California Energy Commission (CEC)

CEC is the lead state agency on zero-emission vehicle (ZEV) infrastructure planning and deployment. The CEC sets the direction for California's multi-agency ZEV infrastructure deployment and ZEV-related manufacturing efforts. This includes efforts to expand charging and hydrogen fueling, vehicle-grid integration, and planning for resilient transportation systems powered by renewable energy. This also includes funding research, development, and deployment of next-generation ZEV technologies and investments in ZEV related manufacturing. In December 2022, the CEC adopted a $2.9 billion investment plan update for the Clean Transportation Program[1], which will continue the transition of the state's transportation sector towards zero-emission vehicles. This investment plan incorporates the largest California budget allocation approved to date for the Clean Transportation Program. These efforts will expand deployment of plug-in electric vehicle (PEV) charging and fuel cell electric vehicle (FCEV) hydrogen fueling stations. The 2022 – 2023 Investment Plan breakdown for the next four years is as follows:

- $602 million for light-duty charging infrastructure
- $465 million for clean trucks, buses, and off-road equipment and infrastructure to support electric and hydrogen vehicles[2]
- $406 million for drayage truck ZEV infrastructure
- $404 million for school bus ZEV infrastructure
- $299 million for equitable at-home charging
- $199 million for transit bus ZEV infrastructure
- $150 million for port ZEV infrastructure
- $119 million for ZEV manufacturing
- $97 million for Emerging Opportunities
- $90 million for hydrogen fueling infrastructure
- $44 million for medium- and heavy-duty ZEV infrastructure to support electric and hydrogen vehicles
- $15 million for zero- and near-zero carbon fuel production and supply
- $10 million for workforce training and development

Equity: The CEC's Investment Plan sets a goal of spending more than 50% on projects that benefit low-income and disadvantaged communities. In 2023, the CEC will

[1] CEC Investment Plan (2022-2023 update page): https://www.energy.ca.gov/publications/2022/2022-2023-investment-plan-update-clean-transportation-program-0 (The Investment Plan Update is an annual activity and is subject to future Budget Act appropriations. The next iteration will reflect changes and actions that occur between Dec. 2022 and the publishing of the draft staff report version of the 2023 Investment Plan Update.)
[2] Clean trucks, buses, and off-road equipment and infrastructure includes the traditional medium- and heavy-duty ZEV infrastructure investments but can also fund a broader set of vehicle infrastructure investments.

define, measure, track and increase benefits to communities through a robust public process and inter-agency engagement. Benefits to priority communities include increased access to ZEV infrastructure (including in multi-family dwellings and rental homes), ZEV-focused pathways to high-road jobs, increased zero-emission mobility (e.g., through transit infrastructure investments), and improved air quality in priority communities.

CEC ZEV MARKET DEVELOPMENT OBJECTIVES

1. **Analysis:** Develop and maintain analysis on ZEV infrastructure needs and progress, as well as data and shared analytical understanding of the integration of transportation into the energy system, in collaboration with the California Air Resources Board (CARB), California Public Utilities Commission (CPUC), Governor's Office of Business and Economic Development (GO-Biz), California Independent System Operator (CAISO), and other agencies. Forecast transportation energy demand for all vehicles, including ZEVs. Analyze and publicize data on California ZEV sales, ZEV on-road fleet, and ZEV infrastructure. Maintain database of California's ZEV-related manufacturing companies.

   Direct Pillar Connection: Vehicles, Infrastructure, End Users
   Indirect Pillar Connection: Workforce

   Key Collaborators: CARB, CPUC, CAISO and grid operators, GO-Biz, local air districts, California Dept. of Transportation, California Dept. of Motor Vehicles, national labs and universities, non-governmental organizations (NGOs) including equity and environmental justice, and private entities including vehicle and infrastructure manufacturers.

   Key Results & Actions:

   a. **AB 2127 Charging Infrastructure Assessment.** The inaugural AB 2127 Commission Report was published in the summer of 2021. Its analyses project that by 2030 nearly 1.2 million chargers (shared private and public) will be required to meet the needs of 8 million light-duty ZEVs and an additional 157,000 chargers will be needed for the 180,000 medium- and heavy-duty ZEVs expected on California roadways.

