Date of Hearing: July 1, 2024

ASSEMBLY COMMITTEE ON UTILITIES AND ENERGY
Cottie Petrie-Norris, Chair
SB 59 (Skinner) – As Amended June 10, 2024

SENATE VOTE: 32-0

SUBJECT: Battery electric vehicles: bidirectional capability

SUMMARY: Authorizes the California Air Resources Board (CARB), in consultation with the California Energy Commission (CEC) and the California Public Utilities Commission (CPUC), to require any weight class of battery electric vehicle (BEV) to be bidirectional-capable, as defined, if it determines that there is a sufficiently compelling benefit to the BEV operator and the electrical grid.

Specifically, **this bill**:

1) Defines "beneficial bidirectional-capable use case" to mean the usage of bidirectional-capable BEVs and BEV service equipment in a manner that results in electrical reliability and resiliency benefits and cost savings to the BEV operator, and is compatible with BEV operator needs.

2) Authorizes CARB to periodically update definitions provided in Health and Safety Code 44269 to ensure that the definitions align with current technologies.

3) Authorizes CARB, in consultation with the CEC and the CPUC, to require any weight class of BEV to be bidirectional-capable if it determines that there is a sufficiently compelling beneficial bidirectional-capable use case.

4) Specifies that CARB is not prohibited from crediting a manufacturer of a BEV that voluntarily includes bidirectional capability for that BEV weight class.

EXISTING LAW:

1) Defines "electric vehicle grid integration" to mean any method of altering the time, charging level, or location at which grid-connected electric vehicles (EVs) charge or discharge, in a manner that optimizes plug-in EV interaction with the electrical grid and provides benefits to ratepayers by doing any of the following: increasing electrical grid asset utilization, avoiding otherwise necessary distribution infrastructure upgrades, integrating renewable energy resources, reducing the cost of electricity supply, or offering specified electric reliability services. (Public Utilities Code § 740.16)

2) Requires the CPUC to establish by December 31, 2020 strategies and metrics to maximize the use of vehicle grid integration (VGI) by January 1, 2030. Existing law specifies certain requirements for the strategies, including, but not limited to, requiring ratepayer-funded EV integration activities to be in the best interests of ratepayers. ((Public Utilities Code § 740.16)

3) Establishes the Clean Transportation Program (CTP) at the CEC to provide grants, loans, and other funding opportunities to develop and deploy innovative fuel and vehicle

technologies to support California's climate change policies. (Health and Safety Code § 44272)

4) Requires the CEC, working with the CARB and the CPUC, to prepare a statewide assssment of EV charging infrastructure needed to support the levels of EV adoption required for the state to meet its goals of putting at least 5 million zero-emission vehicles (ZEVs) on California roads by 2030, and of reducing emission of greenhouse gases (GHGs) to 40% below 1990 levels by 2030. (Public Resources Code § 25229)

5) Establishes a goal that 100% of in-state sales of new passenger cars and trucks will be zero-emission by 2035, and that 100% of medium- and heav-duty vehicles be zero-emission by 2045 for all operations where feasible and by 2035 for drayage trucks. (Executive Order N-79-20)

FISCAL EFFECT: Unknown. This bill was significantly changed with recently adopted amendments, such that its prior year fiscal analysis no longer applies. This bill is keyed fiscal and will be referred to the Committee on Appropriations for its review.

BACKGROUND:

Progress to ZEVerything ZEVerywhere – California's transportation sector is currently the largest source of GHG emissions in the state. In the interest of meeting the state's emissions reduction targets, California has set a goal that 100% of new passenger vehicle sales will be ZEVs by 2035.[1] ZEV is an umbrella term encompassing BEVs, plug-in hybrid EVs, and hydrogen fuel cell EVs. With these goals at work, California has seen increasing adoption of ZEVs in recent years. Cumulative sales of light-duty ZEVs in California reached 1.8 million in the fourth quarter of 2023, with ZEVs accounting for 25% of new car sales.[2] Meanwhile, one in six new medium- and heavy-duty vehicles bought in California in 2023 were ZEVs. Together, California has surpassed both its zero-emission light-duty vehicle sales goal and its medium- and heavy-duty vehicle sales goal two years ahead of schedule.[3]

