

DOCKETED	
Docket Number:	22-ALT-01
Project Title:	2022-2023 Investment Plan Update for the Clean Transportation Program
TN #:	248494
Document Title:	2022–2023 Investment Plan Update for the Clean Transportation Program
Description:	N/A
Filer:	Spencer Kelley
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	1/23/2023 4:07:30 PM
Docketed Date:	1/23/2023



**CALIFORNIA
ENERGY COMMISSION**



California Energy Commission

COMMISSION REPORT

2022–2023 Investment Plan Update for the Clean Transportation Program

January 2023 | CEC-600-2022-062-CMF



California Energy Commission

David Hochschild
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Siva Gunda
Vice Chair

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J. Andrew McAllister, Ph.D.
Patty Monahan
Kourtney Vaccaro

Drew Bohan
Executive Director

Patrick Brecht
Primary Author
Project Manager

Benjamin Tuggy
Assistant Project Manager

Charles Smith
Branch Manager
TRANSPORTATION INTEGRATION AND PRODUCTION BRANCH

Hannon Rasool
Director
FUELS AND TRANSPORTATION DIVISION

ACKNOWLEDGEMENTS

The following California Energy Commission staff members contributed to the development of this Investment Plan Update:

Jane Berner

Jonathan Bobadilla

Miki Crowell

Susan Ejlalmaneshan

Brian Fauble

Tami Haas

Tiffany Hoang

Madison Jarvis

Elizabeth John

Thanh Lopez

Jeffrey Lu

Pilar Magaña

Jim McKinney

Tomas Ortiz

Larry Rillera

Michelle Vater

Mark Wenzel

Taiying Zhang, Ph.D.

ADVISORY COMMITTEE MEMBERS

The California Energy Commission thanks the Clean Transportation Program Investment Plan Advisory Committee for guidance in helping identify opportunities and priorities for consideration in the Investment Plan Update:

Leslie Aguayo — Greenlining Institute

Ruben Aronin — Better World Group

William Barrett — American Lung Association

Morgan Caswell — Port of Long Beach

Tyson Eckerle — Governor's Office of Business and Economic Development

Bill Elrick — California Fuel Cell Partnership

Larry Engelbrecht — Engelbrecht Consulting

John Frala — Rio Hondo College

Casey Gallagher — California Labor Federation

Katherine Garcia — Sierra Club

Matt Gregori — Southern California Gas Company

Kevin Hamilton — Central California Asthma Collaborative

Samantha Houston — Union of Concerned Scientists

Dylan Jaff — Consumer Reports

Daryl Lambert — Rising Sun Center

Joel Levin — Plug In America

Jose Lopez — Private Citizen

Morris Lum — Recreational Boaters of California

Bill Magavern — Coalition for Clean Air

Robert Meyer — Employment Training Panel

Micah Mitrosky — IBEW 9th District

Miles Muller — Natural Resources Defense Council

Lori Pepper — California State Transportation Agency

Michael Pimentel — California Transit Association

Jerome Qiriazzi — Humboldt Transit Authority

Craig Segall — California Air Resources Board

Mary Solecki — AJW, Inc.

Tracy Stanhoff — American Indian Chamber of Commerce

JB Tengco — BlueGreen Alliance

Zac Thompson — East Bay Community Energy

Eileen Tutt — Electric Transportation Community Development Corporation

Lucas Zucker — Central Coast Alliance United for a Sustainable Economy

ABSTRACT

The *2022–2023 Investment Plan Update for the Clean Transportation Program* guides the allocation of program funding for Fiscal Year 2022–2023 and the first six months of Fiscal Year 2023–2024. The program is set to expire at the end of the calendar year 2023. The California Energy Commission (CEC) reviews the proposed allocations annually and adjusts as needed. This update also includes funding allocations from the State Budget Acts of 2021 and 2022, which include funding through 2026.

This 2022–2023 investment plan covers the fourteenth year of the program and reflects laws, executive orders, regulations, and other funding programs to reduce greenhouse gas emissions, petroleum dependence, and criteria pollution emissions for all Californians. Program priorities are determined with input from stakeholders, the Disadvantaged Communities Advisory Group, the Clean Transportation Program Advisory Committee, and by CEC analyses such as the *Senate Bill 1000 Electric Vehicle Charging Infrastructure Deployment Assessment* and the *Assembly Bill 2127 Electric Vehicle Charging Infrastructure Assessment-Analyzing Charging Needs to Support Zero-Emission Vehicles in 2030*. These priorities are consistent with the overall program goal “to develop and deploy innovative technologies that transform California’s fuel and vehicle types to help attain the state’s climate change policies.”

This *2022–2023 Investment Plan Update* establishes funding allocations based on identified needs and opportunities, including a focus on zero-emission vehicle infrastructure. The investment plan also prioritizes jobs, economic stimulus, and equity.

This Commission Report represents the last step in developing the *2022–2023 Investment Plan Update* and was unanimously adopted at an Energy Commission business meeting on December 14, 2022.

Keywords: California Energy Commission, Clean Transportation Program, AB 118, AB 8, funding program, alternative transportation fuels, investment plan, equity, electric vehicles, hydrogen, biofuels, biomethane, biodiesel, renewable diesel, diesel substitutes, gasoline substitutes, disadvantaged communities, workforce, training, sustainability, fueling stations, fuel production, alternative fuel infrastructure, manufacturing, COVID-19

Please use the following citation for this report:

Brecht, Patrick. 2023. *2022–2023 Investment Plan Update for the Clean Transportation Program*. California Energy Commission. Publication Number: CEC-600-2022-062-CMF

TABLE OF CONTENTS

	Page
2022–2023 Investment Plan Update for the Clean Transportation Program.....	i
Acknowledgements	i
ADVISORY COMMITTEE MEMBERS.....	ii
Abstract	v
Table of Contents	vi
List of Figures	viii
List of Tables.....	viii
Executive Summary	1
Purpose of the Clean Transportation Program	1
Description of the Investment Plan	3
Highlights of Investments	3
Commitment to Inclusion, Diversity, Equity, and Access	5
Zero-Emission Vehicle Infrastructure Gap.....	7
The Zero-Emission Vehicle Infrastructure Plan (ZIP)	8
Federal Support for ZEV Infrastructure	8
Recent State Budgets Provide Significant Funding to Transform Transportation in California	
.....	10
Budget Act of 2021.....	10
Budget Act of 2022.....	10
Clean Transportation Program Funding Allocations for 2022–2023	11
CHAPTER 1: Introduction	15
Moving Forward.....	16
CHAPTER 2: Context of the 2022–2023 Investment Plan.....	18
Implementation of the Clean Transportation Program	18
Description of Funding Mechanisms.....	19
Program Outreach and Engagement	20
Highlights of Investments	21
Summary of Program Funding for Disadvantaged Communities	25
Related Policies and Goals	26
Federal Laws	28
State Laws	29
Executive Orders (EO)	32
Regulations by the California Air Resources Board	33
Complementary Funding Programs	35
California Energy Commission’s School Bus Replacement Program.....	35

California Air Resources Board Funding Programs	35
Investor-Owned Utility Investments in Electric Vehicle Charging Infrastructure	36
Volkswagen Diesel Emissions Settlement.....	37
National Electric Vehicle Infrastructure (NEVI) Funding Program.....	38
Alternative Fuel Refueling Property Credit	39
CHAPTER 3: Funding Allocations for 2022–2023	40
CHAPTER 4: Zero-Emission Vehicle Infrastructure	42
Light-Duty Electric Vehicle Charging Infrastructure	42
Quantifying Charging Infrastructure for Light-Duty Vehicles	42
Clean Transportation Program Funding	48
Summary	54
Medium- and Heavy-Duty Zero-Emission Vehicles and Infrastructure.....	54
Charging Infrastructure for Medium- and Heavy-Duty Vehicles	55
Hydrogen Fueling Infrastructure for Medium- and Heavy-Duty Vehicles	55
Clean Transportation Program Funding	56
Summary	60
Public Hydrogen Fueling Infrastructure	60
Evaluating the Deployment of FCEVs and Hydrogen Fueling Stations	60
Clean Transportation Program Funding to Date	61
Other Sources of Project Support.....	62
Summary	62
Emerging Opportunities	63
CHAPTER 5: Alternative Fuel Production and Supply	65
Zero- and Near-Zero-Carbon Fuel Production and Supply	65
Fuel Type Overview	65
Clean Transportation Program Funding to Date	68
Other Sources of Funding.....	69
Summary	70
CHAPTER 6: Related Opportunities.....	71
Manufacturing	71
Summary	72
Workforce Training and Development	73
Summary	74
GLOSSARY	75
APPENDIX A: List of Acronyms.....	1

LIST OF FIGURES

	Page
Figure ES-1: Disparities in Transportation-Related Pollution Exposure by Race and Income.....	2
Figure ES-2: Proportion of Clean Transportation Program Funding Awarded to Projects Located in Disadvantaged or Low-Income Communities (in Millions).....	6
Figure 1: Schematic of the Clean Transportation Program Implementation	19
Figure 2: Clean Transportation Program Funding in Disadvantaged and Low-Income Communities (in Millions)	26
Figure 3: Projected 2030 Charger Counts to Support 5 Million and 8 Million Light-Duty Zero-Emission Vehicles	45
Figure 4: Drive Time to the Nearest DC Fast Charging Station by Urban and Rural Communities	47
Figure 5: Map of Los Angeles Area Disadvantaged Community Drive Times to the Nearest DC Fast Charging Station.....	48

LIST OF TABLES

	Page
Table ES-1: Progress Toward 250,000 Chargers and 200 Hydrogen Stations by 2025	8
Table ES-2: Investment Plan Allocations for FY 2022–2023 and Beyond, Including Clean Transportation Program (Program) and General Funds (in Millions).....	13
Table 1: Clean Transportation Program Investments as of April 2022.....	24
Table 2: Greenhouse Gas, Fuel, and Air Quality Goals and Milestones	27
Table 3: Recommendations From the Disadvantaged Communities Advisory Group and Others, Along With the Actions Taken by the Energy Commission	30
Table 4: FY 2022–2023 CARB Clean Transportation Incentives Allocations (in Millions)	36
Table 5: Investment Plan Allocations for FY 2022–2023 and Beyond, Including Clean Transportation Program (Program) and General Funds (in Millions).....	41
Table 6: Progress Toward 250,000 Chargers by 2025	43
Table 7: Drive Time Ranges by Income Level and Urban or Rural Area	47
Table 8: Chargers Funded by the Clean Transportation Program as of August 2022	49
Table 9: CALeVIP Investments.....	50
Table 10: Summary of Clean Transportation Program Low-Carbon Fuel Production Awards as of July 22, 2022.....	68

Table 11: Summary of Proposed Awards for ZEV and ZEV-Related Manufacturing Under GFO-21-605..... 72

EXECUTIVE SUMMARY

California leads the nation in addressing the climate crisis through aggressive greenhouse gas (GHG) emission reduction goals, regulations, and innovative funding programs. The California Energy Commission's (CEC) Clean Transportation Program is one of the first transportation-focused funding programs created by the California Legislature to help achieve the state's climate policies. The Clean Transportation Program has made significant progress through grant-focused investments designed to transition California to a clean transportation system. Now in its fourteenth year, the Clean Transportation Program has provided more than \$1 billion in funding for a broad spectrum of zero-emission vehicles (ZEV) and infrastructure, alternative fuels and technologies, and workforce development projects in communities that will accrue health, environmental, and economic benefits from these investments.

In this time, California has experienced rapid growth in the sales of plug-in electric vehicles, along with the introduction of hydrogen fuel cell electric vehicles. According to the CEC's Zero-Emission Vehicles and Infrastructure Statistics online dashboard, as of June 2022, the share of new light-duty ZEV sales reached the highest level ever at 16.5 percent of new vehicles. The state reached 1 million passenger ZEVs sold in the fourth quarter of 2021, with more than 1.2 million ZEVs sold through June 2022. While behind the passenger ZEV market, on-road medium- and heavy-duty ZEVs reached more than 1,900 as of June 2022, with transit, school, and delivery vehicles at the forefront.

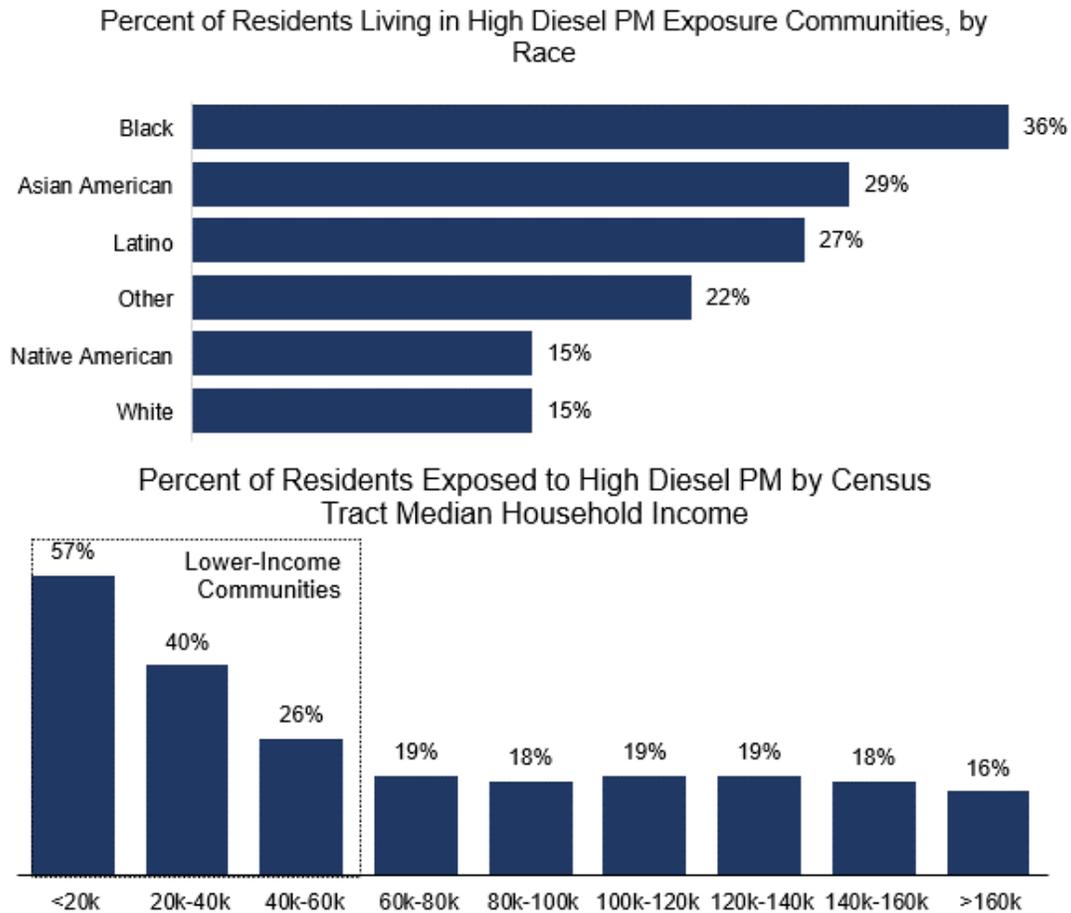
Purpose of the Clean Transportation Program

Since 2006, California has set pivotal goals to reduce GHG emissions, address the threat posed by global climate change, and improve the public health of its residents. These goals require incremental progress that will ultimately lead to major emission reductions, including:

- Reducing GHG emissions to 40 percent below 1990 levels by 2030 (Senate Bill 32, Pavley, Chapter 249, Statutes of 2016).
- Reducing short-lived climate pollutant emissions, such as methane, to 40 to 50 percent below 2013 levels by 2030 (Senate Bill 1383, Lara, Chapter 395, Statutes of 2016).
- Requiring that renewable energy and zero carbon resources supply 100 percent of retail sales of electricity by 2045, with interim goals of 90 percent by 2035 and 95 percent by 2040 (Senate Bill 100, De León, Chapter 312, Statutes of 2018, and Senate Bill 1020, Laird, Chapter 361, Statutes of 2022).
- Requiring a carbon-neutral economy by 2045 (Assembly Bill 1279, Muratsuchi, Chapter 337, Statutes of 2022).

