State of California
AIR RESOURCES BOARD

Electric Vehicle Supply Equipment (EVSE) Standards

Standardized Regulatory Impact Assessment (SRIA)

DATE OF RELEASE: December 20, 2018

Air Resources Board
1001 I Street
Sacramento, California 95814

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A. INTRODUCTION

Mobile sources are a significant contributor to emissions of criteria pollutants and greenhouse gases (GHG) in California, accounting for well over 80 percent of ozone precursor emissions and approximately 40 percent of statewide GHG emissions. Zero emission vehicles (ZEV) and transport modes using zero emission drivetrains help meet California's goals to improve air quality, protect public health, and reduce GHG emissions by displacing internal combustion engine cars, trucks, and other vehicles.

ZEVs include multiple technology types including plug-in electric vehicles (PEV) and fuel cell electric vehicles (FCEV). PEVs plug in to electric sources to charge, while FCEVs utilize hydrogen fuel. The proposed regulation focuses on electric charging stations, known as electric vehicle supply/service equipment (EVSE), therefor focuses on PEVs rather than FCEVs.

PEVs consist of two distinct technology types: plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEV). PHEVs use both an electric range and an internal combustion engine, so rely on both electric charging and gasoline. These vehicles emit lower levels of GHG and criteria pollutants, but are not fully zero emission at the tailpipe. BEVs have a full electric range, and do not rely on any fuels besides electricity.

PEVs require charging which can occur at home using conventional household plugs or upgraded equipment, at private locations such as in a private parking structure, or in public locations. There are three predominate forms of charging for the public to access, Level 1, Level 2 and direct current fast charging (DCFC). Level 1 charging is slowest, using 110V power similar to that of a typical wall outlet.[1] A vehicle with 100 miles of electric range will take around 20 hours to fully charge. Level 2 charging is faster than Level 1 and a vehicle with 100 miles of electric range will take around five hours to fully charge.[2] DCFC is the fastest charging option,[3] a vehicle with a 100 mile range can obtain a full charge in approximately 30 minutes. New DCFCs capable of charging at even faster rates[4,5] are continuing to reduce charging times.

Electric chargers in public locations are sometimes free of charge and sometimes charge for use. A majority of EVSEs that charge for use are operated by one of several private networks which require membership or payment of a subscription fee. In return, members are provided with services that include reserved times for charging, specific EVSE location data, pre-payment or on-site payment options, and fixed prices for electric charging. These EVSEs are not required to allow non-members to charge, provide typical payment options such as credit card readers, or transparently report prices and fees. Thus many public EVSEs are currently

[1] CALeVIP, 2018. "Electric Vehicle Charging 101: Level 1" https://calevip.org/electric-vehicle-charging-101
[2] CALeVIP, 2018. "Electric Vehicle Charging 101: Level 2" https://calevip.org/electric-vehicle-charging-101
[3] CALeVIP, 2018. "Electric Vehicle Charging 101: DC Fast Charging" https://calevip.org/electric-vehicle-charging-101
[4] Electrify America, 2018. "Our investment plan: Community DC Fast and Level 2 Charging" Access November 14, 2018. https://www.electrifyamerica.com/our-plan
[5] Electrify America, 2018. "Our investment plan: DC Fast EV Charging Along Highway Corridors" Access November 14, 2018. https://www.electrifyamerica.com/our-plan

restricted to particular drivers, groups, or vehicles, or burdensome for a non-member to use. This lack of consistency and transparency can make charging stations less accessible and more difficult to use, limiting public charging options for PEV owners.

1. Regulatory History

The California Air Resources Board (CARB) has adopted several regulations, which reduce emissions from light-duty vehicles including the Low Emission Vehicle Criteria Pollution (LEV III Criteria)[6] standards, the Low Emission Vehicle Greenhouse Gas (LEV III GHG)[7] regulation, and the ZEV regulation.[8] These regulations will result in an increasing number of ZEVs on the road including battery electric vehicle (BEVs), hydrogen fuel cell electric vehicles (FCEV), and plug-in hybrid electric vehicles (PHEVs).

In March 2012, Governor Brown issued Executive Order B-16-2012[9] directing California agencies to establish benchmarks for key milestones to help support and facilitate the ZEV market. Some of those milestones include: 1) achieving over 1.5 million ZEVs and PHEVs on the road by 2025, and 2) ensuring Californians have access to ZEV infrastructure. As a result of this order, multiple state agencies, including CARB, worked to develop and release the 2013 ZEV Action Plan (2013 Plan).[10] The 2013 Plan identified over 100 strategies to meet the milestones of the executive order.

The 2013 Plan included four broad goals to advance the ZEV market: 1) complete needed ZEV infrastructure and planning; 2) expand consumer awareness and demand of ZEVs; 3) transform fleets; and 4) grow jobs and investment in the private sector. The 2013 Plan recognized that the charging infrastructure needed to support broad adoption of electric vehicles, known as electric vehicle supply/service equipment (EVSE), would need to be strategically deployed in a variety of locations such as home, work and public parking. The 2013 Plan also highlighted the need to encourage accessibility of charging infrastructure through the development of interoperability standards that allow drivers to be billed regardless of charging network membership. The 2013 Plan encouraged industry efforts to develop interoperability[11] standards and recommended that future state-funded PEV EVSEs be open to the public and accessible to all drivers regardless of membership or subscription to electric vehicle supply provider (EVSP) networks.

In September 2013, Governor Brown signed the Electric Vehicle Charging Stations Open Access Act (SB 454) into law.[12] SB 454 sought to increase PEV owners' confidence in

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[6] CCR § 1961.1
[7] CCR § 1961.3. Note that Section 1961.3 allows manufacturers to comply with 40 CFR 86.1812-12
[8] CCR § 1962.2, 2012.
[9] Executive Order B-16-2012. State of California Executive Order signed by Governor Edmund G. (Jerry) Brown Jr. March 23, 2012. https://www.gov.ca.gov/2012/02/15/news17445/. Accessed July 25, 2018.
[10] Governor's Interagency Working Group on Zero-Emission Vehicles, 2013. 2013 ZEV Action Plan: A roadmap toward 1.5 million zero-emission vehicles on California roadways by 2025. http://opr.ca.gov/docs/Governor%27s_Office_ZEV_Action_Plan_(02-13).pdf. Accessed July 25, 2018.
[11] Interoperability is defined as the ability of a system to work with or use the parts or equipment of another system, by Merriam-Webster
[12] Electric Vehicle Charging Stations Open Access Act, Cal. Health & Safety Code § 44268, (2013).

EVSEs, improve PEV drivers' ease of charging access to encourage future PEV adoption and market development. The California Assembly Floor Analysis explained, "electric vehicle (EV) consumers need confidence that they can access a robust network of publicly available EVSEs. Any EV driver should be able to access any publicly available EVSE, regardless of the system provider."[13] According to the California Assembly Floor Analysis, "EV consumers and drivers need to be able to find the stations and know how much they cost."[14]

SB 454 prohibits a provider of an EVSE from requiring a user to pay a subscription fee or obtain membership to use the EVSE, and "[a]n EVSE that requires payment of a fee shall allow a person desiring to use the station to pay via credit card or mobile technology, or both."[15] Additionally, the bill requires total charges for EVSE use (including any network roaming charges for nonmembers) to be disclosed to the public at the point of sale. SB 454 requires EVSEs to be labeled in accordance with federal regulations,[16] and where commercially reasonable and feasible, requires highway and roadway directional signage to the EVSE.

To assist PEV drivers in finding public EVSEs and to improve consumer access to charging information, SB 454 requires the service provider to disclose the station's location, schedule of fees, accepted payment methods, and the amount of network roaming fees charged to non-members to the National Renewable Energy Laboratory (NREL). EVSPs voluntarily report some data to NREL which is disseminated through the Alternative Fuels Data Center (AFDC) website,[17] and the Alternative Fueling Station Locator.[18] However, SB 454 did not provide any guidance on the reporting requirements or format.

SB 454 also authorizes CARB to adopt interoperability billing standards for EVSEs if no interoperability billing standards are developed by a national standards organization by January 1, 2015. Interoperable billing standards allow the various EVSE networks to communicate so that consumers can seamlessly pay to charge at any EVSE regardless of the owner. There are no national interoperable billing standards to date.

Since the enactment of SB 454, several funding programs have supported electric vehicle infrastructure. The Alternative and Renewable Fuel and Vehicle Technology Program, administered by the California Energy Commission (CEC), provides funding to support PEV infrastructure through various grant solicitations.[19] The California Public Utilities Commission (CPUC), under the direction of Clean Energy and Pollution Reduction Act of 2015 (SB 350, Statutes of 2015), authorizes utilities to undertake transportation electrification activities.[20] In 2016, the CPUC approved charging infrastructure pilot programs for three large investor-

[13] SB 454 Bill Analysis, Assembly Floor Analysis. 09/05/2013.
[14] Cal. S.B. 454, § 1(f) (2013).
[15] Cal. S.B. 454, Health & Safety Code § 44268.2(a)(1) (2013).
[16] Labeling Requirements for Alternative Fuels and Alternative Fueled Vehicles, 16 CFR Part 309 (2013).
[17] Alternative Fuels Data Center, 2018. https://www.afdc.energy.gov/. Accessed July 25, 2018.
[18] Alternative Fueling Station Locator, 2018. https://www.afdc.energy.gov/stations#/find/nearest?fuel=ELEC, Accessed July 1, 2018.
[19] CEC, 2018. Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP) Overview.
[20] CPUC, 2018. Transportation Electrification Activities Pursuant to Senate Bill 350. http://www.cpuc.ca.gov/sb350te/. Accessed July 25, 2018.

owned utilities – Pacific Gas & Electric (PG&E), Southern California Edison (SCE), and San Diego Gas & Electric (SDG&E) – to install EVSEs for a combined budget of $197 million.[21] In 2018, the CPUC approved additional investor-owned utility projects to deploy charging infrastructure as part of the new SB 350 program. Separately, Electrify America, is investing $800 million over a 10-year period in ZEV infrastructure, education, and access in California as part of a settlement with CARB and federal agencies.[22] In the first 30-month investment plan cycle, Electrify America is expected to invest $45 million in community chargers in major metropolitan areas and $75 million in highway fast charging throughout California.[23]

In January 2018, Governor Brown issued Executive Order B-48-18 building on past efforts to increase ZEVs by boosting California's goal to 5 million ZEVs[24] on the road by 2030 and setting a target of 250,000 chargers by 2025.[25] With sizable funding in place to deploy PEV infrastructure, accessibility and interoperability billing standards continue to be key in enabling consumer PEV adoption.

2. Statement of the Need of the Proposed Regulation

The proposed regulation implements the requirements of SB 454 and ensures consistent and transparent access to charging infrastructure that is necessary to support broad deployment of PEVs. SB 454 requires EVSEs to be accessible to EV drivers regardless of membership in network subscription services, that all costs be disclosed at the point of sale, that EVSE locations and payment mechanisms be reported to NREL, that interoperability standards be used to standardize public access to networked stations, that credit card and mobile payment options be available, and requires labeling and reporting. Without the proposed regulation there would be no standardization as required, no consistency in compliance and no mechanism for enforcement of the law.

Current inconsistency among EVSEs reduces consumer accessibility. Each EVSP provides network support for different models of EVSEs. The user interfaces are not standardized and can cause confusion for PEV drivers because a number of methods are used to pay for public charging sessions. Examples of payment methods include using a radio frequency identification (RFID) membership card (for which membership enrollment occurs days to weeks before use), a membership mobile application, or calling a toll free number and providing payment information over the phone. EVSEs may be located in remote locations that may not have a strong cell signal.

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[21] CPUC, 2018. Decision 16-01-045, 16-01-023, and 16-12-065. http://www.cpuc.ca.gov/General.aspx?id=5597. Accessed July 31, 2018.
[22] CARB, 2018. Volkswagen Settlement - California ZEV Investments. https://www.arb.ca.gov/msprog/vw_info/vsi/vw-zevinvest/vw-zevinvest.htm. Accessed July 25, 2018.
[23] Electrify America, 2018. Our Plan. https://www.electrifyamerica.com/our-plan. Accessed July 25, 2018.
[24] 4 million are assumed to be PEVs, and 1 million are assumed to be fuel-cell vehicles which are not impacted by this proposed regulation.
[25] Executive Order B-48-18. State of California Executive Order signed by Governor Edmund G. (Jerry) Brown Jr. January 26, 2018. https://www.gov.ca.gov/2018/01/26/governor-brown-takes-action-to-increase-zero-emission-vehicles-fund-new-climate-investments/. Accessed July 25, 2018.

A pressing need to address public EVSE access comes from the pace at which PEVs are entering the California fleet, and the need to continue to support accelerating PEV adoption to meet climate and air quality goals. According to the Clean Vehicle Rebate Project, between 4,000 and 5,000 new PEVs are being added to California roads each month.[26] Continued growth will benefit from ready access to public chargers. Improving transparency in billing, station locations based on accurately reported data, easily accessible payment methods and non-member access will facilitate consumer adoption. The proposed regulation will provide PEV drivers greater confidence for extending travel beyond daily use, and convenience for state fleet users to use PEVs throughout the state.

Charging session initiation by a smartphone application is not accessible for all drivers. Nearly all California residents (92%) have a cell phone, and 58% have a smartphone. A majority of California residents (56%) access the internet or email by cell phone. However, this usage is associated with higher income and younger population segments.[27] As PEV adoption expands to a broader and more diverse consumer base, smartphone application or internet-based payment mechanisms may not be convenient or available.

Approximately seventy five percent of internal combustion engine vehicle drivers use credit cards for purchasing fuel at the 8,353 gasoline stations in California.[28,29] Total System Services (TSYS) completed a 2017 survey nationwide of consumers who have access to debit, credit cards and mobile transaction technology from which they concluded "Consumers continue to prefer debit for daily purchases at the gas station, supermarket and discount store."[30] New PEV drivers will be familiar with debit and credit card payment methods as they learn how to use charging stations.

There are many articles and internet comments from drivers that highlight key issues EVSPs are still facing.[31] The proposed regulation addresses many of these, including the information gap for the rate of charge, the correct plug, and how long it will take to fill up the driver's vehicle. The proposed regulation requires placement of the CFR Title 16 sticker identifying conductive or inductive charging. It also displays the kW, voltage and amperage capability of the EVSE. Another common complaint is "too many maps, too many apps." SB 454 addresses this complaint by making the AFDC a comprehensive source of current information from all EVSPs. SB 454 addresses "too many apps" by requiring EVSEs to have credit card capability and mobile technology. This will eliminate the need to download specific applications to a driver's phone. Although SB 454 does not address how drivers are charged for the session, requiring clear upfront pricing information will combat the potential of surprise charges. The

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[26] CVRP, 2018. Clean Vehicle Rebate Project: Rebate Statistics. Accessed on September 03, 2018.
[27] PPIC, June 26, 2013. "Big Gains in Californians' Use of Cell Phones, Tablets to Go Online" http://www.ppic.org/press-release/big-gains-in-californians-use-of-cell-phones-tablets-to-go-online/#
[28] California Retail Fuel Outlet Annual Reporting (CEC –A15) Results, 2017. California Energy Commission. https://www.energy.ca.gov/almanac/transportation_data/gasoline/piira_retail_survey.html
[29] NACS, February 13, 2018. "Credit and Debit Card Usage at the Pump" https://www.convenience.org/Topics/Fuels/Cards-at-the-Pump-A-Primer
[30] Total System Services, TSYS, 2017. "U.S. Consumer Payment Study" https://www.tsys.com/Assets/TSYS/downloads/rs_2017-us-consumer-payment-study.pdf
[31] Schaal, 2017. CheatSheet.com "5 Biggest Problems with Electric Vehicle Charging" (https://www.cheatsheet.com/automobiles/5-biggest-problems-electric-vehicle-charging.html/) Accessed April 12, 2017.

proposed regulation addresses challenges with public charging stations and will improve driver accessibility to EVSEs.

3. Major Regulation Determination

The proposed regulation has the first requirements starting in 2020 and will be fully implemented in 2028. The SRIA analyzes the period from 2020 through 2030. While annual costs of the proposed regulation are less than $20 million in any one year, the proposed regulation is a major regulation requiring a Standardized Regulatory Impact Assessment (SRIA) because the estimated annual economic impact is greater than $50 million in multiple years between 2020 and 2030. See Section E – Macroeconomic Impacts for complete results.