      - **Progress in 2022**: All infrastructure models have been refined and updated to produce results for the second AB 2127 assessment due in 2023.
      - **Progress in 2022**: Models for light-duty and medium-/heavy-duty vehicles are now aligned with scenarios from CEC's Energy Assessment Division.
      - **Progress in 2022**: New sections have been added on vehicle-grid integration and the labor and workforce aspects of electric vehicle (EV) charging infrastructure expansion.

   b. **SB 1000 Report on Equitable Distribution of Charging Infrastructure.**

Continue activities under SB 1000 to assess equitable distribution of charging infrastructure.

- **Progress in 2022**: In July 2022, published an analysis of drive times greater than 10 minutes to public fast charging stations. The analysis identified communities by income, disadvantaged status, population density, and geographic areas with sparse fast charging access.

c. **AB 8 CEC/CARB Joint Report.** Continue analysis and coordination for the AB 8 report on hydrogen infrastructure and use the process to identify additional assessment needed to accelerate the medium and heavy-duty hydrogen market.

- **Progress in 2022**: As of November 2022, 62 retail stations are open in California providing hydrogen refueling. At maximum demand, the network can support as many as 51,000 FCEVs.
- **Progress in 2022**: At of the end of the third quarter of 2022, an estimated 12,160 FCEVs were on the road.
- **Progress in 2022**: California is meeting the100-station goal per AB 8 with expended and committed funds and is committed to meeting the 200-station goal. The 2022 Budget Act allocated an additional $60 million to expand hydrogen infrastructure.

d. **Charging Infrastructure Modeling Tool Maintenance.** Continue updates to charging infrastructure modeling tools such as the new version of Electric Vehicle Infrastructure Projections (EVI-Pro) model tool; continue updates to the EVI-Pro RoadTrip model tool for long distance travel; continue to develop and update the Medium- and Heavy-Duty Electric Vehicle Infrastructure Load, Operations, and Deployment (HEVI-LOAD) model.

- **Progress in 2022**: Electric vehicle infrastructure models were refined and produced updated results for the second AB 2127 report. Refinements were focused on providing more fine-tuned projections by harmonizing inputs and outputs across various CEC projects. Such refinements include enhancing geospatial resolution for individual Traffic Analysis Zones and adoption scenarios.
- **Progress in 2022**: HEVI-LOAD – The scope is being expanded to encompass analysis of additional vehicle types including the off-road sector, plus vehicles in these sectors that use hydrogen fuel cell or battery swapping technology. Updated modeling methodologies (inputs, assumptions, and scenarios) will produce higher-resolution results with improved geospatial granularity.
- **Progress in 2022**: EVI-Pro 3, EVI-RoadTrip, and HEVI-LOAD all now use scenarios developed by the CEC's Energy Assessment Division.

e. **Maintain and Update a ZEV-Related Manufacturing Database.** Monthly meetings with CARB and GO-Biz to further develop database to include more companies and develop a public-facing tool for easy access.

- **Progress in 2022**: Created a public CEC webpage to map California's ZEV and ZEV-related manufacturers along with funding resources.

f. **ZEV and Infrastructure Statistics Website.** Update the ZEV and Infrastructure Statistics website with ZEV sales, infrastructure counts, and ZEV population annually. Expand the website to include MD/HD ZEVs. Compile MD/HD ZEV counts from relevant funding programs in the state through cross- agency collaboration. At the end of each year, reassess whether California Department of Motor Vehicles (DMV) data can be used to accurately track MD/HD ZEVs going forward.

- **Progress in 2022**: Updated the ZEV and Infrastructure Statistics website with ZEV sales, annual ZEV populations, and infrastructure counts. The statistics now include medium- and heavy-duty ZEV deployments in California.

g. **Transportation Energy Demand Forecast (TEDF).** Complete the TEDF annually as part of the Integrated Energy Policy Report (IEPR). Review results as an indicator of whether the state is on track to meet its goals with current market conditions. Results will feed into the biennial AB 2127 assessments as well as the IEPR.

- **Progress in 2022**: Completed the California TEDF for 2022 IEPR update.
- **Progress in 2022**: Transitioned to a new TEDF framework referenced as "Additional Achievable Transportation Electrification", consisting of scenarios that add on to the TEDF by incorporating supply-side regulations into the demand forecast.

h. **Transportation Energy Demand Scenarios.** Develop exploratory scenarios for the IEPR that build from the Transportation Energy Demand Forecast to assess potential impacts of proposed plug-in electric vehicle (PEV) policies, incentives, or other trends.