In addition to these GHG emission reduction goals, the state must reduce emissions of criteria pollutants to attain federal and state ambient air quality standards. Reducing air pollution is important to improve equitable outcomes, given that air quality burdens fall disproportionately on low-income residents and people of color (Figure ES-1).

Figure ES-1: Disparities in Transportation-Related Pollution Exposure by Race and Income



Source: CEC analysis of census and CalEnviroScreen 2021 data. “High Diesel PM Exposure” communities are census tracts that score in the highest seventy-fifth percentile of census tracts for diesel particulate matter. Most (90 percent) diesel PM emissions come from vehicles.

Achieving these GHG and air quality goals will require significant investments to support and accelerate the market transformation that is underway within the transportation sector, which accounts for roughly 50 percent of state greenhouse gas emissions when considering “upstream emissions” from fuel production. Accordingly, the state has adopted similarly aggressive goals for zero-emission vehicles and associated refueling infrastructure, including:

- By 2025:
 - Having at least 1.5 million ZEVs on the road. (Executive Order B-16-12).
 - Installing 200 hydrogen-fueling stations and 250,000 battery-electric vehicle chargers, including 10,000 direct-current fast chargers. (Executive Order B-48-18).
- By 2030:
 - Having at least 5 million ZEVs on the road. (Executive Order B-48-18).
- By 2035:

- Transitioning 100 percent of new sales of passenger vehicles and trucks to ZEVs. (Executive Order N-79-20/Advanced Clean Cars II Regulations).
- Transitioning 100 percent of operating drayage trucks to zero emission. (Executive Order N-79-20).
- Transitioning 100 percent of operating off-road vehicles and equipment to zero emission everywhere feasible. (Executive Order N-79-20).
- By 2045:
 - Transitioning 100 percent of operating medium- and heavy-duty trucks and buses to zero emission by 2045 everywhere feasible. (Executive Order N-79-20).

To help the state achieve its climate change policies, the California Legislature passed Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007) and created the Clean Transportation Program, to be administered by the CEC. With funds collected from vehicle and vessel registration, vehicle identification plates, and smog-abatement fees, the Clean Transportation Program funds projects that will "transform California's fuel and vehicle types to help attain the state's climate change policies." Assembly Bill 8 (Perea, Chapter 401, Statutes of 2013) subsequently extended the collection of fees that support the Clean Transportation Program to January 1, 2024.

Description of the Investment Plan

As part of the Clean Transportation Program, the CEC prepares and adopts an annual investment plan update that identifies the funding priorities for the coming fiscal years. Assembly Bill 1314 (Wieckowski, Chapter 487, Statutes of 2011) focused the scope of the annual Clean Transportation Program investment plan to an update. The update builds on the work of previous investment plans while highlighting differences from previous years. The resulting funding allocations reflect the unique technological and market conditions for clean transportation fuels and technologies, as well as state goals, policies, and directives.

The CEC's multiyear approach to Investment Plan allocations provides a consistent signal about the state's planned clean transportation investments. These updates cover investments through the Clean Transportation Program expiration at the end of 2023, as well as general funds approved through the annual state budget through 2026. For the third year in a row, the CEC has implemented a multiyear funding plan to provide the public and stakeholders improved funding certainty and convey short-term and long-term transformative goals of the Clean Transportation Program. The CEC uses a public stakeholder process to evaluate whether adjustments should be made to the allocations.

Highlights of Investments

The Clean Transportation Program has been an essential part of making California a leader in near- and zero-emission transportation. Since the first Clean Transportation Program investment plan was released in 2009, the CEC has invested more than \$1 billion in projects supporting zero-emission vehicle infrastructure, alternative fuels, and advanced vehicle technologies. Key highlights through April 2022 include:

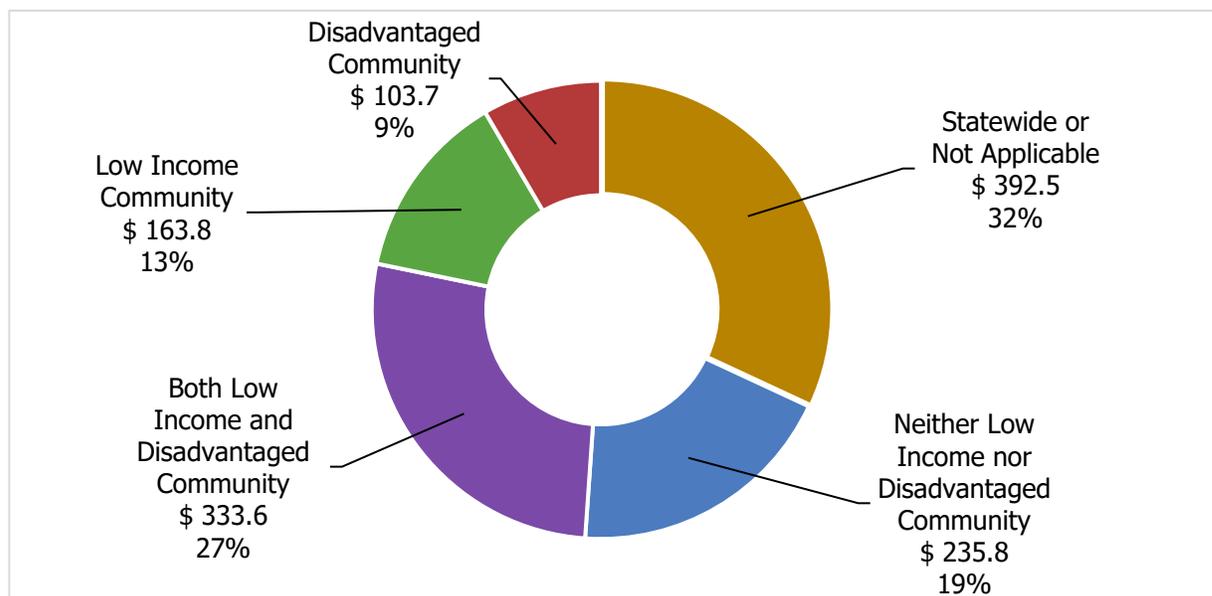
- Installing or planning nearly 17,500 chargers for plug-in electric vehicles, including 4,277 at multi- and single-family homes, 155 for fleets, and 419 at workplaces; 10,415 public and shared-private Level 2 and Level 1 chargers; and 1,968 public direct-current (DC) fast-chargers along highway corridors and urban metropolitan areas. Level 1 chargers provide charging through a 120-volt alternating-current (AC) plug at a rate of about 1.3 to 2.4 kilowatts, whereas Level 2 chargers provide charging through a 240-volt (typical in residential applications) or 208-volt (typical in commercial applications) AC plug at a rate of 3 to 19 kilowatts. DC fast chargers provide charging through a DC plug, typically at a rate of 50 kilowatts or higher.
- Creating the California Electric Vehicle Infrastructure Project (CALeVIP) to provide streamlined Clean Transportation Program incentives for light-duty electric vehicle charging infrastructure. Two additional block grant projects are also under development to continue CALeVIP's progress.
- Funding 86 regional readiness planning grants, regional readiness implementation grants, and medium- and heavy-duty ZEV blueprint grants for communities and fleets that are ramping up for the adoption of ZEV technologies.
- Releasing new solicitations targeting high-priority or underserved EV charging needs, including multifamily housing charging installations; charging infrastructure in rural communities; and charging infrastructure for high-mileage on-demand transportation services.
- Funding 79 publicly available hydrogen fueling stations and approved funding for an additional 74 stations based on deployment progress, funding availability, and Clean Transportation Program Investment Plan funding allocations. Additional funding from the state's general fund is expected to help California meet the 200-station goal. As of August 2022, 61 hydrogen fueling stations were open retail in California. These open retail stations include four stations that are considered temporarily nonoperational (unavailable for more than 30 days) but are expected to become available for customer fueling again in the future.
- Funding five projects to produce 100 percent renewable hydrogen from in-state renewable resources.
- Launching the nation's first commercial vehicle fleet incentive project in March 2022 titled "EnergiIZE Commercial Vehicles" to accelerate the deployment of electric and hydrogen infrastructure needed to fuel zero-emission trucks, buses, and equipment. The \$69 million multiyear project includes a requirement that 60 percent of funds support low-income and disadvantaged communities.
- Releasing targeted grant funding solicitations to provide zero-emission charging and refueling infrastructure for transit buses and drayage trucks, the latter in direct partnership with CARB to provide vehicle funding incentives.
- Funding 27 manufacturing projects supporting in-state economic growth while reducing the supply-side barriers for ZEVs, ZEV components (including batteries), and ZEV infrastructure. The CEC is developing funding agreements for 12 additional in-state ZEV manufacturing projects using one-time funding from the general fund.

- Providing workforce training for more than 22,000 trainees and 277 businesses, helping prepare workers for the clean transportation economy and the opportunity to earn sustainable wages and expand career employment pathways.
- Launching 71 projects to promote the production of sustainable, low-carbon alternative fuels within California. Most of the projects use waste-based feedstocks, which have some of the lowest carbon intensity pathways of alternative fuels within the state.

Commitment to Inclusion, Diversity, Equity, and Access

The CEC is committed to inclusion, diversity, equity, and access, ensuring that all Californians have an opportunity to participate in and directly benefit from programs and services, and supporting in-state employment, in-state manufacturing, and state/local economic development. Furthermore, the CEC will seek to provide more than 50 percent of Clean Transportation Program funds from this investment plan toward projects that benefit low-income and disadvantaged communities. Within the next year, the CEC will seek to quantify these benefits in ways that go beyond measuring funding within a given location and will continue to investigate new metrics to ensure these investments enhance equity within the state. Once it has completed the process to better identify and track benefits, the CEC may consider whether to increase or redefine the 50 percent target. As depicted in Figure ES-2, 49 percent of Clean Transportation Program project funds have been awarded to projects within disadvantaged or low-income communities or both.

Figure ES-2: Proportion of Clean Transportation Program Funding Awarded to Projects Located in Disadvantaged or Low-Income Communities (in Millions)



Source: California Energy Commission. Totals may not match due to rounding. As of April 2022. "Disadvantaged communities" are defined as communities within the top 25 percent scoring areas under CalEnviroScreen, as well as areas of high pollution and low population (such as ports). "Low-income communities" are defined as communities that are at or below 80 percent of the statewide median income.

The Disadvantaged Communities Advisory Group (DACAG), established under Senate Bill 350 (De León, Chapter 547, Statutes of 2015), consults with and advises the CEC and the CPUC in determining how programs can be more effective and beneficial for disadvantaged and other communities. The DACAG and other stakeholders have encouraged the CEC to prioritize investments that directly benefit low-income, disadvantaged, rural, and tribal communities and to conduct outreach and engagement in partnership with local community-based organizations. Expanding outreach is particularly important for smaller, tribal, or rural communities that may not have the resources to compete for funding opportunities nor the information and awareness of state program offerings.

The Advisory Committee for the Clean Transportation Program has 32 members and reflects a broad array of stakeholders representing community-based organizations, social and environmental justice advocates, alternative vehicle technologies, as well as workforce and labor interests. The perspectives and recommendations of the members and other stakeholders help guide an inclusive approach for Clean Transportation Program investments.

In addition, Senate Bill 1000 (Lara, Chapter 368, Statutes of 2018) requires the CEC to assess whether chargers are disproportionately deployed by population density, geographical area, or population income level, including low-, middle-, and high-income levels. Staff published the first *SB 1000 Electric Vehicle Charging Infrastructure Deployment Assessment* on December 30, 2020. The report found that low-income communities, on average, have fewer public chargers per capita than middle- or high-income communities. The second report, published July 14, 2022, assessed drive times to public direct-current fast charging stations. This second

assessment found that rural communities have less public fast charging station coverage than urban communities, with low-income rural communities particularly lacking. The second assessment found also that public fast charging station coverage among disadvantaged urban communities varies, with gaps that will need to be filled.

Zero-Emission Vehicle Infrastructure Gap

Assembly Bill 2127 (Ting, Chapter 365, Statutes of 2018) requires the CEC to evaluate charger needs biennially through 2030 to meet the state goal of 5 million ZEVs on the road and reducing greenhouse gas emissions to 40 percent below 1990 levels by 2030. However, Executive Order N-79-20, signed by Governor Gavin Newsom on September 23, 2020, provided even more ambitious ZEV goals and tasks the CEC with assessing charging infrastructure needs for this higher level of ZEV adoption.

In response, the CEC adopted the *Assembly Bill 2127 Electric Vehicle Charging Infrastructure Assessment — Analyzing Charging Needs to Support Zero-Emission Vehicles in 2030*. For passenger vehicle charging in 2030, this report projects that California will need nearly 1.2 million public and shared-private chargers to support the roughly 8 million ZEVs that CARB projects in its *Mobile Source Strategy*. An additional 157,000 chargers are needed to support 180,000 medium- and heavy-duty vehicles anticipated for 2030.

Between public and private investments, staff anticipates that California will meet the goal of 200 hydrogen refueling stations, with sufficient capacity to serve 273,000 fuel cell vehicles. Automakers expect to have 65,600 light-duty fuel cell vehicles on the road in 2028, so station capacity should not be a near-term barrier to light-duty fuel cell vehicle deployment once these stations are operational. However, medium- and heavy-duty FCEVs could play an important role in goods movement and transit, and additional infrastructure will be needed to support these fleets.