4. Public Outreach and Input

CARB staff has been engaged with stakeholders via forums and public processes from the onset of the proposed rulemaking. Initially, outreach and input focused on stakeholder forum settings to define potential actions by CARB on SB 454. On December 8, 2017, CARB staff hosted the first forum with industry stakeholders to discuss requirements as stipulated by the legislation and to introduce other regulatory considerations CARB was investigating. During the forum, CARB staff sought input on factors for developing open access charging infrastructure requirements for PEVs, including payment for use, data reporting, network roaming and interoperable billing, and that pose barriers for electric vehicle consumer adoption. On March 30, 2018, CARB staff hosted a second forum to further discuss and seek input on the regulatory framework, definitions, proposed data format, and proposed compliance timelines. At this time, stakeholders were solicited for alternatives to the proposed regulation.

CARB staff also gathered public feedback on the proposed regulation through public workshops and a webinar. Staff distributed notice of the May 30, 2018 workshop through a public listserv that includes 5,000+ recipients and posted notice[32] of the public meeting. Information regarding the workshop[33] and associated materials were also posted on the SB 454 website.[34] This public workshop, which was webcast, solicited stakeholder feedback on the proposed regulation and the regulatory process. CARB staff also sought public input regarding alternatives to the proposed regulation. Subsequent to this workshop, CARB staff hosted a public webinar on June 21, 2018, to present proposed definitions for regulated parties and to discuss reporting requirements. CARB staff held a second public workshop[35] on November 7, 2018, during which CARB staff presented draft regulatory language and requested feedback from stakeholders.

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[32] CARB, 2018. Public Workshop Notice to Discuss Implementation of the Electric Vehicle Charging Stations Open Access Act. https://www.arb.ca.gov/msprog/mailouts/ecars1803/ecars1803.pdf. Accessed July 25, 2018.
[33] CARB, 2018. Public Workshop to Discuss Implementation of the Electric Vehicle Charging Station EVSEs Open Access Act (Senate Bill 454, Statutes of 2013). https://ww2.arb.ca.gov/public-workshop-discuss-implementation-electric-vehicle-charging-stations-open-access-act-senate. Accessed July 25, 2018.
[34] CARB, 2018. Electric Vehicle Charging Station EVSEs Open Access (Senate Bill 454). https://ww2.arb.ca.gov/our-work/programs/electric-vehicle-charging-stations-open-access-senate-bill-454. Accessed July 25, 2018.
[35] CARB, 2018. Mail-Out ECARS #18-06. “Public Workshop to Discuss the Implementation of the Electric Vehicle Charging Stations Open Access Act.” https://www.arb.ca.gov/msprog/mailouts/ecars1806/ecars1806.pdf

5. Baseline

The baseline includes full compliance with all enforceable regulatory measures in place. The baseline projects the annual number of PEVs estimated to be on the road for full compliance, but not over compliance, with current regulations and estimates the number of EVSEs that would be necessary to support those PEVs.

The Emissions Factor Model (EMFAC2017) was used to forecast the number of PEVs each year through 2030. EMFAC2017 projects new vehicle PEV populations for exact compliance with the ZEV Regulation. EMFAC's attrition rates based on vehicle age were used to account for vehicle turnover. Using this methodology, the total on-road PEV vehicle population in the baseline will be approximately 1 million by 2025 and 1.5 million by 2030 (Table 1).

Table 1 - Projected On-Road PEV Populations, Baseline

Year	BEV Population	PHEV Population	Total Population
2020	199,363	261,683	461,046
2021	221,395	321,082	542,477
2022	245,516	383,521	629,037
2023	273,324	450,916	724,240
2024	304,102	522,507	826,609
2025	337,767	598,323	936,090
2026	370,604	672,778	1,043,382
2027	402,434	745,371	1,147,805
2028	433,068	815,602	1,248,670
2029	462,735	883,954	1,346,689
2030	490,843	949,225	1,440,068

CARB staff then used these PEV projections to estimate the total number of EVSEs that would be in place through 2030 using the Electric Vehicle Infrastructure Projection Lite (EVI Pro Lite) tool.[36] EVI Pro Lite is a tool developed by NREL to identify how much (and in which location) public infrastructure would need to be in place to support future PEV targets throughout California.[37] The tool generates Level 2 and DCFC projections based on inputs of on-road vehicle population of BEVs and PHEVs, and the mix of vehicle type. The EVI Pro Lite mix of vehicle type includes low range BEV and PHEV and high range BEV and PHEV.

EVI-Pro Lite provides projected port counts, rather than EVSE counts. The term "port" describes the number of vehicles that may charge at an EVSE at a single time. CARB staff converted the number of ports to EVSEs, using the current distribution of EVSE technologies. Currently, 51 percent of DCFCs are single port[38] and 49 percent are dual port.[39] Therefore, the

[36] CEC, NREL. 2018. https://maps.nrel.gov/cec/?aL=0&bL=cdark&cE=0&lR=0&mC=36.87962060502676%2C-116.34521484375001&zL=6

[37] CEC, March 2018. "California Plug-In Electric Vehicle Infrastructure Projections: 2017-2025" https://www.nrel.gov/docs/fy18osti/70893.pdf Accessed April 1, 2018.

[38] Single port means only one vehicle can charge at a time.

[39] Dual port means two vehicles can charge at a time.

number of DCFC EVSEs is 75.5 percent of the number of DCFC ports (0.57 + 0.43÷2 = 0.755) At this time 13 percent of Level 2 EVSEs are single port and 87 percent are dual port; thus Level 2 EVSEs are 56.5 percent of the number of Level 2 ports (0.13 + 0.87÷2 = 0.565)

Level 2 workplace charging is included in the total EVSE population counts in Table 2. Though staff projects only 50 percent to be publicly accessible. The other 50 percent is projected to be restricted to employee or fleet use which would not be accessible to the public, and thus would not be covered by the proposed regulation. Thus, the economic analysis only includes incremental compliance costs for half of the workplace Level 2 chargers listed in Table 2.

Table 2 - Projected EVSE Populations, Baseline

Year	Public Level 2	Work place Level 2*	DCFC	Total
2019	9,092	5,716	1,716	16,524
2020	9,672	6,612	1,782	18,066
2021	10,317	7,597	1,869	19,783
2022	10,997	8,650	1,958	21,605
2023	11,685	9,756	2,051	23,493
2024	12,379	10,961	2,138	25,478
2025	13,067	12,263	2,217	27,547
2026	13,653	13,410	2,277	29,339
2027	14,250	14,585	2,317	31,152
2028	14,735	15,442	2,339	32,516
2029	15,249	16,332	2,345	33,926
2030	15,632	16,860	2,336	34,827

*Only 50 percent are anticipated to be publically accessible, thus impacted by the proposed regulation. The economic analysis only estimated incremental compliance costs for 50 percent of this population.

6. Proposed Regulation

The proposed regulation will affect all public Level 2[40] and DCFC[41] EVSEs that charge for service, including those operational today and future installations.[42] The proposed requirements are equivalent for Level 2 and DCFC EVSEs and include consistent payment platforms, disclosure of fees upon charging, interoperability standards, labeling and reporting requirements, as described in further detail in this section. The proposed requirements will begin on January 1, 2020 for new DCFC installations. DCFCs installed prior to January 1,

[40] SAE J1772, February 2016. Electrical ratings (North America) 208 to 240V AC, 1-phase, <= 80 amps. A method that uses dedicated AC EV/PHEV supply equipment in either private or public locations. The vehicle shall be fitted with an on-board charger capable of accepting energy from single phase alternating current (AC) electric vehicle supply equipment.

[41] SAE J1772, February 2016. Electrical ratings (North America) 50-500 V DC, 80 amps to 200 amps. A method that uses dedicated direct current (DC) EV/PHEV supply equipment to provide energy from an appropriate off-board charger to the EV/PHEV in either private or public locations.

[42] There are limited examples of publicly accessible networked Level 1 EVSEs requiring fee for use. Given the low charging rates and likely low annual utilization of Level 1 EVSEs for pay, Level 1 chargers were excluded from the proposed regulation.

2020, will need to be retrofitted or replaced to meet the proposed requirements by January 1, 2020, or 5 years from date of installation, whichever is later. The proposed requirements for Level 2 EVSEs will begin on January 1, 2023 for new Level 2 installations. Level 2 EVSEs that are installed prior to January 1, 2023, will need to be retrofitted or replaced to meet the proposed requirements by January 1, 2023, or five years from date of installation, whichever is later.

To comply with SB 454's requirement that an EVSE "shall allow a person desiring to use the station to pay via credit card or mobile technology, or both,"[43] the proposed regulation requires the service provider ensure that EVSEs have a physical credit card reader and a physical RFID reader (to accept mobile payment). The credit card reader and RFID reader may be installed either on the EVSE itself or at a nearby kiosk that services one or more EVSEs at the site.

For each EVSE, the service provider shall provide to the EV user a complete listing of all fees that may be incurred at the time of a charging session. The fees may include, but are not limited to, the kilowatt-hour (kWh) cost of electricity, credit card fees, parking fees, non-membership plug-in fees, increased charges after plug-in session ends, and any other fees chargeable to the EV user. Fees must be displayed at the point of sale to ensure the fee structure is transparent to the driver. Consumers paying for a charging session may be billed on different scales such as $/kWh, $/minute, $/hour, and flat $ fee per session. The Electric Power Research Institute completed a study of National Charging Costs[44] which found over 350 unique charging cost examples.

Under the proposed regulation, service providers may not make payment contingent on becoming a member of the service provider network. Service providers are permitted, however, to continue offering discounts and other promotions to members, provided that non-members are able to pay for charging at the EVSE using the methods previously described.

Payment system security is critically important. The proposed regulation requires that credit card reader and near field communications (NFC) reader payment systems must be Payment Card Industry Data Security Standard (PCI-DSS) Level 1 compliant, to secure the payment transactions and protect EV consumers' personally identifiable information.[45] PCI-DSS Level 1 compliance requires a third party to annually inspect the EVSE, and requires the service provider or network operator to use data encryption from the EVSE to the EVSP and back. PCI-DSS Level 1 compliance is industry standard for curbside parking meters and some DCFCs. For example, this technology is commonly required as a minimum security measure on parking meters that use credit card readers or other payment technologies.[46]

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[43] Cal. Health & Safety Code § 44268.2(a)(1).
[44] Dunkeley, 2017. Jamie Dunkeley, Electric Power Research Institute "National Charging Costs" December 2017.
[45] Control Scan, 2018. "What's the point of PCI DSS compliance requirements?" https://www.controlscan.com/data-sheet-pci-dss-compliance-solutions/?utm_source=pcicomplianceguide.org&utm_medium=referral&utm_campaign=pcicg-overview, Accessed September 10, 2018
[46] City of Sacramento, May 29, 2013. "Request for Proposal: Parking Meter Procurement" http://dockets.sandiego.gov/sirepub/cache/2/3lh0hxykr0stpot3e3bz2hpx/678426111420181105325 95.PDF

SB 454 permits CARB to adopt interoperability billing standards for network roaming payment methods,[47] and the proposed regulation does so because national standards are not established. EVSPs must install and operate, at a minimum, the interoperable billing standard Open Charge Point Interface (OCPI). The objective of OCPI was to improve the exchange of information between EVSPs and EVSE operators.[48] The OCPI standard will create the foundation for EVSPs to have market certainty in standards, allowing EVSPs to make roaming agreements. Roaming agreements will allow consumers to use a membership with one EVSP at another EVSP charger location if an agreement is in place. Consumers would not have to take the time to sign up for memberships with each EVSP, while benefitting from a membership with one or more EVSPs. EVSPs are not limited to only installing OCPI, and may use additional networking or payment standards to provide further benefits to consumers, auto manufacturers, EVSPs, or other parties.

To conform with SB 454's labeling requirement,[49] the proposed regulation requires each EVSE to be labeled in accordance with Part 309 of Title 16 of the Code of Federal Regulations. This label will display the voltage (V) and the current (A) of which the EVSE is capable. It will also state the unit is dispensing electricity and if the EVSE is conductive or inductive. This will let users know the maximum electric supply at which their car may be able to charge at the EVSE.

To conform with SB 454's location disclosure requirement,[50] the proposed regulation requires EVSPs to report data for all of their publicly available EVSEs in California to NREL, which would then be posted on the AFDC. The reported data is applicable to networked and non-networked Level 2 and DCFC that are free and pay for service. EVSPs would also be required to use a uniform data fields to ensure the companies are reporting the same information in the same format. The proposed reporting template requests model and serial number of EVSE units installed, open hours, facilities where the EVSE(s) are installed, what form of access is required of drivers, cost to charge at the EVSE, contact number for the EVSP, connector type and number of ports and connectors. All of this information will give the user more information, from a singular source that they can use when choosing places to charge their vehicle in public.

The proposed regulation will make public EVSEs more accessible and easy to use, putting in place consistent and transparent access for customers as required by SB 454. While increased accessibility will support wider adoption of ZEVs, other actions will be needed to incentivize broader PEV adoption to meet the Governor's goal of 5 million ZEVs by 2030. In

[47] Cal. Health & Safety Code § 44268.2(d).
[48] NKL, 2017. Open Charge Point Interface OCPI. "Objective: Improving the exchange of information between service providers and charge point operators. Ensuring better information for EV drivers about the status (availability and location) of the charge points and insight into the associated costs prior to, during and after charging. Access to charge points is improved by means of developing and offering independent interface communication software between the charge point and the charge vendor – this is called Open Charge Point Interface, or OCPI for short. OCPI can have an enormous impact on the speed at which publicly available charging infrastructure develops. Through its broad objective and independent position, the Netherlands Knowledge Platform for Charging Infrastructure plays a stimulating and crucial role in this.
[49] Cal. Health & Safety Code § 44268.2(c).
[50] Cal. Health & Safety Code § 44268.2(b).

March 2017 the Board directed staff to develop new ZEV regulatory requirements[51] to increase certainty of future PEV volumes. This rulemaking is anticipated in 2020 and will affect vehicles in 2026 and future years. Recent amendments to the Low Carbon Fuel Standard regulation[52] will also work towards the 2030 ZEV goals by providing a mechanism for utilities to use credit proceeds for consumer purchase rebates.[53] CARB also manages the Low-Carbon Transportation program that includes the Clean Vehicle Rebate Program (CVRP), which has provided over $502 million for consumer purchase rebates[54], the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) which provides incentives for hybrid, zero emission, and low-NOX technologies for trucks and buses, as well as electric vehicle car sharing pilot projects.

The proposed regulation does not contain requirements to increase PEV adoption or increase the number of EVSEs, and is not anticipated increase these inventories compared to the baseline. Stakeholders also do not anticipate that this proposed regulation will increase the population of EVSEs. For this reason, the EVSE inventories in the baseline and proposed regulation are assumed to be the same (Table 2). The proposed regulation adds an incremental compliance cost to each existing and new EVSE; these costs are described in detail in Section C.

7. Sensitivity Analysis

Significant ZEV adoption is needed in California to meet the State's air quality and climate goals. While regulations in place are anticipated to increase ZEV adoption over time, other actions are needed to drive sales beyond current requirements to meet the Governor's goals of 4 million PEVs[55] on the road by 2030. As described above, this proposed regulation is not anticipated to drive broader PEV adoption directly, but sets the stage for future action. A sensitivity analysis was developed to estimate the potential range of costs of the proposed regulation if California were to meet the Governor's goals via other actions. This is a theoretical case that may not occur exactly as projected, but provides estimates of maximum potential costs as a result of the proposed regulation for disclosure purposes. A separate "sensitivity baseline" was developed which considers the population of PEVs and EVSEs needed to meet the 4 million PEV goal.

The sensitivity baseline assumes 1.3 million PEVs in 2025, and 4 million PEVs in 2030. The assumption of 1.3 million PEVs through 2025 comes from the CEC EVI Pro report,[56] and the 4

[51] CARB, 2017. California Air Resources Board. "Advanced Clean Cars Midterm Review Resolution 17-3" Released March 24, 2017. https://www.arb.ca.gov/msprog/acc/mtr/res17-3.pdf
[52] Cal. Health & Safety Code §95480-95503
[53] CARB, 2018. California Air Resources Board. "Proposed Fiscal Year 2018-2019 Funding Plan for Clean Transportation Incentives for Low Carbon Transportation Investments and the Air Quality Improvement Program" Released September 21, 2018. https://www.arb.ca.gov/msprog/aqip/fundplan/proposed_1819_funding_plan.pdf
[54] CARB, 2018. California Air Resources Board. "Proposed Fiscal Year 2018-2019 Funding Plan for Clean Transportation Incentives for Low Carbon Transportation Investments and the Air Quality Improvement Program" Released September 21, 2018. https://www.arb.ca.gov/msprog/aqip/fundplan/proposed_1819_funding_plan.pdf
[55] 4 million are anticipated to be PEVs, and 1 million are anticipated to be fuel-cell vehicles which are not impacted by the proposed regulation.
[56] The Executive Order target of 1.5 zero emission vehicles by 2025 assumes a proportion of these vehicles are hydrogen fuel cell vehicles.

million PEVs by 2030 are anticipated to be needed to meet the Governor's Executive Order. The CEC EVI Pro report provides estimates for PEVs and EVSEs (both Level 2 and DCFC) for 2019 through 2025. Staff assumed a linear projection of PEVs from 2026 through 2030, and estimated the number of EVSEs necessary to support these PEVs using the ratio of EVSEs to PEVs from the CEC EVI Pro report.