It could be a two-way street – Bidirectional charging is a process by which a BEV works with a specified charger to cycle the BEV's battery and use its current to power devices in a home, building, or elsewhere. In other words, bidirectional-capable EVs can both receive energy (charge) and provide energy to an external load (discharge). The most straightforward manifestation of bidirectional charging is known as vehicle to home (V2H), in that it requires only the vehicle and charger to be bidirectionally capable. The batteries powering BEVs have substantial energy storage capacity, typically 60 kilowatt-hours (kWh) or more. Since the average daily home usage is about 20 kWh, a fully charged BEV could therefore theoretically power a typical home for three days should the home's electricity service be disrupted.[4]

Alternatively, bidirectional charging may be used for pricing arbitrage and grid reliability, either through V2H or through a more complicated process known as vehicle to grid (V2G). In V2H,

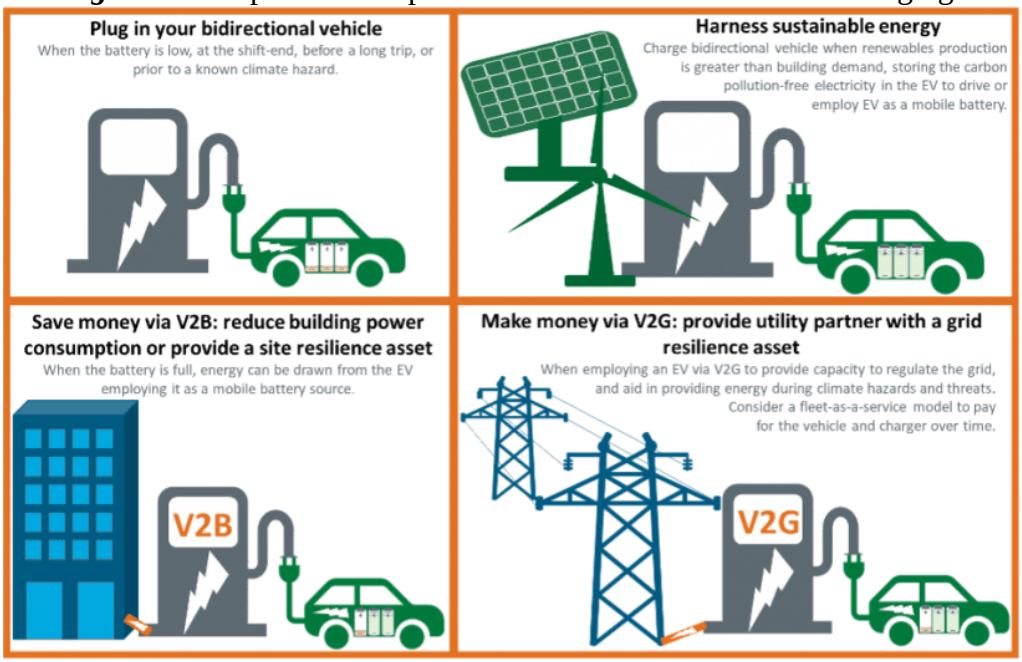
---

[1] Executive Order N-79-20
[2] CEC; "New ZEV Sales in California"; https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics-collection/new-zev
[3] Executive Order B-16-2012
[4] The Washington Post; "Electric vehicles can now power your home for three days"; February 2023; https://www.washingtonpost.com/climate-environment/2023/02/07/ev-battery-power-your-home/

electricity is drawn from the BEV's battery for usage in the home during times of peak demand (such as 4 to 9 p.m.), when electricity rates are at their highest, to reduce the amount of electricity otherwise being drawn from the grid. The BEV battery may then be recharged at a time of lower demand and correspondingly lower electricity rates. Such BEV usage may be viewed as load reduction or demand response, and could correspond to lower energy bills for customers. In V2G, BEVs not only reduce local energy usage but actually send electricity back to the grid, netting the BEV owner a profit.[5] Widespread engagement in V2G is theorized to increase grid reliability by supplementing existing energy generation during periods of peak load as well as reduce the need for certain generation resources, particularly "peaker" natural gas plants.[6]

V2H and V2G fall under the umbrella of vehicle grid integration (VGI). As shown in Figure 1, VGI includes a range of strategies, rate designs, and technologies aimed at helping BEV owners optimize their charging behavior to increase the reliability of electricity supply, avoid certain costs to the electric system, and help owners charge when electricity rates provide the best value.[7]