Table ES-1: Progress Toward 250,000 Chargers and 200 Hydrogen Stations by 2025

Category	Level 2 Chargers	DC Fast Chargers	Hydrogen Fueling Stations
Existing Chargers/Open Retail Hydrogen Fueling Stations (Estimated)*	71,449	8,528	61
Number of Chargers/Fueling Stations for Which Funding Has Been Allocated (includes anticipated funding from Clean Transportation Program)**	195,080	10,323	139
Total	266,529	18,851	200
<i>2025 Goal</i> (Executive Order B-48-18)	<i>240,000</i>	<i>10,000</i>	<i>200</i>
Gap From 2025 Goal	0	0	0
AB 2127 Report's 2030 Estimate of Charging Needs	1,126,855	37,461	
Gap From 2030 Estimates	860,326	18,610	

Source: California Energy Commission. Analysis as of October 2022. *Existing charging ports estimated based on available data from U.S. Department of Energy's Alternative Fuels Data Center and surveys to electric vehicle network service providers, utilities, and public agencies in California. Not included in this table are an estimated 545 statewide public or shared-private Level 1 chargers, which are included in the CEC [ZEV and Infrastructure Statistics page](https://www.energy.ca.gov/data-reports/energy-insights/zero-emission-vehicle-and-charger-statistics) (https://www.energy.ca.gov/data-reports/energy-insights/zero-emission-vehicle-and-charger-statistics) but are not part of the goal of 250,000 chargers. **Estimate of ports from other state programs derived from public presentations and statements by utilities, CPUC, CARB, other entities, and CEC. Includes PG&E's application for EV Charge 2 under CPUC review. Includes funding from the State Budget Act of 2021 and State Budget Act of 2022 intended to close the gaps for Level 2 and DC Fast Chargers and hydrogen fueling stations; the estimated number of chargers and fueling stations could change as solicitations are released.

The Zero-Emission Vehicle Infrastructure Plan (ZIP)

CEC staff, in coordination with various state agencies including the CPUC, CARB, California State Transportation Agency (CalSTA), California Department of Transportation (Caltrans), California Governor's Office of Business and Economic Development (GO-Biz), and Department of General Services (DGS), has been developing the Zero-Emission Vehicle Infrastructure Plan (ZIP). This document supports decision-making in the public and private sectors by documenting plans and strategies to deploy ZEV infrastructure for all Californians. The document divides ZEV infrastructure into five market segments to address the specific challenges and opportunities unique to each sector. The market segments include hydrogen fueling for light-duty FCEVs, charging and hydrogen fueling for medium- and heavy-duty ZEVs, Level 1 and Level 2 charging for light-duty EVs, DC fast charging for light-duty BEVs, and emerging technologies. When completed in the fall of 2022, this document will be a resource for public and private entities to better understand the status and short-term and long-term state actions to support ZEV infrastructure.

Federal Support for ZEV Infrastructure

President Joseph R. Biden Jr. signed the \$1.2 trillion Infrastructure Investment and Jobs Act (IIJA) into law in November 2021. (Public Law 117-58). The law authorizes hundreds of

billions of dollars in new investments in a wide array of infrastructure categories, including roads and bridges, water infrastructure, passenger rail, energy, and broadband internet. Electric vehicle charging infrastructure will see significant new funding, with \$5 billion to accelerate EV infrastructure deployment nationally titled the National Electric Vehicle Infrastructure Funding Program (NEVI). California's share is expected to be \$384 million, allocated over five years. An additional \$2.5 billion nationally is available on a competitive basis for EV and hydrogen infrastructure.

On August 1, 2022, the CEC and Caltrans released the *California's Deployment Plan for the National Electric Vehicle Infrastructure Program*, and on September 14, 2022, the Biden-Harris administration approved California's plan. The deployment plan will be updated each year to reflect progress of the previous year, identify new challenges and opportunities, highlight future deployment plans, and ensure alignment with California's EV charging infrastructure planning. California is committed to reviewing the outcomes from the deployment plan to determine best practices, ensure that the plan meets the program guidelines, and confirm that the plan is accomplishing the state's goals for a connected network of EV chargers.

Subsequently, President Biden also signed the Inflation Reduction Act of 2022 into law in August 2022 (Public Law 117-169). The law extends a federal tax credit for the sale of new ZEVs, lifts a manufacturer's eligibility cap on the new ZEV sales, and provides a new tax credit for used ZEV purchases. Importantly for ZEV infrastructure, the law extended the alternative fuel infrastructure tax credit of up to 30 percent of the equipment cost, to a new maximum of \$100,000 (up from \$30,000) for equipment subject to depreciation, or \$1,000 for other equipment. The equipment must be installed in a low-income or nonurban community. The amount of the credit can also be significantly increased under certain prevailing wage and apprenticeship circumstances.

California has led the way in preparing for transportation electrification and is proof to other states and countries that decarbonization of the transportation sector is not just necessary to address the climate crisis, but also possible. This has been a collaborative effort with contributions from a range of stakeholders, including public, private, ratepayer, and federal investments. California agencies and utility customers have made substantial investments to prepare for transportation electrification. Additional grid capacity investments will be needed to ensure broad and equitable access for everyone. As such, utilities should be eligible for federal funding to support distribution grid and substation upgrades to meet climate goals, improve local air quality, and ease rate pressures. These investments will be needed in addition to critical site level zero-emission vehicle infrastructure investments. Further, federal investments will be an important funding source to support microgrids and resiliency as regional heat storms and the impacts of the climate crisis become annual events.

The CEC will use a portfolio approach to invest federal and state funds to meet state goals, policies, and directives. The funding streams will be coordinated to ensure that they complement one another and to leverage additional private investments in California.

Recent State Budgets Provide Significant Funding to Transform Transportation in California

Budget Act of 2021

On July 12, 2021, Governor Gavin Newsom strengthened California's commitment to a clean transportation future by approving the State Budget Act of 2021 (Senate Bill 129, Skinner, Chapter 69), which includes a three-year, \$3.9 billion budget for ZEV-related investments by CEC, CARB, and GO-Biz. The budget prioritizes diesel emission reduction by earmarking funding for 1,125 zero-emission drayage trucks, 1,000 zero-emission school buses, and 1,000 zero-emission transit buses along with their appropriate charging and refueling infrastructure. Of that package amount, the CEC will administer \$1.165 billion over three years.

The CEC funding also includes funding for grants to promote in-state ZEV and ZEV-related manufacturing, such as infrastructure equipment and ZEV components including EV batteries. The investments will help the markets for ZEVs and infrastructure grow to scale and, more importantly, serve as a foundation for equitable and sustainable economic growth by drawing private investments to California and creating jobs in manufacturing, construction, and engineering.

Budget Act of 2022

The Governor's 2022–2023 budget framework includes \$6.1 billion for the transportation system and other related zero-emission vehicle efforts. The funding builds on the already historic clean transportation funding from the Budget Act of 2021. Of the \$6.1 billion, the CEC would administer more than \$2.4 billion over four fiscal years to continue deploying ZEV infrastructure to support the goals outlined in the Governor's Executive Order N-79-20.

The funding will help increase ZEV charging for light-duty vehicles with a focus on equity and access. This funding includes \$870 million toward light-duty passenger vehicle infrastructure, primarily for a broad network of grid-integrated, high-powered fast chargers, as well as at-home charging for multifamily residents and priority community single-family homes.

The four-year budget also provides \$1.385 billion in infrastructure funding to power medium-duty and heavy-duty vehicles and equipment. This funding would include ZEV infrastructure funding totaling:

- \$250 million for drayage trucks.
- \$140 million for transit buses.
- \$375 million for school buses.
- \$470 million for trucks, buses, and off-road equipment.
- \$150 million for ports.

In addition to light-duty and medium- and heavy-duty zero-emission vehicle infrastructure investments the budget includes \$60 million specific to hydrogen infrastructure. Finally, the

budget framework allocates \$100 million to an emerging opportunities category dedicated to zero-emission aviation, locomotive, and marine vehicles and vehicle-grid integration efforts.

Clean Transportation Program Funding Allocations for 2022–2023

The Investment Plan Update includes Clean Transportation Program funding and the General Fund ZEV Package investments from the enacted budgets of 2021 and 2022. Table ES-2 shows the program funding allocations for FY 2022–2023, the funding projections for the remainder of the Clean Transportation Program (through the end of Calendar Year 2023), as well as the recent general fund allocations under the Budget Acts of 2021 and 2022. CEC staff emphasizes that the CEC can only make adjustments in Clean Transportation Program funding; the Budget Acts of 2021 and 2022 are prescriptive and cannot be modified. The Clean Transportation Program allocations for the *2022–2023 Investment Plan Update* are unchanged from last year's *2021–2023 Investment Plan Update*.

Table ES-2 shows combined allocations of just more than \$900 million to support light-duty passenger vehicle charging (first three rows) and nearly \$1.7 billion to support medium- and heavy-duty ZEV infrastructure (next six rows). Investments in medium- and heavy-duty ZEV infrastructure reflect the need to transition swiftly the most polluting vehicles toward zero-emission technologies in the most sensitive regions of the state.

Of the more than \$900 million allocated for light-duty charging infrastructure, the Clean Transportation Program's original funds will provide \$30.1 million in the current fiscal year and \$13.8 million in the remaining half fiscal year, which, along with last year's cumulative investment of \$270.1 million, should be sufficient to meet the state's goal of having 250,000 chargers by 2025. The general fund provides \$558.5 million over the next four fiscal years to build out a broad network of grid-integrated, high-powered fast chargers to support travel across the state and to supplement federal NEVI funding for corridor fast charging. The General Fund also provides \$299 million for equitable at-home charging for multifamily residents and priority community single-family homes.

Assembly Bill 8 (AB8, Perea, Chapter 401, Statutes of 2013) directs the CEC to allocate \$20 million annually, not to exceed 20 percent of the funds appropriated by the Legislature, from the Clean Transportation Program to deploy hydrogen fueling stations until there are at least 100 publicly available stations in operation. This Investment Plan allocates \$90 million for hydrogen infrastructure, but this is a minimum, not a maximum, since funding for medium and heavy-duty ZEV infrastructure will also be used for hydrogen infrastructure. Funding from the Clean Transportation Program fund (\$30 million) will be sufficient to meet and exceed the 100-station goal set by AB 8, while additional General Fund investments from last year will help the state reach the 200-station goal. The Budget Act of 2022 requires the CEC to fund hydrogen infrastructure at \$20 million per year for three years starting in Fiscal Year 2023–2024. This new funding from the Budget Act of 2022 will allow the state to further expand access to hydrogen infrastructure, including for medium and heavy-duty vehicles.

The Investment Plan allocates \$1.7 billion for medium and heavy-duty ZEV infrastructure. The Budget Acts of 2021 and 2022 require the CEC to fund ZEV infrastructure for specific categories: \$406 million for drayage trucks; \$198.5 million for transit buses; \$404.25 for

school bus ZEV infrastructure; \$465.05 for truck, bus, and off-road equipment; \$150 million for ports. The CEC is allocating an additional \$44 million of Clean Transportation Program funding for medium and heavy-duty ZEV infrastructure. These funds will support the deployment of thousands of ZEV drayage trucks, school buses, transit buses, and other medium- and heavy-duty vehicles within the state. In addition to grant funding, the CEC is working with partner agencies and exploring alternative funding mechanisms, such as loan financing. A comprehensive package could combine vehicle and infrastructure financing and provide additional access to funding options. Loan financing has the potential to create a streamlined lending process for small businesses that are transitioning to zero-emission vehicles.

Allocations from the Clean Transportation Program fund and General Fund will also support a broader portfolio of activities. The \$97 million Emerging Opportunities allocation, for instance, includes funding from the General Fund for sectors that are only beginning to transition to zero-emission technologies, including zero-emission aviation, locomotive, and marine vehicles. The allocation will also support vehicle–grid integration efforts, such as mitigating electric vehicles’ charging during peak capacity or high carbon intensity hours, as well as bidirectional charging to actively support the grid. Investments will support charging technologies and behaviors that benefit California’s electric grid system.

To support the development of clean, low carbon fuels, the Investment Plan allocates a total of \$15 million of Clean Transportation Program funding over the next two years. An additional \$10 million of Clean Transportation Program funding will support ZEV workforce development and will prioritize community members from disadvantaged and low-income communities. Workforce development strategies and investments will be refined through continued public engagement workshops. Finally, the general fund includes \$118 million for ZEV-related manufacturing to help keep California at the forefront of ZEV manufacturing.

Table ES-2: Investment Plan Allocations for FY 2022–2023 and Beyond, Including Clean Transportation Program (Program) and General Funds (in Millions)

Category	Funding Source	2022–2023	2023–2024 1/ 2/ 3/	2024–2025 1/ 3/	2025–2026 1/ 3/
Light-Duty Electric Vehicle Charging Infrastructure*	Program	\$30.1	\$13.8	-	-
Light-Duty Electric Vehicle Charging Infrastructure	General Fund	\$218.5	\$210.0	\$90.0	\$40.0
Equitable At-home Charging	General Fund	\$19.0	\$160.0	\$80.0	\$40.0
Medium- and Heavy-Duty Zero-Emission Vehicle (ZEV) Infrastructure	Program	\$30.1	\$13.8	-	-
Drayage Truck ZEV Infrastructure	General Fund	\$171.95	\$185.0	\$49.0	-
Transit Bus ZEV Infrastructure	General Fund	\$28.50	\$90.0	\$50.0	\$30.0
School Bus ZEV Infrastructure	General Fund	\$389.25	\$15.0	-	-
Clean Trucks, Buses and Off-Road Equipment ZEV Infrastructure	General Fund	\$94.05	\$315.0	\$31.0	\$25.0
Port ZEV Infrastructure	General Fund	-	\$40.0	\$80.0	\$30.0
Emerging Opportunities	General Fund	\$51.3	\$35.0	\$11.0	-
Hydrogen Fueling Infrastructure	Program	\$20.0	\$10.0	-	-
Hydrogen Fueling Infrastructure	General Fund	-	\$20.0	\$20.0	\$20.0
Zero- and Near Zero-Carbon Fuel Production and Supply	Program	\$10.0	\$5.0	-	-
ZEV Manufacturing	General Fund	\$118.75	-	-	-
Workforce Training and Development	Program	\$5.0	\$5.0	-	-
	Total Program	\$95.2	\$47.6		
	Total General Fund	\$1,091.3	\$1,070	\$411	\$185

Source: California Energy Commission. The FY 2022–2023 funding amount from the general fund was reduced by \$37.7 million, which is the maximum administrative costs the CEC is authorized to incur associated with that funding. An additional \$18.75 million may be reallocated from FY 2022–2023 funding for administrative costs to support the Proposition 98 School Bus Program. The CEC reserves the ability to use unused administrative costs to fund additional projects within each funding allocation. *Does not include \$384 million over five years under federal NEVI program for charging along highways and interstates.

- 1/ Subject to future Budget Act appropriations.
- 2/ The Clean Transportation Program is authorized through December 31, 2023; therefore, only half of the revenues/appropriations are anticipated in this fiscal year.
- 3/ The anticipated general fund amounts in FY 2023–2024 through FY 2025–2026 have not been reduced to reflect administrative costs. Those fiscal year allocations will be reduced in accordance with direction in the associated Budget Act.