In 2025, the CEC EVI Pro report estimates that there are 1,321,368 PEVs, 13,708 DCFC, 40,116 public Level 2 and 30,824 workplace Level 2 chargers. These ratios were applied to 2026 through 2030 PEV projections to project the number of EVSEs in the sensitivity baseline. Only 50 percent of workplace Level 2 charges are anticipated to be impacted by the proposed regulation, thus incremental compliance costs are only applied to half of these populations. Table 3 displays the EVSE projections used in the sensitivity baseline.

Table 3 – Projected EVSE Populations, Sensitivity Baseline[57]

Year	Public Level 2	Work place Level 2*	DCFC	Total
2019	19,776	13,833	6,594	40,204
2020	23,318	16,974	7,896	48,187
2021	26,806	19,972	9,139	55,917
2022	30,222	22,837	10,343	63,402
2023	33,588	25,598	11,497	70,683
2024	36,882	28,259	12,621	77,762
2025	40,116	30,824	13,708	84,647
2026	56,380	43,321	19,265	118,966
2027	72,644	55,818	24,823	153,285
2028	88,908	68,316	30,381	187,604
2029	105,172	80,813	35,938	221,923
2030	121,436	93,310	41,496	256,242

*Only 50 percent are anticipated to be publically accessible, thus impacted by the proposed regulation. The economic analysis only estimated incremental compliance costs for 50 percent of this population.

Both the sensitivity baseline and the sensitivity scenario use the EVSE populations in Table 3. The sensitivity scenario adds an incremental compliance cost to each existing and new regulated EVSE, which is described in Section C – Direct Costs.

[57] 2019 through 2025 is based on CEC EVI Pro report, and 2026 through 2030 is projected.

B. BENEFITS

The proposed regulation is intended to make public charging more consistent, transparent, accessible and easy for consumers to use. There are anticipated to be multiple benefits as a result of the proposed regulation, which are described in this section.

1. Emissions Benefits

As discussed previously this proposed regulation alone is not anticipated to increase the population of PEVs on the road or increase the number of EVSEs installed compared to the baseline. This regulation is one initial piece of a multipronged strategy, which sets the stage to allow broader PEV adoption once other actions are in place. The proposed regulation is also complimentary to and supports realization of the statewide emission benefits expected from the existing ZEV Regulation that increases in stringency to 2025.[58,59] The proposed regulation also supports realization of California's 2030 GHG target of 40 percent emissions reductions below 1990 levels.[60]

The proposed regulation is anticipated to increase driver access to EVSEs and allow a more consistent and transparent charging experience. This increased access is anticipated to result in drivers having confidence to transition more of their driving miles to PEVs, which could increase electric vehicle miles traveled (eVMT) statewide and provide emissions benefits. Consumers have a wide variety of mobility and charging options which results is a complex matrix of consumer choices with vastly different emissions profiles. Currently, there is insufficient data available to understand how increased access will quantitatively change statewide emissions.

The proposed regulation is anticipated to increase utilization of for fee public charging which will likely increase eVMT. To estimate the emissions benefits, it would be necessary to quantitatively identify how much of this eVMT is new miles traveled that would not have otherwise occurred, substitution of eVMT for a higher or lower emitting mode, or simply a shift in charging behavior resulting in no emissions difference (i.e., less home charging and more public charging). New eVMT that would not have otherwise occurred could result in a slight increase in emissions due to increased electricity use. Substitution of eVMT for other modes could result in increased emissions or significant emissions benefits. For example, if increased confidence in charging causes a consumer to use an electric vehicle in place of walking or public transit, then emissions may increase. Where consumers are substituting personal conventional vehicle use for eVMT the emissions benefits are significant.

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[58] CARB, 2011. California Environmental Protection Agency Air Resources Board. Staff Report: Initial Statement of Reasons Advanced Clean Cars 2012 Proposed Amendments to the California Zero Emission Vehicle Program Regulation. Page 78 accessed September 01, 2018.

[59] Projections of the statewide fleet emission benefits were recently updated to support the LEV III regulation changes for the "Deemed to Comply" provision. CARB, August 7, 2018. "Public Hearing to Consider Proposed Amendments to the Low-Emission Vehicle III Greenhouse Gas Emission Regulation: Staff Report: Initial Statement of Reasons" https://www.arb.ca.gov/regact/2018/leviii2018/leviiiisor.pdf

[60] https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf

Given that approximately 75 percent of trips in California use a personal vehicle,[61] the proposed regulation is anticipated to result in net statewide emissions benefits. Substitution of transit, walking or biking for eVMT is likely a small proportion of the change, as the majority of substituted miles are anticipated to be from a conventional personal gasoline vehicle since these trips dominate mode share in California. This will decrease tailpipe emissions and emissions from production of fossil fuels resulting in decreased emissions of GHGs, particulate matter (PM), oxides of nitrogen (NOx) and other air pollutants. Reductions of these pollutants provide climate and health benefits.

To convey the potential scale of emissions reductions from trips that switch to electric miles, CARB staff have quantified the marginal difference in GHG emissions between driving a mile with a gasoline conventional vehicle compared to an electric drive vehicle. Figure 1 shows the GHG emissions per mile for a gasoline vehicle (GAS) compared to a PHEV and BEV in California. The data displays both the tailpipe emissions ("tank to wheel" or TTW) and upstream emissions associated with producing and delivering the fuel to the vehicles ("well to tank" or WTT). Combined, this is called a well-to-wheel emissions analysis comparing varying powertrain types.

In addition to comparing emissions between powertrain types, the analysis also compares new passenger vehicles in two different years to account for improved vehicle efficiency and fuel carbon content (both electricity and gasoline) over time. Emissions from vehicles are taken from the most current CARB on-road vehicle inventory, the EMFAC2017 model approved by the U.S. EPA for SIP purposes. Emissions from producing gasoline in 2020 and 2030 accounts for the anticipated lower carbon fossil and renewable fuel blends expected in the market due to the recently adopted Low Carbon Fuel Standard (LCFS) amendments. Emissions from producing electricity are based on California's power generation mix in 2020 and 2030 under the SB 100[62] renewable requirements (a 60 percent renewable portfolio standard by 2030) and the phase-out of coal generation. These assumptions, therefore, account for the unique conditions in California and show that driving an electric vehicle produces significantly lower GHG emissions, as compared to other states or regions with different vehicle and fuel policies. The well to wheel GHG emissions from a new BEV are anticipated to be about a 75 percent lower than a new gasoline (GAS) vehicle in 2020, and an 85 percent lower in 2030.

In addition to GHG emissions, CARB staff evaluated other pollutants in this analysis. In 2020, the BEV has approximately 80 percent lower NOx emissions than the conventional vehicle, and in 2030, the difference is anticipated to be even slightly larger. For particulate matter (PM) pollutants, the difference is slightly smaller at approximately 50 percent reduced emissions compared to a conventional vehicle. These values represent the full well-to-wheel emissions factor.[63]

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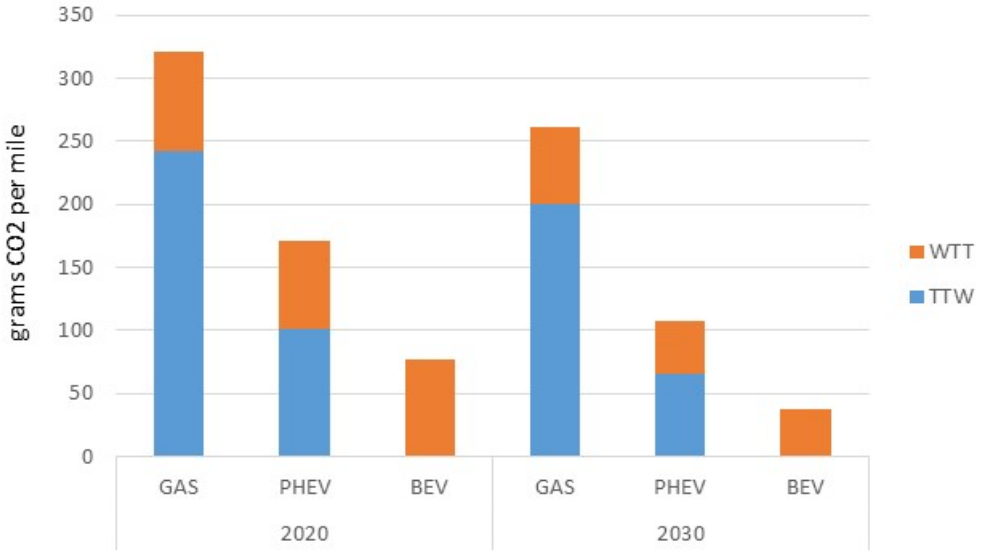
[61] CalTrans, 2013. 2010-2012 California Household Travel Survey Final Report. Table 1.2.3 on pg 4. http://www.dot.ca.gov/hq/tpp/offices/omsp/statewide_travel_analysis/Files/CHTS_Final_Report_June_2013.pdf

[62] Cal. Health & Safety Code § 399.11, 399.15, 399.30 and 454.53 to the Public Utilities Code

[63] Emissions Factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant.

Figure 1 - Greenhouse gas emission factors (grams of CO2/mile) for three vehicle technology types on passenger cars, accounting for direct vehicle emissions (TTW) as well as fuel production and delivery emissions (WTT); Source: CARB Vision Program 2018



2. Fuel Cost Savings

If the proposed regulation reduces conventional personal vehicle use and replaces this with eVMT then vehicle operators could enjoy fuel cost savings. These potential cost savings could not be quantified for the reasons described in the last section, but are qualitatively discussed here. As above, the substitution of conventional personal vehicle for eVMT is only one of the possible outcomes of the proposed regulation, but is anticipated to represent the majority of the substitution choices.

On average, electric vehicles are estimated to save consumers between $440 and $1,340 dollars per year on fuel, relative to a conventional vehicle.[64] Thus, substitution of conventional VMT for eVMT would likely result in small fuel savings for consumers. The range is large because savings depend on the relative prices of gasoline and electricity, as well as the fuel economy of the conventional vehicle. The annual savings of $440 assumes a low gasoline price and high fuel economy conventional vehicle, and the $1,340 represents the high gasoline price and low fuel economy conventional vehicle. Gasoline prices are anticipated to increase in the future relative to today,[65] which could increase the potential fuel cost savings to consumers.

3. Benefits to a Typical Business

The proposed regulation is anticipated to increase consumer confidence in public charging and result in increased utilization of public chargers. These public chargers could be located at or

[64] CEC 2017. Preliminary Analysis of Benefits from 5 million Passenger Vehicles in California. https://www.energy.ca.gov/2017publications/CEC-999-2017-008/CEC-999-2017-008.pdf
[65] DOF 2018. Consumer Price Index Forecast – Annual & Monthly. http://www.dof.ca.gov/Forecasting/Economics/Eco_Forecasts_Us_Ca/documents/FRCPI0418.xlsx

near any number of businesses including retail locations and work places. In addition, compliance with the proposed regulation will increase demand for credit card and mobile payment equipment and electrical contracting services from businesses within California.

Increasing consumer confidence could make it easier to include PEVs in rental car fleets and other private fleets where drivers are accustomed to paying by corporate or private credit card. In 2017, California saw 224 million people-trips to the state.[66] As longer electric driving-range PEVs become available, open access to charging could facilitate additional PEV use in rental fleets and private fleets. This could provide benefits to the fleets because PEVs generally have lower fueling and maintenance costs compared to an internal combustion vehicle.[67] If access to the public charging infrastructure is not certain, costs are not transparent, and payment options are not standard it may reduce the desirability of PEVs as an option in fleets.

The proposed regulation may provide a benefit to EVSE operators from increased utilization of public charging stations. Easier access to EVSEs and a transparent pricing structure could reduce barriers to public charging enabling drivers to confidently use their PEVs for longer trips or switch some charging from home to public locations. This could result in increased revenue to some of these businesses.

Increased use of public charging stations could have benefits to businesses near the charging station. Many EVSEs are located in areas with shopping or restaurants available. Each of these businesses has the opportunity to have an EVSE located in the parking lot providing the opportunity to attract new visitors or retain current visitors longer as drivers wait for their car to charge. Businesses with EVSEs in the parking lot have the option to collect fees from the drivers for a charging session, or provide the electricity for free. Current PEV models take anywhere from 2 to 6 hours to get a full charge on a Level 2 EVSE. A portion of this time can be filled doing daily shopping activities, getting food on a road trip or experiencing a new location. Increased public utilization could drive more consumers to these locations.

Additionally, compliance with this proposed regulation would enable EVSEs to be eligible for the new LCFS amendments generating marketable credits for new EVSE installations.[68] These credits would go to the station owner, which in the proposed regulation could be the EVSPs or site hosts such as retail centers. The recent change to the LCFS program requires all DCFCs seeking LCFS credit to be able to accept credit cards. The proposed regulation defines how the DCFCs should accept credit cards.

The proposed regulation requires all EVSEs currently operational to be retrofitted or replaced for compliance. This will increase demand for electricians, contractors, and other related businesses in California. Site hosts who own and operate EVSEs could also see increased demand to use the EVSEs. Manufactures of EVSEs could see increased demand to create

[66] Visit California, May 17, 2018. “2018 California Travel and Tourism Forecast – State” https://industry.visitcalifornia.com/Research/Report/California-Travel-Tourism-Forecast-State-2018
[67] CARB, 2017. California’s Advanced Clean Cars Midterm Review Report, Appendix B: Consumer Acceptance of Zero Emission Vehicles and Plug-In Hybrid Electric Vehicles, III.C.4.b. Effects of Energy Prices on PEV Operating Costs. January 18, 2017.
[68] Page 93. https://www.arb.ca.gov/regact/2018/lcfs18/frolcfs.pdf

new models of EVSEs. Companies who supply credit card readers and the accompanying software could see increased demand.

4. Benefits to Small Businesses

For the purpose of this regulation, a small business is defined as having fewer than 100 employees, independently owned and operated, and not dominate in its industry.[69] Small businesses may obtain benefits similar to those described for typical businesses. Some small businesses in California may choose to provide EVSEs to attract PEV drivers to their businesses or may obtain increased revenue from higher use of existing EVSEs. Some electricians and contractors that retrofit or replace EVSEs are small businesses, and will see increased demand. All of the EVSPs that are regulated parties, except one are considered to be a small business.

5. Benefits to Individuals

Individuals will benefit from increased access, transparency, and ease of use of EVSEs in public locations. Transparency in pricing will help consumers make informed decisions about the costs of charging at different locations compared to home charging. Ease of access will reduce anxiety about charging and could save consumers time in searching for and traveling to a useable charging location. The ability to use standard payment methods such as credit card readers will simplify payment and allow individuals with limited mobile technology to seamlessly utilize public chargers.

Individuals from multiple income groups will benefit from the proposed regulation because they will have greater accessibility to EVSEs. The proposed regulation will allow for lower income groups to pay for fueling a PEV by requiring credit card and mobile payment options on EVSEs. With the required reporting to AFDC drivers from all income groups will be able to see how many existing EVSE stations are available. Knowing where to fuel a PEV in public is very important for drivers. As drivers see more EVSEs in public they will have more confidence in their ability to charge in public if they need to.

The potential emissions reductions of the proposed regulation will also benefit individuals. As described in Section B1, emissions of NOx, PM and other pollutants are anticipated to decline as a result of the proposed regulation, though the exact magnitude and location of these benefits is not easy to estimate. Emissions reductions are anticipated to occur at the tailpipe and could also occur at locations that produce fossil fuels. These emissions reductions could reduce exposure to pollution for the general population as well as occupational exposure for individuals who work near vehicles. Reduction of PM emissions reduce the risk of premature deaths and hospital visits, especially for sensitive groups such as children, elderly, and people with chronic heart or lung disease. Air pollution may disproportionately impact individuals with low socioeconomic standing,[70] thus reductions in these pollutants may disproportionally benefit these groups.

