758	- Requires CEC to develop and implement a comprehensive energy efficiency plan for all of California's existing buildings
Agriculture	SB 1383	- 40% reduction in methane & hydrofluorocarbon emissions by 2030 - 50% reduction in black carbon emissions by 2030
Total Scoping Plan GHG Reduction	**Combined effect of policies with cross-sector impacts**	**Approximately 132 MMT GHG Abatement**

*Zero emission vehicles primarily include Plug-in Hybrid Electric Vehicles, Hydrogen Fuel-cell Vehicles, and Battery Electric Vehicles.

GHG Abatement Methodology

Potential measures for additional GHG abatement from each economic sector were assessed across four key criteria and weighted based on their suitability for an optimized pathway to achieve the 2030 GHG goal.

Table 3 Legend

Marginal Cost	Low	Medium	High
Abatement	Low	Medium	High
Feasibility			
Enables 2050 Target			

Table 3. GHG Abatement Pathway Selection Criteria

Sectors	Measure	Marginal Cost †	Abatement Potential ‡	Feasibility	Enables 2050 Target Δ
Transportation	Light-Duty Hydrogen Fuel-Cell Trucks				
	Light-Duty Hydrogen Fuel-Cell Autos				
	Medium-Duty Hydrogen Fuel Cell Vehicles				
	Electric Light-Duty Autos				
	Electric Light-Duty Trucks				
	Heavy-Duty Hydrogen Fuel Cell Vehicles				
	Light-Duty Plug-in Hybrid Autos				
	Light-Duty Plug-in Hybrid Trucks				
	Heavy-Duty Electric Vehicles				
	Medium-Duty Electric Vehicles				
	Medium-Duty Natural Gas Vehicles				
	Aviation Efficiency				
Electric Power	Hydrogen Pipeline Injection ¶				
	Rooftop Photovoltaic (PV)				
	Renewable Diesel Production				
	Large-Scale Renewable Generation				
	Biogas				
Industrial	Process Cooling Efficiency				
	Boiler Efficiency				
	Process Heating Efficiency				
	HVAC Efficiency				
	Lighting Efficiency				
	Machine Drive Efficiency				
Residential	Air Conditioning Efficiency				
	Clothes Washer Efficiency				
	Clothes Drying Efficiency				
	Refrigeration Efficiency				
	Dishwasher Efficiency				
	Heat Pump Water Heaters				
	Other Efficiency #				
	Air Source Heat Pumps				
	Lighting Efficiency				
	Freezer Efficiency				
Commercial	Water Heating Electrification				
	Space Heating Electrification				
	Ventilation Efficiency				
	Other Efficiency				
	Lighting Efficiency				
	Refrigeration Efficiency				

† An average Marginal Cost abatement curve represents a snapshot in time and a relative cost ranking of measures.
‡ Abatement potential represents total technical potential, rather than feasible potential.
Δ Likelihood that technology will enable California to meet its 2050 GHG emissions reduction goal.
¶ Restricted by a technical limit of 7 percent natural gas replacement.

Table 4. The Clean Power and Electrification Pathway Assumptions by Sector

	Measures	Measure Assumptions	Incremental GHG Abatement Contribution*	Full Path GHG Abatement Contribution*
Transportation	**Electric Light-Duty Autos** **Electric Light-Duty Trucks** **Light-Duty Plug-in Hybrid Autos** **Light-Duty Plug-in Hybrid Trucks** **Heavy-Duty Electric Vehicles** **Medium-Duty Electric Vehicles** **Medium-Duty Natural Gas Vehicles**	• Economic adoption alone drives 2MM of the 7 MM EVs necessary in 2030, requiring state and federal support for charging infrastructure and vehicles. • Increased EV adoption to at least 7 MM vehicles requires the extension of existing state and federal subsidies. EV growth will be driven by improved technology/lower costs, purchase incentives, charging infrastructure availability, consumer education and other measures. • Ridesharing is projected to grow by 20% through 2030. Policies that encourage the electrification of rideshare services can drive increased vehicle turnover and greater EV adoption. • On a per-vehicle basis, converting an ICE vehicle to an EV has significant air quality impacts, reducing NOx emissions by 98% for light duty and medium duty vehicles, and 84% for heavy duty vehicles, in addition to having no tailpipe emissions.	15 MMT	**58 MMT**
Electric Power	**Large-Scale Renewable Generation, Energy Storage, Energy Efficiency and Distributed Solar**	• Adding up to 30 GW of large scale renewable generation combined with existing large hydro facilities can enable 80% carbon-free electricity (determined through 2030 demand forecasts, less existing renewable generation contracts). • Expanding transmission and distribution infrastructure to accommodate large-scale and distributed generation. Adding up to 10 GW of energy storage for grid balancing, in addition to current mandates. • Full pathway abatement includes the doubling of energy efficiency and additional distributed solar as defined in CARB's Proposed Scoping Plan.	15 MMT	**56 MMT**
Industrial	**Reduction in Refinery (Calculated outside of Pathways)**	• Increase in EV adoption reduces petroleum demand and associated refining.	4 MMT	**30 MMT**
Residential **Commercial**	**Heat Pump Water Heaters** **Air Source Heat Pumps** **Space Heating Electrification**	• Updating market costs and efficiency data, SCE calculated consumer adoption based on total cost of ownership. • Updated market data on cost plus policy-driven adoption in new construction leads to an increased adoption of high efficiency space and water heaters for residential buildings, totaling over 5 million units by 2030. Commercial space and water heating is also electrified and comprises 24% of thermal load. These represent up to 30% of space and water heaters expected in California in 2030.	2 MMT	**12 MMT**
Agricultural	**(Same as CARB Proposed Scoping Plan)**			**11 MMT**
Total			36 MMT	**180 MMT**

* **Incremental GHG Abatement Contribution** represents the GHG reductions from the identified technologies to meet the incremental 36 MMT of reductions after offsets to achieve California's 2030 GHG target. This 36 MMT reduction is incentivized by the cap-and-trade market under CARB's Proposed Scoping Plan. **Full Path GHG Abatement Contribution** represents both current and expected measures in CARB's Proposed Scoping Plan and the additional identified technologies used to meet the total 2030 GHG emission reduction goal.

Results Summary

Table 5 summarizes the three pathways. All scenarios include significant new electrification, in addition to major market transformations. (More information on the alternative pathways is detailed on page 6.)

Table 5. Comparing Decarbonization Pathways

	Clean Power and Electrification	Renewable Natural Gas (RNG)	Hydrogen (H2) Pathway
Carbon-Free Electricity Delivered	80%	60%	80%
Renewable Energy Over Generation	Managed through up to 10 GW of battery storage	Used to produce synthetic methane through "power to gas"	Used for hydrogen production from steam reforming and electrolysis
Transportation: Light-Duty Passenger Vehicles (EVs)	7MM EVs 24% of LDV stock	7MM EVs 24% of LDV stock	2MM EVs 4MM H2 fuel cell vehicles 22% of LDV Stock
	~13% reduction in transportation-related refinery throughout		
Transportation: Medium-Duty (MDV) and Heavy-Duty (HDV) Vehicles (Buses and Trucks)	9% MDVs, 6% HDVs are compressed natural gas (CNG)	12% MDVs, 12% HDVs are CNG	4% HDVs are H2 7% MDVs, 6% HDVs are CNG
	15% MDVs and 6% HDVs are EVs	7% MDVs and 1% HDVs are EVs	
Space and Water Heating (Residential and Commercial buildings)	Up to 30% electrification of space and water heating end uses	42% of natural gas replaced by RNG, 7% of natural gas replaced by H2	Up to 30% electrification of space and water heating end uses
Fuels and Other End Uses	7% of natural gas replaced by RNG		7% of natural gas replaced by H2 (technical limit)
Risks	- Most feasible pathway as technology already exists - Dependent on broad adoption of electrified technologies	- Power to gas not yet commercially available - A large biogas market requires expensive imports	- Most expensive pathway - Requires significant H2 adoption outside CA - Lack of sufficient delivery infrastructure
Average Abatement Cost (180 MMT)	**$37/metric ton**	**$47/ metric ton**	**$70/metric ton**
Incremental Abatement Cost (last 36 MMT)	**$79/metric ton**	**$137/metric ton**	**$262/metric ton**

Alternative Pathway 1: Renewable Natural Gas (RNG)

The RNG pathway includes the same assumptions as the CARB Proposed Scoping Plan with a few notable differences, which include:

- Higher percentage of MDV and HDV vehicles using compressed natural gas;
- Natural gas replaced in pipeline with RNG primarily from landfill capture and conversion, including the injection of hydrogen into the pipeline; and
- Renewable power over-generation is balanced on the grid through production of synthetic methane (power to gas), a technology that is not yet commercially available.

The RNG case requires less large-scale renewable generation because a large segment of the natural gas pipeline is replaced with RNG. Consequently, the cost per ton of abatement is higher due to the cost to procure and produce RNG, which would likely require significant imports into California.

Alternative Pathway 2: Hydrogen

The hydrogen pathway builds on the CARB Proposed Scoping Plan assumptions with the following differences:

- Hydrogen Fuel Cell Vehicles have higher adoption rates across two classes (light duty vehicles, medium duty vehicles);
- Hydrogen replaces pipeline natural gas for end uses up to the technical potential of 7 percent by volume (mid-range of 5-15 percent hydrogen concentration level defined in NREL's "Blending Hydrogen into Natural Gas Pipeline Networks: A Review of Key Issues"); and
- The addition of large-scale renewable generation in the hydrogen pathway is consistent with the generation capacity called for in the Clean Power and Electrification Pathway. Excess renewable generation during peak generation periods can be used in electrolysis to produce hydrogen, helping to balance the grid and reducing the need for energy storage.

The abatement cost of the Hydrogen Pathway is the highest among all three cases, due to the need for construction of hydrogen production infrastructure not currently present in California. Additionally, hydrogen production is energy intensive and its energy storage potential is limited. Infrastructure and production costs are embedded in the cost per ton.

APPENDIX II: Additional Information and Resources

Relevant Policies

Action	Authorization	Reference
Renewables Portfolio Standard (RPS): 20% by 2010 and then 33% by 2020	SB 1078 (2002)	Sen. Bill 1078, 2001-2002 1st Ex. Sess., ch. 516, *California State Legislatur*e, Sept 12, 2002. http://www.energy.ca.gov/portfolio/documents/documents/SB1078.PDF
	SB 107 (2006)	Sen. Bill 107, 2005-2006 1st Ex. Sess., ch. 464, *California State Legislature*, September 26, 2006. http://www.energy.ca.gov/portfolio/documents/documents/sb_107_bill_20060926_chaptered.pdf
	SB X1-2 (2011)	Sen. Bill X1 2, 2010-2011 1st Ex. Sess., ch. 1, *California State Legislature*, April 12, 2011. http://www.leginfo.ca.gov/pub/11-12/bill/sen/sb_0001-0050/sbx1_2_bill_20110412_chaptered.html
Target established to reduce GHG emissions 80% below 1990 levels by 2050	Executive Order S-3-05 (2005)	California Executive Order S-3-05, June 2005. https://www.gov.ca.gov/news.php?id=1861
GHG emissions target of 1990 levels by 2020 is codified and economy-wide cap-and-trade program is created	AB 32 (2006)	Assem. Bill 32, 2005-2006 1st Ex. Sess., ch. 488, *California State Legislature*, Sept 27, 2006. http://www.leginfo.ca.gov/pub/05-06/bill/asm/ab_0001-0050/ab_32_bill_20060927_chaptered.pdf
Established RPS of 50% by 2030 and new requirements for doubling energy efficiency and wide-scale transportation electrification deployment	SB 350 (2015)	Sen. Bill 350, 2015-2016 1st Ex. Sess., ch. 547, *California State Legislature*, Oct 07, 2015. https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350
GHG target of reducing emissions 40% below 1990 levels by 2030 is codified	SB 32 (2016)	Sen. Bill 32, 2015-2016 1st Ex. Sess., ch. 249, *California State Legislature*, Sept 08, 2016. https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB32
Cap-and-trade program extended to 2030 and new offset levels are defined	AB 398 (2017)	Assem. Bill 398, 2017-2018 1st Ex. Sess., ch. 398, *California State Legislature*, July 25, 2017. https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB398
CARB Proposed Scoping Plan to achieve the 2030 GHG target	CARB (2017)	AB 32 Scoping Plan, *California Air Resource Board*, last modified Jul 14, 2017, accessed Sept 13, 2017. https://www.arb.ca.gov/cc/scopingplan/scopingplan.htm
Low Carbon Fuel Standard to encourage the production and use of cleaner low-carbon fuels	Executive Order S-1-07 (2007)	*California Air Resource Board*, last modified Sept 8, 2017, accessed Sept 21, 2017. https://www.arb.ca.gov/fuels/lcfs/lcfs.htm
Zero Emission Vehicle (ZEV) Program	CARB (1990)	*California Resource Board*, last modified August 16, 2017, accessed Sept 21, 2017. https://www.arb.ca.gov/msprog/zevprog/zevprog.htm
"The Partnership for Sustainable Communities	U.S. Department of Housing and	*Sustainable Communities*, accessed Sept 21, 2017. https://www.sustainablecommunities.gov/partnership-resources/community-planning

Action	Authorization	Reference
(PSC) works to coordinate federal housing, transportation, water, and other infrastructure investments to make neighborhoods more prosperous, allow people to live closer to jobs, save households time and money, and reduce pollution. The partnership agencies incorporate six principles of livability into federal funding programs, policies, and future legislative proposals."	Urban Development (HUD), U.S. Department of Transportation (DOT), U.S. Environmental Protection Agency (EPA) 2009	

Additional Sources

CARB Scoping Plan

The 2017 climate change scoping plan update establishes a proposed framework of action for California to achieve a 40 percent GHG emissions reduction by 2030 compared to 1990 levels. The key programs under the proposed plan are the Cap-and-Trade market, the Low Carbon Fuels standard, movement toward cleaner vehicles, increasing electricity generation from renewable sources and strategies for methane emission reduction from agriculture.
https://www.arb.ca.gov/cc/scopingplan/scopingplan.htm

Energy Costs of GHG Emissions: National Pathway Clean Energy Study (NRDC)

NRDC's analysis shows that the United States can achieve 80 percent GHG emission reduction by 2050 from 1990 levels with only 1 percent cost increase compared with current U.S. energy cost. The key actions under the NRDC plan are: implement energy efficiency technologies to reduce energy demand by 40 percent, expand renewable energy to achieve 70 percent RPS by 2050, employ near-zero carbon electricity to displace fossil fuel usage in transportation, residential and commercial buildings and industry, and decarbonize remaining fuel use in transportation and industry.
https://www.nrdc.org/sites/default/files/americas-clean-energy-frontier-es.pdf

EV Market Trends

Electric cars sales are forecasted to surpass internal combustion engine sales by 2038 because electric cars could be cost competitive with gasoline models by 2025, battery manufacturing capacity will continue to grow, and lithium-ion cell cost will decline significantly. The global shift toward electric vehicles will create upheaval for the auto industry, will increase EV electricity consumption from 6 terawatt-hours in 2016 to 1800 terawatt-hours in 2040, and will affect the oil industry through gasoline demand reduction.
https://www.bloomberg.com/news/articles/2017-07-06/the-electric-car-revolution-is-accelerating

Electric vehicles are becoming increasingly common, with automakers indicating that about 70 EV passenger models will likely be available within five years. Key factors driving additional purchases of electric cars are that electric cars use far less energy than gasoline-powered cars, cost less to run and have lower maintenance costs. Limited variety among electric vehicles, high price premium and limited range are among the barriers that prevent people from purchasing EVs.
https://www.consumerreports.org/hybrids-evs/electric-cars-101-the-answers-to-all-your-ev-questions/