Figure 1. The process and potential benefits of bidirectional charging[6]



In 2019, the CPUC, CEC, CARB, the California Independent System Operator (CAISO), and a variety of stakeholders jointly launched the VGI Working Group.[8] The group was tasked with assessing the potential benefits of VGI, weighing those benefits against alternative methods of meeting energy demand and identifying policies which could realize those benefits. The working group evaluated 320 different VGI use cases spanning multiple sectors (e.g. residential,

---

[5] U.S. Department of Energy; "Bidirectional Charging and Electric Vehicles for Mobile Storage"; https://www.energy.gov/femp/bidirectional-charging-and-electric-vehicles-mobile-storage
[6] Fast Company; "How California is looking to use EVs as a solution for blackouts"; May 2023; https://www.fastcompany.com/90892534/california-bill-evs-solution-blackouts-bidirectional-charging
[7] CEC; "Vehicle-Grid Integration Program"; https://www.energy.ca.gov/programs-and-topics/programs/vehicle-grid-integration-program
[8] CPUC; "VGI Policy, Pilots, and Technology Enablement"; https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/transportation-electrification/vehicle-grid-integration-activities

commercial, rideshare, and fleets), applications, and types of charging across vehicle types, and found widely varying benefits across these use cases. The final report admitted to limitations in fully assessing barriers to VGI, including customer interest and adoption, and suggested that further study may be necessary.

The working group developed a set of 92 individual recommendations for policy actions that state agencies, investor-owned utilities (IOUs), community choice aggregators, and CAISO could undertake to advance VGI in the short term (2020-22), medium term (2023-25), and long term (2026-2030).[9] Given the broad potential of use cases for VGI, with highly variable levels of total benefit, the working group concluded that developing VGI markets will demand further study and persistent experimentation over the next several years, rather than immediate, broad, and sweeping strokes.

Test drives – Pursuant to SB 676 (Bradford, Chapter 484, Statutes of 2019), the CPUC issued a decision in 2020 adopting strategies and metrics to further the integration of EVs as electric grid resources. As part of that decision, the CPUC authorized electric utilities to propose and undertake VGI pilot projects that use EVs in a demand response capacity to shift or curtail load, explore managed charging, and test various possible use cases of V2G, with a focus on aspects of VGI that are technically feasible but not yet commercially available.[10] Numerous pilot projects, as a result, have been initiated throughout California, with others soon to launch and more pending CPUC approval.[9] Enrollment in these projects, however, remains low due to shipping delays from BEV charging equipment manufacturers who are facing difficulties in getting their equipment certified for inverter safety,[11] which is required by Electric Rule 21.[12]

Limits abound – There are significant barriers to the effective, widespread implementation of bidirectional charging related to the capabilities of the vehicles, charging equipment, and the electric grid. On the vehicle side, there are a limited number of BEVs available today with bidirectional charging capability,[13] but manufacturers have announced plans to add bidirectional capability to a wider variety of models – even potentially adding this capability to existing cars[14] – in the coming years.[15,16] A study conducted by the Hawai'i Natural Energy Institute on the impacts of consistent bidirectional cycling on BEV batteries suggests, however, that VGI may substantially diminish the lifespan of the battery.[17] This indicates a potential for increased costs to consumers from more frequent repairs or replacements.

---

[9] CPUC; *Final Report of the California Joint Agencies Vehicle-Grid Integration Working Group*; June 2020.
[10] D. 20-12-029, CPUC; *Decision Concerning Implementation of Senate Bill 676 and Vehicle-Grid Integration Strategies*; December 2020.
[11] Per data request from PG&E on June 20th, 2024.
[12] D. 20-09-035, R. E-5165, CPUC; November 2021.
[13] Dcbel; "New year, new bidirectional cars: 2024 edition"; January 2024; https://www.dcbel.energy/blog/2024/01/15/new-year-new-bidirectional-cars-2024-edition/
[14] In 2022, Nissan approved all model year 2013 and newer Nissan Leafs for use with the Fermata FE-15 bidirectional charger. The Verge; "The Nissan Leaf can now officially power buildings using bidirectional charging"; September 2022; https://www.theverge.com/2022/9/12/23349971/nissan-leaf-bidirectional-charging-approved-v2h-v2g-fermata-energy
[15] Electrek; "Tesla says it could have bidirectional charging in two years, but will it?"; March 2023; https://electrek.co/2023/03/01/tesla-says-it-could-have-bidirectional-charging-in-two-years-but-will-it/
[16] CNET; "GM Says Bidirectional Charging Will Come Standard Across Its EV Lineup"; August 2023; https://www.cnet.com/home/electric-vehicles/gm-says-bidirectional-charging-will-come-standard-across-its-ev-lineup/
[17] Hawai'i Natural Energy Institute; "Durability and reliability of electric vehicle batteries under electric utility grid operations: Bidirectional charging impact analysis"; *Journal of Power Sources*; May 2017.