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[69] AB 1033. Chapter 346 (2016). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB1033

[70] Gwynn RC, Thurston GD. (2001) The burden of air pollution: impacts among racial minorities. Environ Health Perspectives;109(4):501–6. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1240572/

C. DIRECT COSTS

Compliance with the proposed regulation will add an incremental costs to existing and future Level 2 and DCFC EVSEs in California that require payment for service. These costs include one-time upfront costs as well as ongoing operations and maintenance. EVSPs and EVSE site hosts are expected to bear the compliance costs, which could be passed on to site providers or consumers. New EVSEs will be required to comply with the proposed regulation if they are installed after January 1, 2020 for DCFC and after January 1, 2023 for Level 2 EVSEs. Existing EVSEs in place before these deadlines that are not compliant will be required to be retrofitted or replaced to meet the proposed requirements by 2025 for DCFC and 2028 for Level 2 EVSEs.

1. Direct Cost Inputs

Direct costs consist of one-time up-front and ongoing costs related to: replacement costs for existing Level 2 EVSEs, costs related to the required credit card and mobile payment technologies, interoperability costs, costs for disclosure of charging prices, labeling costs, and reporting.

One-time costs are annualized based on a real discount rate of 5 percent and a 10 year useful life of the EVSEs and begin to be incurred when Level 2 EVSE is replaced and when DCFC EVSE is retrofitted. Ongoing costs, such as networking costs, are not financed and are primarily calculated as the number of compliant Level 2 and DCFC EVSE multiplied by the ongoing cost per EVSE. All costs are in the 2018 dollar year. Staff surveyed 7 EVSPs operating in California for cost information. An average was taken of their responses.

a. Level 2 Installation Costs

The proposed regulation requires multiple hardware and software updates to existing EVSEs. Existing Level 2 EVSEs are less expensive and much older on average than DCFC and retrofitting payment hardware may be largely infeasible. As a conservative assumption to fully encompass the potential compliance costs, all existing Level 2 EVSEs are assumed to be fully replaced, in addition to the costs for the required upgrades described in later sections.[71] As a result, many Level 2 EVSEs are projected to be replaced earlier than their natural end of useful life, which changes the timing businesses would incur installation costs. DCFC are assumed to be retrofit with the required upgrades and will not incur replacement costs.

The full cost of purchasing and replacing Level 2 EVSEs earlier than anticipated is included in the economic analysis. Public Level 2 EVSE costs vary widely. CARB staff assumes a cost of $6,000[72] per existing Level 2 EVSE that must be replaced early to comply with the proposed regulation. These costs are annualized at a rate of 5 percent over the 10 year useful life of EVSEs and will be borne by the EVSE site host. In other words, a site host replacing a Level 2

[71] Site hosts could potentially comply by installing payment kiosks. Instead of replacing all existing Level 2 EVSEs at a site, a kiosk that accepted payment for multiple Level 2 EVSEs could be installed at the site.
[72] U.S. DOE 2015, U.S. Department of Energy, Costs Associated With Non-Residential Electric Vehicle Supply Equipment, November 2015, http://www.afdc.energy.gov/uploads/publication/evse_cost_report_2015.pdf
The cost does not account for any electrical or concrete work on these sites, because the proposed regulation does not require any site upgrades.

EVSE incurs annual costs of approximately $777 for the next 10 years. EVSPs serve as the site hosts for approximately 58 percent of the EVSEs. State and local government serve as site hosts for approximately 1 percent of EVSEs, and the remainder of EVSEs are owned by other site hosts such as retail establishments and workplaces.

Under the baseline, an existing Level 2 EVSE would be replaced at the end of its 10 year useful life. Under the proposed regulation, many existing EVSEs are anticipated to require early replacement to comply with the proposed regulation. Most of these replacements are anticipated to occur in 2023, when the requirements for existing Level 2 EVSEs go into effect.[73] From 2024 to 2027, a smaller number of additional replacements are needed relative to the baseline in most years. In later years, there are fewer replacements compared to the baseline (negative numbers) because EVSEs were replaced ahead of the baseline schedule as a result of the proposed amendments. While there are fewer replacements relative to the baseline, amortization of costs results in net costs every year. Table 4 illustrates the number of Level 2 replacements relative to the baseline for both the proposed regulation and sensitivity scenario. The total replacement costs for Level 2 EVSE are summarized in Table 5 and 7.

Table 4 - Level 2 EVSE Replacements Relative to the Baseline

Year	Proposed Regulation	Sensitivity Scenario
2020	0	0
2021	0	0
2022	0	0
2023	10265	20525
2024	149	4632
2025	254	4337
2026	-90	3761
2027	111	3754
2028	-5922	-16182
2029	-808	-5291
2030	-1046	-5129

b. Credit Card and Mobile Payment Technologies

i. Basic Technology Costs

The proposed regulation requires each existing and new EVSE to accept both credit card and mobile payments. The proposed regulation requires Europay Mastercard Visa (EMV) chips for credit card payments and Near Field Communication (NFC) for mobile payments. Sixty percent of DCFCs installed prior to December 2018 already have credit card reader availability, and 15 percent have mobile payment options. Staff assumes these numbers continue until January 1, 2020. DCFCs with credit card readers already exist in the baseline, and are not anticipated to

[73] Under the proposed amendments, all Level 2 EVSE installed between 2013 and 2018 would be replaced in 2023. In the baseline, only Level 2 EVSE installed in 2013 would be replaced in 2023.

require additional costs to comply. All other existing and new EVSEs are anticipated to incur compliance costs. Staff assumes no existing Level 2 EVSEs have credit card reader availability.

CARB staff contacted EVSPs for data on costs to install and maintain these new payment types. Upfront costs for EMV chips are estimated at $371 per EVSE on average, with ongoing annual maintenance of $270 per EVSE per year. Upfront costs for NFC capabilities averaged to $8 per EVSE and ongoing networking fees of $1 per EVSE per year. The upfront costs are annualized at a rate of 5 percent over 10 years while the maintenance costs are incurred each year. The reason that NFC capabilities are only $8 is because staff expects the EVSPs to be using a single hardware unit that is capable of EMV chip and NFC payments. The incremental costs associated with the increased networking costs with the NFC hardware is also considered minimal which is why $1 per EVSE is used for estimated costs. Two credit card suppliers were contacted to obtain quotes for EMV chip and NFC hardware costs.[74] These were also factored into the cost of the hardware.

ii. Cost of Credit Card Security - PCI

In order to ensure the security of the credit card payments EVSPs would need to ensure the EVSE and their networks are PCI-DSS Level 1 compliant. PCI-DSS Level 1 compliance is commonly used in industries that require payment on machines that are not in a location with a constant human presence. Stakeholder feedback[75] has estimated the cost of compliance to be $8,165 per EVSP per year which includes all required checks from the PCI governing body. Currently there are 7 EVSPs so the estimated yearly cost is $48,990. There is an additional one-time $25,000 per EVSE model which accounts for PCI compliance certification and testing procedures. Currently CARB staff estimates 30 new EVSE models each year so the annual cost is $750,000.

c. Interoperability (IO)

The proposed regulation requires that EVSPs that have not implemented the OCPI interoperability standard will need to do so. OCPI works in the data cloud network space and interacts with the primary network and any secondary networks if such contracts exist. Costs for compliance with the OCPI standard consist of a one-time cost of staff (engineering) time to implement the standard. This cost is expected to be borne by the seven EVSPs. Through stakeholder feedback CARB staff estimate it would take six months at 40 hour work week to implement the OCPI standard, with engineering labor billed at $125 per hour.[76] This is estimated to be $120,000 per EVSP in 2020. Currently there are seven major EVSPs so the total cost is expected to be $840,000. This requirement applies to all EVSPs that operate networked EVSEs that require fee for service.

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[74] Staff phone and email conversations with credit card suppliers, October 25, 2018.

[75] CARB staff received 7 quotes from EVSPs and 2 quotes from credit card companies for the cost of PCI-DSS Level 1 compliance. The individual quotes were provided to CARB staff as business confidential information and the average value was used for this analysis.

[76] Based on information received from a survey of EVSPs submitted as business confidential information on the cost of a consultant engineer to implement the OCPI standard.

d. Disclosure of Charging Price and Fees

EVSEs will be required to disclose charging price and fees before the consumer begins fueling. The proposed regulation does not specify the manner in which customers are notified of pricing at EVSEs. EVSPs have been clear that each site may have different atheistic requirements. Therefore the EVSPs have the ability to choose which signage method would be best for each site. This can range from a software upgrade on EVSEs that have digital screens, a simple metal sign or a weatherproof sticker.

Stakeholder feedback estimates the cost, to EVSPs, of disclosing fees using these methods to range from $0 to $100 per EVSE. To be conservative, staff assumes a cost of $100 for each existing and new EVSE. This is a one-time cost incurred when an existing EVSE is retrofit or replaced, or when a new EVSE is installed and is annualized at a rate of 5 percent over the 10 year useful life of the EVSE. Over the lifetime of the regulation, this $100 cost will be incurred by 26,398 EVSEs in the Low PEV scenario, and 209,587 EVSEs in the High PEV scenario.

e. Labeling

The proposed regulation requires that all EVSEs have the CFR Title 16 Part 309 label. No EVSEs currently have this labeling in place. It is assumed existing EVSEs will have the sticker placed upon upgrade or replacement, and new EVSEs will be installed with the sticker. Through stakeholder feedback the cost of each sticker is estimated to be $45. While a service person is required to place the sticker on the EVSE it can be done at a routine maintenance check. Therefore CARB staff did not include the cost of a technician visit. Each existing EVSE that is retrofit or replaced and each new EVSE is assumed to incur this onetime cost. Over the lifetime of the regulation, this $45 cost will be incurred by 26,398 EVSEs in the Low PEV scenario, and 209,587 EVSEs in the High PEV scenario.

f. Reporting

Currently all EVSPs voluntarily report basic station information to NREL. CARB staff has worked with NREL to develop a standardized reporting sheet that all EVSPs will use. The proposed regulation does not require the EVSPs to change their method of data transfer, only what information they transfer to NREL. EVSPs have indicated that the data necessary for reporting is readily available and will easily transfer to the proposed format. Based on stakeholder feedback, CARB staff estimates the costs of NREL reporting to be $0.

2. Total Costs of the Proposed Regulation

The total direct costs for the proposed regulation are calculated on an annual basis using the incremental costs described in Section C1 and the EVSE inventory assumptions in Table 2. The total direct cost estimated here represents the total cost of the proposed regulation including both costs to businesses and fiscal impacts.[77] Figure 2 breaks down the estimated annual compliance costs of the proposed regulation. The majority of compliance costs are expected to come from the credit card and mobile payment technologies. The installation costs

[77] Fiscal Impacts are also separately described in detail in Section D.

represent EVSEs that are out of compliance with the credit card and signage requirements. Because these units would not have normally turned over these costs are attributed to the proposed regulation.

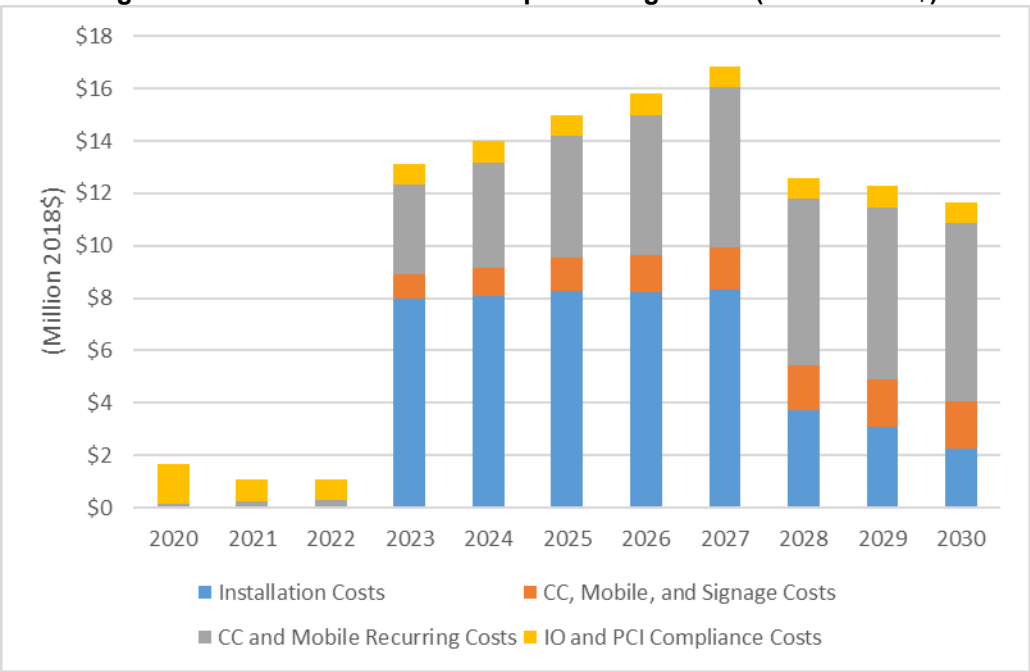
The proposed regulation will go into effect January 1, 2020 for DCFC and January 1, 2023 for Level 2 EVSEs. Because the DCFC population count is lower than the Level 2 population count, Level 2 EVSEs represent the bulk of the cost incurred by EVSPs and will occur between 2027 and 2030 as indicated in Table 5 and Figure 2.

Table 5- Annual Costs for the Proposed Regulation (Million 2018$)*

	Level 2 Costs				DCFC Costs				
Year	Level 2 Installation Costs	CC, Mobile, and Signage One-Time Costs	CC and Mobile Recurring Costs	Total	CC, Mobile, and Signage One-Time Costs	CC and Mobile Recurring Costs	Total	IO and PCI Compliance Costs	Grand Total
2020	$0.00	$0.00	$0.00	$0.00	$0.03	$0.13	$0.16	$1.65	$1.81
2021	$0.00	$0.00	$0.00	$0.00	$0.06	$0.20	$0.26	$0.81	$1.07
2022	$0.00	$0.00	$0.00	$0.00	$0.07	$0.21	$0.28	$0.81	$1.09
2023	$7.98	$0.80	$3.20	$11.97	$0.13	$0.22	$0.35	$0.81	$13.13
2024	$8.09	$0.94	$3.77	$12.80	$0.14	$0.23	$0.38	$0.81	$13.98
2025	$8.29	$1.11	$4.41	$13.81	$0.15	$0.24	$0.39	$0.81	$15.01
2026	$8.22	$1.27	$5.08	$14.58	$0.17	$0.25	$0.41	$0.81	$15.80
2027	$8.31	$1.46	$5.84	$15.61	$0.17	$0.25	$0.43	$0.81	$16.84
2028	$3.70	$1.52	$6.09	$11.31	$0.21	$0.25	$0.46	$0.81	$12.58
2029	$3.08	$1.59	$6.35	$11.01	$0.21	$0.26	$0.46	$0.81	$12.28
2030	$2.26	$1.63	$6.52	$10.42	$0.18	$0.25	$0.43	$0.81	$11.66
Total	**$49.93**	**$10.33**	**$41.25**	**$101.51**	**$1.51**	**$2.50**	**$4.02**	**$9.72**	**$115.24**

* Includes both cost to businesses and fiscal impacts. While the total direct costs to not exceed $50 million in any given year, the economic impact exceeds $50 million in all years after 2023, as shown in Section E: Macroeconomic Impacts.