Mass-produced electric vehicles first entered the market late in 2010, with the benefit of high performance, safety, versatility and ability to conveniently charge at home at a low cost. Displacing gasoline with electricity also lowers emissions and decreases petroleum use. The challenge to consumers is to understand their own driving needs and how each vehicle option can meet their specific requirements as more options become available.
https://www.epri.com/#/pages/product/1023161/

Job Creation

The Bureau of Labor Statistics projects that solar PV installers and wind turbine service technicians will be the fastest growing occupations in the US from 2016 to 2026.
https://www.bls.gov/news.release/pdf/ecopro.pdf?utm_source=newsletter&utm_medium=email&utm_campaign=newsletter_axiosgenerate&stream=politics

According to a UC Berkeley report, 10,200 job years (one full time job for one year) have been created in the solar industry in California in the five years ending in 2014; in 2014, the average salary for these jobs was $78,000 per year plus benefits.
http://laborcenter.berkeley.edu/environmental-and-economic-benefits-of-building-solar-in-california-quality-careers-cleaner-lives/

CAISO's Senate Bill (SB) 350 report concluded that an additional 90,000 – 110,000 statewide jobs would be created from the 50% Renewables Portfolio Standard and also projected higher statewide gross product, real output, and state revenue across all the scenarios studied.
http://www.caiso.com/Documents/SB350Study-Volume8EconomicImpacts.pdf

The Southern California Association of Governments 2016-2040 Regional Transportation Plan is projected to create 351,000 additional jobs (in part from transportation electrification strategies).
http://scagrtpscs.net/Documents/2016/final/f2016RTPSCS.pdf

A report issued by the Union for Concerned Scientists and Greenlining Institute, reports that "California's heavy-duty EV sector is an emerging job market," and that family-supporting jobs will be available in maintenance, charging infrastructure and truck and bus manufacturing.
http://www.ucsusa.org/sites/default/files/attach/2016/10/UCS-Electric-Buses-Report.pdf

NRDC research finds that "today's automotive sector provides a powerful example of how we can simultaneously meet the nation's environmental, economic, and job-creation goals." Currently, 288,000 American workers are "building technologies that reduce pollution and improve fuel economy for today's innovative vehicles, from family sedans to long-haul tractor trailers."
https://www.nrdc.org/sites/default/files/supplying-ingenuity-clean-vehicle-technologies-report.pdf

Appendix C

SCE Electric Vehicle Charging Infrastructure Needs Assessment

SCE Electric Vehicle Charging Infrastructure Needs Assessment

Overview

SCE's charging infrastructure needs estimates are largely derived from "National Plug-In Electric Vehicle Infrastructure Analysis" developed by the National Renewable Energy Laboratory (NREL) in September 2017. NREL's analysis assessed charging infrastructure to support national and regional deployment of Battery Electric Vehicles (BEV) and Plug-in Hybrid Electric Vehicles (PHEV) through the U.S. NREL's study used the Electric Vehicle Infrastructure Projection tool (EVI-Pro), which optimizes infrastructure needs based on driving/charging simulations, spatial/temporal processing of EVSE shared use potential, and scaling to account for vehicle densities.

Methodology and Key Assumptions

SCE Methodology

SCE developed an infrastructure needs assessment by leveraging NREL's modeling results with some modified assumptions unique to SCE territory. The EVSE infrastructure assessment establishes the number of residential (Level 1 & 2), public and work (Level 2), and direct current fast chargers (DCFC) necessary to support 2.6 million EVs in SCE's territory by 2030.

Assumptions

The EVSE supply projections are primarily driven by two input variables:

- Assumed Residential Charging Capabilities (e.g. the number of vehicles with access to home-based charging and are able to embark with 100% charge in either BEV or PHEV)
- Electric Vehicle Fleet Mix (e.g. the vehicle type, share and quantity, such as PHEV20, PHEV50, BEV100 and BEV250, that are projected to be deployed in a given year)

Residential Charging

Residential charging capability is significant as it determines the range the average EV can travel before it must recharge. All vehicles with access to residential charging are therefore assumed to begin their trips with a full charge. These vehicles require less public infrastructure as the majority of trips taken in a day are able to be met with one charge. In events of limited residential charging ability, an increased number of public and work chargers are necessary for individuals to complete the same trip.

The residential charging potential for SCE was determined through a combination of housing assessments, supporting travel data analysis, and adoption of time-of-use (TOU) rates and added daytime charging facilitated through added charging infrastructure. Census data was used to determine the share of individuals that reside in single-unit dwellings (SUD) and multi-unit dwellings (MUD) with access to parking suitable for charging an EV. MUDs account for 30% of service accounts in SCE territory while SUDs account for 70%. Applying a weighted average of single- and multi-unit dwellings against average EV per household, final MUD and SUD share was calculated for residential charging potential.

For consumers that have residential charging capabilities, two plug types with varying power ratings may be used for EV charging. Consumer plug-type preference is correlated to EV battery capacity and subsequently varies significantly. Plug-type adoption is calculated as an average from two data sources;

ICF International's California Transportation Electrification Assessment[i] and California Air Resources Board's Advanced Clean Car Midterm Review.[ii] The following table summarizes residential plug type by vehicle adopted in the EVSE assessment.

	PHEV20	PHEV50	BEV100	BEV250
L1	95%	50%	54%	13%
L2	5%	50%	46%	87%

Table 1. Residential plug preference by vehicle class

Assumed increases in daytime away-from-home charging, beginning in 2024, were incorporated into the modeling of residential charging potential. Based on these findings, SCE assumes that 83% of charging occurs during the evening at residences in 2020 while the remainder of charging occurs during the day away from home. By 2030, the home charging reduces to 75% while the away-from-home charging increases to 25%.

Vehicle Forecast

SCE developed a forecast on vehicle adoption for the utility's service territory. The forecast is comprised of four vehicle types consistent with those found in the NREL 2017 report. Vehicle share remains relatively consistent from 2018 through 2030. PHEV20 account for 20%, PHEV50 account for 25% and BEV100 and 250 account for 24% and 31% respectively. In order to address consumer preference for sport utility vehicles, 7% of PHEV20 and BEV250 vehicles are projected to be SUVs. SUV share is derived from California vehicle statistics for SCE territory. Figure 3 summarizes the SCE EV adoption over time.

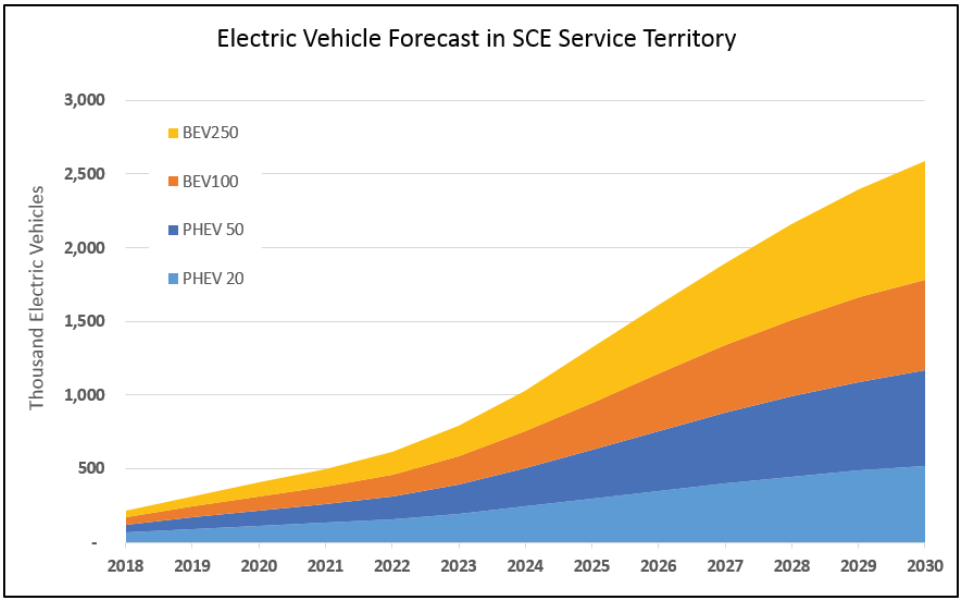


Figure 1. EV adoption forecast

EV Plug Attachment Rate

Vehicle attachment rates were developed using the EVI-Pro modeling results. The base case results of the EVI-Pro modeling provided the plug type and count for each vehicle type. The results as reported by the study address the non-residential coverage requirements for a given population and are reported as plugs per 1,000 vehicles. Figure 2 summarizes the resulting EVI-Pro and post model adjustments based on each vehicle type. The attachment rates were calculated assuming a residential charging potential of 88% and were derived from three case studies (Columbus, California, Massachusetts) and subsequently scaled to produce a national attachment rate.

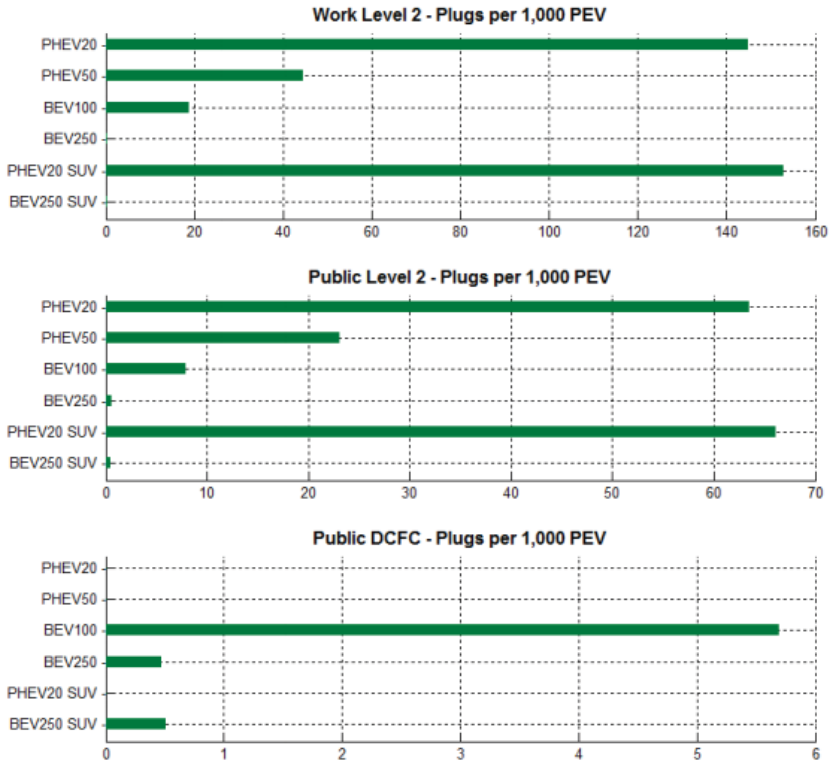


Figure 2. NREL 2017 Nominal non-residential EVSE/PEV ratios (home dominant behavior of 88%)[iii]

The reference attachment rates adopted are reported in the National Plug-In Electric Vehicle Infrastructure Analysis, which assumes a residential charging potential of 88%. As previously noted, vehicle battery capacity is a significant driver of non-residential charging infrastructure requirements maintaining the assumption of maximizing eVMT. Supporting data and analyses of charging behavior, including discussions with OEM providers, indicates that individuals with low-capacity hybrid vehicles (e.g. PHEV20) do not optimize their eVMT, but rather charge during periods of convenience. As PHEV drivers are not dependent on charging infrastructure, unlike BEV drivers, SCE determined that PHEV20 drivers charge more similarly to PHEV50 drivers. Subsequently SCE adjusted the attachment rate for PHEV20 drivers to address real-world charging behavior and match the NREL PHEV50 attachment rate. Vehicle attachment rates used in the EVSE assessment are found in Figure 1 for each vehicle class modeled.

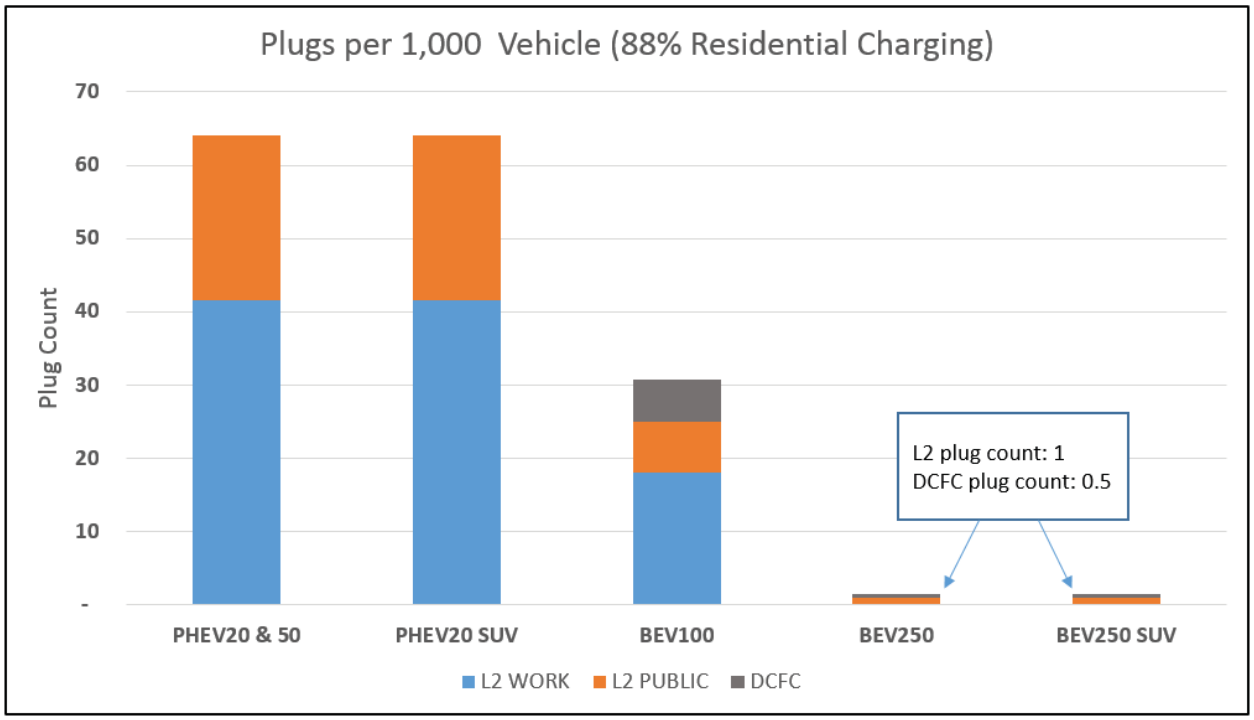


Figure 3. Away-from-home vehicle attachment rates by vehicle type (NREL 2017 assumption – PHEV20 Adjustment)

Non-residential attachment rates are determined by residential charging potential. In order to account for annual forecasted changes in residential charging potential specific to SCE territory, attachment rates for the base case (Figure 1) were linearly scaled in accordance with NREL residential charging sensitivities. This allowed SCE to determine variable attachment rates for a given population while accounting for residential charging potential in our territory.

DCFC Corridor Charging

In addition to the attachment rates described in the previous section, long-distance travel remains a primary concern of consumers and contributes to range anxiety. Addressing long distance travel, the EVSE infrastructure assessment applied the same methodology as reported by NREL.

Through the use of geographical information systems (GIS), highway and interstate corridors were separated from incorporated city limits and aggregated. This was done to avoid double counting with the spatial analyses previously modeled by EVI-Pro. The results, yielding 4,858 highway miles and 872 interstate miles, were used to determine station and plug count requirements.