CHAPTER 1:

Introduction

California has been at the forefront of national efforts to combat climate change since the passage of the Global Warming Solutions Act of 2006, which established a goal of reducing statewide greenhouse gas (GHG) emissions to 1990 levels by 2020.¹ Senate Bill 32 established a goal of 40 percent below 1990 levels by 2030.² Executive Order B-55-18 established a goal to achieve carbon neutrality as soon as possible, and no later than 2045, and achieve and maintain net negative emissions thereafter.³

The state's efforts to address the climate crisis are showing progress, and in 2016, California achieved its goal of reducing GHG emissions to 1990 levels, four years ahead of schedule. Despite the steady reduction in GHG emissions overall, emissions from the transportation sector decreased only modestly over the last several years, as Californians purchased more light trucks (sport utility vehicles, pickups, and vans) instead of cars and drove more miles. When including upstream emissions, the transportation sector is the largest source of GHG emissions in California, with vehicles, oil extraction, and oil refining accounting for roughly 50 percent of in-state emissions.⁴

In addition to greenhouse gases, the transportation sector is a major emitter of criteria pollutants, with mobile sources responsible for nearly 80 percent of nitrogen oxide emissions and 96 percent of diesel particulate matter emissions statewide.⁵ Protecting and improving public health in the state will require substantial reductions in criteria pollutant emissions. The California Air Resources Board (CARB) estimates that attaining federal air quality standards in 2023, 2024, 2031, and 2037 will require significant reductions of nitrogen oxide emissions in parts of the state.⁶

To help address state climate change and air quality objectives, the California Legislature passed Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007). This legislation created the Clean Transportation Program. With funds collected from vehicle and vessel registration, vehicle identification plates, and smog abatement fees, the Clean Transportation Program

1 [Assembly Bill 32 \(Núñez, Chapter 488, Statutes of 2006\)](https://leginfo.ca.gov/faces/billNavClient.xhtml?bill_id=200520060AB32), https://leginfo.ca.gov/faces/billNavClient.xhtml?bill_id=200520060AB32.

2 [Senate Bill 32 \(Pavley, Chapter 249, Statutes of 2016\)](https://leginfo.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB32), https://leginfo.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB32.

3 [Executive Order B-55-18](https://www.ca.gov/archive/gov39/wp-content/uploads/2018/09/9.10.18-Executive-Order.pdf). September 10, 2018. Available at <https://www.ca.gov/archive/gov39/wp-content/uploads/2018/09/9.10.18-Executive-Order.pdf>.

4 California Air Resources Board. July 18, 2021. [California Greenhouse Gas Emissions for 2000 to 2019 – Trends of Emissions and Other Indicators](https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2019/ghg_inventory_trends_00-19.pdf). Available at https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2019/ghg_inventory_trends_00-19.pdf.

5 California Air Resources Board. October 2021. [Mobile Source Strategy](https://ww2.arb.ca.gov/sites/default/files/2021-12/2020_Mobile_Source_Strategy.pdf). Available at https://ww2.arb.ca.gov/sites/default/files/2021-12/2020_Mobile_Source_Strategy.pdf.

6 Ibid.

funds projects that will "transform California's fuel and vehicle types to help attain the state's climate change policies." Assembly Bill 8 (Perea, Chapter 401, Statutes of 2013) extended the collection of fees that support the Clean Transportation Program to January 1, 2024.

As part of the Clean Transportation Program, the California Energy Commission (CEC) prepares and adopts an annual Investment Plan Update that identifies the funding priorities for the coming fiscal year. The funding allocations reflect state policy goals, the potential for each alternative fuel and vehicle technology to contribute to the goals of the program, the anticipated barriers and opportunities associated with each fuel or technology, and the effect of other investments, policies, programs, and statutes. The Investment Plan Update also describes how the allocations will complement existing public and private efforts, including related state programs.

Moving Forward

This *2022–2023 Investment Plan Update* is the fourteenth investment plan in the history of the Clean Transportation Program and builds on the analyses and recommendations contained in prior documents. The Commission Report is the final version of the *2022–2023 Investment Plan Update*. As part of developing the *2022–2023 Investment Plan Update*, the CEC holds two public meetings with the Clean Transportation Program Advisory Committee. The first meeting was held April 12, 2022, and the second was held October 6, 2022. The advisory committee is a broad representation of interests that reflect California communities and provide representation of program beneficiaries, environmental justice communities, rural communities, tribes, and others. Representatives from the advisory committee, other stakeholders, and the public are encouraged to discuss and comment on drafts of this document during these meetings and through the CEC's docket system.⁷

The unexpected public health and economic conditions brought on by the COVID-19 pandemic will continue to impact CEC's near-term implementation of the Clean Transportation Program and related investment plan. In addition, the invasion of Ukraine by Russia has spurred gasoline and diesel prices to new heights and exacerbated supply chain issues already constrained by the COVID-19 pandemic. The supply of new and used ZEVs as well as ZEV refueling infrastructure have been impacted by supply chain constraints, especially as consumers seek to buy more ZEVs to avoid high prices at the gasoline pump. The CEC is leveraging funding from the Clean Transportation Program and other sources to expand ZEV manufacturing and build the ZEV supply chain in-state, including using California sources of precious minerals like lithium.

In addition to meeting state clean air and clean transportation goals set by executive orders and statute, the Clean Transportation Program can also play an immediate role in helping consumers who are being hammered with high gasoline prices transition to ZEVs. The Clean Transportation Program can also help create jobs and stimulate the economy to support the

⁷ The Energy Commission's [docket](https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=19-ALT-01) for the *2020–2021 Investment Plan Update for the Clean Transportation Program* (Docket #19-ALT-01) can be found at <https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=19-ALT-01>.

state's recovery from the impacts of COVID-19. Prioritizing investments in ZEV infrastructure can spur near-term employment and economic development.

Chapter 2 of this document provides the context for the current investment plan, including an update on the CEC's implementation of the Clean Transportation Program to date and a review of related policies and programs. Chapter 3 summarizes the funding allocations for FY 2022–2023. The subsequent chapters are organized by specific investment areas. Chapter 4 focuses on zero-emission infrastructure. Chapter 5 addresses the types of opportunities for zero- and near-zero-emission fuel production and supply within California. Chapter 6 describes related opportunities to support the development and deployment of zero-emission vehicle infrastructure and fuel production such as manufacturing and workforce development.

CHAPTER 2:

Context of the 2022–2023 Investment Plan

Implementation of the Clean Transportation Program

Since the inception of the program, the CEC has followed a consistent approach toward implementing the Clean Transportation Program. Each annual Investment Plan Update allows the program to be responsive and can shift funds in response to gaps in investments by utilities, the private sector, and settlement agreements. As summarized in Figure 1, the process begins with an investment plan that determines the coming fiscal-year funding allocation for categories of projects.

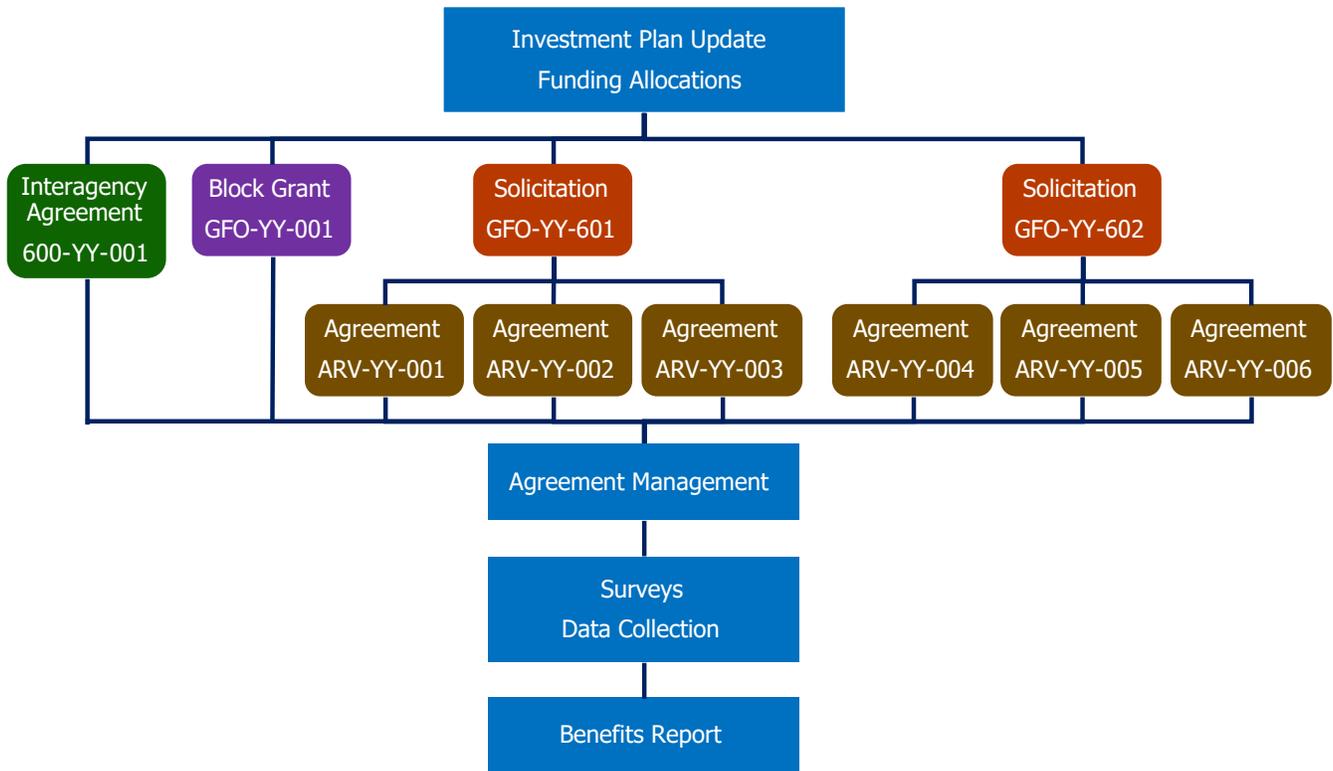
The funding allocations typically do not determine the specific funding solicitations and grant programs that will be issued. Rather, based on these funding allocations, the CEC subsequently issues a series of competitive solicitations, known as “grant funding opportunities” (GFOs).

CEC staff reviews, scores, and ranks the proposals for each solicitation using the evaluation criteria developed for the solicitation. Based on the total scores of each application, the CEC releases a notice of proposed awards (NOPA) for each solicitation. For specialized agreements with certain partner agencies, the CEC may develop interagency agreements without using the solicitation process.

Each funded application becomes a funding agreement once it has been approved and signed by the CEC and the applicant. CEC staff oversees completion of these agreements according to the respective schedules, budgets, scopes of work, and terms and conditions.

Data collection and project review are key aspects of the Clean Transportation Program implementation. The CEC surveys funding recipients on the anticipated results of their projects, with questions relating to alternative fuel use, petroleum displacement, GHG emission reductions, air-quality benefits, and in-state economic benefits.

Figure 1: Schematic of the Clean Transportation Program Implementation



Source: California Energy Commission

Description of Funding Mechanisms

To date, the CEC has predominantly used grants to distribute funding, with awardees selected through competitive solicitations. The suite of potential funding and financing mechanisms have respective strengths and weaknesses, and the CEC weighs these options when developing the funding implementation strategy for each allocation. The most prominent funding mechanisms used for the Clean Transportation Program by the CEC are described below.

- **Competitive Solicitation for Grants** — This type of solicitation represents the most common funding mechanism for the Clean Transportation Program to date. It is flexible, as project requirements and scoring criteria can be adapted for a broad variety of commercial and technological maturity levels. Competitive scoring allows increased scrutiny on key issues for each project type. However, it also requires significant time and attention to review each application and oversee each subsequent funding agreement.
- **Block Grants** — The CEC has used this funding mechanism to distribute Clean Transportation Program funding through third-party implementers. The block grant implementer is selected through a competitive process. Block grants allow the CEC to select another organization to administer Clean Transportation Program funding while following set procedures for project and applicant eligibility.

- **First-Come, First-Served** — This type of funding mechanism has been used by the Clean Transportation Program for vehicle and infrastructure incentives. Once eligibility requirements are established, the funding can be administered relatively quickly and provide greater market certainty for a project type.
- **Production or Operation Incentives** — The CEC has used these types of incentives for in-state ethanol production and hydrogen fueling station operation and maintenance. The primary aim of these incentives is to provide greater market certainty, which encourages further investment from nongovernment sources.
- **Direct Agreements** — The CEC may make a sole source award for applied research. The CEC may also enter into interagency agreements or contracts with public entities to obtain technical, scientific, or administrative services to support the Clean Transportation Program.
- **Federal Cost Sharing** — This mechanism will provide match funding support to applicants of federal funding opportunities.
- **Revolving Loans** — CEC is embarking on an in-depth examination of one or more revolving loan programs to be administered by the California Infrastructure and Economic Development Bank (IBank) on CEC's behalf. Like block grants, IBank will handle the operational aspects of the revolving loan program(s), while CEC provides the technical and market expertise to ensure the programs are successful.

Several factors and considerations can guide which funding mechanism is appropriate for a given solicitation. These factors and considerations include using public funds to address infrastructure gaps, targeting use cases where the private market is not investing, meeting equity goals, and accelerating infrastructure deployment to move California away from a reliance on fossil fuels.

Program Outreach and Engagement

The CEC seeks to increase the participation of disadvantaged and underrepresented communities from a diverse range of geographical regions and populations. The CEC also seeks to effectively engage communities disproportionately burdened by pollution and improve economic resiliency, including rural and tribal communities. This effort includes:

- Diversifying the Clean Transportation Program Advisory Committee, as accomplished in 2020, to better reflect California communities and provide increased representation of program beneficiaries, environmental justice communities, rural communities, tribes, and others.
- Consulting with the Disadvantaged Communities Advisory Group⁸ for guidance and recommendations on program effectiveness as it relates to disadvantaged communities and other vulnerable and underrepresented groups.

⁸ More information available on the [Disadvantaged Communities Advisory Group Page](https://www.energy.ca.gov/about/campaigns/equity-and-diversity/disadvantaged-communities-advisory-group). Available at <https://www.energy.ca.gov/about/campaigns/equity-and-diversity/disadvantaged-communities-advisory-group>.

- Consulting with the CEC’s Tribal Program and the Tribal Lead Commissioner for assistance with outreach and promotion of transportation-related funding opportunities to tribes.
- Hosting a presolicitation workshop and receiving docketed comments on funding opportunities to provide light-duty charging infrastructure that can serve rural communities and multifamily housing residents.
- Assessing whether electric vehicle charging station infrastructure is disproportionately deployed, as examined in the SB 1000 analysis. The first report, *California Electric Vehicle Infrastructure Deployment Assessment: Senate Bill 1000 Report*, published December 30, 2020, assessed distribution of public Level 2 chargers and DCFCs by geographical area, population, and income level. The second report, published July 14, 2022, *Senate Bill 1000 California Electric Vehicle Infrastructure Deployment Assessment Drive Times to Direct-Current Fast Chargers*, assessed drive times to public direct-current fast charging stations. Both reports were developed through a public process, including stakeholder engagement and public workshops.
- Through an agreement with the Foundation for California Community Colleges (FCCC), the CEC launched the IDEAL Communities Partnership Project. Since the start of the project in early 2021, FCCC has completed an equity-focused assessment of the Clean Transportation Program, drafted an outreach and engagement plan, created outreach materials, and launched the ZEV IDEAL Student Ambassadors Program (a cohort of eight community college students across five rural geographic focus areas). In 2022, the IDEAL Communities Partnership Forum provided a public venue for community-based partners to share their clean transportation needs, outline charging infrastructure issues, and provide essential feedback to the CEC and Clean Transportation Program.