Figure 2 - Annual Costs of the Proposed Regulation (Million 2018$)



3. Total Costs Sensitivity Scenario

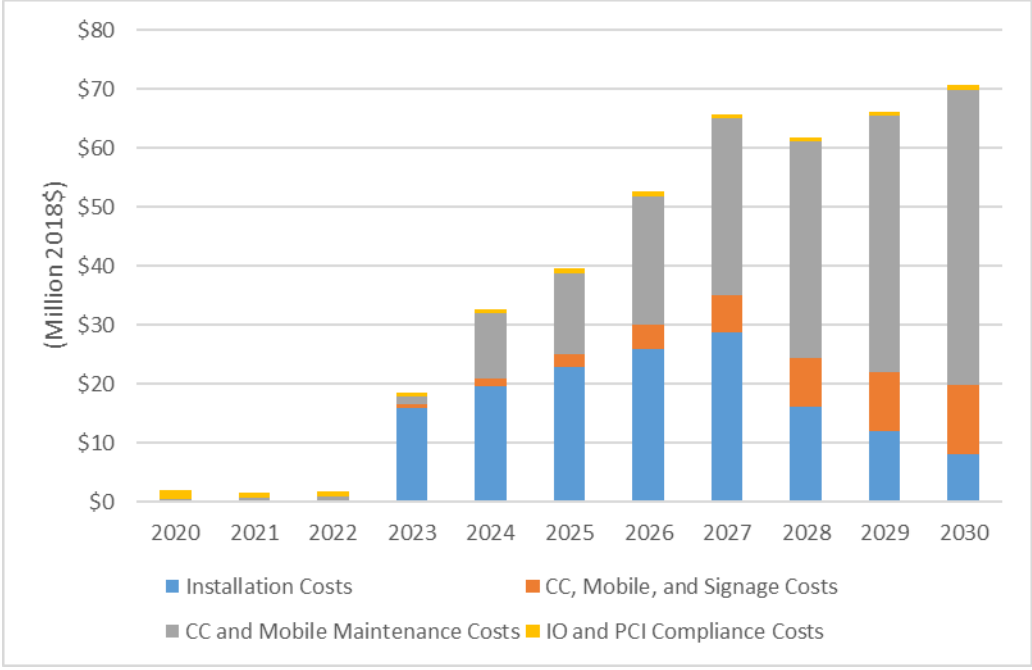
The total compliance costs in the sensitivity scenario are estimated using the incremental costs described in Section C1 and the EVSE inventory projections from Table 3. Figure 3 breaks down the estimated annual costs. Compliance costs in the sensitivity scenario are larger than in the proposed regulation due to the high EVSE population projections. In particular, the Level 2 EVSE population is a critical driver for the total costs, as Level 2 EVSEs are expected to have a high population count compared to DCFCs.

Table 6 - Annual Costs for the Sensitivity Scenario (Million 2018$)*

Year	Level 2 Costs				DCFC Costs			IO and PCI Compliance Costs	Grand Total
	Level 2 Installation Costs	CC, Mobile, and Signage One-Time Costs	Operations and Maintenance Recurring Costs	Total	CC, Mobile, and Signage One-Time Costs	Operations and Maintenance Recurring Costs	Total		
2020	$0.00	$0.00	$0.00	$0.00	$0.08	$0.26	$0.34	$1.65	$1.99
2021	$0.00	$0.00	$0.00	$0.00	$0.15	$0.48	$0.63	$0.81	$1.43
2022	$0.00	$0.00	$0.00	$0.00	$0.21	$0.65	$0.86	$0.81	$1.66
2023	$15.95	$0.00	$0.00	$15.95	$0.55	$1.25	$1.80	$0.81	$18.56
2024	$19.55	$0.67	$9.61	$29.83	$0.69	$1.37	$2.07	$0.81	$32.71
2025	$22.92	$1.33	$12.23	$36.47	$0.74	$1.49	$2.23	$0.81	$39.51
2026	$25.84	$3.21	$19.73	$48.77	$0.97	$2.10	$3.07	$0.81	$52.65
2027	$28.76	$5.09	$27.25	$61.10	$1.19	$2.70	$3.89	$0.81	$65.79
2028	$16.18	$6.62	$33.35	$56.15	$1.58	$3.31	$4.88	$0.81	$61.84
2029	$12.07	$8.14	$39.45	$59.67	$1.84	$3.91	$5.76	$0.81	$66.23
2030	$8.09	$9.67	$45.55	$63.31	$2.03	$4.52	$6.55	$0.81	$70.67
Total	**$149.35**	**$34.73**	**$187.18**	**$371.25**	**$10.03**	**$22.04**	**$32.07**	**$9.72**	**$413.04**

* Includes both direct cost to businesses and fiscal impacts.

Figure 3: Annual Costs for the Sensitivity Scenario (Million 2018$)



4. Direct Costs on Typical Businesses

In this section, staff estimate the cost for a typical EVSP to comply with the proposed regulation. There are currently seven EVSPs operating in California which act as site hosts for 58 percent of EVSEs. Of these seven, only one is not a small business.[78] This one business has over 100 employees and is the service provider for 15 percent of the Level 2 EVSE and 81 percent of the DCFC EVSE and is used as the typical business in this section.

To calculate the costs for this "typical" EVSP, staff first calculated the costs borne by all EVSPs operating in California from 2020 through 2030. EVSPs are responsible for replacement costs for Level 2 EVSE where they are the site hosts, and are also responsible for all compliance costs associated with credit card and mobile payment technologies, interoperability and PCI compliance costs, and ongoing operations and maintenance costs for the credit card and mobile payment technologies.

The replacement costs borne by all EVSPs for Level 2 EVSEs is assumed proportional to the number of Level 2 chargers that all EVSPs operate, coming out to approximately $28.7 million (0.58*$49.93). Costs for EVSPs associated with credit card and mobile payment, and signage total $51.6 million for LEVEL 2 EVSE and $4.0 million for DCFC EVSE.[79] Each EVSP also faces costs of totaling approximately $1.4 million from 2020 to 2030 for interoperability and PCI compliance. The total costs borne by all EVSPs is approximately $94 million.

To calculate the costs for the typical business, costs were apportioned based on the company's market share of Level 2 and DCFC EVSE relative to all the EVSPs. This business currently acts as the service provider for 15 percent of the Level 2 EVSE and 81 percent of the DCFC EVSE that are operated by EVSPs. This results in a total cost of $17 million from 2020 through 2030.

$$
\begin{aligned}
&Cost\ to\ a\ Typical\ Business \\
&\quad = (Level\ 2\ Costs\ for\ All\ EVSPs) \times Level\ 2\ Market\ Share \\
&\quad + (DCFC\ Costs\ for\ All\ EVSPs) \times DCFC\ Market\ Share \\
&\quad + Per\ EVSP\ Interoperability\ and\ PCI\ Compliance\ Cost \\
&\quad = (\$28.7 + \$51.6) \times 0.15 + (\$4 \times 0.81) + \$1.4
\end{aligned}
$$

5. Direct Costs on Small Businesses

For the purposes of this regulation, a small business is defined as having fewer than 100 employees and not dominate in its industry. Of the seven EVSPs operating in California, six meet the definition of a small business, and one of these small businesses is headquartered in California. To calculate the costs to a typical small business, staff took the remaining costs to EVSPs after taking out the one typical business and divided the cost equally among the remaining six EVSPs.[80] The total costs to all six EVSPs is estimated to be $77.3 million, and

[78] For the purposed of this regulation, a small business is defined as having fewer than 100 employees and not dominate in its industry.
[79] See Table 5.
[80] Costs for all EVSPs = Costs to the typical EVSP + (6 * Costs to the typical small EVSP). The cost to a typical small business can be derived from this equation.

the typical small business would be expected to face costs of approximately $12.9 million over the 2020 through 2030 lifetime of the proposed regulation.

This calculation assumes that the EVSPs that are currently classified as small businesses maintain their small business status through 2030. It is possible, particularly under the High PEV Scenario that these small businesses would grow and no longer be classified as small businesses, new service providers could enter the market, and utilization of EVSE would increase. These factors would lead to fewer small businesses being impacted and could potentially spread compliance costs across more businesses.

6. Direct Costs on Individuals

Individuals are not required to comply with the proposed regulation, but may be impacted if compliance costs are passed on. Staff estimated the direct compliance cost per kWh of EVSE utilization to estimate a potential price impact if all of the compliance costs are passed through to end-users. This represents an upper bound impact which is not anticipated to occur in practice, as some of the costs may be absorbed by the EVSP or site host.

To estimate the potential price impact, annual compliance costs for Level 2 and DCFC chargers were first divided by the corresponding population of EVSEs (Table 2) then averaged for 2020 through 2030. This provided the average annual cost of $152 per DCFC and $493 per Level 2 EVSE. The cost per kWh is then estimated by dividing this annual cost by the annual energy utilization per EVSE. The energy utilization for an EVSE depends on many factors and may vary significantly; it may also change as the industry grows in the future. However, based on reports and data available to Staff,[81] the annual average utilization of a typical EVSE is estimated to be 19,600 kWh per DCFC and 6,400 kWh per Level 2 EVSE.[82] The price increase as a result of the proposed regulation is estimated to be $0.01 per kWh for DCFCs and $0.08 per kWh for Level 2 chargers. The average market rates in California for Level 2 and DCFC EVSEs are $0.36 per kWh and $0.41 per kWh respectively.[83] The proposed regulation is anticipated to have an upper bound price impact of 2 percent for DCFC and 21 percent for Level 2 EVSEs.

Based on the current EVSE business model, it is not likely that all Level 2 EVSE compliance costs would be passed through to end-users. Currently 1245 EVSEs[84] do not require payment for public use. While some of these free chargers could be subsidized by incentives, a proportion are operated by businesses as a means to attract customers. These businesses absorb the costs to own and operate the EVSE along with the annual electricity necessary to provide free charging. Using the typical charging rates and electricity prices cited in the previous paragraph, the annual electricity costs absorbed by these businesses would be on the order of $2,304 for a Level 2 EVSE. This is over four times larger than the typical annual compliance cost that result from the proposed regulation. Given that these levels of costs are

[81] Based on information received from a survey of stakeholders one submitted as business confidential information on the utilization of Level 2 charging.
[82] Southern California Edison. Charge Ready and Market Education Program Pilot Report. April 2018. EVSE California utilization reporting data. 2016-2017.
[83]Dunckley, 2017. Jamie Dunckley, Electric Power Research Institute. “National Charging Costs”
[84] AFDC, 2018. Alternative Fuels Data Center. “Alternative Fueling Station Locator: Advanced Filters Downloaded Results” June, 2018.

routinely absorbed, and that this is an increasingly competitive industry, full compliance costs may not be passed through to consumers.

Even if the compliance costs were fully passed on to end-users, it is unlikely that driving habits or the adoption of PEV technology would change. The price change calculated for Level 2 chargers above would only constitute a portion of total annual charging costs. To demonstrate the change in overall annual charging prices, Staff calculated the average increase in total annual charging costs that could result from the Low PEV Scenario. Typical charging behavior indicates approximately 65 percent home charging[85] and 35 percent of public charging. Of the public charging, approximately 20 percent is at free Level 2 EVSEs, 71 percent is at for pay Level 2 EVSEs and 9 percent is at for pay DCFC.[86] Using these typical charging behaviors, Staff estimates the total cost for charging in one year is $1,190 on average. This assumes a PEV is driven 15,000 miles per year[87], consumes 0.3 kW of electricity per mile driven, and that charging prices are $0.19 per kWh for residences[88], $0.36 per kWh for public Level 2[89], and $0.41 per kWh for DCFC.[90] This also includes costs for home charging infrastructure ($1,616)[91] which was annualized over 10 years at a 5 percent interest rate. Assuming all the costs were passed through to the end user, the new total cost for charging would be $1,280 under the proposed regulation. The end user would see an increase of $79 per year or about 6.6 percent of total cost. The total economic impact of these compliance costs are systematically analyzed on an economy-wide basis in the Macroeconomic Impact section (Section F) of this report.

Although Level 2 public charging is a relatively small portion of the total charging needs for PEV drivers, it provides an important service. Making Level 2 more accessible enables more usage by drivers who don't have memberships to EVSPs, and also supports PEV drivers who don't have home charging options.

D. FISCAL IMPACTS

1. Local government

The proposed regulation is anticipated to impact local governments that own EVSEs that are available to the public. Local government agencies are site hosts, meaning they contract with EVSPs for network services. Thus local government agencies will incur direct costs related to

[85] Menser, 2018. Paul Menser for INL Public Affairs and Strategic Initiatives. "Large Nation Studies Analyze EV Infrastructure Needs". December 19, 2018.
[86] AFDC, 2018. Alternative Fuels Data Center. "Alternative Fueling Station Locator: Advanced Filters Downloaded Results" June, 2018.
[87] FuelEconomy.gov, 2018. "Electric Vehicles: Learn More About the Label". https://www.fueleconomy.gov/feg/label/learn-more-electric-label.shtml
[88] U.S. Energy Information Administration, 2018. Electric Power Monthly. March 2018- October 2018 reports. Average yearly cost of residential electricity cents per kilowatt hour, California.
[89] Dunckley, 2017. Jamie Dunckley, Electric Power Research Institute. "National Charging Costs – L2: Average cost by state".
[90] Dunckley, 2017. Jamie Dunckley, Electric Power Research Institute. "National Charging Costs – DCFC: Average cost by state".
[91] CARB, 2017. California Air Resources Board. "California's Advanced Clean Cars Midterm Review Report: Appendix D: Zero Emission Vehicle Infrastructure Status in California and Section 177 ZEV States". January 18, 2017.

the charger, but will not directly incur the PCI security and IO costs to EVSPs for network security and interoperability. It is assumed that EVSPs would pass through network compliance costs in proportion to the number of chargers each local government agency operates. For this reason, the overall compliance costs to local government agencies is anticipated to be proportional to the number of EVSEs they operate.

CARB staff estimated the current EVSE population for local and state governments based on the owner type ID from AFDC. Local government agencies own 29 publicly available networked Level 2 EVSEs which is 0.6 percent of the 2017 California EVSE total population. Local government currently does not own any DCFCs so there will be no cost incurred for these units. Assuming all local government agencies continue to operate Level 2 EVSEs into the future represents a conservative assumption since the costs associated with Level 2 chargers are larger than those for DCFCs. If local government agencies begin to use DCFCs rather than Level 2 EVSEs, then costs could be lower than those estimated here. The total cost to local government for 2020 through 2030 as a result of the proposed regulation is estimated to be approximately $300,000 for the Low PEV Scenario, and $896,000 for the High PEV Scenario. Table 7 and Table 8 display the annual costs to local government.

Table 7 - Fiscal Impacts to State and Local Government – Proposed Regulation (Thousand 2018$)

Year	State Government	Local Governments	Total
2020	$0.00	$0.00	$0.00
2021	$0.00	$0.00	$0.00
2022	$0.00	$0.00	$0.00
2023	$87.74	$47.86	$135.59
2024	$89.01	$48.55	$137.56
2025	$91.18	$49.73	$140.92
2026	$90.42	$49.32	$139.73
2027	$91.37	$49.84	$141.20
2028	$40.75	$22.23	$62.97
2029	$33.84	$18.46	$52.30
2030	$24.90	$13.58	$38.48
Total	**$549.19**	**$299.56**	**$848.75**

Table 8 - Fiscal Impacts to State and Local Government – Sensitivity Scenario (Thousand 2018$)

Year	State Government	Local Governments	Total
2020	$0.00	$0.00	$0.00
2021	$0.00	$0.00	$0.00
2022	$0.00	$0.00	$0.00
2023	$175.43	$95.69	$271.12
2024	$215.02	$117.29	$332.31
2025	$252.09	$137.51	$389.60
2026	$284.24	$155.04	$439.27
2027	$316.32	$172.54	$488.86
2028	$178.01	$97.10	$275.11
2029	$132.78	$72.43	$205.21
2030	$88.94	$48.51	$137.46
Total	**$1,642.84**	**$896.10**	**$2,538.94**

2. State Government

The proposed regulation is anticipated to impose compliance costs on California State agencies that own EVSEs that are available to the public. It is estimated that the Department of General Services and Cal Trans own and operate 1.1 percent of publicly available EVSEs.[92] As with local government agencies, these are Level 2 chargers and networks are operated and maintained by EVSPs, so compliance costs to State agencies are assumed to be proportional to the percent of statewide EVSEs owned. Most Level 2 EVSEs owned by these government agencies are located in Sacramento, CA though there are a few scattered throughout the state at various sites. The fiscal impacts for the State agencies from 2020 through 2030 are estimated to be $549,190 in for the proposed regulation and $1,642,840 for the sensitivity scenario. Annual fiscal impacts to State agencies are included in Table 7 and Table 8.

The California Department of Food and Agriculture (CDFA) Division of Measurement Standards (DMS) has initiated a rulemaking that will affect all commercial EVSEs.[93] CARB's proposed regulation does not interfere with or change the oversight and enforcement activities of CDFA's proposed requirements, and will not incur additional cost to CDFA.

E. MACROECONOMIC IMPACTS

3. Methods for determining economic impacts

This section describes the estimated total impact of the proposed regulation on the California economy. The proposed regulation will result in changes in expenditures by EVSPs in order to

[92] AFDC, June 2018.

[93] California Department of Food and Agriculture, Division of Measurement Standards, 2018. Proposed Regulations Under Review: Electric Vehicle Fueling Systems. Notice File No. Z2018-1023-01. https://www.cdfa.ca.gov/dms/pdfs/regulations/EVSE_NoticeofProposedRulemaking.pdf

comply with the proposed regulation. These changes in expenditures will affect employment, output, and investment in sectors that supply goods and services in support of EVSEs.