- **Progress in 2022**: Renamed "Exploratory Forecast Scenarios" to "Transportation Energy Demand Scenarios".

i. **Vehicle-Grid Integration (VGI) Simulation Studies.** Explore electric grid impacts of including ZEVs as a supply-side resource using a production cost simulation model software such as PLEXOS. These simulations will demonstrate the cost effectiveness and resilience benefits of using a battery-electric vehicle as an energy storage resource for buildings or the grid. (This activity also supports work in Objective 4, "Infrastructure

Resilience".)

- **Progress in 2022**: Continued work on initial version of the EVSE (i.e., charger) Deployment and Grid Evaluation (EDGE) tool, including coordinating with utilities and planning a public workshop to highlight the tool's functionality and potential benefits.

2. **Infrastructure Development:** Catalyze the development and deployment of economically and environmentally sustainable ZEV infrastructure, with focus on gaps in access for California's most impacted communities. Enable public and private sector investment in ZEV infrastructure, with focus on freight transport given disproportionate and growing pollution burden. Oversee publicly owned utilities' electricity resource planning, including plans for transportation electrification through investments and rates.

   Direct Pillar Connection: Infrastructure, Workforce
   Indirect Pillar Connection: End Users

   Key Collaborators: CPUC, CARB, GO-Biz, CAISO and grid operators, local air districts, California Dept. of Transportation, California Dept. of Motor Vehicles, utilities, the Disadvantaged Communities Advisory Group, the Clean Transportation Program Advisory Committee, electricity and hydrogen providers, federal, regional, local and tribal governments, NGOs, fleets, universities and researchentities, and other external stakeholders who have an interest in zero-emissiontransportation including vehicle manufacturers and infrastructure manufacturers and companies.

   Key Results & Actions:

   a. **Fund Infrastructure through Grants, Loans, and Interagency Agreements.** The Clean Transportation Program administers funding targeted to appropriate ZEV sectors and customer groups including light-duty passenger vehicles and medium-duty and heavy-duty vehicles and off-road equipment for both electric and hydrogen infrastructure deployment.

      - **Progress in 2022:** Completed solicitations for more than $57 million in light-duty EV charging grants and launched a $22 million rebate project.
      - **Progress in 2022:** Developed and received federal approval for National Electric Vehicle Infrastructure Program (NEVI) deployment plan. Federal NEVI funding is expected to total about $384 million over 5 years.
      - **Progress in 2022:** Developed and implemented reliability standards for CEC-funded chargers.
      - **Progress in 2022:** Offered $69 million in infrastructure incentives through the MD/HD block grant project EnergIIZE

Commercial Vehicles.
- **Progress in 2022:** Approved nearly $25 million for four large-scale zero-emission transit and drayage infrastructure deployment projects.
- **Progress in 2022:** Began to collaborate with CARB to design and develop a MD/HD Loan Pilot Project to provide financing for ZEVs and necessary infrastructure.

b. **Equitable Access to Infrastructure for all Californians.** Ensure all Californians have access to infrastructure by including equity objectives in all funding opportunities and by designing programs to provide benefits to underserved communities.

- **Progress in 2022:** Facilitated the EV Strike Force's Equity Workgroup and published the "EV Charging in Communities Report."
- **Progress in 2022:** Working with National Indian Justice Center to provide Electric Vehicle Infrastructure Training Program (EVITP) training and certification to 23 California tribes.
- **Progress in 2022:** Incorporated expressions of community inclusion, business diversity, and economic equity into the NEVI Deployment Plan for California.
- **Progress in 2022:** Ongoing and direct work with Disadvantaged Communities Advisory Group and the communities it represents.

c. **Strive for Equipment Standardization.** Fund efforts that encourage sustainable and novel business models, and solicitations covering topics such as equipment testing and certification to encourage interoperability.