In addition to the above actions, the CEC has provided a scoring preference for projects in the California Communities Environmental Health Screening Tool (CalEnviroScreen4.0).⁹ These preferences have been used in recent Clean Transportation Program solicitations, where appropriate, and nearly half of site-specific Clean Transportation Program funding has gone directly toward projects in low-income and disadvantaged communities.

Highlights of Investments

As of April 2022, the CEC has invested more than \$1 billion in Clean Transportation Program funding. In many cases, projects are in progress, with ongoing siting, installation, construction, and demonstrations. Table 1 summarizes program investments, including the following highlights:

- Installed or planned 17,631 chargers for plug-in electric vehicles, including 4,277 at multi- and single-family homes, 155 for fleets, and 419 at workplaces; 10,415 public and shared-private Level 2 and Level 1 chargers; and 1,990 public direct-current (DC) fast-chargers and 255 Level 2 chargers along highway corridors and urban metropolitan

⁹ The [CalEnviroScreen 4.0 tool](https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-40) is available online from the California Office of Environmental Health Hazard Assessment at <https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-40>.

areas. Level 1 chargers provide charging through a 120-volt alternating-current (AC) plug, whereas Level 2 chargers provide charging through a 240-volt (typical in residential applications) or 208-volt (typical in commercial applications) AC plug. DC fast chargers provide charging through a DC plug, typically at a rate of 50 kilowatts or higher.

- Created the California Electric Vehicle Infrastructure Project (CALeVIP) to provide streamlined Clean Transportation Program incentives for light-duty electric vehicle charging infrastructure. Two additional block grant projects are also under development to continue the progress of CALeVIP.
- Funded 86 regional readiness planning grants, regional readiness implementation grants, and medium- and heavy-duty ZEV blueprint grants for communities and fleets that are ramping up for the adoption of ZEV technologies.
- Released new solicitations targeting high-priority or underserved EV charging needs, including multifamily housing charging installations, charging infrastructure in rural communities, and charging infrastructure for high-mileage, on-demand transportation services.
- Released new solicitations to expand innovative and interoperable charging opportunities, including a vehicle-grid innovation laboratory, a future symposium on electric vehicle charging interoperability, and the demonstration of innovative charging solutions to accelerate commercialization.
- Funded 79 publicly available hydrogen fueling stations and approved funding for an additional 74 stations based on deployment progress, funding availability, and Clean Transportation Program Investment Plan funding allocations. Of these stations, 13 will be capable of serving medium- and heavy-duty vehicles, as well as passenger vehicles. In addition, there are 23 privately funded stations (16 privately funded stations under CEC agreement and 7 privately funded stations outside any CEC agreement) under development. With the expended funds and committed allocation of funds, California is on track to meet the AB 8 requirement of 100 stations. Funding from last year's ZEV Package is expected to help California meet the 200-station goal. As of August 2022, 61 hydrogen fueling stations were open retail in California.
- Developed retail fueling standards to enable hydrogen sales on a per-kilogram basis.
- Launched the nation's first commercial vehicle fleet incentive project in March 2022 titled "EnergIIZE Commercial Vehicles" to accelerate deployment of electric and hydrogen infrastructure needed to fuel zero-emission trucks, buses, and equipment. The project uses a concierge-like model to work directly with eligible applicants to plan and fund the purchase of charging and hydrogen fueling infrastructure. The multiyear project, approved for up to \$276 million, will help communities most impacted by transportation-related pollution by meeting essential infrastructure needs and has a requirement that 60 percent of funds support low-income and disadvantaged communities.

- Released targeted grant funding solicitations to provide zero-emission charging and refueling infrastructure for transit buses and drayage trucks, the latter in direct partnership with CARB to provide vehicle funding incentives.
- Funded 27 manufacturing projects supporting in-state economic growth while reducing the supply-side barriers for alternative fuels and advanced technology vehicles, primarily in electric drive-related components and vehicles. The CEC is developing funding agreements for 12 additional in-state ZEV manufacturing projects using one-time funding from the general fund.
- Provided workforce training for more than 20,000 trainees and 277 businesses, helping prepare workers for the clean transportation economy and the opportunity to earn sustainable wages and expand employment opportunities.
- Launched 71 projects to promote the production of sustainable, low-carbon alternative fuels within California, with a cumulative annual production capacity equivalent to more than 158 million gallons of diesel fuel. Most of the projects use waste-based feedstocks such as dairy manure and municipal solid waste, which have some of the lowest carbon intensity pathways recognized under the Low Carbon Fuel Standard, a CARB regulation that requires the carbon intensity of transportation fuels to be cut by 20 percent by 2030.
- Funded five projects to produce 100 percent renewable hydrogen from in-state renewable resources. The hydrogen will be used for on-road fuel cell electric vehicles, both light-duty and medium-/heavy-duty.

Table 1: Clean Transportation Program Investments as of April 2022

Funded Activity	Cumulative Awards to Date (in Millions)*	# of Projects or Units
Alternative Fuel Production		
Biomethane Production	\$73.86	29 Projects
Gasoline Substitutes Production	\$26.94	14 Projects
Diesel Substitutes Production	\$66.99	26 Projects
Renewable Hydrogen Production	\$16.93	5 Projects
Alternative Fuel Infrastructure		
Electric Vehicle Charging Infrastructure**	\$331.12	17,631 chargers
Hydrogen Fueling Infrastructure (Including Operations and Maintenance)	\$168.82	79 Public Fueling Stations
Medium- and Heavy-Duty ZEV Infrastructure	\$176.22	83 Projects
E85 Fueling Infrastructure	\$3.61	21 Fueling Stations
Upstream Biodiesel Infrastructure	\$6.98	7 Infrastructure Sites
Natural Gas Fueling Infrastructure	\$24.11	70 Fueling Stations
Alternative Fuel and Advanced Technology Vehicles		
NG and Propane Vehicle Deployment, Hybrid and ZEV Deployment (Including CVRP, HVIP, and Low-Income Mobility Incentives), and Advanced Technology Freight and Fleet Vehicles	\$250.40	14,516+ NG, Propane, Hybrid and ZEVs and 54 Demonstrations
Related Needs and Opportunities		
Manufacturing	\$55.32	27 Manufacturing Projects
Workforce Training and Development	\$39.715	20,000 Trainees
Fuel Standards and Equipment Certification	\$3.90	1 Project
Sustainability Studies	\$2.04	2 Projects
Regional Alternative Fuel Readiness	\$18.00	86 Regional Plans
Centers for Alternative Fuels	\$5.41	5 Centers
Technical Assistance and Program Evaluation	\$17.52	n/a
Total	\$1.287 Billion	-

Source: California Energy Commission. *Includes all agreements that have been approved at a CEC business meeting or are expected for business meeting approval following a notice of proposed award. For canceled and completed projects, includes only funding received. **Includes a total of \$186 million for the California Electric Vehicle Infrastructure Project to provide EV incentives throughout California, which will fund a yet-to-be-determined number of EV chargers.

Using funds from the Clean Transportation Program, the CEC has also leveraged the additional investment of more than \$730 million in private and other public funds. However, this amount represents only the minimal, contractually obligated amount of match funding provided toward

Clean Transportation Program projects; the actual amount of investment prompted by the Clean Transportation Program funding exceeds this amount.

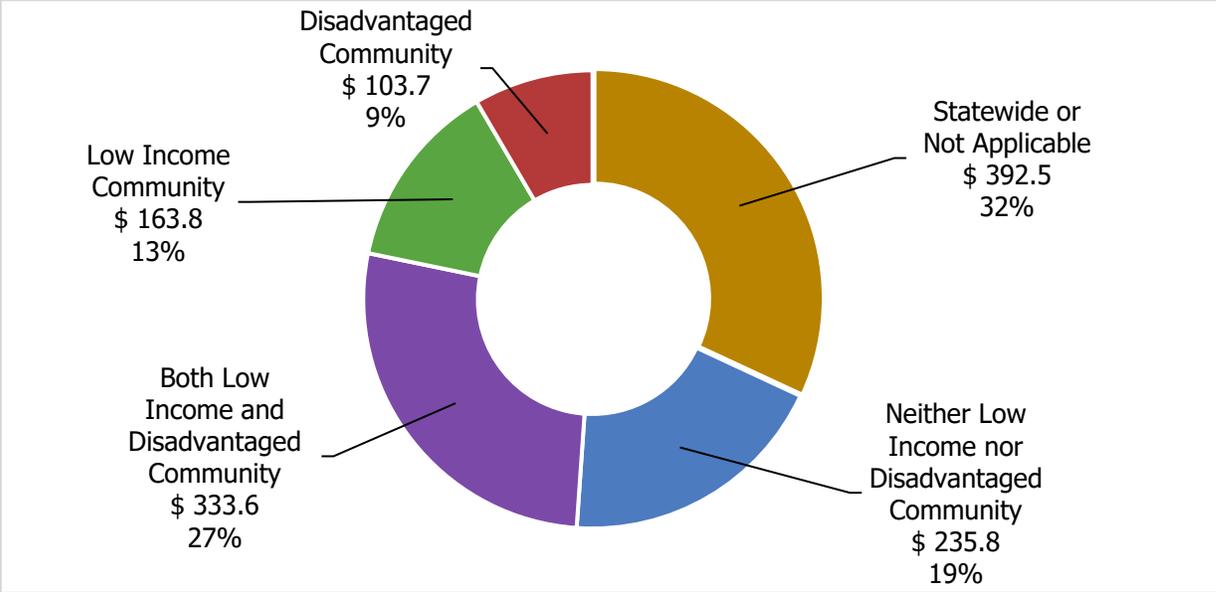
Summary of Program Funding for Disadvantaged Communities

The CEC seeks to increase participation and benefits to disadvantaged and underrepresented communities from a diverse range of regions in implementing the Clean Transportation Program. As depicted in Figure 2, roughly 49 percent of Clean Transportation Program project funding has gone into disadvantaged communities or low-income communities or both.¹⁰ The CEC seeks to invest more than 50 percent of funding to support projects benefitting low-income and disadvantaged communities for the remainder of the Clean Transportation Program.

The CEC recognizes that the location of a project is not the only metric of whether a project will benefit low-income and disadvantaged communities. The CEC will continue to work with the Clean Transportation Program Advisory Committee, DACAG, communities, and stakeholders to define and track project benefits to increase program equity and inclusion. These efforts include engaging in partnerships with community-based organizations and community organizers in project scoping and grant applications. Efforts also include identifying new qualitative and quantitative metrics beyond project location to evaluate the effects of projects on local communities and continuing to work with other state and local agencies to share critical lessons and community needs.

¹⁰ New to this Investment Plan Update, these funding percentages incorporate CARB's Priority Population Maps, which show disadvantaged communities and low-income communities as defined for California Climate Investments. This map provides a more precise geospatial analysis tool for finding which projects fell within low-income or disadvantaged communities' boundaries. Previous CEC analysis used older demographic data and less granular GIS mapping. In conjunction with the SB 1000 Report (published December 2020) analysis, the demographic data and mapping have been refined to provide more accurate mapping and better count low-income and disadvantaged communities investments.

Figure 2: Clean Transportation Program Funding in Disadvantaged and Low-Income Communities (in Millions)



Source: California Energy Commission. As of April 2022.

Related Policies and Goals

The CEC’s implementation of the Clean Transportation Program reflects the effect of numerous policies and goals. Table 2 highlights examples of the significant policy goals and milestones developed to reduce emissions and reduce petroleum use in California. CEC staff consulted with other state agencies and considered state policies when developing this Investment Plan Update.

Table 2: Greenhouse Gas, Fuel, and Air Quality Goals and Milestones

Policy Origin	Objectives	Goals and Milestones
Assembly Bill 32	GHG Reduction	Reduce GHG emissions to 1990 levels by 2020
Senate Bill 32	GHG Reduction	Reduce GHG emissions to 40 percent below 1990 levels by 2030
Executive Order B-55-18	GHG Reduction	Achieve carbon neutrality by 2045
SB 100	Renewable Electricity	Achieve 60 percent renewable electricity sales by 2030 and 100 percent by 2045
Senate Bill 1020		Achieve 90 percent renewable or zero-carbon electricity sales by 2035, 95 percent by 2040, and 100 percent by 2045 Achieve 100 percent renewable or zero-carbon electricity procured by state agencies by 2035
Assembly Bill 1279	GHG Reduction	Reduce GHG emissions to 85 percent below 1990 levels and net zero GHG emissions by 2045
Low Carbon Fuel Standard	GHG Reduction	Reduce carbon intensity of transportation fuels in California by 20 percent by 2030 Increase zero-emission vehicle infrastructure
Clean Air Act; California State Implementation Plans	Air Quality	80 percent reduction in NOx by 2031
Senate Bill 1275; Executive Order B-16-2012; Executive Order B-48-18; Executive Order N-79-20	Increase Zero-Emission Vehicles	Infrastructure to accommodate 1 million electric vehicles by 2020 1 million zero-emission and near-zero-emission vehicles by 2023 1.5 million electric vehicles by 2025 250,000 electric vehicle chargers, including 10,000 DC fast chargers, and 200 hydrogen fueling stations by 2025 5 million zero-emission vehicles by 2030 100% of new passenger cars and truck sales will be ZEVs by 2035 100% of operating drayage trucks, off-road vehicles, and equipment will be ZEVs by 2035 100% of operating medium- and heavy-duty trucks and buses will be ZEVs, where feasible by 2045
Advanced Clean Cars II Regulations	Increase Zero-Emission Vehicles	100% of all new passenger cars sales in California to be zero-emission by 2035, including 35% by 2026 and 68% by 2030.
Innovative Clean Transit Regulation	Increase Zero-Emission Vehicles	100 percent of all new transit buses will be zero-emission by 2029; all operating buses will be zero-emission by 2040
Advanced Clean Trucks Regulation	Increase Zero-Emission Vehicles	Requires truck manufacturers to transition from diesel trucks and vans to zero-emission trucks beginning in 2024. By 2045, every new truck sold in California will be zero-emission.

Source: California Energy Commission

Federal Laws

Clean Air Act, State Implementation Plans, and Mobile Source Strategy

The federal Clean Air Act of 1970 (42 U.S.C. 7401) authorizes the U.S. Environmental Protection Agency (U.S. EPA) to establish National Ambient Air Quality Standards (NAAQS) for criteria air pollutants that are harmful to public health. To achieve these standards, the Clean Air Act directs states to develop State Implementation Plans (SIPs) that describe how an area will attain the NAAQS.