These lead to additional induced effects, like changes in personal income that affect consumer expenditures across other spending categories. The incremental total economic impacts of the proposed regulation are simulated relative to the baseline for both the Low PEV and High PEV Scenario using the cost data described in Section C. The analysis focuses on the incremental changes in major macroeconomic indicators from 2020 to 2030 including employment, growth, and gross state product (GSP). The years of the analysis are used to simulate the proposed regulation through 12 months post full implementation.

Regional Economic Models, Inc. (REMI) Policy Insight Plus Version 2.1.1 is used to estimate the macroeconomic impacts of the proposed regulation on the California economy. REMI is a structural economic forecasting and policy analysis model that integrates input-output, computable general equilibrium, econometric and economic geography methodologies.[94] REMI Policy Insight Plus provides year-by-year estimates of the total impacts of the proposed regulation, pursuant to the requirements of SB 617[95] and the California Department of Finance.[96] CARB uses the REMI single-region, 160-sector model with the model reference case adjusted to reflect the Department of Finance conforming forecasts. These forecasts include California population figures dated January 2018, U.S. real GDP forecast, and civilian employment growth numbers dated November 2017.

4. Inputs of the assessment

The estimated economic impact of the proposed regulation are sensitive to modeling assumptions. This section provides a summary of the assumptions used to determine the suite of policy variables that best reflect the macroeconomic impacts of the proposed regulation. The direct costs of the proposed regulation estimated in Section D are translated into REMI policy variables and used as inputs for the macroeconomic analysis.[97]

As described in Section C, it is conservatively assumed as to not understate the costs, that existing Level 2 EVSEs lacking compliant hardware and signage will be replaced instead of retrofitted. This installation cost is input into the REMI model as an increase in production costs for the directly affected industries. The directly affected industries are assumed to be the EVSPs, of which an industry classification distribution is estimated based on the market share of current businesses. This distribution of the EVSE site host market share has 58 percent in Other Electrical Equipment and Component Manufacturing (NAICS 3359), about 38 percent in Retail Trade (NAICS 44-45), 3 percent in Management, Scientific, and Technical Consulting Services (NAICS 5416), and about 1 percent in Electric Power Generation, Transmission, and Distribution (NAICS 2211), based on current data on site ownership by businesses in California.[98]

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[94] For further information and model documentation see: https://www.remi.com/model/pi/

[95]http://dof.ca.gov/Forecasting/Economics/Major_Regulations/SB_617_Rulemaking_Documents/documents/Section%202000%20ISOR%201%20sb_617_bill_20111006_chaptered.pdf

[96]http://dof.ca.gov/Forecasting/Economics/Major_Regulations/SB_617_Rulemaking_Documents/documents/Order_of_Adoption-1.pdf

[97] Refer to Section G: Macroeconomic Appendix for a full list of REMI inputs for this analysis.

[98] AFDC, June 2018.

The compliance costs incurred by the EVSPs for the installation, equipment, and other items will result in a corresponding increase in demand for industries supplying those goods and services. The installation of replacement Level 2 EVSEs will be contracted out to businesses best classified as Electrical Contractors and Other Wiring Installation Contractors (NAICS 238210), which is part of the construction sector. The credit card reader and mobile payment equipment as well as PCI compliance will be provided by businesses best classified as Monetary Authorities, Credit Intermediation, and Related activities (NAICS 521, 522). The interoperability compatibility will be developed by contractors classified within the Computer System Design and Related Services (NAICS 5415) industry. The estimated compliance cost categories and corresponding changes in demand are summarized in Table 9 below.

The relatively small fiscal impacts, as estimated in Section D (Table 7 & Table 8), are also input into the REMI model. The installation cost estimated to be incurred by state and local government is input as an increase in government demand for Construction along with a corresponding decrease in state and local government spending on other goods and services.

Table 9: Primary Industries Incurring Compliance Cost and Secondary Industries with changes in Demand by Source of Costs

Source of Compliance Costs	Industries Incurring Compliance Costs (NAICS)	Industries with Changes in Final Demand (NAICS)
Level 2 EVSE Installation	Electrical Equipment and Component Manufacturing (3359) Retail Trade (44-45) Management, Scientific, and Technical Consulting Services (5416) Electric Power Generation, Transmission, and Distribution (2211)	*One-time Cost:* Construction (23)
Credit Card and Mobile Payment	Electrical Equipment and Component Manufacturing (3359)	*One-time and Recurring Cost:* Monetary Authorities, Credit Intermediation, and Related activities (521, 522)
IO Compatibility		*One-time Cost* Computer Systems Design and Related Services (5415)
PCI Compliance		*Recurring Cost:* Monetary Authorities, Credit Intermediation, and Related activities (521, 522)
Signage and Stickers		*One-time Cost:* Other Miscellaneous Manufacturing (3399)

These inputs are based on the direct cost estimates as described in Section C and follow the trends as illustrated in Figure 2 and Figure 3. In the initial years of the implementation of the

proposed regulation the primary costs are incurred for interoperability compatibility and PCI compliance. These relatively small costs will lead to a small negative effect on the affected industries and slightly positive affect on Computer Systems Design and Related Services (5415) and Monetary Authorities, Credit Intermediation, and Related activities (521, 522) industries as shown in Table 9. As the mobile payment and credit card reader requirement comes into effect, the equipment and recurring cost make up the largest share cost. These costs tend to have a negative effect on the affected industries will have a stimulating effect on the Monetary Authorities, Credit Intermediation, and Related activities industry. Additionally, in 2023 it is anticipated that incremental installation cost will begin to be incurred for EVSEs that were installed prior to the requirements of this proposed regulation and are not yet at the end of their useful life. This has the effect of increasing costs to affected industries and shifting the timing of demand for construction (23), such that it increases in 2023 but then decreases in subsequent years.

As described in Section B, there are anticipated to benefits from this proposed regulation in the form of increased accessibility through open and consistent access to EVSEs. This increased accessibility could result in increased eVMT, and reduced emissions. Increased eVMT could benefit EVSPs through greater revenues for EV charging and reduced emissions result in improved public health. Due to insufficient data, staff is unable to quantify these benefits in this analysis. The benefits can therefore not be input in the REMI model for macroeconomic analysis. If these benefits were quantified it would be expected to lessen the negative impacts estimated here. For example, improved public health may reduce healthcare expenses, and increased eVMT could increase revenues for EVSPs. These outcomes would have a positive effect on economic growth within the modeling framework; but were not quantified due to a lack of information. Staff therefore considers the economic impact estimated here to be conservative, as it does not account for potentially offsetting economic effects resulting from the benefits of the proposed regulation.

5. Results of the assessment

The REMI output provides the impact of the proposed regulation on the California economy, and is presented as the annual incremental change from the proposed regulation for the proposed regulation and sensitivity scenario, each relative to its respective baseline. The California economy is anticipated to grow through 2030, therefore, negative impacts reported here should be interpreted as a slowing of growth and positive impacts as an increase in the rate of growth resulting from the proposed regulation. The results are reported here in tables for every even year from 2020 through 2030.

a. California Employment Impacts

Table 10 and Table 11 present the impact of the proposed regulation and sensitivity scenario on total employment in California across all industries. Figure 4 compares the job impacts for each scenario annually. As modeled, the proposed regulation is anticipated to result in a relatively small decrease in total employment growth in the early years of the assessment, which grows over time as the population of affected EVSEs grows. There is a positive impact on jobs in 2023 due to the increased number Level 2 EVSE installations that will occur to replace EVSEs that were installed 5 or more years earlier and with new fully compliant EVSEs.

Overall, the change in total employment is small relative to the baseline employment for the California economy, being less than 0.01 percent.

Table 10: Total California Employment Impacts (Proposed Regulation)

	2020	2022	2024	2026	2028	2030
California Baseline Employment	23,449,717	23,814,440	24,196,788	24,585,329	24,980,191	25,381,430
% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Change in Total Jobs	-30	-39	-369	-465	-840	-459

The sensitivity scenario shows job impacts that are qualitatively similar to that found in the proposed regulation (Table 10), but of a larger magnitude. The annual decline in jobs growth over the regulatory lifetime is about 2,300 jobs by 2030. Overall, this change in employment is small relative to the California economy, corresponding to a change of about -0.01 percent. These changes in employment are relative to the baseline of employment growth over this time period; the employment level is still anticipated to grow, but at a slightly slower rate.

Table 11: Total California Employment Impacts (Sensitivity Scenario)

	2020	2022	2024	2026	2028	2030
California Baseline Employment	23,449,717	23,814,440	24,196,788	24,585,329	24,980,191	25,381,430
% Change	0.00%	0.00%	0.00%	0.00%	-0.01%	-0.01%
Change in Total Jobs	-32	-53	-410	-1,006	-2,839	-2,342

Figure 4: Annual Job Impacts by Scenario

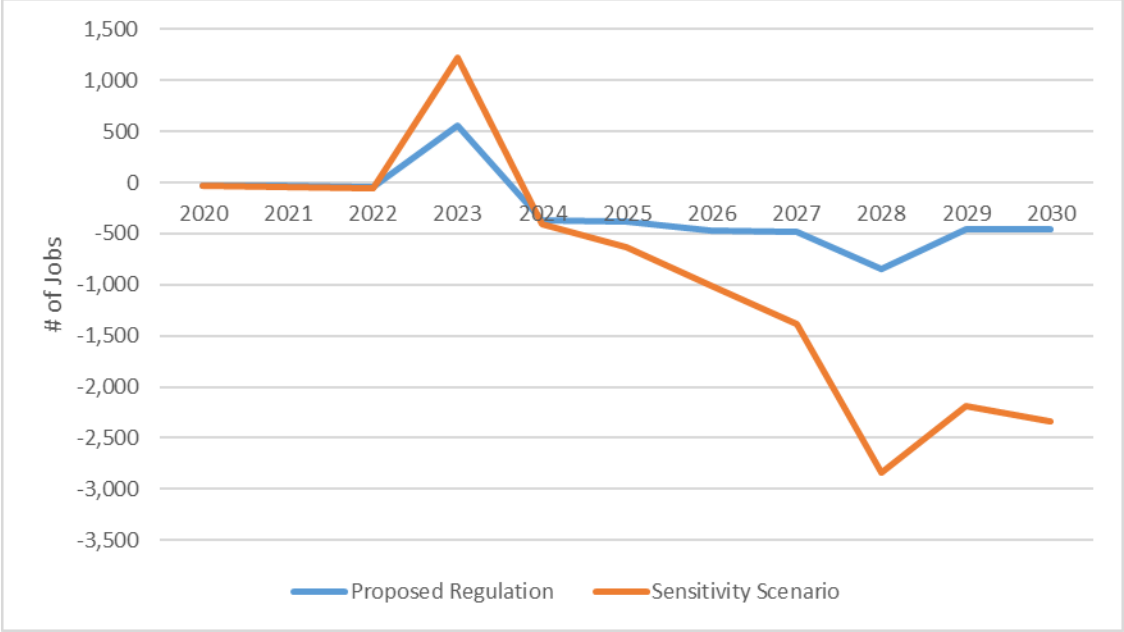


Table 12 shows the changes in employment by industries that are directly impacted by the proposed regulation. All of these industries show a change in jobs over the regulatory lifetime. The change in industry employment is small relative to the baseline for all directly affected industries except the Other Electrical Equipment and Component Manufacturing (NAICS

3359), which is assumed to incur the largest portion of direct compliance costs. Relative to the baseline, job growth may decline by 28 jobs in 2030 or about -0.2 percent of industry employment.

Table 12: Job Impacts by Primary and Secondary Industries (Proposed Regulation)

		2020	2022	2024	2026	2028	2030
Local Government	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change in Jobs	-1	-3	-7	-29	-50	-45
Construction (23)	% Change	0.00%	0.00%	0.00%	-0.01%	-0.02%	-0.01%
	Change in Jobs	-7	-8	-53	-84	-276	-77
Electric power generation, transmission, and distribution (2211)	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change in Jobs	0	0	-1	-1	-1	0
Other Electrical Equipment and Component Manufacturing (3359)	% Change	-0.01%	-0.02%	-0.10%	-0.16%	-0.20%	-0.21%
	Change in Jobs	-1	-2	-13	-22	-27	-28
Other miscellaneous manufacturing (3399)	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change in Jobs	0	0	0	0	0	0
Retail Trade (44-45)	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change in Jobs	-7	-5	-62	-69	-94	-60
Monetary authorities, credit intermediation, and related activities (521, 522)	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change in Jobs	3	2	9	12	9	13
Management, scientific, and technical consulting services (5416)	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change in Jobs	0	0	-4	-5	-7	-5
Computer systems design and related services (5415)	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change in Jobs	4	0	-3	-4	-6	-5

The results of the simulation of the sensitivity scenario (Table 13), show industry job impacts that are qualitatively similar to that found in the proposed regulation (Table 12), but of a larger magnitude. The change in industry employment is small relative to the baseline for all directly affected industries except the Other Electrical Equipment and Component Manufacturing (NAICS 3359), which is assumed to incur the largest portion of direct compliance costs. Relative to the baseline, job growth may decline by 124 jobs in 2030 or about -0.9 percent of industry employment. These changes in employment are relative to the baseline of employment growth over this time period; the employment level is still anticipated to grow, but at a slightly slower rate.

Table 13: Job Impacts by Primary and Secondary Industries (Sensitivity Scenario)

		2020	2022	2024	2026	2028	2030
Local Government	% Change	0.00%	0.00%	0.00%	0.00%	-0.01%	-0.01%
	Change in Jobs	-1	-3	-1	-57	-155	-190
Construction (23)	% Change	0.00%	0.00%	0.01%	-0.01%	-0.07%	-0.04%
	Change in Jobs	-7	-10	61	-92	-866	-470
Electric power generation, transmission, and distribution (2211)	% Change	0.00%	0.00%	0.00%	0.00%	-0.01%	-0.01%
	Change in Jobs	0	0	-1	-1	-3	-2
Other Electrical Equipment and Component Manufacturing (3359)	% Change	-0.01%	-0.02%	-0.17%	-0.41%	-0.69%	-0.92%
	Change in Jobs	-1	-3	-23	-55	-93	-124
Other miscellaneous manufacturing (3399)	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change in Jobs	0	0	0	1	0	0
Retail Trade (44-45)	% Change	0.00%	0.00%	0.00%	-0.01%	-0.02%	-0.01%
	Change in Jobs	-7	-8	-109	-188	-355	-325
Monetary authorities, credit intermediation, and related activities (521, 522)	% Change	0.00%	0.00%	0.01%	0.02%	0.02%	0.03%
	Change in Jobs	4	4	34	70	81	109
Management, scientific, and technical consulting services (5416)	% Change	0.00%	0.00%	0.00%	0.00%	-0.01%	-0.01%
	Change in Jobs	0	-1	-6	-12	-25	-24
Computer systems design and related services (5415)	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change in Jobs	4	0	-4	-10	-21	-24

b. California Business Impacts

Gross output is used as a proxy for business impacts because it is principally a measure of an industry's sales or receipts and tracks the quantity of goods or services produced in a given time period. Output growth, as defined in REMI, is the sum of output in each private industry and State and local government as it contributes to the state's gross domestic product (GDP), and is affected by production cost and demand changes. As production cost increases or demand decreases, output is expected to contract, but as production costs decline or demand increases, industry will likely experience output growth.

Primary industries that incur compliance costs will experience reductions in output, while secondary industries that install EVSEs or supply credit card and mobile payment equipment will see an increase in demand, which will increase output. These two competing trends result in the net change in Output growth on the economy which depends on the timing and magnitude of costs and increases in demand. Because one-time compliance costs are

financed, the costs on the regulated community is spread over time, while the benefits to secondary industries are concentrated in the years that services and equipment are needed.

The results of the proposed regulation show a decrease in Output of $119 million in 2030 for the overall California economy, which is small relative baseline, corresponding to a change of less than 0.01 percent (Table 14). At the industry level, changes in Output are all less than 0.1 percent in 2030, except for the Other Electrical Equipment and Component Manufacturing (3359), which sees a decrease in output of about 0.2 percent.