In terms of charging equipment, only a small portion of those available to consumers are bidirectional.[18] Most of those bidirectional chargers cost substantially more than the price of non-bidirectional chargers today – the bidirectional level 2 (240V) Ford Charge Station Pro retails for $1,310, while the non-bidirectional level 2 Tesla Wall Connector retails for $450. Additionally, most of the commercially available bidirectional chargers today are only compatible with certain vehicle makes and models; for example, only the Fermata FE-15 bidirectional charger is approved for use with the Nissan Leaf.[19] Bidirectional BEV charging equipment will likely drop in price and standardize across vehicle models over time with further development and scaling.

For the electric grid, challenges persist with electricity from BEVs going onto the grid, similar to the complexities of converting a one-way street to accommodate two-way traffic. Homes will likely require upgrades to electric panels to safely accept and manage power supplied from the BEV to the wall outlet. The electric distribution grid must also be capable of transferring electricity, which may be greater than or from a different direction than that which the grid is capable of handling at any moment.[20] Safety concerns arise for electrical workers, who need to know in which direction electricity is flowing to effectively isolate circuits and ensure safety during maintenance.[21]

COMMENTS:

1) *Author's statement.* According to the author, "EV batteries are an asset that can power more than just transportation. Equipping EVs with the capability of bidirectional charging will allow those EVs to power homes or other facilities when electricity demand is at its peak and prices are high. With bidirectional charging, EVs have the potential to help power the grid and help slash energy bills for EV owners. EVs that can deploy their batteries to charge more than just the vehicle will give California the opportunity to harness EVs as mini-power plants on wheels. SB 59 furthers California as a leader in achieving grid stability with clean power sources."

2) *One lane or two?* This bill requires CARB to examine the effects of bidirectional charging on the electrical grid in order to determine bidirectional capability requirements for vehicles. Although CARB develops regulations related to vehicle performance and emissions, the CEC is traditionally the primary entity for assessing and forecasting the state's energy systems and infrastructure. Moreover, bidirectional charging is not an unknown subject for the CEC's review. Through its Clean Transportation Program, the CEC recently awarded more than $10.8 million in grants to support bidirectional infrastructure for electric school buses.[22] As part of the grants, the CEC is developing a "blueprint for bi-directional charging" that will collect data to analyze grid impacts and benefits from the VGI projects. This bill includes the CEC in a consulting capacity, but

---

[18] Solar Power World; "Bidirectional EV chargers to finally materialize in 2024"; January 2024; https://www.solarpowerworldonline.com/2024/01/bidirectional-ev-chargers-to-finally-materialize-in-2024/
[19] The Verge; "The Nissan Leaf can now officially power buildings using bidirectional charging"; September 2022; https://www.theverge.com/2022/9/12/23349971/nissan-leaf-bidirectional-charging-approved-v2h-v2g-fermata-energy
[20] Brattle; "Electric Power Sector Investments of $75-125 Billion Needed to Support Projected 20 Million EVs by 2030, According to Brattle Economists"; June 2020; https://www.brattle.com/insights-events/publications/electric-power-sector-investments-of-75-125-billion-needed-to-support-projected-20-million-evs-by-2030-according-to-brattle-economists/
[21] Idaho National Laboratory; *Vehicle-to-Grid (V2G) Power Flow Regulations and Building Codes Review by the AVTA*; September 2012.
[22] CEC; "GFO-22-612 – Electric School Bus Bi-Directional Infrastructure"; https://www.energy.ca.gov/solicitations/2023-04/gfo-22-612-electric-school-bus-bi-directional-infrastructure

that role may be limited compared to what is required of CARB. As such, it may be prudent to consider having congruent efforts at the CEC to determine impacts on the electrical grid and at CARB to assess vehicle requirements. *At the very least, the author and committee recommend dividing the authority to update vehicle-specific definitions and charger- or grid-relevant definitions to CARB and the CEC, respectively.* Since VGI will require close involvement with electrical utilities to ensure the safe flow of power through the grid, this bill rightly also requires collaboration with the CPUC.