CARB reports that 28 million Californians live in communities that exceed the ozone and particulate matter standards set by the U.S. Environmental Protection Agency (EPA) and that the South Coast and San Joaquin Valley are the only two areas in the nation in extreme nonattainment for the federal ozone standard. The concepts described in the *Draft 2020 Mobile Source Strategy* intend to address these problems through transitioning the mobile fleet to zero-emission, where feasible.¹¹

Infrastructure Investment and Jobs Act

President Joseph R. Biden Jr. signed the \$1.2 trillion Infrastructure Investment and Jobs Act (IIJA) into law in November 2021 (Public Law 117-58). The law authorizes hundreds of billions of dollars in new investments in a wide array of infrastructure categories, including roads and bridges, water infrastructure, passenger rail, energy, and broadband internet. Of particular interest to the CEC are the new investments in clean transportation, clean energy generation, and grid resiliency.

Electric vehicle charging infrastructure will see significant new funding, with \$5 billion to accelerate EV infrastructure deployment nationally titled the National Electric Vehicle Infrastructure Funding Program (NEVI). California's share is expected to be \$384 million, allocated over five years. (The NEVI Program is discussed further below in the "Complementary Funding Programs" section.) An additional \$2.5 billion nationally is available on a competitive basis for EV and hydrogen infrastructure. The IIJA also allocates more than \$6 billion for lithium-ion battery materials processing and cell manufacturing.

Inflation Reduction Act of 2022

President Biden signed the Inflation Reduction Act (IRA) of 2022 into law in August 2022. The law will transform the U.S. energy sector in profound ways through substantial and transformative investments toward 40 percent nationwide GHG reductions by 2030. The act represents the biggest climate and clean energy legislation ever adopted in the United States. In addition to 10 years of support for clean technologies such as solar, wind, energy storage, and electric heat pumps, the legislation will provide an extensive and imperative boost in EV sales and domestic EV manufacturing.

Beginning in 2023, EV manufacturers will no longer face a 200,000-unit-per-manufacturer cap on eligibility for federal tax credits. This will help many popular domestic EV manufacturers

¹¹ [Draft 2020 Mobile Source Strategy](https://ww2.arb.ca.gov/sites/default/files/2020-11/Draft_2020_Mobile_Source_Strategy.pdf) is available at https://ww2.arb.ca.gov/sites/default/files/2020-11/Draft_2020_Mobile_Source_Strategy.pdf.

such as Tesla, Toyota, and GM, who have already passed this cap, as well as others nearing it. New fully electric vehicles will once again be eligible for a \$7,500 tax credit at the point of sale, \$4,000 for used electric vehicles, and \$40,000 for vehicles heavier than 14,000 pounds (starting in 2024).

There are two new components of the tax credit. Qualifying vehicles will receive up to \$3,750 for meeting each of the critical mineral and battery component sourcing requirements. The requirements are based on the vehicle having at least 40 percent of the critical minerals and 50 percent of the battery components from the United States or countries with a free trade agreement. This requirement could be a major boon to California manufacturers and suppliers in the zero-emission vehicle and battery space.

The legislation also provides alternative fuel vehicle refueling infrastructure tax credits while significantly enhancing the amount of the credit available in rural and low-income communities.

State Laws

Assembly Bill 32, Senate Bill 32, and the Greenhouse Gas Reduction Fund

Assembly Bill 32 (Núñez, Chapter 488, Statutes of 2006), also known as the Global Warming Solutions Act of 2006, required CARB to adopt a statewide GHG emission limit for 2020 equivalent to the statewide GHG emission levels in 1990. Senate Bill 32 (Pavley, Chapter 249, Statutes of 2016) amended the Global Warming Solutions Act of 2006 to expand the emission targets of AB 32. The amendment set a statewide GHG emission limit for 2030 equivalent to 40 percent below emission levels in 1990. AB 32 and SB 32 directed CARB to develop a climate change scoping plan to describe the approach that California will take to reduce GHG emissions and achieve the state's climate change goals.

CARB is preparing a 2022 update to its AB 32 Climate Change Scoping Plan. The update will address both the statutory 2030 target, as well as the path to achieving carbon neutrality by 2045.¹²

Senate Bill 350 and the Disadvantaged Communities Advisory Group

SB 350, the Clean Energy and Pollution Reduction Act of 2015, requires that the CPUC and the CEC create a Disadvantaged Communities Advisory Group (DACAG) to advise on programs proposed to achieve clean energy and pollution reduction.

At a June 21, 2019, meeting of the DACAG, Clean Transportation Program staff solicited feedback on the March 27, 2019, draft of the *2019–2020 Investment Plan Update* from the DACAG members.¹³ In response, the DACAG provided comments on the *2019–2020*

12 CARB, [2022 Scoping Plan Documents](https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/2022-scoping-plan-documents). Available at <https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/2022-scoping-plan-documents>.

13 [DACAG meeting materials](https://www.cpuc.ca.gov/DACAG/) available at <https://www.cpuc.ca.gov/DACAG/>. The [previous version of the 2019–2020 Investment Plan Update \(Lead Commissioner Report version\)](https://www.cpuc.ca.gov/DACAG/) is available at <https://efiling.energy.ca.gov/GetDocument.aspx?tn=227444>.

Investment Plan Update on June 28, 2019.¹⁴ These comments included recommendations on how the plan update can effectively benefit communities disproportionately burdened by pollution and socioeconomic challenges. On April 16, 2020, DACAG provided comments on the *2020–2023 Investment Plan Update*.¹⁵ Recommendations from both DACAG letters are included in Table 3, along with actions taken by the Clean Transportation Program to better address equity. Members of the Clean Transportation Program Advisory Committee, DACAG, and others will also have the opportunity to provide recommendations for the *2022–2023 Investment Plan Update*, as well as all future investment plans.

Table 3: Recommendations From the Disadvantaged Communities Advisory Group and Others, Along With the Actions Taken by the Energy Commission

Recommendations From DACAG	Actions Taken by CEC
Moving 100 percent of program funding toward zero-emission fuels.	The Clean Transportation Program is supporting the emerging revolution in the transportation sector with significant investments in zero-emission vehicle infrastructure (both battery-electric and hydrogen fuel cell). Relative to previous Investment Plans, recent allocations have shifted significantly toward zero-emission fuels and technologies relative to non-zero-emission alternatives.
Funding projects exclusively in and benefiting disadvantaged communities.	Committed to seeking to award at least 50 percent of funding to support projects benefitting low-income and disadvantaged communities for the remainder of the Clean Transportation program. Working to better define, measure, track, and increase community benefits from the Clean Transportation Program.
Expanding the definition of disadvantaged communities beyond the CalEnviroScreen definition.	Expanded solicitation eligibility and statutory change to Clean Transportation Program to explicitly include California Native American tribes. Through the CEC’s CALeVIP program, some projects will require 25% of funds be spent in unincorporated towns and 50% of funds be spent in low-income or disadvantaged communities or both.
Increasing transparency and tracking expanded metrics to measure how projects “benefit” disadvantaged communities.	CEC staff continues to work with the CEC’s Public Advisor’s Office to inform and receive input from DACAG during solicitation development. The CEC is also expanding its focus and methods to track and increase 1) benefits for underrepresented communities and 2) air quality impacts and associated health outcomes from the Clean Transportation Program

14 SB 350 Disadvantaged Communities Advisory Group. June 28, 2019. [“SB 350 Disadvantaged Communities Advisory Group Comments on 2019-2020 Investment Plan Update.”](https://efiling.energy.ca.gov/GetDocument.aspx?tn=228878&DocumentContentId=60238) Submitted to Docket 18-ALT-01, TN# 228878. Available at <https://efiling.energy.ca.gov/GetDocument.aspx?tn=228878&DocumentContentId=60238>.

15 SB 350 Disadvantaged Communities Advisory Group, [“SB 350 Disadvantaged Communities Advisory Group comments on 2020-2023 Investment Plan Update.”](https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=19-ALT-01) written on April 16, 2020, and submitted April 30, 2020, to Docket 19-ALT-01, TN# 232879. Available at <https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=19-ALT-01>.

<p>Prioritizing and investing in community outreach and engagement.</p>	<p>1) Explicit inclusion of scoring criteria for various funding solicitations that emphasize location in disadvantaged and low-income communities and development of an equity outreach and engagement plan¹⁶ and 2) established the IDEAL Communities Partnership focused on community engagement activities such as technical assistance, ZEV Community Survey and Outreach Forum, and ZEV Student Ambassador Program in partnership with the Foundation for California Community Colleges. This is in addition to continued engagement with the DACAG and its transportation experts.</p>
<p>Continued investments in workforce training and development.</p>	<p>Dedicated Clean Transportation Program funding allocations that will expand workforce training and development including community-based workforce training and development projects in and near ZEV deployments in priority communities.</p>
<p>Expanding the Clean Transportation Program Advisory Committee to increase representation of program beneficiaries, environmental justice communities, rural communities, tribes, and others.</p>	<p>Reconstituted and diversified the Clean Transportation Program Advisory Committee in 2020 to better reflect California communities and provide increased representation of program beneficiaries.</p>
<p>Prioritize investments in the medium- and heavy-duty vehicle categories and target disadvantaged communities.</p>	<p>Funding allocations for these activities have increased to meet the growing needs of charging and hydrogen fueling infrastructure for medium- and heavy-duty ZEVs and improve air quality, especially in low-income and disadvantaged communities.</p>

Source: California Energy Commission

Assembly Bill 841: Electric Vehicle Infrastructure Training Program

The Electric Vehicle Infrastructure Training Program (EVITP) website states that it is “a collaboration of industry stakeholders including automakers, electric vehicle supply equipment (EVSE) manufacturers, educational institutions, utility companies, electric industry professionals, and key EV industry stakeholders.”¹⁷ Assembly Bill 841 (Ting, Chapter 372, Statutes of 2020) requires that the CPUC, CEC and CARB shall require that EV charging infrastructure located on the customer side of the electrical meter that is funded by those state entities be installed by a contractor with the appropriate license classification and at least one electrician on each crew who holds an EVITP certification. As part of AB 841, the CEC, in consultation with the CPUC, is tasked with conducting joint public workshops to determine if the EVITP curriculum and testing should be supplemented to include updated or additional topics necessary to ensure safe installation of charging infrastructure. The CEC, CARB, and CPUC held a public workshop April 16, 2021, and solicited public comments. The CEC will periodically review whether the EVITP curriculum should be supplemented, and EVITP will have six months to implement the supplemented curriculum.

16 One example: “[GFO-20-606 Zero-Emission Drayage Truck and Infrastructure Pilot Project](https://web.archive.org/web/20221028175406/https://www.energy.ca.gov/solicitations/2020-11/gfo-20-606-zero-emission-drayage-truck-and-infrastructure-pilot-project).” Archived page available at <https://web.archive.org/web/20221028175406/https://www.energy.ca.gov/solicitations/2020-11/gfo-20-606-zero-emission-drayage-truck-and-infrastructure-pilot-project>.

17 “[Electric Vehicle Infrastructure Training Program](https://evitp.org/about-us/)” is available at <https://evitp.org/about-us/>.

Senate Bill 643: Fuel Cell Electric Vehicle Fueling Infrastructure and Hydrogen Production Statewide Assessment

Senate Bill 643 (Archuleta, Chapter 646, Statutes of 2021) requires the CEC, in consultation with CARB and the CPUC, to prepare a statewide assessment of the fuel cell electric vehicle fueling infrastructure and fuel production needed to support the adoption of zero-emission trucks, buses, and off-road vehicles. The CEC expects to complete the inaugural version of this report by the second half of 2023.

Assembly Bill 2061: Charging Station Reliability and Uptime

Ensuring a predictable and reliable charging experience will be critical to encouraging wider adoption of electric vehicles. The CEC held a workshop on this topic in March 2022, focused on (1) how to define and measure reliability, and (2) how to set reliability standards for charging infrastructure funded by the CEC.¹⁸

Assembly Bill 2061 (Ting, Chapter 345, Statutes of 2022) subsequently requires the CEC, in consultation with the CPUC, to develop uptime recordkeeping and reporting standards for charging stations by January 1, 2024. The CEC will assess the uptime of publicly funded charging station infrastructure and update these assessments every two years, beginning January 1, 2025. The law also authorizes the CEC to adopt tools to increase charging station uptime, including requirements and incentives for uptime and operations and maintenance.

Executive Orders (EO)

EO B-55-18: Carbon Neutrality

EO B-55-18 established a goal to achieve carbon neutrality as soon as possible and no later than 2045. The executive order also requires the state to achieve and maintain net negative greenhouse gas emissions thereafter.

EO B-16-12, B-48-18, and N-79-20: Zero-Emission Vehicles

EO B-16-12 set a target of 1.5 million zero-emission vehicles on the road by 2025 and tasked various state agencies with specific actions needed to support this goal.¹⁹ Subsequently, in January 2018, EO B-48-18 set an expanded target of 5 million zero-emission vehicles on the road by 2030, as well as a network of 200 hydrogen fueling stations and 250,000 electric vehicle charging stations, including 10,000 DC fast chargers, installed or constructed by 2025.²⁰ These executive orders have been part of the guidance for the electric vehicle charging and hydrogen fueling infrastructure investments of the Clean Transportation Program.

18 CEC. March 11, 2022. "[Electric Vehicle Charging Infrastructure Reliability Workshop](https://www.energy.ca.gov/event/workshop/2022-03/electric-vehicle-charging-infrastructure-reliability-workshop)." Materials and recording are available at <https://www.energy.ca.gov/event/workshop/2022-03/electric-vehicle-charging-infrastructure-reliability-workshop>

19 [Executive Order B-16-12](https://www.ca.gov/archive/gov39/2012/03/23/news17463/index.html) available at <https://www.ca.gov/archive/gov39/2012/03/23/news17463/index.html>.

20 [Executive Order B-48-18](https://www.ca.gov/archive/gov39/2018/01/26/governor-brown-takes-action-to-increase-zero-emission-vehicles-fund-new-climate-investments/index.html) available at <https://www.ca.gov/archive/gov39/2018/01/26/governor-brown-takes-action-to-increase-zero-emission-vehicles-fund-new-climate-investments/index.html>.

Executive Order N-79-20, signed by Governor Gavin Newsom on September 23, 2020, provides even more ambitious goals and requirements. These include 100 percent of in-state sales of passenger cars and trucks being ZEVs by 2035; 100 percent of operating medium- and heavy-duty vehicles being ZEVs by 2045, where feasible; and 100 percent of drayage trucks and off-road vehicles and equipment being ZEVs by 2035. The order also tasks CEC with providing an updated assessment of the infrastructure needed to support this level of ZEV adoption.