Table 14: Change in California Output Growth by Industry (Proposed Regulation)

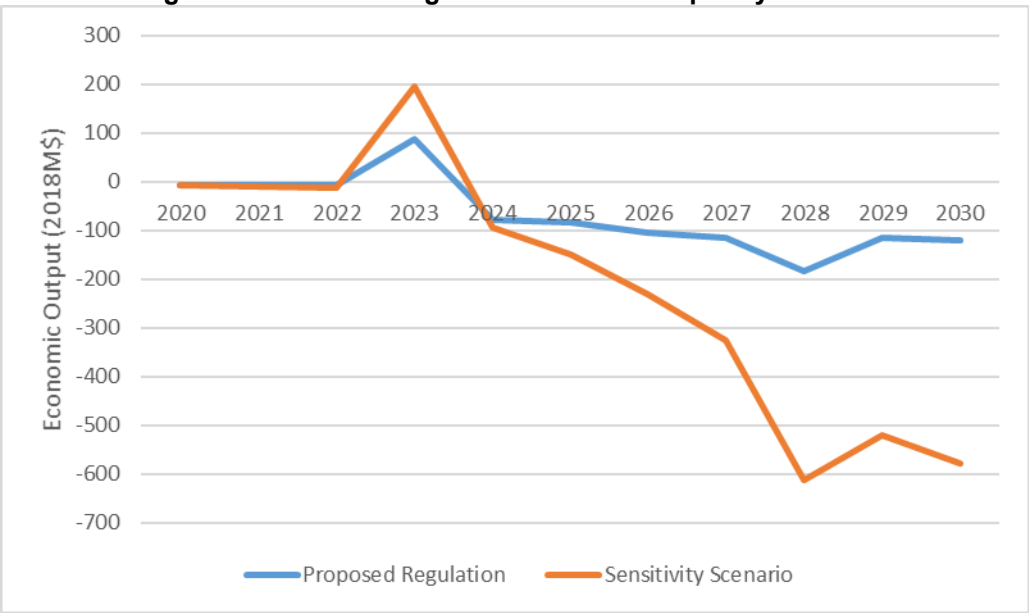
		2020	2022	2024	2026	2028	2030
California Economy	Output (2018M$)	4,423,996	4,655,949	4,890,164	5,134,327	5,401,674	5,690,947
	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change (2018M$)	-6	-8	-77	-105	-182	-119
Local Government	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change (2018M$)	0	0	-1	-5	-9	-8
Construction (23)	% Change	0.00%	0.00%	0.00%	-0.01%	-0.02%	-0.01%
	Change (2018M$)	-1	-1	-8	-13	-45	-14
Electric power generation, transmission, and distribution (2211)	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change (2018M$)	0	0	0	-1	-1	-1
Other Electrical Equipment and Component Manufacturing (3359)	% Change	-0.01%	-0.02%	-0.10%	-0.16%	-0.20%	-0.21%
	Change (2018M$)	0	-1	-6	-10	-13	-14
Other miscellaneous manufacturing (3399)	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change (2018M$)	0	0	0	0	0	0
Retail Trade (44-45)	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change (2018M$)	-1	-1	-8	-9	-13	-9
Monetary authorities, credit intermediation, and related activities (521, 522)	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change (2018M$)	1	1	3	4	3	4
Management, scientific, and technical consulting services (5416)	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change (2018M$)	0	0	0	-1	-1	-1
Computer systems design and related services (5415)	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change (2018M$)	1	0	0	-1	-1	-1

The results of the sensitivity scenario (Table 15), show industry job impacts that are qualitatively similar to that found in the proposed regulation (Table 14), but of a larger magnitude. A comparison of the annual impacts for both scenarios is illustrate in Figure 5. The results at the industry level show changes of less than 0.1 percent, except for the Other Electrical Equipment and Component Manufacturing industry, which is estimated to have a relatively large decrease in Output of about -0.9 percent. While the trend of impacts on economic output is negative, the year 2023 shows a positive impact due to the increase in demand for construction to replace Level 2 EVSEs that 5 or more years earlier with new fully compliant EVSEs.

Table 15: Change in California Output Growth by Industry (Sensitivity Scenario)

		2020	2022	2024	2026	2028	2030
California Economy	Output (2018M$)	4,423,996	4,655,949	4,890,164	5,134,327	5,401,674	5,690,947
	% Change	0.00%	0.00%	0.00%	0.00%	-0.01%	-0.01%
	Change (2018M$)	-6	-11	-93	-231	-613	-578
Local Government	% Change	0.00%	0.00%	0.00%	0.00%	-0.01%	-0.01%
	Change (2018M$)	0	-1	0	-10	-28	-35
Construction (23)	% Change	0.00%	0.00%	0.01%	-0.01%	-0.07%	-0.04%
	Change (2018M$)	-1	-2	10	-14	-140	-81
Electric power generation, transmission, and distribution (2211)	% Change	0.00%	0.00%	0.00%	0.00%	-0.01%	-0.01%
	Change (2018M$)	0	0	-1	-1	-3	-3
Other Electrical Equipment and Component Manufacturing (3359)	% Change	-0.01%	-0.02%	-0.17%	-0.41%	-0.70%	-0.94%
	Change (2018M$)	-1	-1	-10	-25	-45	-64
Other miscellaneous manufacturing (3399)	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change (2018M$)	0	0	0	1	0	0
Retail Trade (44-45)	% Change	0.00%	0.00%	0.00%	-0.01%	-0.02%	-0.01%
	Change (2018M$)	-1	-1	-14	-25	-50	-49
Monetary authorities, credit intermediation, and related activities (521, 522)	% Change	0.00%	0.00%	0.01%	0.02%	0.02%	0.03%
	Change (2018M$)	1	1	10	22	27	38
Management, scientific, and technical consulting services (5416)	% Change	0.00%	0.00%	0.00%	0.00%	-0.01%	-0.01%
	Change (2018M$)	0	0	-1	-1	-3	-3
Computer systems design and related services (5415)	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change (2018M$)	1	0	-1	-2	-4	-5

Figure 5: Annual Changes in Economic Output by Scenario



c. Impacts on Investments in California

Private domestic investment consists of purchases of residential and nonresidential structures and of equipment and software by private businesses and nonprofit institutions. It is used as a proxy for impacts on investments in California because it provides an indicator of the future productive capacity of the economy. Table 16 and Table 17 present the gross private domestic investment level in California under the prosed regulation relative for both the proposed regulation and sensitivity scenario.

The relative changes to growth in private investment for the proposed regulation (Table 16) show a decrease of about $19 million in 2030, or about 0.01 percent of baseline private investment. This slight decrease in private investment growth has a similar trend to that of direct compliance cost (Table 5) and economic output (Table 14).

Table 16: Change in Gross Domestic Private Investment Growth (Proposed Regulation)

	2020	2022	2024	2026	2028	2030
Private Investment (2018B$)	349	369	392	419	445	467
% Change	0.00%	0.00%	0.00%	-0.01%	-0.01%	0.00%
Change (2018M$)	-2	-2	-15	-24	-29	-19

The relative changes to growth in private investment for the sensitivity scenario (Table 17), shows a decrease of about $111 million in 2030, which corresponds to about 0.03 percent of baseline private investment. Trends in this result are similar to those in Table 16.

Table 17: Change in Gross Domestic Private Investment Growth (Sensitivity Scenario)

	2020	2022	2024	2026	2028	2030
Private Investment (2018B$)	349	369	392	419	445	467
% Change	0.00%	0.00%	-0.01%	-0.01%	-0.03%	-0.02%
Change (2018M$)	-2	-3	-25	-62	-112	-111

d. Impacts on Individuals in California

The proposed regulation will impose no direct costs on individuals in California. However, the compliance costs incurred by affected businesses will cascade through the economy and be passed-through to some extent to individuals.

One measure of this impact is the change in real personal income. Table 18 and Table 19 show the annual change in real personal income across all individuals in California. In 2030, total personal income growth decreases by about $58 million as a result of the proposed regulation or less than -0.01 percent. The change in personal income estimated here can also be divided by the California population to show the average or per capita impact on personal income. The change in personal income growth is estimated to not exceed $1 per person in any year in the time horizon, which is anticipated to be indiscernible. Under the sensitivity analysis, total personal income growth in California is anticipated to decline by about $304 million in 2030 or -0.01 percent. The decrease in per capita personal income is estimated to not exceed $5 in any year in the time horizon. The estimated changes in personal income for both scenarios follow the trends in compliance cost.

Table 18: Change in Personal Income Growth (Proposed Regulation)

	2020	2022	2024	2026	2028	2030
Personal Income (2018M$)	2,178,467	2,282,979	2,398,669	2,517,943	2,615,524	2,732,912
% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Change (2018M$)	-5	-5	-56	-58	-84	-58
California Population*	40,639,358	41,321,538	41,994,234	42,655,390	43,304,107	43,938,624
Personal Income per capita (2018$)	55,414	57,142	59,023	60,935	62,283	64,069
% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Change (2018$)	0	0	-1	-1	-1	0

*Population forecast differs slightly from the DOF baseline forecast due to demographic changes estimated by the REMI model as a result of the proposed regulation.

Table 19: Change in Personal Income Growth (Sensitivity Scenario)

	2020	2022	2024	2026	2028	2030
Personal Income (2018M$)	2,178,467	2,282,979	2,398,669	2,517,943	2,615,524	2,732,912
% Change	0.00%	0.00%	0.00%	-0.01%	-0.01%	-0.01%
Change (2018M$)	-6	-7	-97	-158	-315	-304
California Population*	40,639,357	41,321,530	41,994,300	42,655,106	43,302,996	43,936,850
Personal Income per capita (2018$)	55,414	57,142	59,023	60,935	62,283	64,069
% Change	0.00%	0.00%	0.00%	0.00%	-0.01%	0.00%
Change (2018$)	0	0	-2	-3	-5	-3

*Population forecast differs slightly from the DOF baseline forecast due to demographic changes estimated by the REMI model as a result of the proposed regulation.

e. Impacts on Gross State Product (GSP)

GSP is the market value of all goods and services produced in California and is one of the primary indicators used to gauge the health of an economy. Under the proposed regulation and sensitivity scenario, GSP growth is anticipated to decline slightly as a result of the increased compliance costs.

Table 20: Change in Gross State Product (Proposed Regulation)

	2020	2022	2024	2026	2028	2030
GSP (2018B$)	2,504	2,595	2,711	2,856	3,002	3,144
% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Change (2018M$)	-3	-5	-46	-62	-106	-69

Table 21: Change in Gross State Product (Sensitivity Scenario)

	2020	2022	2024	2026	2028	2030
GSP (2018B$)	2,504	2,595	2,711	2,856	3,002	3,144
% Change	0.00%	0.00%	0.00%	0.00%	-0.01%	-0.01%
Change (2018M$)	-4	-6	-58	-139	-359	-339

f. Creation or Elimination of Businesses

The REMI model cannot directly estimate the creation or elimination of businesses. Changes in jobs and output for the California economy described above can be used to understand some potential impacts. The overall jobs and output impacts of the proposed regulation are very small relative to the total California economy, representing changes of less than 0.01 percent. However, impacts in some specific sectors are larger as described in previous sections.

A certain reduction in output could indicate elimination of businesses. Conversely, increased output within an industry could signal the potential for additional business creation if existing businesses cannot accommodate all future demand. There is no threshold that identifies the

creation or elimination of a business. Based on the modeling of output growth in the sensitivity scenario (Table 15), the construction industry sees increased output in some years but this output is not sustained so will not likely lead to long term business creation. Electric equipment and component manufacturers are anticipated to see the largest slowing in output growth (Table 15), but the magnitude of this change is relatively small, and it is assumed that some compliance costs could be passed on to site hosts if necessary. For these reasons, there are not anticipated to be any eliminations of businesses as a result of the proposed regulation.

g. Incentives for Innovation

The proposed regulation could provide incentives to improve EVSEs and network operations to reduce compliance costs. The proposed regulation does require specific technology to be used and there will be technology innovation from multiple parties to ensure the hardware and software is properly integrated. Due to the proposed regulation there is anticipated to be growth in the monetary authorities, credit intermediation, and related activities industry, which will provide the credit card reader, mobile payment hardware, and PCI compliance. As EVSPs integrate the proposed interoperable billing standard staff expects innovation to streamline operations and reduce costs.

h. Competitive Advantage or Disadvantage

EVSPs that support networked EVSEs (Level 2 and DCFCs) that require fee for service are subject to the same proposed requirements. Businesses that predominately support Level 2 EVSEs will have a higher per EVSE compliance costs compared to those that primarily support DCFCs. The potential price impacts for Level 2 chargers is estimated to be larger than for DCFCs, however the business models for these charger types are often different. DCFCs are charging-focused, providing a draw to drivers due to their fast charging speeds. Level 2 chargers are slower and less desirable for public charging, but can benefit site hosts who install these chargers. Many site hosts provide Level 2 charging for free in order to attract customers, thus charging revenue is not always a primary goal for Level 2 EVSEs. These varied business models may mitigate some of the impacts of differential compliance costs.

EV owners primarily charge their vehicle within the range of their residence, thus there is anticipated to be little competition for charging services across state lines. Compliance costs for California EVSEs are not anticipated to impact competitiveness with out of state businesses.

6. Summary and Agency Interpretation of the Assessment Results

As analyzed here, CARB estimates the proposed regulation is unlikely to have a significant impact on the California economy. Overall, the change in the growth of jobs, State GDP, and output is projected to be less than 0.01 percent of the baseline. There, however, may be a more sizable impact on the primarily affected industry, Other Electrical and Equipment Manufacturing. The results also show that purchases of payment equipment and infrastructure will have a positive impact output and employment growth for secondary industries that provide these services including Monetary Authorities, Credit Intermediation, and related activities industry.

F. ALTERNATIVES

In addition to the proposed regulation, CARB staff also evaluated two alternatives. CARB staff and stakeholders discussed potential alternatives during both forums and workshops. CARB staff combined stakeholder comments into the alternatives analyzed.

1. Alternative 1

Alternative 1 would require EVSEs to meet all of the requirements of the proposed regulation, but allows seven years for EVSEs to come into compliance instead of five. Requirements for DCFC would go into effect in 2020 with all required to be fully compliant seven years later, and requirements for Level 2 EVSEs would go into effect in 2023 with all required to be fully compliant seven years later. This additional time reduces the number of existing EVSEs that are required to comply, because more equipment would reach the natural end of its useful life with three additional years. In addition, compliance costs would be spread over a longer period reducing the annual impact. This would reduce the compliance costs to industry but would also result in more time consumers would not have open access to public EV charging.

a. Costs

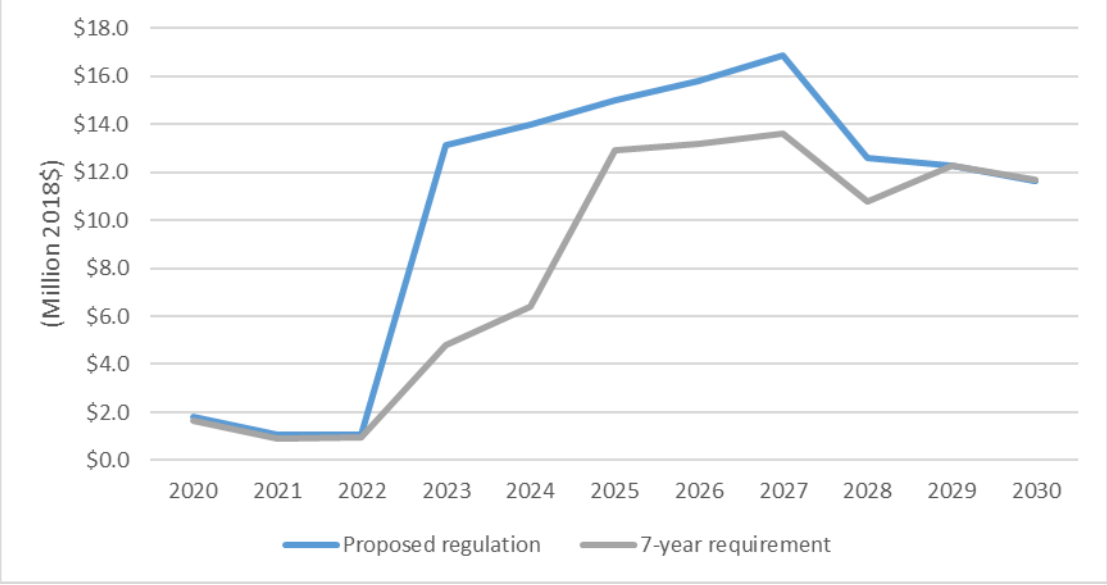
The cost analysis for Alternative 1 uses the same assumptions as the proposed regulation described in Section C5. Under Alternative 1 the number of EVSEs required to comply each year would be different than the proposed regulation, changing the distribution of compliance costs. Table 22 and show the number of Level 2 and DCFC EVSEs that would be required to comply under the proposed regulation and Alternative 1. Alternative 1 delays some compliance requirements which spreads costs more evenly over time, but also reduces the benefits by delaying the number of EVSEs that would be accessible and easy to use.