3) *Maybe not for everybody.* The bigger battery size of larger vehicles compared to light-duty passenger vehicles would seem to provide an appealing use case for bidirectional charging. However, not all medium- and heavy-duty vehicles may be suitable for VGI. In order for a vehicle to be an asset for bidirectional charging, it needs to be idled for relatively long periods of time and have the charge flexibility to provide power while also ensuring sufficient time to charge enough to resume its primary tasks. School buses, as the CEC grant program indicates, seem to fit this best use case. Similarly sized public transit buses or emergency service vehicles may not prove as compatible. This bill begins to recognize these nuances by requiring CARB to consider if a bidirectional-capable requirement is compatible with BEV operator needs. However, it may be beneficial to provide more explicit legislative direction for CARB to take into account. *The committee recommends requiring CARB to consider vehicle readiness and duty cycles required of vehicles operated by essential service providers.*

   This subtlety, however, may be lost when it comes to considering requirements for passenger vehicles. It is unlikely that all EV owners will want to take advantage of bidirectional charging. In addition to purchasing the vehicle, drivers will need to buy bidirectional charging equipment and might also need to make electrical upgrades to their home to take advantage of energy stored in their vehicle. Such upgrades will have high up-front costs, which can diminish the cost savings on utility bills potentially offered by bidirectional charging, or may even be inaccessible for Californians who rent or live in multifamily housing. Therefore, it may be prudent for the Legislature to consider incentive programs that enhance equitable adoption of bidirectional vehicles and that promote bidirectional charging should CARB find that it provides benefits to electrical reliability and resiliency, in concert with this bill.

4) *Are we ready for it?* Despite the increasing availability of bidirectional-capable BEVs and chargers, questions about the readiness of the electrical grid and pricing arbitrage for bidirectional charging remain. Bidirectional vehicle requirements could burden owners and operators with high upfront vehicle costs – maybe without alternative options to purchase lower-priced non-bidirectional vehicles – without the promise of its purported benefits in powering their homes or lowering their utility bills yet, and providing reliability to the state's grid. As such, this bill may be putting the cart before the horse.

5) *Need for further amendments.* In their most recent Electric Vehicle Charging Infrastructure Assessment, the CEC estimated that California's light-duty plug-in EV population will increase to 7.1 million vehicles in 2030 and 15.2 million in 2035.[23] *The committee therefore recommends updating declaration (a) in this bill to reflect the CEC's most recent projections, and to clarify that these are estimations for light-duty vehicles.*

---

[23] CEC; *Assembly Bill 2127 Second Electric Vehicle Charging Infrastructure Assessment Revised Staff Report*; January 2024.

This bill includes a bevy of definitions related to VGI. *Since VGI requires bidirectional capability in vehicles and chargers – and the electrical grid – the author and committee recommend distinguishing the definitions between such vehicles and service equipment by striking the definition of "bidirectional-capable" and adding a definition for "bidirectional electric vehicle" that means a battery electric vehicle capable of both charging and discharging electricity; and authorizing CARB to periodically update this definition.*

Additionally, this bill includes a definition for "interoperability". *Since this bill does not put forth policy related to interoperability, the committee recommends striking this definition from the bill.*

6) *Prior legislation.*

SB 233 (Skinner, 2022) would have required the CEC to convene a stakeholder working group to make recommendations on the costs and benefits of bidirectional charging and submit a report to the Governor and Legislature by January 1, 2026; and would have required all EVs sold in California, with potential exemptions for certain vehicle types as determined by the CARB, to be capable of bidirectional charging beginning with the 2030 model year. Status: Amended out of this subject area, and chaptered. Chapter 11, Statutes of 2024.

SB 676 (Bradford) required the CPUC to establish EV-grid integration strategies for certain load-serving entities. Also, required local publicly owned utilities to consider EV-grid integration strategies in their Integrated Resource Plans and required CCAs to report specified information to the CPUC regarding EV-grid integration activities. Status: Chapter 484, Statutes of 2019.