The NREL reference case, supporting 7MM EVs, assumed 70 mile spacing of stations and required approximately 6 plugs per station. Though the SCE vehicle forecast for the utility's territory approaches 2.6 MM by 2030, the statewide forecast projects 7MM vehicles. Subsequently, these assumptions were maintained in order to account for statewide future growth. NREL DCFC corridor sensitivities are found in Figure 4.

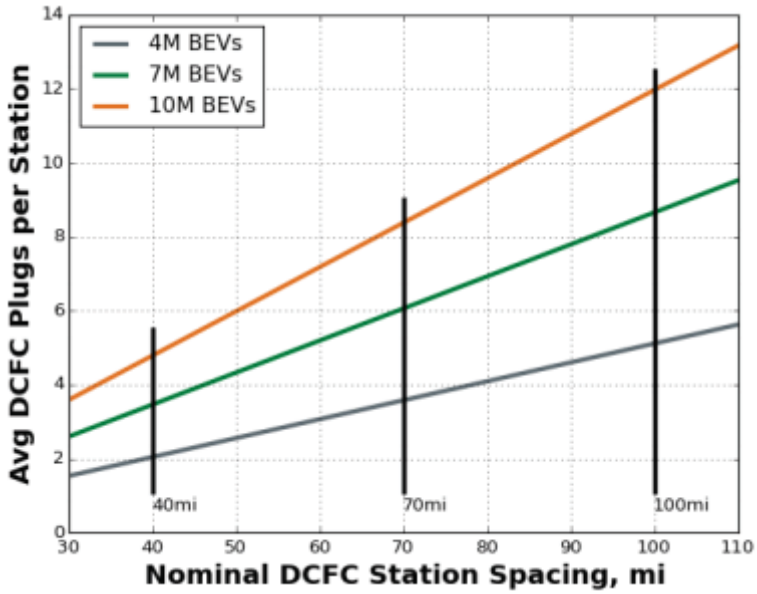


Figure 4. Nationwide corridor DCFC station count versus station spacing, annual average volume

(NREL 2017)

Results

The EVSE infrastructure assessment derive final plug counts for non-residential infrastructure requirements through applying the modified attachment rates to the vehicle forecast. Residential EVSE plug counts were derived by multiplying residential charging potential against total vehicle population. Residential plug-type was calculated by applying vehicle charging preference with the respective available vehicle population.

The results of SCE's EVSE infrastructure needs analysis for MUD, away-from-home (public and workplace), and DCFC are summarized in Figure 5.

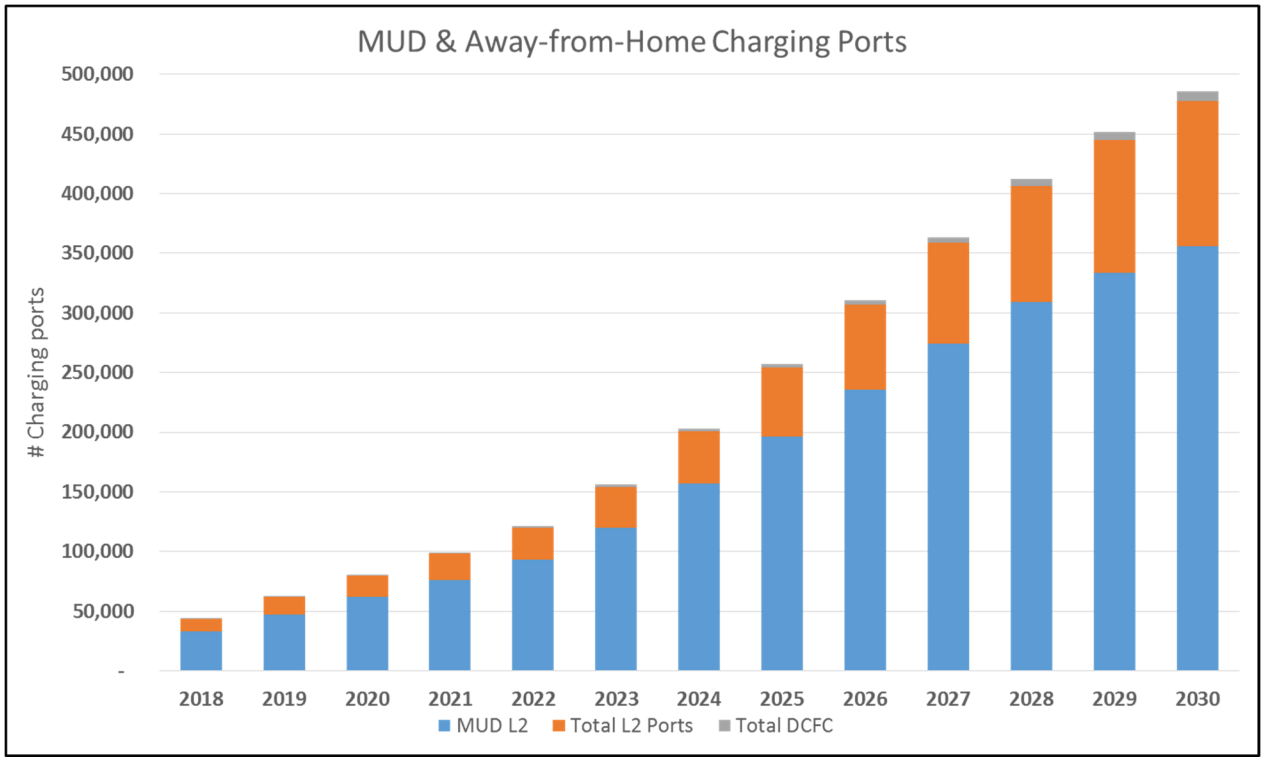


Figure 5. EVSE Infrastructure port count

The results of the EVSE infrastructure assessment represents an approximation of the infrastructure necessary to support a mixed population of BEVs and PHEVs, but uncertainty remains. Infrastructure requirements depend heavily on the types of vehicles that will be adopted in the future. As such, deviations from the vehicle forecast will change the total requirements. Additionally, there is limited data available on port sharing and utilization, which adds to the uncertainty in total ports needed.

[i] ICF International, California Transportation Electrification Assessment Phase 1: Final Report, p.85, Table 53 (Sept. 2014), available at http://www.caletc.com/wp-content/uploads/2016/08/CalETC_TEA_Phase_1-FINAL_Updated_092014.pdf.

[ii] CARB 2017. California's Advanced Clean Cars Midterm Review. https://www.arb.ca.gov/msprog/acc/mtr/acc_mtr_summaryreport.pdf

[iii] NREL 2017. National Plug-In Electric Vehicle Infrastructure Analysis pg. 14. https://www.nrel.gov/docs/fy17osti/69031.pdf

Appendix D

Program Size and Infrastructure Model

Charge Ready 2 Program Size

SCE used internal modeling and a series of census data points to scale the total forecasted infrastructure need to an achievable target for Charge Ready 2. Even though SCE's analysis derives specific port numbers for each customer segment, the results are not intended to set segment-specific goals for the program. Instead, the segment targets were aggregated to determine a total port goal for the program. The ultimate deployment will depend on customer interest, participation and other programmatic targets.

Using the results of the EVI-Pro model (as adjusted by SCE and described in Appendix C, "SCE Electric Vehicle Charging Infrastructure Needs Assessment"), SCE developed an assessment of infrastructure need that could be targeted in Charge Ready 2. Table 1, below, highlights the cumulative annual need for each charging segment and highlights the focus of Charge Ready 2 on MUD, workplace and public infrastructure from 2020-2023.

Table 1: Cumulative EVSE infrastructure need in SCE territory

Segment	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Single-Family (L1)	83,200	117,523	150,143	182,303	220,270	280,381	360,207	443,944	527,559	606,943	677,115	725,524	769,721
Single-Family (L2)	63,298	94,041	124,701	155,821	193,855	255,220	338,964	430,839	523,829	615,237	698,921	760,205	815,820
MUD	32,878	47,481	**61,683**	**75,885**	**92,942**	**120,204**	156,914	196,327	235,962	274,292	308,822	333,440	355,841
Work	6,878	9,380	**11,969**	**14,520**	**17,524**	**22,292**	28,619	37,782	46,453	55,251	63,693	72,902	79,915
Public	3,617	4,932	**6,292**	**7,633**	**9,212**	**11,722**	15,056	19,888	24,468	29,120	33,589	38,471	42,197
DCFC City	446	615	810	1,004	1,238	1,607	2,104	2,980	3,792	4,661	5543	6,640	7,440
DCFC Corridor	0	41	82	123	164	205	246	287	327	368	409	450	491

Multi-unit dwellings

SCE used only the incremental port growth forecasted from 2020-2023 to size the program. This approach assumes that other market forces would be relied upon to satisfy the incremental port need between today and the launch of Charge Ready 2. SCE's infrastructure model estimates incremental port need in MUDs to be 72,723 ports.

Charge Ready 2 proposes a minimum installation of two ports per site. Consequently, only sites with enough parking spaces to be reserved as "EV-only" are assumed to be participants.[1] Consequently, SCE chose to reduce the total incremental forecast by the proportion of MUD sites with more than 20 parking spaces. SCE used MUD property data from CoStar's commercial real estate database[2] to determine that 17 percent of MUD sites contained more than 20 parking spaces. Table 2 shows the breakdown of sites by number of parking spaces. Applying this factor, the total forecasted MUD ports was reduced to 12,089.

Table 2: Parking spaces at MUDs in SCE territory

Parking Spaces	Total MUD Properties (SCE)	Share
1-5	9,506	16%
6-10	17,841	30%

[1] In the Charge Ready Phase 1 Pilot, SCE received feedback from MUD site hosts that parking space limitation were a significant factor preventing participation.

[2] CoStar Realty Information. (2017, October). Data on multi-family properties located within SCE by address and zipcode. Retrieved from http://www.costar.com/

11-20	10,791	18%
21-30	2,954	5%
31-40	1,615	3%
41-50	1,015	2%
51-100	2,051	3%
>100	2,401	4%
Unknown	12,200	20%
TOTAL	**60,374**	**100%**

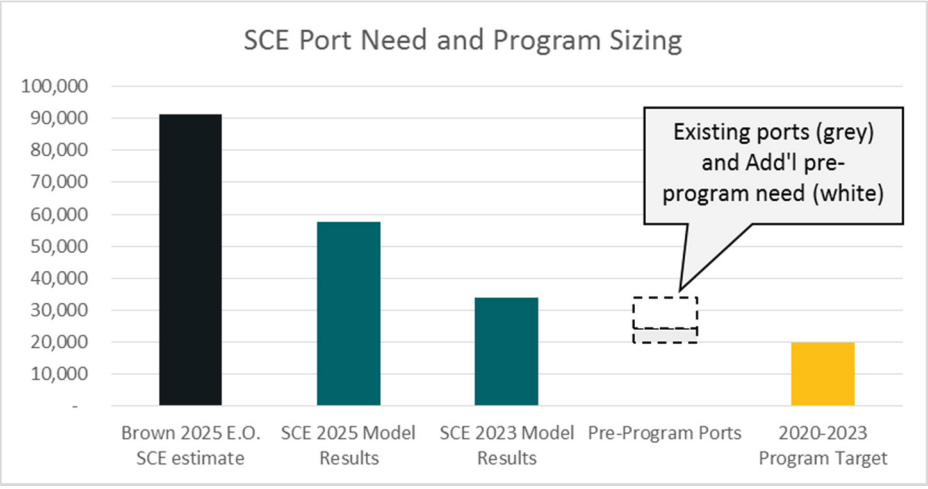
Workplace and public (Away-from-home) infrastructure

The total away-from-home charging port need is 34,014 by 2023. SCE, again, used only the incremental port growth forecasted from 2020-2023 to size the program. SCE's infrastructure model estimates incremental port need in away-from-home locations is 12,912 at workplaces and 6,790 at other public locations for a total of 19,703 ports (42% reduction from 2023 total).

SCE chose not to further reduce the incremental results for away-from-home charging during the program for two main reasons. First, port deployment in the Charge Ready Phase 1 Pilot was overwhelmingly concentrated in these segments, 97 percent of the installations were at workplaces and public sites.[3] Additionally, the away-from-home market segment is meaningful and significant; it increases charging availability, provides additional charging opportunities for customers who do not have access to home charging, and provides infrastructure that enables day-time charging options to better integrate solar generation. Consequently, SCE believes this market segment will continue to be a major contributor to deployments in Charge Ready 2.

Chart 1 shows SCE proposed away-from-home deployments compared to goals expressed by Governor Brown in Executive Order B-48-18. This comparison shows the need for additional players to be participating in the market beyond Charge Ready 2 to achieve state goals.

Chart 1 – Charge Ready 2 port need comparison to California goals[4]



[3] 35/1066 or ports with reserved funding were at non-MUD sites. As of March 2018.

[4] E.O. B-48-18 calls for 240,000 charging ports by 2025. SCE portion assumed to be 91,200 ports or 38% of total. Percentage based on SCE share of 2017 light-duty vehicle sales (all fuel types).

DCFC

SCE used census data on number of employees at commercial establishments to estimate the number of sites that may be interested in installing DC fast charging ports. The number of employees was assumed to represent the number of available parking spaces at a commercial establishment. SCE assumed that sites with 50 or more employees (therefore, more than 50 parking spaces) are likely to be interested in DCFC at their location. According to Census data, 5.4% of businesses in SCE territory have 50 or more employees.

SCE applied this percentage to the total away-from-home ports described above to estimate the number of DCFC ports. SCE then assumed a simple 80/20 split of sites that would install one port versus those that would install 2 ports. This simple estimate translates to an average site installation of 1.2 ports per site.

Table 3 – US Census[5]

Employees	Total Establishments by Number of Employees	Share
1-4	433,010	56.7%
5-9	130,676	17.1%
10-19	91,562	12.0%
20-49	68,108	8.9%
50-99	23,698	3.1%
100-249	12,700	1.7%
250-499	2,978	0.4%
500-999	998	0.1%
1,000+	608	0.1%
TOTAL	**764,338**	**100%**

[5] American Fact Finder – Census Bureau. The raw data provide numbers of business establishments by employment size class for detailed industries. Statistics are provided by detailed industry for five-digit ZIP codes. We then work with our GIS team to determine the ZIP codes within SCE service territory, and summarized the below statistics based on that. United States Census Bureau. "Business Patterns" census.gov. 2015. Web. March 2018, *available at* https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=BP_2015_00CZ2&prodType=table

Appendix E

Charging Standards and Definitions

CHAdeMo: A connector and communication protocol for vehicle DC charging initially developed in Japan during 2005-2009. It was first adopted into international standards IEC 61851-23/24 and IEC 62196-3 in 2014 and then into USA standard IEEE 2030.1.1 in 2015. Further updates to the protocol are managed by the CHAdeMO Association.[1]

Combined Charging System (or Combo/CCS) Connector: A connector that supports both AC J1772 and DC Charging and created by the Society of Automobile Engineers, which is a standards development organization for vehicle technology.[1]

Direct Current Fast Charger (DCFC): Charging at 20 kW and higher using direct current. Direct-current (DC) fast charging provides 50 to 70 miles of range per 20 minutes of charging with an electrical output ranging between 50-120 kW. A charging station that rapidly charges a car battery by connecting it directly to a higher power, direct-current source.[1]

EV Supply Equipment (EVSE): (1) the equipment that interconnects the AC electricity grid at a site to the EV. 2) Sometimes used more broadly to mean charging station, whether AC or DC, but not including the make-ready infrastructure or other charging infrastructure. May include multiple connectors (called multi-port) to charge several EVs or to serve EVs with different types of standard connectors (e.g. SAE Combo and CHAdeMO). .[1]

EVSE Charging Port: Plug or connector on an EVSE capable of plugging into a vehicle for charging it. One EVSE may have multiple charging ports.