- **Progress in 2022**: Conducted a workshop in July 2022 to discuss status of VGI in California and present several funding concepts.
- **Progress in 2022**: Developed the V2G Equipment List based on workshop feedback from industry, utilities, and other stakeholders to understand market and utility needs.
- **Progress in 2022:** CEC's Electric Program Investment Charge (EPIC) program awarded $16.8 million for resilient vehicle-to-building technologies which can supply power from electric vehicles directly to facilities not connected to grid power, such as during an outage.
- **Progress in 2022:** Funded the Vehicle-Grid Innovation Laboratory (ViGIL) focused on increasing ZEV and infrastructure interoperability by testing new charger products for conformance to technical standards.
- **Progress in 2022:** Awarded a contract to support the Vehicle Interoperability Testing Symposium (VOLTS), an event planned

for mid-2023. VOLTS will support product development and standards implementation for light-, medium-, and heavy-duty on-road vehicles and associated charging equipment in a collaborative environment to move toward an interoperable charging ecosystem.

d. **Use Data and Analysis to Inform Investments.** Use the results of the inaugural AB 2127 analysis, SB 1000 analysis, SB 643 analysis, and ongoing AB8 hydrogen studies to inform solicitation design.

- **Progress in 2022**: Developed SB 1000, AB 2127, AB 8 reports. The CEC has published the SB 1000 and AB 8 reports. These reports, along with stakeholder feedback, continue to drive the evolution of funding strategies.

e. **Demonstrate Emerging Technologies for Sectors that are Difficult to Electrify.** Demonstrate hydrogen fuel cell and electric vehicle technologies and fueling infrastructure for zero-emission locomotives andharbor craft serving California ports and other sectors. Focus deployments in or near priority communities whenever feasible.

- **Progress in 2022:** Conducted a workshop in February 2022 that proposed numerous funding concepts that have resulted in the development of several funded grant opportunities.
- **Progress in 2022:** Offering $69 million in infrastructure incentives, the block grant project EnergIIZE Commercial Vehicles launched four main "funding lanes" (EV Fast Track, Hydrogen, EV Jump Start, Public Charging), in addition to one set-aside funding lane for Public School Buses.
- **Progress in 2022:** Released Innovative Hydrogen Refueling Solutions for Heavy Transport, a $16.5 million funding opportunity in collaboration with the Gas R&D Program. It seeks projects to develop and demonstrate innovative hydrogen refueling solutions to support the decarbonization of emerging medium- and heavy-duty on-road and off-road vehicle applications, reduce hydrogen delivery and refueling costs, improve reliability, enable higher fill rates, and minimize energy losses.

f. **ZEV Infrastructure Plan.** The statewide ZEV Infrastructure Plan (ZIP)supports decision-making by State agencies and stakeholders, and public discussions of ZEV infrastructure policies and funding needs. The ZIP incorporates State agency plans and information needs for future decisions. CEC will engage the public for feedback and input.

- **Progress in 2022:** Completed development of a statewide ZEV

Infrastructure Plan (ZIP). The ZIP was published in December 2022. The ZIP describes the state's near- and long-term actions, in collaboration with the private market, to ensure that ZEV infrastructure will meet the needs of the growing ZEV market.

3. **Research, Development & Demonstration:** Support wide range of innovative technologies to accelerate deployment of ZEV infrastructure, facilitate vehicle-grid integration, and increase benefits for all residents and markets, with focused attentionto disadvantaged and low-income communities.

   Direct Pillar Connection: Vehicles, Infrastructure, End Users
   Indirect Pillar Connection: Workforce

   Key Collaborators: CPUC, CARB, CAISO, Caltrans, federal, tribal, local, and regional governments, vehicle manufacturers, grid operators, electricity and hydrogen providers, energy technology developers, NGOs, universities and other research entities, and fleets.

   Key Results & Actions:

   a. **Electric Program Investment Charge (EPIC).** Award more than $20 million through competitive grants that foster innovation in ZEV integration, accelerate advanced clean technologies to market, and create opportunities for economic development. Develop new transportationelectrification R&D initiatives to include in proposed investment plans for the next 5 years of EPIC.