SB 1000 (Lara) required the CEC to evaluate the extent to which charging infrastructure is proportionately deployed and use funds to more proportionately deploy chargers as needed. Additionally, required the CPUC to explore facilitating the development of technologies that prom1ote grid integration and adopting a tariff for heavy-duty EVs that encourages charging during periods of excess grid capacity. Status: Chapter 368, Statutes of 2018.

AB 2127 (Ting) required the CEC to conduct a statewide assessment of vehicle charging infrastructure needed to support the state's ZEV deployment goals. Status: Chapter 365, Statutes of 2018.

7) *Double referral.* This bill was previously heard in the Assembly Committee on Transportation on June 18th, 2024, where it passed with an 11-4-0 vote.

REGISTERED SUPPORT / OPPOSITION:

Support

1000 Grandmothers for Future Generations
350 Bay Area
350 Bay Area Action
350 Conejo / San Fernando Valley

350 Humboldt
350 South Bay Los Angeles
350 Southland Legislative Alliance
350 Ventura County Climate Hub
Active San Gabriel Valley
Adopt a Charger
Alameda County Democratic Party
Alliance of Nurses for Healthy Environments
The Better World Group
California Alliance for Retired Americans (CARA)
California Business Alliance for A Clean Economy
California Climate Voters
California Environmental Voters
California Interfaith Power & Light
California Native Plant Society, Alta Peak Chapter
California Nurses for Environmental Health & Justice
California Religious Action Center of Reform Judaism
California Teachers Association
Catholic Charities, Diocese of Stockton
Center for Biological Diversity
Center for Community Action & Environmental Justice
Center for Community Energy
Center for Energy Efficiency and Renewable Technologies
Central California Asthma Collaborative
Chademo Association
City of Port Hueneme
Civicwell
Clean Coaliton
Clean Earth 4 Kids
Cleanearth4kids.org
Climate Action California
Climate Equity Policy Center
Climate Health Now
Climate Reality Project, San Fernando Valley
Climate Resolve
Climate Witness Project
Coalition for Clean Air
Community Environmental Council
Cool Davis
Courage California
Dcbel
Democrats of Rossmoor
Electrify Now
Endangered Habitats League
Environment California
Environmental Working Group
Ev Loop
Ev-seg
Fierce Courage Consulting

Fossil Free California
Fridays for Future Fresno
Friends Committee on Legislation of California
Friends of The Eel River
Glendale City Council
Glendale Environmental Coalition
Greenlatinos
Greenpeace USA
Grid Alternatives
High Noon Advisors
Human Impact Partners
Indivisible California
Indivisible California Green Team
Indivisible Marin
Indivisible South Bay LA
Joint Venture Silicon Valley
Kaluza
Klm Consulting
Leap
Legacy Solutions
Let's Green Ca!
Local Clean Energy Alliance
Long Beach Alliance for Clean Energy
Los Angeles Business Council
Los Angeles Regional Collaborative for Climate Action and Sustainability
Lucid
Lutheran Office of Public Policy - California
Morongo Basin Conservation Association
Move LA
North Bay Electric Auto Association
Nuvve Holding Corp
Occidental Arts and Ecology Center
Peace and Freedom Party of California
Peninsula Interfaith Climate Action
Plug in America
Queers 4 Climate
Recolte Energy
Redwood Coalition for Climate and Environmental Responsibility
Restore the Delta
Rising Sun Center for Opportunity
Romero Institute
San Diego 350
San Diego Community Power
San Francisco Bay Physicians for Social Responsibility
San Jose Community Energy Advocates
Santa Barbara Standing Rock Coalition
Santa Cruz Climate Action Network
Sierra Club Buena Vista Chapter
Sierra Club California

Socal 350
Stand.earth
Sunflower Alliance
Sunpower Corporation
Sunrun
Sustainable Claremont
Sustainable Rossmoor
Synergistic Solutions
Terraverde Energy
The Climate Center
The Climate Reality Project: Silicon Valley
The Phoenix Group
Union of Concerned Scientists
Uniting the Central Coast for Action
Valley Improvement Projects
Voices for Progress
Vote Solar
World Business Academy
Yolo Interfaith Alliance for Climate Justice

Oppose Unless Amended

Motorcycle Industry Council
Republic Services - Western Region

Analysis Prepared by: Kathleen Chen / U. & E. / (916) 319-2083