Level 1 (L1) Charging: AC Level 1 provides 1 to 5 miles of range per 1 hour of charging using 120VAC electrical service.[1]

Level 2 (L2) Charging: AC Level 2 provides 10 to 20 miles of range per 1 hour of charging using 240VAC or 208VAC electrical service.[1] L2 charging is faster than L1 because it delivers a higher power level to the battery through the EVSE.

Make Ready: Service connection and supply infrastructure to support EV charging comprised of the electrical infrastructure from the distribution circuit to the stub of the EVSE. It can include equipment on the utility-side (e.g., transformer) and customer-side (e.g., electrical panel, conduit, and wiring) of the meter.[1]

Site: Location at which charging infrastructure is installed.[1]

[1] Definitions are taken from D.18-05-040.

Transportation Electrification: The use of electricity from an external source to fuel all, or part, of the energy needs of vehicles, vessels, trains, boats, or other mobility equipment.[1]

Vehicle Charge Port: Generally, refers to the location where the EVSE Charging Port connector attaches to the vehicle.

Appendix F

Charging Station Standards and Technologies

Charging Station Standards and Technologies

The following table defines the different types of electrical vehicle charging specifications and charging connectors. The most popular chargers deployed in the Charge Ready Phase 1 Pilot were Level 2 units rated at 6.6kW. For reference, most onboard light-duty pure electric vehicle chargers are 6.6kW.[1]

Level	Nominal Supply	Max Power Output	Standard
Level 1 (L1)	120 V AC 12 Amps[2]	1.4 kW	SAE J1772
	120 V AC 16 A	1.9 kW	
Level 2 (L2)	208 to 240 V AC up to 80 Amps[3]	19.2 kW	SAE J1772
Three-Phase AC	208 V or 480 V 3-phase	NS	SAE J3068
DC Charging (DCFC)	208 V single-phase or 208 V or 480 V 3-phase	Up to 400 kW (V.7)	SAE J1772 (CCS-1) Or IEEE 2030.1.1 (CHAdeMO)

As outlined in Testimony Section II.A.6, Advancing New Technologies, SCE aims to evaluate new technology and standards throughout the course of the program. As they become available, SCE may add charging standards and connectors recognized by a national standards body into the Charge Ready 2 program, as appropriate.

[1] *See* A Simple Guide to Electric Vehicle Charging, *available at* https://www.fleetcarma.com/electric-vehicle-charging-guide/.
[2] Typically used for home use at 240VAC and 12 Amps.
[3] L1 1.9 kW and L2 6.6kW were both offered in Charge Ready 1.

Appendix G

List of Community Based Organizations (CBOs)

Organization
100 Black Men of Long Beach, Inc.
100 Black Men of Orange County Inc.
1736 Family Crisis Center
2020 Women On Boards
29 Palms Art Gallery
88 Impact Foundation
A Chance For Children Foundation Inc
A New Way Of Life Reentry Project
A Noise Within
A Place Called Home
AbilityFirst
Academy for Grassroots Organizations
Access California Services
ACE Foundation
Ace Mentor Los Angeles Metropolitan Area Inc.
Achievement Institute of Scientific Studies
Achieving My Dreams Foundation
Act For Women And Girls
Adelante Youth Alliance

Advance A Non Profit Corporation
Advancement Project
African American Male Achievers Network
African American Male Educational Network Development (A2MEND)
African American Unity Center
After-School All-Stars, Los Angeles
Age Well Senior Services
Agua Caliente Band of Cahuilla Indians
Agua Caliente Cultural Museum
Ahahui O Lili Uokalani Hawaiiancivic Club Inc
AICCU Research Foundation - California Education Round Table ICC
Aids Food Store
Ainahau O Kaleponi Hawaiian Civic Club
Algalita Marine Research Foundation
Alhambra Public Library Foundation
All From The Heart Inc
Alliance for a Better Community
Alliance for the Arts
Alliance to Save Energy
Alpha Enterprises

AltaSea at the Port of Los Angeles
Alzheimer's Orange County
Amazon Institute
American Association of Blacks in Energy
American Association Of University Women (AAUW) - Antelope Valley
American Association Of University Women (AAUW) - San Clemente
American Council for an Energy-Efficient Economy
American Family Housing - Shelter for the Homeless
American Indian Community Council
American Red Cross - Greater Los Angeles
American Red Cross - San Bernardino County
American Wheat Mission Inc
Amigos De Los Rios
Angel City Chapter, Links, Inc.
Angel View Crippled Children
Angels for Sight
Antelope Valley Boys & Girls Club
Antelope Valley Chamber Of Commerce Education Fund
Antelope Valley College Foundation
Antelope Valley Disaster Relief Network, Inc

APAC Service Center
Aquarium of the Pacific
ARC of Southeast Los Angeles County
Archbishop Hanna High School
Armed Services YMCA - Camp Pendleton
Armed Services Ymca Of The Usa
Arroyos and Foothills Conservancy
Arts and Services for Disabled
Arts Connection
Arts Council for Long Beach
Arts Science and Technology Education Corporation
Arts Visalia
Asian American Drug Abuse Program, Inc.
Asian American Education Institute
Asian American Education Institute - National Association of Asian Pacific Islanders in Politics and Public Affairs
Asian American Professional Association
Asian American Resource Center
Asian American Senior Citizens Service Center
Asian Americans Advancing Justice - Los Angeles
Asian Americans Advancing Justice Los Angeles - API Equality-LA

Asian Americans Advancing Justice Los Angeles - Empowering Pacific Islander Communities
Asian Americans In Energy-The Environment And Commerce
Asian and Pacific Islander American Scholarship Fund
Asian and Pacific Islander Legislative Caucus Foundation
Asian Pacific American Dispute Resolution Center of Los Angeles
Asian Pacific American Leadership Foundation
Asian Pacific Community Fund
Asian Pacific Islander Small Business Program, Inc.
Asian Pacific Policy and Planning Council
Asian Women Entrepreneurs
Asian Youth Center
Asians and Pacific Islanders with Disabilities of California
Asociacion Cultural De South Bay Of Greater Los Angeles
Aspen Institute
Assistance League - Arcadia
Assistance League - Capistrano Valley, Inc.
Assistance League - Covina Valley
Assistance League - Downey
Assistance League - Foothill Communities
Assistance League - Hemacinto

Assistance League - Long Beach
Assistance League - Los Angeles
Assistance League - Palm Springs Desert Area
Assistance League - Pomona Valley
Assistance League - Riverside
Assistance League - Saddleback Valley
Assistance League - San Bernardino
Assistance League - Temecula Valley
Assistance League - Victor Valley
Assistance League - Whittier
Association Of California Cities
Autry Museum of the American West
Avalon Rotary Club Foundation
Azusa Pacific University
Back To Natives Restoration
Bakersfield ARC, Inc.
Bakersfield Association for Retarded Citizens, Inc.
Bakersfield College Foundation
Bakersfield Police Activities League
Baldy View Rop Foundation

Barstow College Foundation
Barstow Senior Citizen Center
Basin Wide Foundation
Being Alive
Bernard and Shirley Kinsey Foundation for Arts and Education
Best Partners (AKA: Energy Conservation Consultants, Inc - ECC)
Bet Tzedek
Bethel Baptist Church
Big Brothers Big Sisters - Greater Los Angeles
Big Brothers Big Sisters of Central CA
Big Brothers Big Sisters of Orange County
Big Brothers Big Sisters of the Desert
Big Brothers Big Sisters of the Inland Empire
Big Brothers Big Sisters of Ventura County, Inc.
Bilingual Foundation of the Arts
Bishop Indian Tribal Council
Bishop Museum and Historical Society
Bishop Paiute Tribe
Black Voice Foundation, Inc.
Black Women for Wellness

Blueprint Earth
Book Outreach
Boy Scouts - Greater Los Angeles Area Council
Boy Scouts of America - Long Beach Area Council
Boy Scouts of America - Southern Sierra Council
Boy Scouts of America - W. LA County Council
Boy Scouts of America Orange County
Boys & Girls Club of Stanton
Boys and Girls Club - Anaheim
Boys and Girls Club - Anderson Youth Center
Boys and Girls Club - Antelope Valley
Boys and Girls Club - Barstow
Boys and Girls Club - Bay Laurel Club
Boys and Girls Club - Brea Placentia Yorba Linda
Boys and Girls Club - Buena Park
Boys and Girls Club - Burbank
Boys and Girls Club - Camarillo
Boys and Girls Club - Capistrano Valley
Boys and Girls Club - Carpinteria
Boys and Girls Club - Carson

Boys and Girls Club - Cathedral City
Boys and Girls Club - Catlin Club
Boys and Girls Club - Chaparral
Boys and Girls Club - Conejo and Las Virgenes
Boys and Girls Club - Cypress
Boys and Girls Club - Desert Hot Springs
Boys and Girls Club - East Valley
Boys and Girls Club - Eastside/Belvedere
Boys and Girls Club - Fontana
Boys and Girls Club - Foothills
Boys and Girls Club - Fullerton
Boys and Girls Club - Garden Grove
Boys and Girls Club - Goleta
Boys and Girls Club - Greater Oxnard/Port Hueneme
Boys and Girls Club - High Desert
Boys and Girls Club - Hollywood
Boys and Girls Club - Huntington Valley
Boys and Girls Club - Johnston Club
Boys and Girls Club - Kern County
Boys and Girls Club - La Habra

Boys and Girls Club - La Puente
Boys and Girls Club - Laguna Beach
Boys and Girls Club - Long Beach
Boys and Girls Club - Los Angeles
Boys and Girls Club - Menifee Valley
Boys and Girls Club - Moorpark
Boys and Girls Club - Mountain Communities
Boys and Girls Club - Oceanside
Boys and Girls Club - Orange Coast
Boys and Girls Club - Palm Springs
Boys and Girls Club - Pasadena
Boys and Girls Club - Perris
Boys and Girls Club - Pomona
Boys and Girls Club - Redlands
Boys and Girls Club - Redwood
Boys and Girls Club - Salesian
Boys and Girls Club - San Fernando Valley
Boys and Girls Club - Santa Barbara County
Boys and Girls Club - Santa Barbara Westside
Boys and Girls Club - Santa Clara Valley

Boys and Girls Club - Santa Clarita Valley
Boys and Girls Club - Santa Monica
Boys and Girls Club - Sequoia Club
Boys and Girls Club - Simi Valley
Boys and Girls Club - South Coast
Boys and Girls Club - Southwest County
Boys and Girls Club - Stanton
Boys and Girls Club - The Harbor Area
Boys and Girls Club - The Los Angeles Harbor
Boys and Girls Club - The Sequoias
Boys and Girls Club - Tustin
Boys and Girls Club - Ventura
Boys and Girls Club - Vista
Boys and Girls Club - Watts/Willowbrook
Boys and Girls Club - West San Gabriel Valley
Boys and Girls Club - Whittier
Boys Hope Girls Hope of Southern California
Boys Town California, Inc.
Boys&Girls Club of San Gabriel
BREATHE California of Los Angeles County

Bresee Foundation
Bridgeport Indian Colony
Bright Prospect
Brightest Star, Inc.
Brother Benno Foundation, Inc.
Buddhist Tzu Chi Foundation
Building Resilient Communities
C5 Youth Foundation Of Southern California Inc
Cabots Museum Foundation
Cabrillo Economic Development Corporation
Cal Poly Pomona Foundation Inc
Cal State Bakersfield Foundation
Cal State Fullerton Philanthropic Foundation
Cal State Long Beach - Antelope Valley Campus
California Armenian Legislative Caucus
California Association of Nonprofits
California Bar Foundation
California Center
California Desert Land Conservancy
California Federation of Womens Clubs

California Fire Chiefs Ems Fire And Education Foundation
California Firefighters Foundation
California Foundation For Independent Living Centers
California Greenworks, Inc.
California Indian Legal Services
California Institute of Technology
California Latino Environmental Advocacy Network
California Latino Leadership Institute
California League of Conservation Voters Education Fund
California Legislative Black Caucus Policy Institute
California Oil Museum Foundation Incorporated
California Poly - San Luis Obispo
California Poly, San Luis Obispo - SWE
California Science Center Foundation
California State Parks Foundation
California State Summer School Arts Foundation
California State University - Northridge Foundation
California State University Channel Islands Foundation
California State University Dominguez Hills Philanthropic Foundation
California State University Foundation

California State University Fresno Foundation
California State University Long Beach Research Foundation
California State University Northridge Foundation
California State University San Marcos Foundation
California Strawberry Growers' Scholarship Fund
California Trout
California Wildlife Center
California Women Lead
Calstart, Inc.
Cambodia Town, Inc
Cambodian Family, The
Camp Quest West
Campaign for College Opportunity
Capistrano Unified School District Foundation Foundation
Caregivers: Volunteers Assisting The Elderly
Carnegie Art Museum Cornerstones
Carnegie Art Museum Cornerstones
Carson African American Empowerment Coalition
Carson Citizens Cultural Arts Foundation
CASA of Los Angeles

CASA of Orange County
Casa Pacifica Centers For Children And Families
Casa Romantica Cultural Center
Casa Youth Shelter
Catalina Choices, Inc.
Catalina Island Womens Forum
Cathedral Center
Catholic Big Brothers Big Sisters Inc.
Catholic Charities - Los Angeles
Catholic Charities of Los Angeles, Inc.
CCC Foundation
Center for Asian American United For Self Empowerment
Center for Energy Efficiency and Renewable Technologies
Center for Energy Workforce Development
Center For Sustainable Energy
Center for the Pacific Asian Family, Inc.
Center Theatre Group of Los Angeles
Central American Resource Center
Central Coast Alliance United For A Sustainable Economy
Central Sierra Historical Society and Museum, Inc.