To meet the ambitious statewide targets set in Executive Order N-79-20, Governor Newsom tasked GO-Biz with collaborating with several agencies and partners to shepherd the administration's ZEV Market Development Strategy. The *California Zero-Emission Vehicle Market Development Strategy*²¹ was published in February 2021 and is part of the ongoing effort to turn California's 100 percent ZEV vision into reality. The strategy is centered around four market pillars: vehicles, infrastructure, end users, and workforce. The pillars must all be fully supported and are built upon a foundation of five core principles: equity in every decision, embracing all zero-emission pathways, collective problem-solving, public actions driving greater private investment, and designing for system resilience and adaptability. GO-Biz continues to work with the CEC, CARB, and other state agencies through this process to determine what actions can be taken to meet ZEV market goals.²²

Regulations by the California Air Resources Board

Low Carbon Fuel Standard

CARB adopted the Low Carbon Fuel Standard (LCFS) regulation in April 2009 with a goal of reducing the overall carbon intensity of fuels within the transportation sector by 20 percent by 2030. The LCFS sets a carbon intensity standard (or benchmark) that declines each year. Providers of low-carbon fuels earn credits under the LCFS by producing fuels with a carbon intensity below the annual carbon intensity standard.

LCFS credits and deficits are denominated in metric tons of carbon dioxide equivalent (CO_{2e}). Credit prices have ranging from a low of \$22 in May 2015 to a high of \$206 in February 2020, reaching all-time highs in 2019 and 2020.²³ Prices remained near \$200 through October 2021.

In September 2018, CARB adopted changes to the LCFS regulations that will benefit ZEVs and ZEV infrastructure. The amendments allow publicly accessible hydrogen fueling stations to earn hydrogen fueling infrastructure credits based on the capacity of the station. The amendments also provide credits for DC fast-charging equipment based on the power rating of the equipment. On the vehicle side, the amendments restructure the approach for providing

21 The [California Zero-Emission Vehicle Market Development Strategy](https://static.business.ca.gov/wp-content/uploads/2021/02/ZEV_Strategy_Feb2021.pdf) is available at https://static.business.ca.gov/wp-content/uploads/2021/02/ZEV_Strategy_Feb2021.pdf.

22 [Zero-Emission Vehicle Market Development Strategy](https://business.ca.gov/industries/zero-emission-vehicles/zev-strategy/) is available at <https://business.ca.gov/industries/zero-emission-vehicles/zev-strategy/>.

23 California Air Resources Board. November 2021. [LCFS Monthly Credit Price and Transaction Volumes Spreadsheet](https://www.arb.ca.gov/fuels/lcfs/dashboard/creditpriceserieswithoutargusopis.xlsx). Available at <https://www.arb.ca.gov/fuels/lcfs/dashboard/creditpriceserieswithoutargusopis.xlsx>.

PEV rebates at the time of purchase, funded through LCFS credit proceeds. The vehicle program is known as the “Clean Fuel Reward (CFR).”

Zero-Emission Vehicle Regulation

CARB’s Advanced Clean Cars program consists of a suite of regulations for reducing emissions from the state’s light-duty fleet. One element of the Advanced Clean Cars program is the ZEV Regulation, which requires auto manufacturers to offer for sale specific numbers of the cleanest cars available, including full battery-electric vehicles, hydrogen fuel cell electric vehicles, and plug-in hybrid electric vehicles. On August 25, 2022, CARB approved ZEV regulations under the Advanced Clean Cars II rulemaking, requiring 100 percent of new car sales in California to be ZEVs by 2035. The yearly targets of the plan would require 35 percent of new sales be ZEVs by 2026, 68 percent by 2030, and 100 percent by 2035.

Innovative Clean Transit Regulation

The Innovative Clean Transit Regulation²⁴ was adopted in December 2018 to replace the Fleet Rule for Transit Agencies. The regulation requires all public transit agencies to transition gradually to a 100-percent zero-emission bus fleet and encourages them to provide innovative first- and last-mile connectivity and improved mobility for transit riders.

Advanced Clean Trucks

Within California, trucks are the largest source of air pollution among all vehicles, responsible for 70 percent of the smog-causing pollution and 80 percent of carcinogenic diesel soot, despite numbering only 2 million among the 30 million registered vehicles in the state. To address this sector, on June 25, 2020, CARB adopted a first-in-the-world rule requiring truck manufacturers to transition trucks and vans toward zero-emission technologies beginning in 2024.²⁵

Advanced Clean Fleets

CARB is tasked with cleaning up the existing combustion fleet and accelerating the zero-emission market by developing a medium- and heavy-duty zero-emission fleet regulation. The goal of the Advanced Clean Fleets regulation is to achieve a California zero-emission truck and bus fleet by 2045, everywhere feasible and significantly earlier for certain market segments such as last-mile delivery and drayage applications. The initial focus would be on high-priority fleets with vehicles that are suitable for early electrification, their subhaulers, and entities that hire them. This effort would accelerate the number of medium- and heavy-duty zero-emission vehicle purchases to achieve a full transition to zero-emission vehicles in California as soon as possible.

24 California Air Resources Board. “[Innovative Clean Transit](https://ww2.arb.ca.gov/our-work/programs/innovative-clean-transit/about).” Available at <https://ww2.arb.ca.gov/our-work/programs/innovative-clean-transit/about>.

25 California Air Resources Board. June 25, 2020. “[California Takes Bold Step to Reduce Truck Pollution](https://ww2.arb.ca.gov/news/california-takes-bold-step-reduce-truck-pollution).” Press release. Available at <https://ww2.arb.ca.gov/news/california-takes-bold-step-reduce-truck-pollution>.

Complementary Funding Programs

California Energy Commission's School Bus Replacement Program

In the November 2012 California general election, voters approved Proposition 39 to improve energy efficiency and expand clean energy generation in schools and community colleges. Senate Bill 110 (Committee on Budget and Fiscal Review, Chapter 55, Statutes of 2017) allocated funds from the implementation of Proposition 39 to improve energy efficiency at California schools. The energy efficiency measures in SB 110 include one-time funding of \$75 million for the retrofit or replacement of school buses.

The CEC administers this funding, and priority is given to school districts operating the oldest and most polluting diesel school buses, as well as to school buses operating in disadvantaged and low-income communities. The \$75 million in funding provided by SB 110 is being used exclusively for the purchase of battery-electric school buses, and this amount is being supplemented with more than \$14 million in Clean Transportation Program funds to provide the necessary charging infrastructure to operate the buses.

California Air Resources Board Funding Programs

In addition to the CEC's Clean Transportation Program, AB 118 also created the Air Quality Improvement Program (AQIP), which CARB administers. The CEC and CARB have complementary responsibilities, with CARB serving as the lead agency on ZEV deployment and the CEC as the lead agency on ZEV fueling infrastructure and vehicle-grid integration. Coordination between agencies continues to be paramount to ensure strategic use of limited state funds. Since 2009, AQIP has provided deployment incentives for light-duty electric vehicles through the Clean Vehicle Rebate Project (CVRP); deployment incentives for alternative medium- and heavy-duty vehicles through the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP); the Truck Loan Assistance Program, which helps small business truckers secure financing for newer trucks to meet compliance deadlines; as well as funding for other advanced emission-reduction technologies for vehicles and equipment.

CARB also distributes Greenhouse Gas Reduction Fund (GGRF) capital through its Low Carbon Transportation Investments. The Legislature appropriated more than \$2.5 billion to CARB for Low Carbon Transportation Investments since 2013. To support the rapidly growing zero-emission vehicle market and support additional investments focused on equity, several funding sources are helping support Low Carbon Transportation Investments.

In July 2022, CARB released the draft *FY 2022–23 Funding Plan for Clean Transportation Incentives* that included more than \$2.9 billion in incentive funding from the GGRF and the general fund, as well as \$28.64 million in clean transportation investments from AQIP. In September 2022, the final budget appropriation was revised to \$2.6 billion from GGRF, the general fund, and AQIP. A detailed breakdown of these investments is shown in Table 4 below.

Table 4: FY 2022–2023 CARB Clean Transportation Incentives Allocations (in Millions)

Project Category	Greenhouse Gas Emissions Reduction Fund (GGRF)	General Fund	Proposition 98 General Fund	Air Quality Improvement Fund
Clean Transportation Equity Programs Established Under SB 1275				
Vehicle Purchase Incentive Programs	\$111	\$215*		
Clean Mobility Investments	\$15	\$40*		
Heavy-Duty Zero-Emission				
Drayage Trucks, School/Transit Buses		\$362	\$1,125	
Clean Trucks, Buses, and Off-Road Freight	\$578			
Emerging Opportunities	\$42	\$93*		
AQIP				\$28.64

Source: California Air Resources Board.²⁶

CARB released the proposed FY 2022–2023 Funding Plan on October 12, 2022, and on November 17, 2022, it was approved by the California Air Resources Board.

Investor-Owned Utility Investments in Electric Vehicle Charging Infrastructure

In 2014, the CPUC adopted Decision 14-12-079 to allow consideration of utility ownership of electric vehicle charging stations and infrastructure on a case-specific basis. Subsequently, the CPUC approved infrastructure pilot programs for Pacific Gas and Electric Company (PG&E),²⁷ San Diego Gas & Electric Company (SDG&E),²⁸ and Southern California Edison (SCE)²⁹ to

26 CARB. July 2022. Draft [Fiscal Year 2022–23 Funding Plan for Clean Transportation Incentives](https://www2.arb.ca.gov/sites/default/files/2022-07/fy2223_draft_funding_plan_accessible.pdf). Available at https://www2.arb.ca.gov/sites/default/files/2022-07/fy2223_draft_funding_plan_accessible.pdf.

27 California Public Utilities Commission. December 2016. [Decision \(D.\) 16-12-065](https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M171/K539/171539218.PDF). Available at <https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M171/K539/171539218.PDF>.

28 California Public Utilities Commission. January 2016. [D.16-01-045](https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M158/K241/158241020.PDF). Available at <https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M158/K241/158241020.PDF>.

29 California Public Utilities Commission. January 2016. [D.16-01-023](https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M157/K835/157835660.PDF). Available at <https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M157/K835/157835660.PDF>.

install a total of up to 12,500 charging stations with initial budgets up to \$197 million. In December 2018, the CPUC approved \$22 million in bridge funding for the SCE Charge Ready Pilot to build at least 1,000 more Level 2 chargers. In August 2020, the CPUC approved SCE's Charge Ready 2 infrastructure program, with a \$436 million budget that will fund about 38,000 electric vehicle chargers in the utility's service territory. In April 2021, the CPUC approved SDG&E's Power Your Drive Extension Program for \$43.5 million that will fund nearly 2,000 electric vehicle chargers.

Much of the CPUC's current ZEV work is focused on Senate Bill 350 implementation. The CPUC directed the six investor-owned electric utilities under the CPUC's jurisdiction to propose portfolios of transportation electrification programs and investments. Under this array of programs, the CPUC reports that the IOUs collectively hold \$1.48 billion in authorized unspent funding. The CPUC's current transportation electrification funding policy will last through 2024, after which it may implement a transportation electrification rebate program not through the IOUs. This action is proposed and not yet final.

Starting in 2022, after the passage of AB 841, utility-side EV infrastructure will be funded by ratepayers under the IOUs' general rate case proceedings instead of the aforementioned programs. These changes, formalized under Rule 29 for PG&E and SCE and Rule 45 for SDG&E, provide greater consistency and certainty for cost recovery of utility-side infrastructure upgrades in support of EV charging.

Volkswagen Diesel Emissions Settlement

California received about \$423 million from the Volkswagen Environmental Mitigation Trust for projects to reduce the lifetime excess oxides of nitrogen (NO_x) emissions caused by illegal devices installed in certain 2.0- and 3.0-liter diesel vehicles to defeat emissions tests. In May 2018, CARB approved a Beneficiary Mitigation Plan outlining how these funds will be spent.³⁰ In addition, Volkswagen has an \$800 million ZEV Investment Commitment in the state and must offer and sell additional battery-electric vehicle models in California between 2019 and 2025.

California's Beneficiary Mitigation Plan includes five funding categories: \$130 million for zero-emission transit, school, and shuttle buses; \$90 million for zero-emission Class 8 freight and drayage trucks; \$70 million for zero-emission freight and marine projects; \$60 million for combustion freight and marine projects; and \$10 million for ZEV infrastructure for light-duty vehicles. California's three largest air districts are administering these projects statewide. The first installment from each project category has been made available starting with the release of zero-emission bus money in fall 2019.

Volkswagen's \$800 million ZEV Investment Commitment will occur over a 10-year period. Eligible projects include the design, planning, construction, and operation and maintenance of qualified fueling infrastructure for ZEVs; brand-neutral education and public outreach to increase consumer awareness of ZEVs; programs or actions to increase public exposure or

³⁰ California Air Resources Board. June 2018. [Beneficiary Mitigation Plan for the Volkswagen Environmental Mitigation Trust](https://ww2.arb.ca.gov/resources/documents/californias-beneficiary-mitigation-plan). Available at <https://ww2.arb.ca.gov/resources/documents/californias-beneficiary-mitigation-plan>.

access or both to ZEVs without requiring a consumer purchase or lease (for example, programs for car-share and ride-hail services); and two “Green City” initiatives that may include the operation of ZEV car-sharing services, transit applications, and freight transport projects. Volkswagen has submitted the first three of four 30-month, \$200 million ZEV investment plans to CARB for approval. In June 2021, CARB approved Electrify America’s third 30-month ZEV Investment Plan, which began January 1, 2022.

National Electric Vehicle Infrastructure (NEVI) Funding Program

Established under the aforementioned IIJA, NEVI is expected to provide \$384 million over five years to expand California’s network of charging stations. The CEC is collaborating with Caltrans, the lead agency for California, to administer the funds.

A primary policy objective for NEVI is to establish a coast-to-coast network of 500,000 modern, high-powered DC fast chargers along the nation’s freeways and highways to enable long-distance travel in electric vehicles. Another key policy objective is to extend the benefits of this new charging network to disadvantaged, rural, and tribal communities under the Justice40 framework, which requires that 40 percent of program benefits accrue to disadvantaged communities. Additional NEVI policy objectives are to enhance ZEV access to national parks and federal lands and provide station connectivity along freeways and highways continuing into adjacent states.

On August 1, 2022, the CEC and Caltrans released California’s Deployment Plan for the National Electric Vehicle Infrastructure Program, and on September 14, 2022, the Biden-Harris administration approved the first 35 state plans, including California’s plan. To maximize NEVI investments and benefits, California’s initial deployment plan includes ongoing engagement and outreach, including labor, to shape the continued development and refinement of plan elements. The initial deployment plan will focus on investments in light-duty vehicle charging infrastructure and consider projects that can also accommodate medium- and heavy-duty charging infrastructure. Subsequent plans will reevaluate NEVI investments across segments and continue to evaluate the NEVI funding in the context of the broader set of state and federal investments in light-duty, medium-duty, and heavy-duty vehicle infrastructure. The deployment plan will be updated each year to reflect progress of the previous year, identify new challenges and opportunities, highlight future deployment plans, and ensure alignment with California’s EV charging infrastructure planning efforts, such as the state’s ZIP. California is committed to reviewing the outcomes from the deployment plan to determine best practices, ensure that the plan meets the program guidelines, and confirm that the plan is accomplishing the state’s goals for a connected network of EV chargers.