      - **Progress in 2022:** Awarded $17 million for five R&D projects to advance and demonstrate technologies that can enable electric vehicles to provide resilient back-up power to buildings and facilities during outages or intentional islanding events. These projects aim to demonstrate that electric vehicles can provide services equivalent to stationary energy storage at lower costs.
      - **Progress in 2022:** Established the Electric Truck Utilization and Research Center (eTRUC) through a $13 million grant. eTRUC is a stakeholder driven consortium of industry, government, academia, and community partners committed to the development of public access high-power charging infrastructure for heavy-duty trucks along freight corridors. The eTRUC project includes technology development and testing, demonstrations at two pilot sites in Southern California, and modeling and engagement to inform freight corridor development.

   b. **Gas R&D Program.** Develop new funding opportunities accelerating the integration and demonstration of hydrogen fuel celltrucks and buses, including advanced hydrogen refueling station designs capable of supporting multiple heavy transport applications and

submit to CPUC as part of the annual Natural Gas R&D Program budget plan.

- **Progress in 2022**: Awarded $4 million to two projects to integrate and demonstrate hydrogen fuel cells in heavy-duty trucks with challenging regional haul and industrial gas bulk delivery duty cycles.
- **Progress in 2022**: Released a $16.5 million funding opportunity in collaboration with the Clean Transportation Program for Innovative Hydrogen Refueling Solutions for Heavy Transport. The funding opportunity seeks projects to develop and demonstrate innovative hydrogen refueling solutions to support the decarbonization of emerging MD/HD on-road and off-road vehicle applications, reduce hydrogen delivery and refueling costs, improve reliability, enable higher fill rates, and minimize energy loses.

4. **Infrastructure Resilience:** Support strategies to improve resiliency including relatedto energy storage, vehicle-grid integration, hydrogen supply and refueling station reliability, electric grid and EVSE reliability, on-site generation, and related workforce adequacy.

   Direct Pillar Connection: Vehicles, Infrastructure
   Indirect Pillar Connection: End Users, Workforce

   Key Collaborators: CAISO and grid operators, CARB, CPUC, California Labor & Workforce Development Agency, California Workforce Development Board, Employment Training Panel, GO-Biz, utilities, vehicle manufacturers and supply chain stakeholders, electricity and hydrogen providers, energy technology developers, federal and tribal governments, local and regional governments,non-governmental organizations, universities and other research entities, andorganized labor.

   Key Results & Actions:

   a. **Fund Demonstration Projects.** Fund demonstrations of resilient capabilities such as vehicle-to-building technology.

      - **Progress in 2022**: Awarded $17 million to five R&D projects to advance and demonstrate technologies that can enable electric vehicles to provide resilient back-up power to buildings and facilities during outages or intentional islanding events. These projects aim to demonstrate that electric vehicles can provide services equivalent to stationary battery storage at a lower cost.

   b. **Workforce Development.** Support workforce and equity priorities articulated in the Clean Transportation Program Investment Plan.

- **Progress in 2022:** Approved 14 projects for workforce training and development on ZEV and ZEV infrastructure through the Inclusive, Diverse, Equitable, Accessible, and Local (IDEAL) ZEV Workforce Pilot project.
- **Progress in 2022:** Partnered with CARB to contribute funding toward the 14 projects.
- **Progress in 2022:** Added more funding to establish 20 new ZEV High School Automotive programs in the state, for a total of 52 ZEV high schools.
- **Progress in 2022:** Augmented an existing agreement to add $2 million and establish six new medium- and heavy-duty ZEV truck programs at community colleges in the state.

c. **Hydrogen Supply and Station Reliability.** Collaborate with stakeholders to ensure the hydrogen supply and distribution system has sufficient backup to continue functioning through supply disruptions.

- **Progress in 2022**: Continued to work toward increasing hydrogen supply source options by including supply requirements in solicitations and by funding renewable hydrogen production plants. For example, the funding solicitation GFO-19-602 required funded stations to have a second supply agreement as backup to ensure station operators do not rely on a single supply source.
- **Progress in 2022:** Funded four new renewable hydrogen production plants, and an upgrade to an existing plant, with a combined daily nameplate capacity of nearly 24,000 kilograms. Two of these plants are expected to open in 2023. The rest of the plants are still in early stages of development.
- **Progress in 2022:** In May 2022, Air Liquide officially opened the North Las Vegas plant in Nevada, its largest liquid hydrogen production and logistics infrastructure plant in the world, capable of producing 30,000 kilograms per day to serve various customers, including those in the California FCEV market.
- **Progress in 2022:** The 2022 Budget Act provides $100 million to the CEC to distribute grants for producing hydrogen instate through electrolysis or biofuels using renewable energy. In addition to private investments, this commitment should help improve supply consistency.
- **Progress in 2022:** Staff continues to gather information on supply chain issues affecting equipment procurement/maintenance and station availability. Station operators reported that they have experienced equipment repair delays due to supply chain issues.

d. **EV Charging Station Reliability.** Collaborate with stakeholders to measure and track EV charging station reliability and up-time.