Central Ventura County Fire Safe Council
Centro Community Hispanic
Century Villages At Cabrillo Inc
Cerritos College Foundation
Cesar Chavez Foundation
Chaffey College Foundation
Chamber of Commerce - Apple Valley
Chapman University
Charitable Fund Benefitting Gardena
Charles Drew University of Medicine and Science
Chemehuevi Indian Tribe
Cherished Hands Foundation
Chicano and Latino Youth Leadership Project, Inc.
Child Advocates Of San Bernardino County
Children Today
Children Youth and Family Collaborative
Children's Bureau of Southern California
Children's Burn Foundation
Children's Education Foundation of Orange County
Children's Fund

Children's Institute International
Children's Maritime Foundation
Childrens Museum of Santa Barbara
Children's Museum of the Desert
Childrens Network International
Chinatown Service Center - Los Angeles
Chinese Christian Herald Crusades
Chinese-American Engineers and Scientists Association
Chino Hills State Park Interpretive Assocation
Chino Neighborhood House
Chino Youth Museum
Choice Group Inc
CHP 11-99 Foundation
Christ Unity Center
Circle of Change Foundation, Inc.
CitiHousing Real Estate Services
Citrus College Foundation
Citrus Valley Health Partners
City Impact
City of Barstow

City of Beaumont Senior Center
City of Bishop
City of Blyth
City of Canyon Lake
City of Fillmore
City of Gardena
City of La Palma
City of Menefee
City of Montebello
City of Moorpark
City of Orange Public Library Foundation
City of Palos Verdes Estates
City of Plan Desert
City of Pomona
City of San Gabriel
City of Santa Paula
City of Sierra Madre
City of Tehachapi
City of Tulare
City of Visalia

City Scholars Foundation
City Year, Inc.
Claremont Graduate University
Claremont McKenna College
Climate Action Reserve
Climate Resolve
Coachella Valley Economic Partnership
Coachella Valley Housing Coalition
Coachella Valley Rescue Mission
Coachella Vally Council of Governments
Coalition for Clean Air
Coalition For Responsible Community Development
Coastline Community College Foundation
Colburn School of Performing Arts
College Bound - Greater Los Angeles Area
College of the Canyons Foundation
College of the Desert Foundation
College of the Sequoias Foundation
College Of The Sequoias Foundation - Hanford Campus
College Of The Sequoias Foundation - Tulare Campus

College Summit California
Collegespring Inc
Collette's Children's Home
Columbia Memorial Space Science Learning Center Foundation
Communities Actively Living Independent & Free
Communities In Schools of Los Angeles
Community Action Partnership of Orange County
Community Action Partnership of Riverside County
Community Advocate for People's Choice
Community Asset Development Re-Defining Education
Community Center at Tierra Del Sol
Community Coalition For Substance Abuse Prevention & Treatment
Community Coalition For Substance Abuse Prevention and Treatment
Community Environmental Council
Community Foundation
Community Foundation - Environmental Education Collaborative
Community Foundation - Lake Elsinore Valley Education Foundation
Community Health Action Network
Community Housing Corp. - Orange County
Community Pantry

Community Partners
Community Partners - African American Board Leadership Institute
Community Partners - California Safe Schools
Community Partners - Christmas in July
Community Partners - College Bound Today
Community Partners - College Match
Community Partners - Educate California
Community Partners - Get to Know
Community Partners - Green Camps Initiative
Community Partners - Move LA
Community Partners - STEAM:CODERS
Community Partners - Sustainable Works
Community Partners - TXT: Teens Exploring Technology
Community Partners - URBAN Teens eXploring Technology
Community Partners - VerdeXchange Institute
Community Partners - Wildwoods Foundation
Community Partners El Monte Promise Foundation
Community Partners Inc - Girls Fly!
Community Recovery Team Inc
Community Seniorserv, Inc.

Community Service Programs, Inc.
Community Services and Employment Training, Inc.
Community Settlement Association
Concerned Resource and Environmental Workers
Concordia University Foundation
Conejo Open Space Foundation
Congress of California Seniors
Conservation Corps - Long Beach
Conservation Lands Foundation
Constitutional Rights Foundation
Consumer Coalition of California
Continuing The Dream
Cool The Earth, Inc.
Copper Mountain College Foundation
COR Community Development Corporation
Coro Southern California
Corona Parent Advisory Group
Corona Symphony Orchestra
Corona-Norco Family YMCA
Council for Watershed Health

Council of African American Parents
Council on Aging - Orange County
Council on Aging - Orange County (HICAP)
County of Los Angeles
County of Riverside
County of Santa Barbara Arts Fund
Court Appointed Special Advocates Of Kern County
Cove Communities Senior Center
Crafton Hills College Foundation
Creative Center
Creative Teachers
CREER Communidad Y Familia
Crown Jewel Club
Crystal Cove Alliance
CSULA Auxiliary Services Inc.
CSULA Auxiliary Services, Inc.
CSULB 49er Foundation
CSUSB Philanthropic Foundation
Cucamonga Christian Fellowship
Culver City Centennial Celebration Committee Inc

Cypress College Foundation
David and Margaret Home, Inc.
Delhi Center
Desert Manna Ministries, Inc.
Desert Mountain Resource Conservation and Development Council
Desertarc
Designated Exceptional Services For Independence
Disability Rights Legal Center
Disabled Resources Center, Inc.
Discovery Cube of Orange County
Discovery Cube's Ocean Quest
Don Bosco Technical Institute
Dos Pueblos Engineering Academy Foundation
Downtown Women's Center
Dramatic Results
Duarte Community and Educational Foundation
East Los Angeles College Foundation
East Los Angeles Women's Center
East San Gabriel Valley Japanese Community Center
East West Players, Inc.

East Yard Communities for Environmental Justice
Eastern Sierra Foundation
Eastern Sierra Land Trust
Eastern Sierra Wildlife Care
ECLIPSE, Inc.
Eddie Nash Foundation
Edison International's Relief Fund
Educating Young Minds, Inc.
Educational Student Tours Inc
Edwin And Dorothy Baker Foundation
El Camino Community College District Foundation
El Centrito Family Learning Centers
El Concilio Family Services
El Conicilio Family Services
El Viento Foundation
Elevate Your G.A.M. E.
Embracing Latina Leadership Alliances
Empowher Institute, Inc.
EnCorps, Inc.
Energy Assistance Fund (EAF)

EnrichLA
Entrenous Youth Empowerment Services
Environmental Justice Coalition For Water
Environmental Nature Center
Equal Justice Works
Equality California Institute
Eubanks Conservatory of Music and Arts, Inc.
Exceptional Children's Foundation
Executive Services Corps of Southern California
Explore Ecology
Fair Housing Council of Riverside County, Inc
Faith Temple Church
Families Forward
Families In Schools
Family Assistance Ministries
Family Service Agency - Santa Barbara
Family Service Association
Family Service Association - Redlands
Family Service Association of Redlands
Family Services Of The Desert Inc

Family YMCA of the Desert
FIRST - For the Inspiration and Recognition of Science and Technology
First Star, Inc.
Fisler Foundation For The Advancement Of Science And Technol
Five Acres
Flintridge Center
Food Share
Foodbank of Santa Barbara County
Foothill Unity Center
Ford Theatre Foundation
Forgiving For Living, Inc.
Foundation for Leadership California
Foundation for Los Angeles Community College District
Foundation for Public Affairs
Foundation for Santa Barbara City College
Foundation for Second Chances, Inc.
Friendly Center, Inc.
Friends of A K Smiley Library
Friends of Ballona Wetlands
Friends of Cabrillo Marine Aquarium

Friends of San Clemente Beaches, Parks and Recreation Foundation
Friends of Sisters at the Well, Inc.
Friends Of The Auberry Library
Friends of the Children's Museum at La Habra
Friends of the Community Arson Watch & Disaster
Friends of the Desert Mountains
Friends of the Inyo
Friends of the LA County Law Library
Friends Of The Long Beach Firefighters
Friends of the Los Angeles River
Friends of the Saban Community Clinic
Friends of the Temecula Childrens Museum
From Lot To Spot, Inc.
Frontier Project Foundation
Fulfillment Fund
Fullerton College Foundation, Inc.
Fund For Resource Conservation
Gamma Zeta Boule Foundation
Ganna Walska Lotusland
Gardena Valley Japanese Cultural Institute

Gay and Lesbian Alliance Against Defamation
Gay and Lesbian Community Services Center of Orange County
Gay Men's Chorus of Los Angeles
George C and Hazel H Reeder Heritage Foundation
George Washington University Law School
Get Inspired
Girl Scout Council of Orange County
Girl Scouts of California's Central Coast
Girl Scouts of Central California South
Girl Scouts of Greater Los Angeles
Girl Scouts Of San Gorgonio Council
Girls Incorporated of Greater Santa Barbara
Girls Today Women Tomorrow
Girls, Inc. - Orange County
Girls, Incorporated of Carpinteria
Girlshood
Glendora Community Conservancy
Go! The Calendar Stop
Golden Heart Ranch
Golden West College Foundation

Good Shepherd Center for Homeless Women and Children
Goodwill Industries of Orange County California
Goodwill Industries of Southern California
Goodwill Serving The People of Southern Los Angeles County
Governors Cup Foundation Inc
Grades of Green, Inc.
Grammy Museum Foundation, Inc.
Grand Vision Foundation
Grandmas House - A Vision of Hope
Grandmas House Of Hope
Grassroots Community Network Connecting Communities
Great Minds in STEM
Great Opportunities
Greater Los Angeles Zoo Association
Greater Palm Springs Pride Inc.
Green Dot Public Schools
Green Education Inc
Greenlining Institute
Grid Alternatives - Los Angeles
GRID Alternatives - Riverside

Grossman Burn Foundation
Habitat for Humanity - Pomona Valley
Habitat for Humanity - San Bernardino
Habitat for Humanity - Ventura
Habitat for Humanity Greater Los Angeles
Habitat for Humanity of Tulare County
Habitat For Humanity San Fernando/Santa Clarita Valleys
Happy Trails For Kids
Hart Community Homes, Inc.
Harvey Mudd College
Haven Hills Inc.
Heal the Bay
Heart of Compassion
Help of Ojai, Inc.
Helping Others Prepare For Eternity
Helpline Youth Counseling, Inc.
Henry E. Huntington Library and Art Gallery
Hernandez Mariachi Heritage Society
Heroes Hall Veterans Foundation
High Desert Partnership in Academic Excellence Foundation

High Desert Transitional Living Connection
High Sierra Energy Foundation
Highway 168 Fire Safe Council
Hispanas Organized for Political Equality
Hispanic 100 Foundation
Hispanic Outreach Taskforce
Hollenbeck Police Activities League
Home of Neighborly Service
Homeboy Industries
Homer F. and Marian G. Broome Family Foundation
Hope Through Housing Foundation
Hour of Truth Ministry
Housing Authority - City of San Buenaventura
Housing Authority of the County of Los Angeles
Hubbs-SeaWorld Research Institute
Hugh O'Brian Youth Leadership
Human Services Association
Huntington Lake Big Creek Historical Conservancy
Huntington Park Youth Foundation
I Have A Dream Foundation - Los Angeles

Ideal Youth Incorporated
Illumination Foundation
Imagine Community Arts Center Inc
Incredible Edible Community Garden
Indian Land Tenure Foundation
Indian Wells Valley Concert Association
Infinite Learning
Inland Empire Conurned African American Churches
Inland Empire Scholarship Fund
Inland Wellness Information Network Inc
Inner City Law Center
Inner City Youth Orchestra Of Los Angeles Incorporated
Inner-City Arts
InnerCity Struggle
INROADS Pacific Southwest Region, Inc.
Inside the Outdoors Foundation
Inspire Life Skills Training, Inc.
Institute for Corporate Counsel
Institute for the Redesign of Learning
Institute of Art, Music and Science

Institute of Electrical and Electronics Engineers, Inc.
Integrated Rehabilitation Therapies, Inc.
International Womens Media Foundation
Interval House
Irvine Public Schools Foundation
Irvine Valley College Foundation
Japan America Society of Southern California
Japanese American Cultural and Community Center
Japanese American National Museum
Jeffrey Foundation
Jewish Vocational Service
John F Kennedy Memorial Foundation dba Ophelia Project
John M. Langston Bar Association of Los Angeles, Inc.
Johns Hopkins University
Jonas Project
Joshua Tree National Park Council For The Arts
JOYA Scholars
Jumpstart For Young Children
Junior Achievement of Orange County
Junior Statesmen Foundation

Jurupa Valley Adopt A Family
Just Communities Central Coast
Just Lovin' Music Studios, Inc
Just Teach
Kcbcc Development Foundation
Keck Graduate Intitute
Keepers of the Kern, Inc.
Kern County
Kern County Superintendent Of Schools Education Service
Kern River Revitalization, Inc.
Kern Valley Hospital Foundation
Khmer Girls In Action
Kids Come First
KidWorks Community Development Corporation
Kings And Clowns Inc
Kings Art Center Foundation
Kings Community Action Organization, Inc.
Kings County Commission on Aging Council
Korean American Coalition
Korean Churches for Community Developement

Korean Community Services, Inc.
Korean Cultural Center
Korean Health Education Information and Research Center
Korean Immigrant Workers Advocates of Southern California
Korean Resource Center, Inc.
Koreatown Youth and Community Center
L.A. African American Womens Public Policy Institute
La Canada Flintridge Sister Cities Inc
La Canada Flintridge Youth House
La Casa Community Center
La Hermandad Hank Lacayo Youth and Family Center
La Mirada Community Foundation
La Mirada Symphony Association
La Sierra University
LACER Afterschool Programs
Lake Avenue Foundation, Inc.
Lancaster Community Services Foundation
Lancaster Performing Arts Center Foundation
LA's Best
Las Promise

Latina Lawyers Bar Association
Latino Donor Collaborative, Inc.
Latino Leaders Network, Inc.
Laura's House
Leadership Coachella Valley
Leadership Education for Asian Pacific
Leadership Long Beach
League of California Homeowners, The
Legacy LA Youth Development Corporation
Legacy Ladies, Inc.
Legal Aid Foundation of Los Angeles
Leo Sullivan Multimedia Foundation
Leroy Haynes Center
LGBT Community Center of the Desert
Liberty Hill Foundation
Library Foundation of Los Angeles
Life Skills Training And Educational Programs Inc.
Lincoln Training Center and Rehabilitation Workshop
Links Foundation Inc
Living Advantage, Inc.

Local Initiatives Support Corporation
Long Beach BLAST
Long Beach City College Foundation
Long Beach Day Nursery
Long Beach Education Foundation
Long Beach Education Foundation - Long Beach College Promise
Long Beach Education Foundation - Long Beach Math Collaborative
Long Beach Lesbian and Gay Pride, Inc.
Long Beach Nonprofit Partnership
Long Beach Public Library Foundation
Long Beach Rescue Mission
Long Beach Symphony Association
Long Beach Veterans Day Committee
Los Alamitos Youth Center
Los Angeles Alliance for a New Economy
Los Angeles Audubon Society, Inc.
Los Angeles Brotherhood Crusade, Inc.
Los Angeles Business Council Institute
Los Angeles Children's Chorus
Los Angeles City College Foundation

Los Angeles Community Garden Council
Los Angeles Conservation Corps
Los Angeles County Alliance for Boys and Girls Clubs
Los Angeles County Community Development Foundation
Los Angeles County Fire Department Foundation
Los Angeles County Museum of Natural History Foundation
Los Angeles County Public Library Foundation
Los Angeles County Science and Engineering Fair
Los Angeles Education Partnership
Los Angeles LGBT Center
Los Angeles Maritime Institute
Los Angeles Metropolitan Debate League
Los Angeles Neighborhood Land Trust
Los Angeles Opera
Los Angeles Pathfinder Asian American Senior Association
Los Angeles Philharmonic Association
Los Angeles Press Club
Los Angeles Sustainability Collaborative
Los Angeles Team Mentoring Inc A Deleware Corp
Los Angeles Teen Shop

Los Angeles Trade Technical College Foundation
Los Angeles Urban League
Los Angeles Waterkeeper
LOT318
Loyola Marymount University
Loyola Marymount University Center for Urban Resilience
LTSC Community Development Corporation
Lutheran Social Services of So. Calif. - Central Coast - DBA: LSS Community Care Center
Lutheran Social Services Of Southern California
Lutheran Social Services Of Southern California - San Gabriel Valley
Lynette R Juniel Foundation
Lytle Creek Community Center
Main Street Murals, Inc.
Manhattan Beach CERT
Many Mansions
Mar Vista Family Center
Marguerite Kiefer Education Center Inc.
Marianne Frostig Center of Educational Therapy
Marthas Village and Kitchen, Inc.
Mary Erickson Community Housing

Marymount California University
Meals on Wheels West
Menifee Valley Chamber of Commerce
Mental Health Association
Mentally and Educationally Retarded Citizens, Inc.
Mentoring and Partnership for Youth Development
MESA, University of California - Berkeley
Meta Foundation
Mexican American Bar Foundation
Mexican American Legal Defense and Education Fund
Mexican American Opportunity Foundation
Micahs Way
Miguel Contreras Foundation
Mika Community Development Corporation
Mile High Radio Club
Military Women In Need
Millennium Momentum Foundation
Millionaire Mind Kids
Mind Research Institute
Mixteco/Indigena Community Organizing Project

Mizell Senior Center of Palm Springs
Mojave Environmental Education Consortium
Mono County
Mono Nation
Monterey Park Library Foundation
Moorpark College Education Foundation
Moorpark Community Foundation for the Arts
Moreno Valley Black Chamber of Commerce Community Foundation
Moreno Valley Cultural Arts Foundation
Morongo Band of Mission Indians
Morongo Basin Community Response Team
Morongo Basin Conservation Association Inc
Mount Saint Mary's University
Mountain Communities Family Resource Center
Mr Hollands Opus Foundation Inc
Mt. San Antonio College Foundation
Mt. San Jacinto College Foundation
Mt. Washington Jessica Neighborhood, Inc.
Museum Associates - Los Angeles County Museum of Art
Museum of Contemporary Art

Museum of Latin American Art
Music Changing Lives
Musica Angelica
Mychals Learning Place
National Association of Latino Elected Officials Educational Fund
National Audubon Society
National Audubon Society - Audubon Center at Debs Park
National Center for American Indian Enterprise Development
National College Resources Foundation
National Forest Foundation
National Fuel Funds Network - National Energy and Utility Affordability Coalition
National Hispanic Media Coalition
National Utilities Diversity Council
National Veterans Foundation Inc
National Wildlife Federation
Nature Track Foundation
Naturebridge
Neighborhood Homework House
Neighborhood Legal Services of LA County
Neighborhood Youth Association Inc.