Table 22 - Compliant EVSEs by Year in the Proposed Regulation and Alternative 1

Year	Proposed Regulation		Alternative 1	
	Total Compliant Public Level 2s	Total Compliant DCFC	Total Compliant Public Level 2s	Total Compliant DCFC
2020	0	767	0	406
2021	0	1,154	0	674
2022	0	1,393	0	973
2023	11,796	2,051	4,389	1,394
2024	13,900	2,138	7,170	1,782
2025	16,286	2,217	14,432	2,217
2026	18,762	2,277	16,398	2,277
2027	21,543	2,317	18,630	2,317
2028	22,456	2,339	20,860	2,339
2029	23,415	2,345	23,415	2,345
2030	24,062	2,336	24,062	2,336

Figure 6 shows the annual costs for Alternative 1 and the proposed regulation. Alternative 1 results in $89 million in total compliance costs over 2020 through 2030, which is 23 percent lower than the proposed regulation.

Figure 6: Comparison of Compliance Cost for the Proposed Regulation vs. Alternative 1



b. Benefits

Alternative 1 results in the same benefits as the proposed regulation, but these benefits are delayed due to the delay in compliance requirements. Benefits include accessibility and ease of use of charging stations, and the resulting emissions benefits from increased eVMT. Though these benefits are not quantified, the relative difference compared to the proposed regulation can be approximated by comparing the cumulative number of compliant chargers over time, as displayed in Table 23. This data shows that Alternative 1 would result in a significant delay in benefits relative to the proposed regulation.

Table 23 - Compliant EVSEs in the Proposed Regulation and Alternative 1

	Proposed Regulation		Alternative 1	
	Level 2	DCFC	Level 2	DCFC
2020	0%	43%	0%	23%
2021	0%	62%	0%	36%
2022	0%	71%	0%	50%
2023	71%	100%	26%	68%
2024	78%	100%	40%	83%
2025	85%	100%	75%	100%
2026	92%	100%	81%	100%
2027	100%	100%	86%	100%
2028	100%	100%	93%	100%
2029	100%	100%	100%	100%
2030	100%	100%	100%	100%

c. Economic Impacts

By allowing for a longer period for EVSEs to comply, Alternative 1 reduces compliance costs incurred between 2020 and 2030. The trend in compliance costs compared to the proposed regulation is displayed in Figure 6. As a result of lower compliance costs, macroeconomic impacts of Alternative 1 are slightly smaller than the proposed regulation (Table 24).

Table 24: Summary of Macroeconomic Impacts of Alternative 1

		2020	2022	2024	2026	2028	2030
GSP	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change (2018M$)	-3	-4	-14	-53	-84	-66
Personal Income	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change (2018M$)	-5	-4	-20	-54	-67	-57
Employment	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change in Jobs	-28	-34	-100	-406	-668	-444
Output	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change (2018M$)	-5	-7	-23	-88	-144	-112
Private Investment	% Change	0.00%	0.00%	0.00%	0.00%	-0.01%	0.00%
	Change (2018M$)	-2	-2	-6	-18	-24	-19

d. Reason for Rejecting

Allowing additional time to comply would create more time in which the consumer does not have publicly available open access EVSEs. As the EV market continues to expand, it is vital that EVSEs are ready and easy to use for these consumers. Requiring a simple and uniform way to pay for charging will increase driver confidence of using EVSEs in public. Delay in this standardization could discourage the adoption of electric vehicle technology.

Alternative 1 would result in significantly fewer compliant Level 2 and DCFC EVSE in the early years of implementation (Table 22). In 2023, there would be less than half the number of compliant Level 2 EVSE under Alternative 1. It is important to have as many compliant EVSEs in the ground and operational as possible. The PEV market is changing monthly and adoption rates are steadily increasing in California. It is imperative that drivers have confidence that charging infrastructure is available and easy to use. Having a robust infrastructure will provide driver and regulatory confidence for future ZEV regulation development. Alternative 2 was rejected because it does not provide the maximal benefits which can be achieved through the proposed regulation.

2. Alternative 2

Alternative 2 proposes less time to retrofit or replace EVSEs resulting in public open-access EVSEs faster than the proposed regulation (three years instead of five). The proposed requirements would go into effect for DCFC EVSEs in 2020 with all EVSEs to be fully compliant 3 years from 2020. Level 2 EVSE requirements would go into effect in 2022 with all EVSEs to be fully compliant 3 years from 2022.

a. Costs

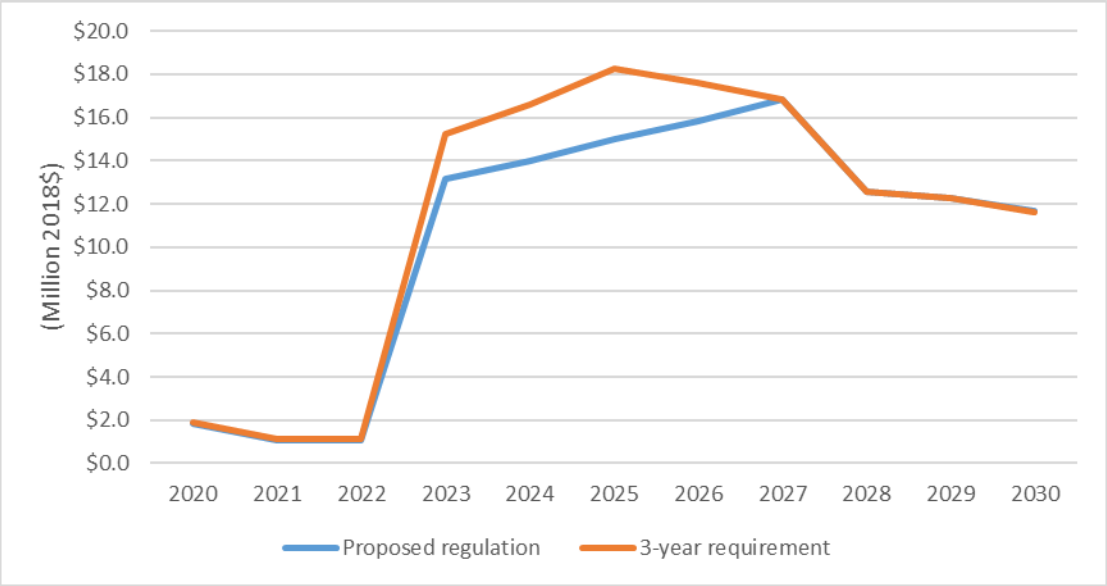
The cost analysis for Alternative 2 uses the same assumptions as the proposed regulation described in Section C1. Thus, under Alternative 2 the number of EVSEs required to comply each year, and the distribution of compliance costs are different than for the proposed regulation. Table 25 shows the number of compliant Level 2 and DCFC EVSEs under Alternative 2 compared to the proposed regulation. Alternative 2 concentrates compliance costs in early years, but also hastens the benefits by increasing the number of EVSEs that would be accessible and easy to use.

Table 25 - Compliant EVSEs by Year for the Proposed Regulation and Alternative 2

Year	Proposed Regulation		Alternative 2	
	Total Compliant Public Level 2s	Total Compliant DCFC	Total Compliant Public Level 2s	Total Compliant DCFC
2020	0	767	0	1,188
2021	0	1,154	0	1,869
2022	0	1,393	0	1,958
2023	11,796	2,051	13,650	2,051
2024	13,900	2,138	16,263	2,138
2025	16,286	2,217	19,199	2,217
2026	18,762	2,277	20,358	2,277
2027	21,543	2,317	21,543	2,317
2028	22,456	2,339	22,456	2,339
2029	23,415	2,345	23,415	2,345
2030	24,062	2,336	24,062	2,336

Figure 7 shows the annual costs for Alternative 2 versus the proposed regulation. Alternative 2 results in $125 million in total compliance costs over 2020 through 2030, which is 8.7 percent higher than the proposed regulation.

Figure 7 Comparison of Compliance Cost for the Proposed Regulation vs. Alternative 2



b. Benefits

Alternative 2 results in the same benefits as the proposed regulation, but some benefits accrue earlier. These benefits include accessibility and ease of use of charging stations, and the resulting emissions benefits from increased eVMT. Though these benefits are not quantified, the relative difference compared to the proposed regulation can be approximated by comparing the cumulative number of compliant chargers over time, as displayed in Table 25. This data shows that Alternative 2 would result in approximately 6 percent increase in benefits compared to the proposed regulation.

c. Economic Impacts

By requiring a shorter period of time for EVSEs to comply with the requirements, Alternative 2 increases costs compared to the proposed regulation and shifts these costs to earlier years. As a result the macroeconomic impacts of Alternative 2 are slightly larger than the proposed regulation (Table 26).

Table 26: Summary of Macroeconomic Impacts of Alternative 2

		2020	2022	2024	2026	2028	2030
GSP	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change (2018M$)	-3	-5	-51	-81	-109	-71
Personal Income	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change (2018M$)	-5	-5	-64	-73	-84	-59
Employment	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change in Jobs	-31	-41	-397	-628	-857	-462
Output	% Change	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Change (2018M$)	-6	-9	-84	-137	-187	-121
Private Investment	% Change	0.00%	0.00%	0.00%	-0.01%	-0.01%	0.00%
	Change (2018M$)	-2	-2	-17	-29	-31	-18

d. Reason for Rejecting

Compared to the proposed regulation, Alternative 2 results in an 9percent increase in costs, but only approximately a 6 percent increase in benefits. These differences are small, but indicate that Alternative 2 is likely less cost effective than the proposed regulation.

In addition, Alternative 2 may not be feasible for all regulated parties. There are thousands of EVSE locations and it will take time to coordinate the effort to bring the non-compliant EVSEs into compliance. Implementing the retrofit or replace requirement earlier could place a strain on the hardware supply chain and there is already a shortage of fundamental hardware components for EVSEs. Contracting companies that will help complete these tasks may be in short supply if the compliance deadline is moved up.
Costs for compliance was calculated by EVSE, many sites have single EVSEs the rest of the sites have multiple EVSEs. The sites that have more EVSEs installed could take longer to become compliant depending on sizing and resources. If the EVSPs do not meet the timeline for compliance CARB would need to take enforcement actions.

While the goal is to get open access EVSEs into the market as quick as possible, forcing the EVSEs to be compliant in 3 years may not be feasible. Alternative 2could lead to non-compliance issues and place strain on enforcement activities. By speeding up the compliance time requirement, consumers will have publicly available open access EVSEs more quickly. Open access more quickly for consumers is vital, but industry needs sufficient time to retrofit or replace existing EVSEs or there will likely be non-compliance requiring enforcement action. Alternative 2 was rejected because it is less cost effective, and the implementation timeline may not be feasible for all regulated parties.

G. MACROECONOMIC APPENDIX

Table G1: REMI Inputs for Proposed Regulation

REMI Policy Variable	REMI Industry	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Production Cost	Retail trade	0	0	0	2.86	2.91	2.98	2.95	2.98	1.33	1.1	0.81
Production Cost	Other electrical equipment and component manufacturing	1.7	1	1.03	9.19	9.94	10.82	11.6	12.54	10.37	10.34	10.08
Production Cost	Electric power generation, transmission, and distribution	0	0	0	0	0.01	0.01	0.01	0.01	0	0	0
Production Cost	Management, scientific, and technical consulting services	0	0	0	0.19	0.2	0.2	0.2	0.2	0.09	0.07	0.05
Exogenous Final Demand	Construction	0	0	0	57.04	0.83	1.41	-0.5	0.62	-32.91	-4.49	-5.81
Exogenous Final Demand	Monetary authorities, credit intermediation, and related activities	1.04	1.06	1.02	8.5	5.33	6.04	6.72	7.51	7.19	7.33	7.38
Exogenous Final Demand	Other miscellaneous manufacturing	0.07	0.06	0.03	1.74	0.33	0.36	0.39	0.41	0.23	0.14	0.1
Exogenous Final Demand	Computer systems design and related services	0.79	0	0	0	0	0	0	0	0	0	0
State and Local Government Spending	Local Government	0	0	0	0.13	0.13	0.14	0.14	0.14	0.06	0.05	0.03
Government Demand	Construction	0	0	0	1.09	0.03	0.04	0.01	0.03	-0.56	-0.07	-0.1

REMI input values are rounded to the nearest $10,000.

Table G2: REMI Inputs for Sensitivity Scenario

REMI Policy Variable	REMI Industry	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Production Cost	Retail trade	0	0	0	5.73	7.02	8.23	9.28	10.33	5.81	4.33	2.9
Production Cost	Other electrical equipment and component manufacturing	1.87	1.35	1.57	11.11	23	28.07	39.27	50.49	51.8	57.58	63.34
Production Cost	Electric power generation, transmission, and distribution	0	0	0	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.01
Production Cost	Management, scientific, and technical consulting services	0	0	0	0.39	0.47	0.56	0.63	0.7	0.39	0.29	0.2
Exogenous Final Demand	Construction	0	0	0	114.06	25.74	24.1	20.9	20.86	-89.92	-29.4	-28.5
Exogenous Final Demand	Monetary authorities, credit intermediation, and related activities	1.35	1.49	1.6	3.68	15.33	17.31	32.06	39.72	44.79	50.67	56.98
Exogenous Final Demand	Other miscellaneous manufacturing	0.23	0.22	0.19	0.77	1.71	1.49	4.58	4.57	4.44	4.02	4.02
Exogenous Final Demand	Computer systems design and related services	0.79	0	0	0	0	0	0	0	0	0	0
State and Local Government Spending	Local Government	0	0	0	0.26	0.31	0.37	0.42	0.46	0.26	0.2	0.13
Government Demand	Construction	0	0	0	1.97	0.53	0.5	0.59	0.59	-1.37	-0.32	-0.3

REMI input values are rounded to the nearest $10,000.

Table G3: REMI Inputs for Alternative 1

REMI Policy Variable	REMI Industry	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Production Cost	Retail trade	0	0	0	0.8	1.03	2.46	2.29	2.17	0.88	1.1	0.81
Production Cost	Other electrical equipment and component manufacturing	1.55	0.83	0.91	3.63	4.89	9.44	9.84	10.39	9.19	10.34	10.1
Production Cost	Electric power generation, transmission, and distribution	0	0	0	0	0	0	0	0	0	0	0
Production Cost	Management, scientific, and technical consulting services	0	0	0	0.05	0.07	0.17	0.15	0.15	0.06	0.07	0.05
Exogenous Final Demand	Construction	0	0	0	15.88	4.59	28.51	-3.33	-2.43	-25.59	4.38	-5.81
Exogenous Final Demand	Monetary authorities, credit intermediation, and related activities	0.78	0.89	0.96	3.78	3.89	7.6	5.95	6.58	7.24	7.9	7.38
Exogenous Final Demand	Other miscellaneous manufacturing	0.02	0.04	0.04	0.65	0.43	1.14	0.32	0.33	0.42	0.36	0.1
Exogenous Final Demand	Computer systems design and related services	0.79	0	0	0	0	0	0	0	0	0	0
State and Local Government Spending	Local Government	0	0	0	0.03	0.05	0.11	0.11	0.09	0.04	0.05	0.03
Government Demand	Construction	0	0	0	0.31	0.1	0.55	-0.04	-0.02	-0.42	0.1	-0.1

REMI input values are rounded to the nearest $10,000.

Table G4: REMI Inputs for Alternative 2

REMI Policy Variable	REMI Industry	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Production Cost	Retail trade	0	0	0	3.38	3.56	3.79	3.4	2.98	1.33	1.1	0.81
Production Cost	Other electrical equipment and component manufacturing	1.79	1.06	1.08	10.56	11.69	12.98	12.78	12.54	10.37	10.34	10.05
Production Cost	Electric power generation, transmission, and distribution	0	0	0	0.01	0.01	0.01	0.01	0.01	0	0	0
Production Cost	Management, scientific, and technical consulting services	0	0	0	0.23	0.24	0.26	0.23	0.2	0.09	0.07	0.05
Exogenous Final Demand	Construction	0	0	0	67.35	3.66	4.46	-7.82	-8.25	-32.91	-4.49	-5.81
Exogenous Final Demand	Monetary authorities, credit intermediation, and related activities	1.26	1.26	0.99	9.35	6.1	6.97	6.65	6.95	7.19	7.33	7.38
Exogenous Final Demand	Other miscellaneous manufacturing	0.13	0.13	0.02	1.88	0.39	0.44	0.2	0.19	0.23	0.14	0.1
Exogenous Final Demand	Computer systems design and related services	0.79	0	0	0	0	0	0	0	0	0	0
State and Local Government Spending	Local Government	0	0	0	0.15	0.16	0.17	0.15	0.14	0.06	0.05	0.03
Government Demand	Construction	0	0	0	1.28	0.09	0.1	-0.13	-0.13	-0.56	-0.07	-0.1

REMI input values are rounded to the nearest $10,000.