- **Progress in 2022:** Historically, there has been limited anecdotal information and virtually no empirical data on EVSE reliability. Staff invested significant time into understanding the potential scope of this challenge. This included conducting two workshops, attending an industry conference, collaborating with stakeholders, and conducting a review of standards and literature.
- **Progress in 2022:** Developed reliability recordkeeping and reporting requirements to include in CEC solicitations moving forward. These requirements will hold funding recipients accountable for maintaining chargers such that they are operable and able to deliver a charge to customers. These requirements will provide empirical data that will allow the CEC to form a better understanding of the challenges surrounding charger reliability.
- **Progress in 2022:** Began working with UC Davis to develop field testing program that will test charger reliability. The data from this program coupled with data from chargers installed through grant funding agreements will better inform modelling and policy development.
- **Progress in 2022:** The Governor signed Assembly Bill 2061 into law in September 2022. It requires the CEC to develop uptime (a term often used as a surrogate for reliability) recordkeeping and reporting standards for all chargers that received an incentive from a state agency or through a charge on ratepayers and installed on or after January 1, 2024.

e. **Vehicle-Grid Integration Roadmap.** Publish draft VGI Roadmap update.

- **Progress in 2022**: Throughout 2021 and 2022, the CEC conducted workshops on VGI-related funding concepts and other matters, published staff recommendations, and coordinated across its divisions and with sister agencies on VGI and load flexibility generally. A decision was made to not publish a full-scale follow-on report to the CAISO's original California VGI Roadmap, and instead redirect staff to VGI implementation, creation of a V2G Equipment List, and related grant funding. The CEC's October 12, 2022, Business Meeting featured a high-profile staff presentation and commissioner-level discussion on vehicle-to-grid technology and policy[3]. And in 2022, the CEC updated its VGI website[4]. As the CEC explores the capabilities of transportation as a distributed energy resource, it will connect the dots between VGI and resilience in the context of a broader analysis of flexible loads that support a 100% clean electricity grid and resilience. No tasks specifically for a VGI Roadmap update are proposed for

[3] https://www.energy.ca.gov/event/meeting/2022-10/energy-commission-business-meeting
[4] https://www.energy.ca.gov/programs-and-topics/programs/vehicle-grid-integration

the 2023 Action Plan.

5. **Special Projects, Lithium Valley:** Work with multiple stakeholders to develop and implement recommendations for lithium extraction in California, per AB 1657 (2020), aswell as through other CEC efforts to facilitate a California-based lithium industry.

   Direct Pillar Connection: Vehicles, Workforce
   Indirect Pillar Connection: Infrastructure, End Users

   Key Collaborators: Lithium Valley Commission Appointed Members, CPUC, California Natural Resources Agency, tribal representatives, local and regional governments, and private market participants. Additional collaboration with GO-Biz, the United States Environmental Protection Agency, and the United States Department of Energy.

   Key Results & Actions:

   a. **Lithium Valley Commission.** Convene Lithium Valley Commission (LVC) in March 2021. AB 1657 charges the Lithium Valley Commission with reviewing, investigating, and analyzing certain issues and potential incentives regarding lithium extraction and use in California. The Lithium Valley Commission will consider a range of issuesincluding the further development of geothermal power and lithium recovery from existing and new geothermal facilities, market opportunities for lithium, and potential economic and environmental impacts to the state resulting from extraction and processing of lithium from geothermal brines and production of lithium-dependent products.

      - **Progress in 2022:** The Blue Ribbon Commission on Lithium Extraction in California submitted its report to the legislature on December 1, 2022.
      - **Progress in 2022:** The LVC conducted numerous community and public meetings throughout the year, with three meetings devoted to local tribal interests and concerns.
      - **Progress in 2022:** US DOE Sectary Granholm visited Lithium Valley.
      - **Progress in 2022:** Initial permitting and CEQA development began for some of the geothermal-brine extraction projects.