New Directions, Inc.
New Environmental Leaders Of America Inc
New Hope Village, Inc.
New Horizons Caregivers Group
New Horizons Serving Individuals With Special Needs
New Visions Foundation
New West Symphony Association
Newport Bay Naturalists and Friends
No Limits Theater Group Inc
North Fork Mono Tribe
NTC Research Foundation
Oak Grove Center for Education Treatment and the Arts
Oakbrook Park Chumash Indian Corporation
Oaks Christian School
Ocean Institute
Oceanside Ivey Ranch Park Association
Office of Education - Tulare County
Office Of Samoan Affairs Of California Inc.
Ojai Raptor Center
Olive Crest

OMID Multicultural Institute for Development
Omni Nano
On A Mission, Inc.
One In Long Beach, Inc.
One Voice
Ontario-Montclair Schools Foundation
OPARC
Operation Jump Start
Operation Silver Star
Orange County Asian and Pacific Islander Community Alliance, Inc.
Orange County Coastkeeper
Orange County Community Foundation -- Hispanic Education Endowment Fund
Orange County Conservation Corps
Orange County Current Affairs Forum
Orange County Fire Authority Foundation
Orange County First Assembly Of God
Orange County Human Relations Council
Orange County Rescue Mission
Orange County School of the Arts Foundation
Orange County Uplift Foundation

Orange County Veterans Employment
Orange Countys Youth
Orange Elderly Services, Inc.
Orange High Marine Corps Jrotc Association
Orangewood Foundation
Organization of Chinese-Americans, Inc.
Orme School
Our Community Works
Oxnard Foundation For Education And Economic Development
Oxnard Police Explorers 9286 Inc
Pacific American Student Services
Pacific Battleship Center
Pacific Chorale
Pacific Islander Health Partnership
Pacific Marine Mammal Center
Pacific Pride Foundation
Pacific Symphony - Orange County
Pacific Wildlife Project
Padres Unidos
Palm Springs Art Museum

Palmdale Community Foundation
Palos Verdes On the Net
Palos Verdes Peninsula Education Foundation
Palos Verdes Peninsula Land Conservancy
Palos Verdes Peninsula Rotary Foundation, Inc.
Pan African Technical Association
Paramount Education Partnership, Inc.
Parent Institute For Quality Education Inc - Kern County
Parent Institute for Quality Education, Inc. - Fresno County
Parent Institute for Quality Education, Inc. - Los Angeles
Parent Institute for Quality Education, Inc. - Orange County
Parent Institute for Quality Education, Inc. - San Bernardino/Riverside County
Parent Institute for Quality Education, Inc. - San Gabriel Valley
Partnership Scholars Program
Pasadena Arts Council - Scholarship Audition Performance Preparatory Academy (SAPPA)
Pasadena Child Development Associates Inc.
Pasadena Educational Foundation
Pasadena Playhouse State Theatre of CA
Pasadena-Altadena Ivy Foundation
Path Of Life Ministries

Pathways Volunteer Hospice
PBS SoCal
Penny Lane Centers
People Assisting The Homeless
People For Irvine Community Health
People for Parks Charitable Fund
Pepperdine University
Peppermint Ridge
Pfleger Institute of Environmental Research
Phd Project Association
Pitzer College
Plaza Community Center
Plaza de la Raza
Pleasant Valley Education Foundation
Plug In America
Pomona College
Pomona Hope Community Center
Pomona Valley Community Services
Porters Place, Inc.
Porterville College Foundation

Porterville University Women Scholarship Fund, Inc.
Posse Foundation
Power 4 Youth
Prayer Warriors Enhancement Team
Professional Resource Center Of Ca Prcc
Project Access, Inc.
Project Concern International
Project Echo
Project GRAD Los Angeles
Project Kindle
Project MotiVATe
Project Scientist
Project Tomorrow
Project Understanding
Providence Speech and Hearing Center
Proyecto Pastoral
Public Counsel Law Center
Public Law Center
Public Policy Institute of California
Puente Learning Center

Pukuu Cultural Commuity Services
Quality of Life Center, Inc.
Rainbow Family, Inc.
Rancho Cucamonga Public Library Foundation
Rancho Cucamonga Rotary Club Foundation
Rancho Los Alamitos Foundation
Reach Out Morongo Basin
Reality Changers
Redbird
Redlands Community Music Association, Inc.
Redlands Symphony Association
Reef Check Foundation
Refugee Forum Of Orange County
Regalettes, Inc. Social and Charity Club
Regents Of The University Of California, Davis
Regents of the University of California, Riverside - Center for Environmental Research and Technology
Regents University Of California Los Angeles
Regents University Of California Los Angeles - American Indian Science and Engineering Society
Regents University Of California Los Angeles - National Society of Black Engineers
Regents University Of California Los Angeles - Society of Latino Engineers and Scientists

Regional Access Project
Rim of The World Educational Foundation
Rio Hondo College Foundation
Rio Hondo Education Consortium
Riverside Art Museum
Riverside Community College District Foundation
Riverside Community College District Foundation - Moreno Valley
Riverside Community College District Foundation - Norco Campus
Riverside County Office Of Education Foundation
Riverside Dept Community Action
Riverside General Hospital University Medical Center Foundation
Riverside Land Conservancy
Roman Archbishop Of Los Angeles A Corporation Sole - Catholic Education Foundation
Ronald McDonald House - Long Beach
Rosemead Youth Leadership Center
Rotary Club of Corona
Rotary Club of Lake Elsinore
Rotary Club of Wildomar
S.T.A.R. Education
Saddleback College Foundation

Safety Harbor Kids
Saint Mary's Academy
Salvadorean American Leadership and Educational Fund
Salvation Army - Alexandria, VA
Salvation Army - Cathedral City
Salvation Army - Haven
Salvation Army - Pomona
Salvation Army - San Bernardino Citadel Corps
Salvation Army - Tehachapi
Salvation Army - Tustin
Salvation Army Visalia Corps
San Bernardino City Library Foundation Inc
San Bernardino County Museum Association
San Bernardino Symphony Association
San Bernardino Valley College Foundation
San Clemente Watershed Task Force
San Diego Regional Fire and Emergency Services Foundation
San Gabriel Valley Conservation Corps
San Manuel Indian Band of Mission Indians
San Marcos AAPLE For Leadership And Enrichment Foundation

San Pedro Art Association
Sanctuary of Hope
Santa Ana College Foundation
Santa Barbara Channel Keeper
Santa Barbara County
Santa Barbara Education Foundation -The Academy program
Santa Barbara Firefighters Alliance
Santa Barbara Mariachi Festival, Inc.
Santa Barbara Museum Of Art
Santa Barbara Museum Of Natural History
Santa Barbara Partners in Education
Santa Catalina Island Conservancy
Santa Cecilia Opera And Orchestra Association
Santa Clarita Valley Youth Project
Santa Monica College Foundation
Santa Monica Historical Society
Santa Monica-Malibu Education Foundation
Santa Paula Latino Town Hall, Inc.
Santa Paula Police and Fire Foundation
Santa Rosa Plateau Foundation

Santiago Canyon College Foundation
Saturday Night Bath Concert Fund
Scholarship America
Scholarship America - Esperanza Scholarship Foundation
Scholarship Foundation of Santa Barbara
School on Wheels
Science and Technology Education Partnership
Science Buddies
Science Math and Robotic Technology Education
Scripps College
Segerstrom Center for Arts
Self-Help Enterprises
Self-Help Graphics
Senior Advocates of the Desert
Senior Center - Highland
Sequoia Riverlands Trust
Share Our Selves
Sharefest Community, Inc.
Shaver Lake Visitors Bureau
Sheriff's Relief Fund #238

Shining Glory Publications
Sierra Foothill Conservancy
Sierra Madre CERT
Sigma Beta Xi, Inc.
Silhouettes For Vets Inc
Silicon Valley Community Foundation
Single Room Occupancy Housing Corporation
SJV Clean Energy Organization
Smithsonian Institution - National Museum of Natural History
Smooth Transition, Inc.
Soboba Band of Luiseno Indians
Soboba Foundation
Social And Environmental Entrepreneurs - DIY Girls
Social and Environmental Entrepreneurs - Wild Places
Social Justice Learning Institute Inc
Society For California Archaeology
Society for Science and the Public
Society of St. Vincent de Paul, St. Joseph Placentia Conference (aka St. Vincent de Paul)
Soka University of America
Soroptimist International of Corona

Soroptimist International of Manhattan Beach
Soroptimist International of Norwalk, Inc.
South Asian Helpline and Referral Agency
South Asian Network, Inc.
South Bay Cities Council of Governments
South Bay Wildlife Rehab
South Bay Workforce Investment Board, Inc.
South Central Scholars Foundation
South Coast Repertory
Southeast Cities Service Center
Southeast Community Development Corporation
Southern California Center for Nonprofit Management
Southern California Chinese American Environmental Protection Association
Southern California Emergency Services Association
Southern California Grantmakers
Southern California Leadership Network
Southern California Public Radio
Southwest Voter Registration Education Project, Inc.
Spark
Special Needs Network, Inc.
Special Olympics Southern California Inc.- Long Beach

Special Service For Groups Inc - Asian and Pacific Islander Obesity Prevention Alliance
Special Service for Groups/Older Adult Program
Special Services Group Inc - Asian Pacific Legislative Staffers Network
Speech and Language Development Center
Spirit of Entrepreneurship Foundation
Spiritt Family Services
St Carries Center For Human Development
St John of God Health Care Services/Samaritan Helping Hand
St Joseph Catholic Church
St. Stephen S and St Agnes School Foundation
Starman Developmental Learning Corporation
Stop the Violence and Increase the Peace
Street Law, Inc.
Strength In Support
Strive Foundation
Studio Channel Islands, Inc.
Success In Challenges, Inc.
Teach For America
Team Science
TechMission, Inc.

Teen Leadership Foundation
Teen Success Inc
TELACU Education Foundation
Templo Calvario Community Development Corporation
Thai Community Development Center
The Alliance for Children's Rights
The Arc of Riverside County
The Association of Vietnamese Language and Culture Schools of Southern California
The California 4-H Foundation - Santa Barbara
The California State Protocol Foundation
The Children's Center of Antelope Valley
The Children's Lifesaving Foundation
The Dream Center
The Energy Coalition
The Harmony Project
The Heart Project
The Laguna Playhouse
The Learning Centers at Fairplex
The Lucille And Edward R Roybal Foundation Inc
The Music Center

The Oxnard College Foundation
The Rancho Cucamonga Community Foundation
The Rotary Club Of Yucca Valley Foundation Inc
The San Onofre Foundation
The Turner Foundation - Since 1958
The UCLA Foundation
The Wildlands Conservancy
The Women's Foundation of California
Think Earth Environmental Education Foundation, Inc.
THINK Together
Thinking About Tomorrow Inc
Thomas House Temporary Shelter
Thousand Oaks Police Charitable Foundation
Tierra Del Sol Foundation
Tiger Woods Foundation
Toberman Neighborhood Center, Inc
Together We Rise Corporation
Topanga Coalition For Emergency Preparedness
Town Hall Los Angeles
Transitions - Mental Health Association

Trash For Teaching
Trauma Intervention Programs Inc.
Tree Musketeers
TreePeople
Trevor Project, Inc.
Trust For Public Land
Tulare Basin Wildlife Partners
Tulare County Farm Bureau Educational and Scholarship Fund
Tulare County League of Mex-Am Women, Inc.
Tulare County Library Foundation
Tulare County Symphony League
Tulare County Symphony Orchestra
Tulare Emergency Aid Council
Tuskegee Airmen Scholarship Foundation
Twenty-Nine Palms Band of Mission Indians
U.C. Riverside Foundation
U.S. Green Building Council - Los Angeles Chapter
UC Davis - Institute of Transportation Studies
UC Santa Barbara Foundation
UCLA Black Alumni Association

UCLA Foundation
Uncommon Good
Unearth and Empower Communities
Unidos Por La Musica
Union Station Foundation
United American Indian Involvement
United Boys And Girls Clubs Of Santa Barbara County
United Cambodian Community, Inc.
United Friends of the Children
United Negro College Fund, Inc.
United States Air Force Academy Endowment
United States Veterans Initiative
United Way - Arrowhead/San Bernardino
United Way - Corona / Norco
United Way - Desert Communities
United Way - Greater Los Angeles
United Way - Inland Empire
United Way - Inland Valley
United Way - Kern County
United Way - Kings County

United Way - Mojave Valley
United Way - Orange County
United Way - Santa Barbara
United Way - Tulare County
United Way - Ventura County
United Way Central County
United Way Inland Empire - Alliance for Education
United Way of the Desert
University Foundation at Sacramento State
University of California - Irvine
University Of California Irvine Foundation
University of California Merced Foundation
University of Idaho Foundation, Inc.
University of La Verne
University of Redlands
University of Southern California
University of Southern California - Sol Price School of Public Policy
University of Virginia
University of Washington Foundation
Upward Bound Study Center Inc

Urban Media Foundation
Urban Scholars Academy
Usa Cares Corporation - NAACP
USC - Viterbi School of Engineering
Valley Childrens Healthcare
Valley Clean Air Now
Valley Resources Center for the Retarded, Inc.
Vanguard University of Southern California
Ventura Audubon Society
Ventura College Foundation
Ventura Community Partners Foundation
Ventura County Community Foundation
Ventura County Council - Boy Scouts
Ventura County Discovery Center
Ventura County Maritime Museum Inc. dba Channel Islands Maritime Museum
Ventura County Military Collaborative
Verbum Dei High School
Veterans Advocacy Group of America, Inc.
Veterans Legal Institute
Veterans Transition Support

VIA Education Foundation
Victor Valley College Foundation
Viet Rainbow of Orange County
Vietnamese American Arts and Letters Association
Vietnamese Community of Orange County, Inc.
Villa Esperanza Services
Visalia Emergency Aid Council
Vital Link Education-Business Consortium
Volunteer Center of Greater Orange County - OneOC
Volunteer Center of Greater Orange County - Science@OC
Volunteer Center of Greater Orange County dba OneOC
Volunteers of East Los Angeles
Walk With Sally
Walking Shield, Inc.
Washington Center for Internships and Academic Seminars
Wawokiye Foundation
Weingart Center Association
West Angeles Community Development Corporation
Western Center on Law and Poverty
Western Foundation of Vertebrate Zoology

Western Justice Center Foundation
Westmont College
Westside Cultural Center
Wetlands and Wildlife Care Center
Whats Next Now Org
Whittier Area First Day Coalition
Whittier College
Whittier Conservancy
Whittier Historical Society
Whittier Public Library Foundation
Wilderness Society
Wilderness Youth Project Incorporated
William C. Velasquez Institute, Inc.
Wiseplace
Wishtoyo Foundation
Women Helping Women
Women In Action Reaching Out
Women In Non Traditional Employment Roles
Womens Professional Roundtable of Murrieta-Temecula
Working Wardrobes

Wrightwood Village Association Inc
Wyland Foundation
XFiniti Solutions, LLC
YMCA - Channel Islands
YMCA - Chino Valley
YMCA - Corona-Norco Family
YMCA - Culver-Palms Family
YMCA - Downey
YMCA - Gardena/Carson Family
YMCA - Glendale
YMCA - Greater Long Beach
YMCA - Greater Whittier
YMCA - Metropolitan Los Angeles
YMCA - Montebello-Commerce
YMCA - North Valley
YMCA - Palisades-Malibu
YMCA - Palm Desert
YMCA - Redlands
YMCA - San Pedro and Peninsula
YMCA - Santa Ana

YMCA - Santa Anita Family
YMCA - Santa Clarita/Valencia
YMCA - Santa Monica
YMCA - Southeast Rio Vista
YMCA - Torrance South Bay
YMCA - Upland
YMCA - Weingart East Los Angeles
YMCA - West San Gabriel Valley
Yosemite-Sequoia Resource Conservation & Development Council
Yosemite-Sequoia Resource Conservation and Development Council
Young Eisner Scholars
Young Musicians Foundation
Young Visionaries Youth Leadership Academy
Young Womens Empowerment Foundation
Your Childrens Trees
YourCause, LLC
Youth Action Project, Inc.
Youth Employment Service- Harbor Area
Youth Hope Foundation
Youth Mentoring Action Network

Youth Mentoring Connection
Youth Policy Institute
Youth Science Center
Youth Speak Collective
YouthPower Community Solutions
YWCA - Greater Los Angeles
YWCA - North Orange County
YWCA - Pasadena-Foothill Valley
YWCA - San Gabriel Valley
Zeta Rho Foundation, Inc.- Bridge Builders Foundation, Inc.

Appendix H

Electric Vehicle Forecast Charge Ready

Electric Vehicle Forecast

SCE forecasts future transportation electrification (TE) load growth for both light-duty electric vehicle (EV) load and non-light-duty electric transportation load. SCE develops its own internal model for EV forecasts. SCE considers both light-duty and non-light-duty TE load as positive load contributors.

As a nascent and dynamic market, EV load is affected by multiple drivers, such as manufacturer supply, policies set by federal, state, and local governments, and electric vehicle technology advancement. SCE models light-duty EV through a Generalized Bass Diffusion model.[1] The Bass diffusion model, originally developed in 1969, is a common method in forecasting new technology adoptions.[2] The SCE model estimates the impact from Total Cost of Ownership (TCO) for EVs relative to the TCO of internal-combustion engine vehicles. The SCE model also considers the impact from customers' range anxiety effect using the California Energy Commission's (CEC's) average vehicle range forecast as its explanatory variable.[3] In addition, SCE uses the American Community Survey (ACS) to estimate the maximum potential for future likely EV adopters.[4]

For all non-light-duty EV forecasts, SCE uses the "in-between" forecasts from Phase 1 study results of ICF International and Energy+Environmental Economics's Transportation Electrification Assessment report (TEA Study).[5]

Figure 1 below compares SCE's EV forecast[6] and CEC's 2017 IEPR Low Demand Case EV Forecast[7] scenarios in California.

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[1] *See* Bass, Frank M., Trichy V. Krishnan, Dipak C. Jain, "Why the Bass Model Fits Without Decision Variables," Marketing Science, Vol. 13, No. 3, Summer 1994, *available at* http://www.bassbasement.org/F/N/FMB/Pubs/Bass%20Krishnan%20Jain%201994%20Why%20Bass%20Model%20Fits.pdf.

[2] Bass, Frank, "A New Product Growth for Model Consumer Durables," Management Science, Vol. 15, Issue 5, 1969, *available at* http://tx.liberal.ntu.edu.tw/SilverJay/Literature/!Adoption/A%20NEW%20PRODUCT%20GROWTH%20FOR%20MODEL%20CONSUMER%20DURABLES.pdf.

[3] Bahrenian, Aniss, Jesse Gage, Sudhakar Konala, Bob McBride, Mark Palmere, Charles Smith, and Ysbrand van der Werf, 2018, Revised Transportation Energy Demand Forecast, 2018-2030. California Energy Commission, Publication Number: CEC-200- 2018-003, *available at* https://efiling.energy.ca.gov/GetDocument.aspx?tn=223241.

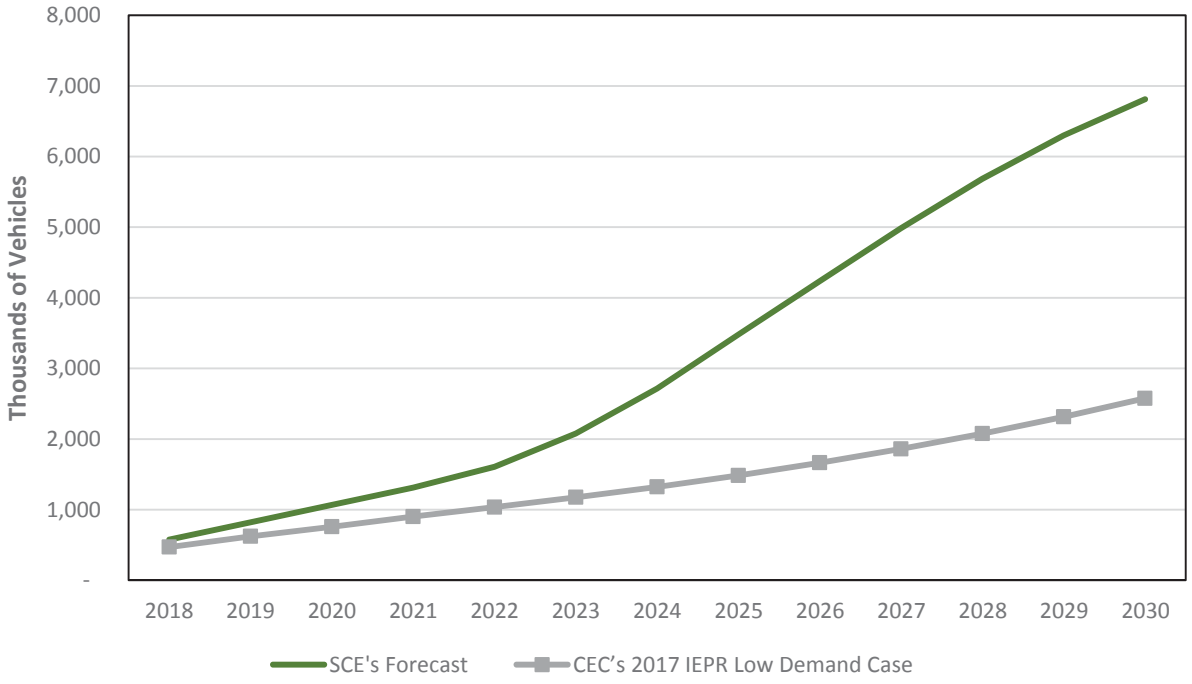
[4] U.S. Census Bureau, *American Community Survey*, *available at* https://www.census.gov/programs-surveys/acs/ (utilizing socio-economic data in SCE's territory, including household structure, education level, and income level).

[5] *See* ICF International, California Transportation Electrification Assessment Phase 1: Final Report, p. 15, Table 8 (Sept. 2014), *available at* http://www.caletc.com/wp-content/uploads/2016/08/CalETC_TEA_Phase_1-FINAL_Updated_092014.pdf.

[6] SCE's annual corporate retail sales forecast as of 2017 Q4.

[7] http://www.dawg.info/sites/default/files/meetings/6.PEV%20Forecast%20DAWG%2011-08%20V2_0.pdf, Slide5.

Figure 1 - Comparison of Light-Duty EV Forecasts in California

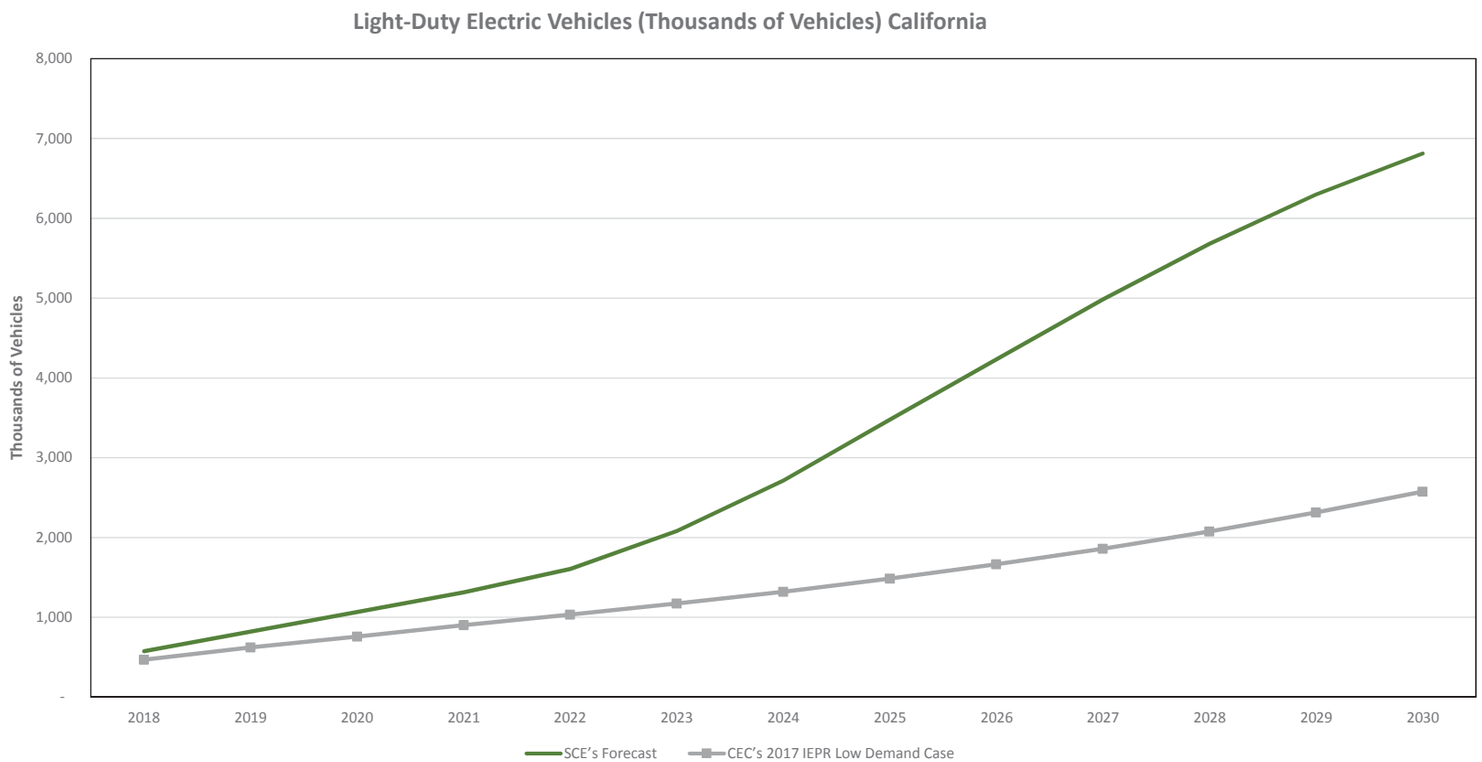


Appendix I

Figure 1 Date Charge Ready 2 EV Forecast

PEV Stock	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
SCE's Forecast	575,661	821,323	1,066,984	1,312,646	1,607,693	2,079,281	2,714,284	3,479,890	4,234,701	4,984,917	5,684,404	6,299,064	6,811,864
CEC's 2017 IEPR Low Demand Case	470,320	622,174	757,959	902,489	1,035,344	1,174,910	1,322,057	1,484,342	1,664,109	1,860,809	2,076,985	2,314,266	2,575,871

PEV Stock(Thousands)	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
SCE's Forecast	576	821	1,067	1,313	1,608	2,079	2,714	3,480	4,235	4,985	5,684	6,299	6,812
CEC's 2017 IEPR Low Demand Case	470	622	758	902	1,035	1,175	1,322	1,484	1,664	1,861	2,077	2,314	2,576



Appendix J

GHG Reduction Comparison

GHG Reduction Comparison

SCE compared CO_2e net reduction from CEC's 2017 IEPR Low Demand Case's ("CEC") forecasted light-duty vehicles with those from SCE's Clean Power and Electrification Pathway ("Pathway") forecasts. This comparison is illustrative in contrasting the expected CO_2 reductions in a low policy support/low TE infrastructure scenario compared to a scenario that includes a TE forecast and electric sector resource mix that reflects the policies and TE infrastructure to reach California's GHG goals. SCE used the methodology from the 2018 draft CARB Low Carbon Fuel Standard (LCFS) to calculate net GHG reductions from EVs. The results of the calculation are detailed below.

SCE compared CAISO 2030 CO_2e emission abatement between the light-duty TE forecast in CEC's 2017 IEPR Low Demand Case and SCE's Pathway forecast. SCE ran the 2030 expected loads from each forecasts separately through SCE's internal PLEXOS production simulation model to determine economic electric dispatches and associated emission intensities of electric generation to serve electric vehicles.

SCE used Equation 1, below, from the 2018 draft CARB LCFS to compare million metric tons (MMT) of CO_2e credits between the two TE forecasts above. The CARB formula calculates the emissions avoided through the use of electricity as the transportation fuel compared to gasoline, diesel, or natural gas fuel. Table 1 below lists the definition and sources for each variable.

Equation 1 - LCFS Net Emission Formula

$$\frac{\text{Credits}_i^{XD}}{\text{Deficits}_i^{XD}}(\text{MMT}) = \left[\left(\text{CI}_{\text{standard}}^{XD} - \text{CI}_{\text{reported}}^{XD}\right) \text{x } \text{E}_{\text{displaced}}^{XD} \text{ x C}\right] * 1\text{x}10^{-12}$$

Table 1 - CARB Low Carbon Fuel Standard Emissions Savings: Inputs Summary

Variable	Definition	Unit	Source
CI (Carbon Intensity) Standard	Transportation Gas Intensity (Average Carbon Intensity of Gasoline, Diesel, or Natural Gas).	g/MJ	CARB LCFS
CI (Carbon Intensity) Reported	Electric Carbon Intensity.	g/MJ	Production Simulation Model
E Displaced	E Displaced $= E_i$ x EER E_i = TE Forecast EER = Dimensionless Energy Economic Ratio relative to gas or diesel fuel	kWh	Ei = TE Forecast (CEC and Pathway forecasts) EER = From 2018 draft CARB LCFS
C	Convert MJ into kWh	3.6	N/A
$1x10^{-12}$	Convert grams to million metric tons	$1x10^{-12}$	N/A

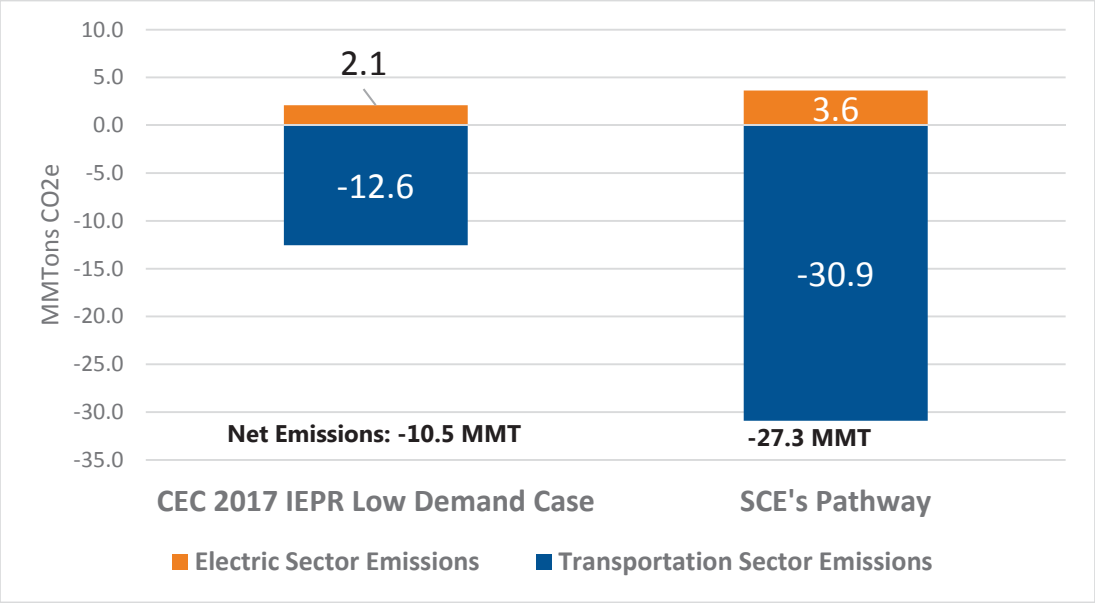
The transportation sector's 2030 carbon intensity is approximately 101 g CO_2e/MJ for light-duty, medium-duty, and heavy-duty vehicles. Based on SCE's production simulation model, the CAISO average electric sector carbon intensity in 2030 to serve all associated EV load is 59 and 41 g CO_2e/MJ for the CEC and Pathway forecasts, respectively. The Pathway's average electric intensity is lower than CEC's because in addition to 7 million electric vehicles needed to meet California's GHG targets by 2030, SCE's Pathway also requires higher amounts of zero-carbon energy and energy storage to help power electric vehicles and other customer demand.[1]

SCE's Pathway shows additional CO_2e emission reductions, compared to CEC's forecast, due to a higher projection of light-duty electric vehicles and more mid-day charging. Figure 1 shows increased emissions from the electric sector in both the CEC and Pathway scenarios (2.1 and 3.6 MMT respectively), as well as decreased emissions in the transportation sector (12.6 and 30.9 MMT respectively). The combined results equal total net emissions reduced for each

[1] Note that the total MMT CO_2e credit results represent the total of light-duty, medium-duty, and heavy-duty TE forecasts. However, only the light-duty forecast differs between CEC and SCE's Pathway; Pathway's medium- and heavy-duty TE forecast was applied to CEC's forecast to isolate the net emission impact from differing light-duty vehicle projections.

forecast (credits generated). CEC's forecast shows approximately 10.5 MMT of CO_2e reduced, while SCE's Pathway forecast shows approximately 27.3 MMT reduced. The difference in CO_2e emission abatement is 16.8 MMT.

Figure 1 – CAISO 2030: Transportation and Electric Sector Emissions



Appendix K

SCE Acronyms and Abbreviations

SCE'S 2018 CHARGE READY 2 PORTFOLIO APPLICATION

ACRONYMS & ABBREVIATIONS

A.	Application
AB	Assembly Bill
ACR	Assigned Commissioner's Ruling
ADA	Americans with Disabilities Act
AFDC	Alternative Fuels Data Center
AFUDC	Allowance For Funds Used During Construction
AHJ	Authority Having Jurisdiction
AL	Advice Letter
APCD	Air Pollution Control District
AQMD	Air Quality Management District
BEV	Battery Electric Vehicle
BRRBA	Base Revenue Requirement Balancing Account
CAAQS	California Ambient Air Quality Standards
CalEnviroScreen 3.0	CalEPA's Office of Environmental Health Hazard Assessment's California Communities Environmental Health's Screening Tool
CalEPA	California Environmental Protection Agency
CalETC	California Electric Transportation Coalition
CARB	California Air Resources Board
CCS	Combined Charging System
CEC	California Energy Commission
CES	CalEnviroScreen
CEVWG	CALSTART's Commercial Electric Vehicle Working Group
CHAdeMO	Abbreviation of "**CHA**rge **de MO**ve," (equivalent to "charge for moving"). It is the trade name of a quick charging method for battery electric vehicles delivering up to 62.5 kW of direct current via a special electrical connector. It is proposed as a global industry standard by an association of the same name.
CRPBA	Charge Ready Program Balancing Account
CO2 / CO_2	Carbon Dioxide
CO_{2e}	Carbon Dioxide Equivalent
COL	Conclusion of Law
Commission/CPUC	California Public Utilities Commission
CWIP	Construction Work In Progress
D.	Decision
DAC	Disadvantaged Community
DC	Direct Current
DCFC	Direct Current Fast Charge
DOE	U.S. Department of Energy

DR	Demand Response
EPA	U.S. Environmental Protection Agency
EPIC	Electric Program Investment Charge
EPRI	Electric Power Research Institute
ERRA	Energy Resource Recovery Account
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
EVNSP	Electric Vehicle Network Service Provider
EVSP	Electric Vehicle Service Provider
FCEV	Fuel Cell Electric Vehicle
FERC	Federal Energy Regulatory Commission
FOF	Finding of Fact
g/bhp-hr	Grams Per Brake Horsepower-Hour
g/kWh	Grams Per Kilowatt Hour
GHG	Greenhouse Gas
GO	General Order
GS	General Service
HVIP	CARB's Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project
ICE	Internal-Combustion Engine
IDR	Interval Data Recorder
IRC	Internal Revenue Code
IOU	Investor-Owned Utilities
ISO/IEC	International Organization for Standardization and International Electro-technical Commission
kV	RPM/Volt (the speed a motor need to turn so it produce 1 volt of force)
kWh	Kilowatt Hour
LCFS	Low Carbon Fuel Standard
MACRS	Modified Accelerated Cost Recovery System
ME&O	Marketing, Education & Outreach
MMT	Million Metric Tons
MUD	Multi-Unit Dwelling
NAAQS	National Ambient Air Quality Standards
NOx	Nitrogen Oxides
NRDC	Natural Resources Defense Council
NREL	National Plug-In Electric Vehicle Infrastructure
O&M	Operation and Maintenance
OEHHA	CalEPA's Office of Environmental Health Hazard Assessment
OEM	Original Equipment Manufacturer
OIR	Order Instituting Rulemaking
OP	Ordering Paragraph
PBOP	Post-Employment Benefits Other Than Pensions
PD	Proposed Decision
PEV	Plug-In Electric Vehicle
PG&E	Pacific Gas and Electric Company

PHEV	Plug-In Hybrid Electric Vehicle
PM2.5	Fine Inhalable Particles with diameters that are generally 2.5 micrometers and smaller
PM10	Inhalable Particles with diameters that are generally 10 micrometers and smaller
PMO	Project Management Office
R.	Rulemaking
RDW	Rate Design Window
RFI	Request for Information
RFP	Request for Proposal
RPS	Renewables Portfolio Standard
SAE	Society of Automotive Engineers; now "SAE International"
SB	Senate Bill
SCAG	Southern California Association of Government
SCAQMD	South Coast Air Quality Management District
SCE	Southern California Edison Company
SDG&E	San Diego Gas & Electric Company
T&D	Transmission and Distribution
TEA	Transportation Electrification Assessment
TEA Study	ICF International and E3's Transportation Electrification Assessment
TEPBA	Transportation Electrification Portfolio Balancing Account
TOU	Time-of-Use
USoA	Uniform System of Accounts
VOC	Volatile Organic Compounds
WMDVBE	Women Minority Disabled Veteran Business Enterprise
ZEV	Zero-Emission Vehicle

Appendix L

Witness Qualifications

SOUTHERN CALIFORNIA EDISON COMPANY

QUALIFICATIONS AND PREPARED TESTIMONY

OF MICHAEL BACKSTROM

Q. Please state your name and business address for the record.

A. My name is Michael Backstrom, and my business address is 8631 Rush Street, Rosemead, California 91770.

Q. Briefly describe your present responsibilities at the Southern California Edison Company.

A. I am currently a Managing Director of SCE's Energy and Environmental Policy Department. As such, I am responsible for leading the analysis of proposed energy and environmental Regulations: developing regulatory engagement strategies, overseeing advocacy at state and federal environmental agencies, and ensuring effective case management of key energy policy proceedings.

Q. Briefly describe your educational and professional background.

A. I earned a Bachelor's degree in English from Pepperdine University in 1997, and a Juris Doctor from the University of Southern California in 2000. I joined SCE in 2005 as an attorney in the 16 legal department, responsible for regulatory proceedings before the California Public Utilities 17 Commission. I subsequently held positions in both regulatory and legislative affairs. In 2013, I 18 become Director, Chairman's Office, where I served as chief of staff to Ted Craver, Chairman 19 and CEO of Edison International. In 2015, I moved to the position of Director, Customer 20 Experience at SCE. In 2017 I assumed my current position..

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of my testimony in this proceeding is to sponsor portions of Exhibit SCE-01, entitled *Testimony in Support of SCE's 2018 Charge Ready Phase 2 and Market Education Programs*, as identified in the Table of Contents thereto.

Q. Was this material prepared by you or under your supervision?

A. Yes, it was.

Q. Insofar as this material is factual in nature, do you believe it to be correct?

A. Yes, I do.

Q. Insofar as this material is in the nature of opinion or judgment, does it represent your best judgment?

A. Yes, it does.

Q. Does this conclude your qualifications and prepared testimony?

A. Yes, it does.

SOUTHERN CALIFORNIA EDISON COMPANY

QUALIFICATIONS AND PREPARED TESTIMONY

OF ERICA BOWMAN

Q. Please state your name and business address for the record.

A. My name is Erica Bowman, and my business address is 2244 Walnut Grove Avenue, Rosemead, California 91770.

Q. Briefly describe your present responsibilities at the Southern California Edison Company.

A. I am a Director of Environmental Strategy and Analytics at Southern California Edison. My current responsibilities include managing the Environmental Strategy and Resource Planning functions within SCE's Strategy, Integrated Planning and Performance department. I have held this position since July 21, 2017.

Q. Briefly describe your educational and professional background.

A. I received a Bachelor of Science and Engineering degree in Operations Research and Financial Engineering from Princeton University and a Master of Science degree in Operations Research from Northeastern University. Prior to my position at SCE, I was the Chief Economist at the American Petroleum Institute where I managed all commodity market analysis and was API's primary spokesperson on issues related to economic development and energy market movements, and their associated impacts. I have not previously testified before the California Public Utilities Commission.

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of my testimony in this proceeding is to sponsor portions of Exhibit SCE-01, entitled *Testimony in Support of SCE's 2018 Charge Ready Phase 2 and Market Education Programs*, as identified in the Table of Contents thereto.

Q. Was this material prepared by you or under your supervision?

A. Yes, it was.

Q. Insofar as this material is factual in nature, do you believe it to be correct?

A. Yes, I do.

Q. Insofar as this material is in the nature of opinion or judgment, does it represent your best judgment?

A. Yes, it does.

Q. Does this conclude your qualifications and prepared testimony?

A. Yes, it does.

SOUTHERN CALIFORNIA EDISON COMPANY

QUALIFICATIONS AND PREPARED TESTIMONY

OF KATHLEEN SLOAN MOODY

Q. Please state your name and business address for the record.

A. My name is Kathleen Sloan Moody, and my business address is 2244 Walnut Grove Avenue, Rosemead, California 91770.

Q. Briefly describe your present responsibilities at the Southern California Edison Company.

A. I am a Principal Manager of Innovation, Development, & Controls in Customer Programs & Services at Southern California Edison. I lead a team responsible for developing and implementing new products and services for customers. My team focuses in areas of transportation electrification, customer energy solutions (including energy efficiency & demand response), and distributed energy resources for customers including solar and energy storage. I have held this position since October 2017.

Q. Briefly describe your educational and professional background.

A. I hold a Masters in Regulatory Economics and a Bachelor's in Business Administration from New Mexico State University. Prior to my previous role, I worked in Strategic Planning at Edison International where I developed innovative business opportunities for the company in areas including microgrids and transportation electrification. Prior to that, I led a regulatory and legislative policy team at SCE that worked on procurement of renewable, alternative, and conventional generation. Prior to that role, I was a Public Affairs manager at First Solar responsible for developing global policy positions for the company. Early in my career, I took on increasing responsibilities at SCE, focusing on policy, strategic, and analytical issues relating to clean energy. I have previously testified before the California Public Utilities Commission.

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of my testimony in this proceeding is to sponsor portions of Exhibit SCE-01, entitled *Prepared Testimony in Support of Southern California Edison Company's (U 338-E)*

Application for Approval of its Charge Ready 2 Infrastructure and Market Education Programs, as identified in the Table of Contents thereto.

Q. Was this material prepared by you or under your supervision?

A. Yes, it was.

Q. Insofar as this material is factual in nature, do you believe it to be correct?

A. Yes, I do.

Q. Insofar as this material is in the nature of opinion or judgment, does it represent your best judgment?

A. Yes, it does.

Q. Does this conclude your qualifications and prepared testimony?

A. Yes, it does.

SOUTHERN CALIFORNIA EDISON COMPANY

QUALIFICATIONS AND PREPARED TESTIMONY

OF MATTHEW D. SHERIFF

Q. Please state your name and business address for the record.

A. My name is Matthew David Sheriff, and my business address is 2244 Walnut Grove Avenue, Rosemead, California 91770.

Q. Briefly describe your present responsibilities at the Southern California Edison Company (SCE).

A. I am currently Senior Advisor in SCE's CPUC Revenue Requirements and Tariffs Department. As such, I am primarily responsible for preparation of SCE's Cost Recovery showing and forecasting SCE's revenue requirements and system average rate.

Q. Briefly describe your educational and professional background.

A. I graduated from the University of Maryland Baltimore County in May of 1995 with a Bachelors of Arts Degree in Political Science. For the next seven years I worked at several venture-backed new media startups in marketing and business development roles. In August of 20024 I earned a Master of Business Administration (MBA) degree from the University of Southern California. After graduation, I worked for Raytheon Inc. as a senior financial analyst responsible responsible for balance sheet and cash flow forecasting. In April of 2007, I joined Southern California Edison Company as Senior Financial Analyst in the Financial Planning and Analysis group of the Treasurer's department. In this role as a financial subject matter expert, I prepared cost-effectiveness analysis in support of applications before the CPUC, including SmartConnect®, SONGS High Pressure Turbine and the sale of SCE's interest in Four Corners. I was promoted to senior project manager while in this department. I started in my current position in January of 2014. I have previously testified before the California Public Utilities Commission.

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of my testimony in this proceeding is to sponsor portions of Exhibit SCE-01, entitled *Testimony in Support of SCE's 2018 Charge Ready Phase 2 and Market Education Programs*, as identified in the Table of Contents thereto.

Q. Was this material prepared by you or under your supervision?

A. Yes, it was.

Q. Insofar as this material is factual in nature, do you believe it to be correct?

A. Yes, I do.

Q. Insofar as this material is in the nature of opinion or judgment, does it represent your best judgment?

A. Yes, it does.

Q. Does this conclude your qualifications and prepared testimony?

A. Yes, it does.