California has led the way in preparing for transportation electrification and is proof to other states and countries that decarbonization of the transportation sector is not just necessary to address the climate crisis, but also possible. This has been a collaborative effort with contributions from a range of stakeholders, including public, private, ratepayer, and federal investments. California agencies and utility customers have made substantial investments to prepare for transportation electrification. Additional grid capacity investments will be needed to ensure broad and equitable access for everyone. As such, utilities should be eligible for federal funding to support distribution grid and substation upgrades to meet climate goals, improve

local air quality, and ease rate pressures. These investments will be needed in addition to critical site level zero-emission vehicle infrastructure investments. Dedicated site level funds, such as NEVI, should remain for their intended purpose. However, complementary federal funding should be accessible for distribution upgrades. Further, federal investments will be an important funding source to support microgrids and resiliency as regional heat storms and the impacts of the climate crisis become annual events.

Alternative Fuel Refueling Property Credit

The Inflation Reduction Act of 2022, signed into law by President Biden in August 2022, extends and expands a federal tax credit for alternative fuel infrastructure, including charging equipment and hydrogen refueling equipment. The law extended the alternative fuel infrastructure tax credit of up to 30 percent of the equipment cost, to a new maximum of \$100,000 (up from \$30,000) for equipment subject to depreciation, or \$1,000 in any other case. The credited equipment must be installed in a low-income or nonurban community. The amount of the credit can also be significantly increased under certain prevailing wage and apprenticeship circumstances.

CHAPTER 3:

Funding Allocations for 2022–2023

The funding allocations for FY 2022–2023, and the projected funding allocations for the subsequent fiscal year, are outlined in Table 5. For FY 2022–2023, \$95.2 million of Clean Transportation Program funds may be available for the purposes described in this Investment Plan Update. If a different amount of funding is available, the allocations in this document may be amended either before or after final adoption.

Table 5 shows the program funding allocations for FY 2022–2023, the projected funding allocations for the remainder of the Clean Transportation Program, as well as the recent and anticipated general fund allocations under the Budget Act of 2021 and Budget Act of 2022. The additional funds will help close funding gaps in infrastructure deployment, accelerate charging and hydrogen fueling station deployment, and promote in-state ZEV and ZEV-related manufacturing, including infrastructure manufacturing and ZEV component manufacturing such as EV batteries.

The investments will help the markets for zero-emission vehicles and infrastructure grow to scale and, more importantly, serve as a foundation for an equitable and sustainable economic recovery by drawing private investments to California and creating jobs in manufacturing, construction, and engineering. The increased funds will create jobs and invest in ZEV refueling infrastructure for passenger vehicles, big rigs, port equipment, transit, and school buses while supporting more domestic ZEV manufacturing. These investments will allow California to lead the nation and pave the way to a cleaner, healthier transportation system.

Table 5 shows combined allocations of just over \$900 million to support light-duty passenger vehicle charging (first three rows) and \$1.7 billion to support medium- and heavy-duty ZEV infrastructure (next six rows). Investments in medium- and heavy-duty ZEV infrastructure reflect the need to transition the most polluting vehicles swiftly toward zero-emission technologies in the most sensitive regions of the state.

Table 5: Investment Plan Allocations for FY 2022–2023 and Beyond, Including Clean Transportation Program (Program) and General Funds (in Millions)

Category	Funding Source	2022–2023	2023–2024 1/ 2/ 3/	2024–2025 1/ 3/	2025–2026 1/ 3/
Light-Duty Electric Vehicle Charging Infrastructure*	Program	\$30.1	\$13.8	-	-
Light-Duty Electric Vehicle Charging Infrastructure	General Fund	\$218.5	\$210.0	\$90.0	\$40.0
Equitable At-home Charging	General Fund	\$19.0	\$160.0	\$80.0	\$40.0
Medium- and Heavy-Duty Zero-Emission Vehicle (ZEV) Infrastructure	Program	\$30.1	\$13.8	-	-
Drayage Truck ZEV Infrastructure	General Fund	\$171.95	\$185.0	\$49.0	-
Transit Bus ZEV Infrastructure	General Fund	\$28.50	\$90.0	\$50.0	\$30.0
School Bus ZEV Infrastructure	General Fund	\$389.25	\$15.0	-	-
Clean Trucks, Buses and Off-Road Equipment ZEV Infrastructure	General Fund	\$94.05	\$315.0	\$31.0	\$25.0
Port ZEV Infrastructure	General Fund	-	\$40.0	\$80.0	\$30.0
Emerging Opportunities	General Fund	\$51.3	\$35.0	\$11.0	-
Hydrogen Fueling Infrastructure	Program	\$20.0	\$10.0	-	-
Hydrogen Fueling Infrastructure	General Fund	-	\$20.0	\$20.0	\$20.0
Zero- and Near Zero-Carbon Fuel Production and Supply	Program	\$10.0	\$5.0	-	-
ZEV Manufacturing	General Fund	\$118.75	-	-	-
Workforce Training and Development	Program	\$5.0	\$5.0	-	-
	Total Program	\$95.2	\$47.6		
	Total General Fund	\$1,091.3	\$1,070	\$411	\$185

Source: California Energy Commission. The FY 2022–2023 funding amount from the general fund was reduced by \$37.7 million, which is the maximum administrative costs the CEC is authorized to incur associated with that funding. An additional \$18.75 million may be reallocated from FY 2022–2023 funding for administrative costs to support the Proposition 98 School Bus Program. The CEC reserves the ability to use unused administrative costs to fund additional projects within each funding allocation. *Does not include \$384 million over five years under federal NEVI program for charging along highways and interstates.

- 1/ Subject to future Budget Act appropriations.
- 2/ The Clean Transportation Program is authorized through December 31, 2023; therefore, only half of the revenues/appropriations are anticipated in this fiscal year.
- 3/ The anticipated general fund amounts in FY 2023–2024 through FY 2025–2026 have not been reduced to reflect administrative costs. Those fiscal year allocations will be reduced in accordance with direction in the associated Budget Act.

CHAPTER 4:

Zero-Emission Vehicle Infrastructure

The mass adoption of zero-emission vehicles (ZEVs), including plug-in electric vehicles (PEVs) and fuel cell electric vehicles (FCEVs), is critical to California’s decarbonization goals, air quality standards goals, and petroleum reduction goals. California has made significant progress toward advancing the adoption of ZEVs by surpassing the 1 million PEVs sold milestone at the end of 2021.

The CEC is the lead agency on ZEV infrastructure investment and analysis. The CEC’s investments will catalyze the development and deployment of economically and environmentally sustainable ZEV infrastructure, with a focus on gaps in access for California’s most impacted communities. The CEC investments will enable and leverage private sector investment in ZEV infrastructure.

Light-Duty Electric Vehicle Charging Infrastructure

Quantifying Charging Infrastructure for Light-Duty Vehicles

To track progress toward the state’s 2025 goal, the CEC conducts quarterly surveys, starting in July 2020, to obtain combined counts of public- and shared-access chargers within California. Table 6 below provides estimates of the existing number of public or shared Level 2 and DC fast chargers within the state as of December 2021. The table also provides estimates of the number of chargers to be installed from allocated or upcoming Clean Transportation Program funds, as well as the number of connectors to be installed based on announced plans from other major funding programs, which are tracked by the CEC. This estimate anticipates the additional funding from the ZEV Package under Senate Bill 129, which provides light-duty electric vehicle charging infrastructure funding with the purpose of reducing the shortfall to the goal, to go primarily toward Level 2 charger deployment to meet the state’s 2025 charger goal.

Table 6: Progress Toward 250,000 Chargers by 2025

Category	Level 2 Chargers	DC Fast Chargers
Existing Chargers (Estimated)*	71,449	8,528
Anticipated Chargers for Which Funding Has Been Allocated (including anticipated funding from Clean Transportation Program)**	195,080	10,323
Total	266,529	18,851
2025 Goal (Executive Order B-48-18)	240,000	10,000
Gap From Goal	0	0
AB 2127 Report's 2030 Estimate of Charging Needs	1,126,855	37,461
Gap from 2030 Estimates	860,326	18,610

Source: California Energy Commission. Analysis as of March 2022. *Existing charging ports estimated based on available data from U.S. Department of Energy's Alternative Fuels Data Center surveys to electric vehicle network service providers, utilities, and public agencies in California. Not included in this table are an estimated 629 statewide public or shared-private Level 1 chargers. **Derived from public presentations and statements by utilities, California Public Utilities Commission, CARB, other entities, and the CEC. Includes PG&E's application for EV Charge 2 under CPUC review. Includes funding from State Budget Act of 2021 and State Budget Act of 2022 intended to close the gaps for both Level 2 and DC Fast Chargers; the estimated number of chargers could change as solicitations are released. Estimates are subject to change as solicitations are released.

Light-Duty Vehicle Findings From the AB 2127 Electric Vehicle Charging Infrastructure Assessment

Assembly Bill 2127 (Ting, Chapter 365, Statutes of 2018) requires the CEC, working with CARB and the CPUC, to prepare and update biennially a statewide assessment of the electric vehicle charging infrastructure. The assessment must focus on the number and types of charging infrastructure needed to support levels of electric vehicle adoption required for the state to meet its goals of deploying at least 5 million ZEVs on California roads by 2030. Executive Order N-79-20 directs the CEC to update the AB 2127 statewide assessment to evaluate the ZEV infrastructure needed to meet the new targets.

The inaugural *Assembly Bill 2127 Electric Vehicle Charging Infrastructure Assessment Analyzing Charging Needs to Support Zero-Emission Vehicles in 2030*³¹ (AB 2127 Report) was adopted by the CEC in June 2021.

To quantify the number of charging stations needed to service the growing population of light-duty PEVs in California, the CEC partnered with the National Renewable Energy Laboratory (NREL) and the University of California, Davis, to develop three quantitative analysis tools covering various vehicle classes, use cases, and local conditions: Electric Vehicle Infrastructure

31 Alexander, Matt, Noel Crisostomo, Wendell Krell, Jeffrey Lu, and Raja Ramesh. July 2021. [Assembly Bill 2127 Electric Vehicle Charging Infrastructure Assessment: Analyzing Charging Needs to Support Zero-Emission Vehicles in 2030 – Commission Report. California Energy Commission](https://www.energy.ca.gov/programs-and-topics/programs/electric-vehicle-charging-infrastructure-assessment-ab-2127). Publication Number: CEC-600-2021-001-CMR. Available at <https://www.energy.ca.gov/programs-and-topics/programs/electric-vehicle-charging-infrastructure-assessment-ab-2127>.

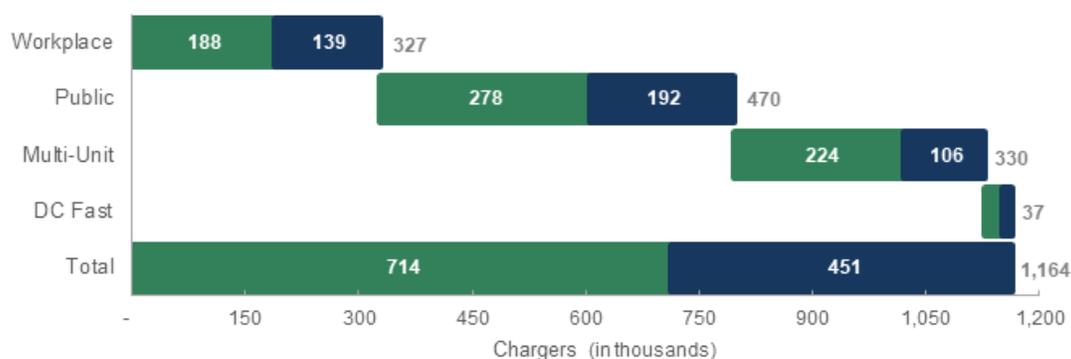
Projections 2 (EVI-Pro 2), Electric Vehicle Infrastructure for Road Trips (EVI-RoadTrip), and Widespread Infrastructure for Ride-hailing EV Deployment (WIRED).

EVI-Pro, developed in collaboration with NREL, is a planning tool that helps determine the number, locations, and types of chargers required to meet the local travel and charging needs of California's light-duty PEV drivers. The original EVI-Pro 1 analysis formed the basis for the Executive Order B-48-18 target of 250,000 chargers statewide by 2025. An update to the model, EVI-Pro 2, expands infrastructure projections to support 5 million ZEVs and beyond by 2030 and incorporates evolving technology and market conditions. In addition to the 5 million ZEVs by 2030 scenario, the *AB 2127 Report* included a scenario using CARB's *Draft 2020 Mobile Source Strategy*. The report projected nearly 8 million ZEVs by 2030, which, at that time, was an estimate of the trajectory needed to achieve the Executive Order N-79-20 target of 100 percent light-duty ZEV sales by 2035.

Separate from EVI-Pro 2, the EVI-RoadTrip model, also developed in collaboration with NREL, projects the number and locations of DC fast chargers needed specifically to enable long-distance (100+ mile) interregional road trips for BEVs within and across California's borders. Moreover, the WIRED model, developed by UC Davis, assesses the need for charging infrastructure demanded by Transportation Network Company (TNC) vehicles, initially in three major California regions: San Diego County, the Greater Los Angeles Region, and the San Francisco Bay Area.

For passenger vehicle charging in 2030, combining the results of these three models, the *AB 2127 Report* projects that nearly 1.2 million public and shared-private chargers will be needed to support 8 million ZEVs. Figure 3 shows the number and types of chargers estimated in the report.

Figure 3: Projected 2030 Charger Counts to Support 5 Million and 8 Million Light-Duty Zero-Emission Vehicles



Models project that California will need more than 700,000 shared-private and public chargers in 2030 to support 5 million ZEVs as called for in AB 2127 and nearly 1.2 million chargers to support 8 million ZEVs by 2030. Counts for chargers at workplaces, public destinations, and multiunit dwellings generally indicate the number of Level 2 chargers needed. In some cases, Level 1 chargers may be sufficient at select multiunit dwellings. These values do not include chargers at single-family homes.

Source: CEC and National Renewable Energy Laboratory.

In addition to providing quantitative discussions of charging infrastructure needs, the *AB 2127 Report* provides a qualitative review of charging infrastructure needs.³² Highlights of such qualitative findings include the following:

- North American market players are generally moving toward a unified DC fast charging standard known as the “Combined Charging System (CCS).” There are three connectors (CCS, CHAdeMO, and Tesla) used for DC fast charging in North America today. The movement toward a single connector type will reduce network costs and maximize convenience.
- Given the additional load PEVs represent for the electric grid, vehicle–grid integration will be a valuable tool to support grid reliability and ensure that drivers can access the cleanest and cheapest electricity possible. Convenient, interoperable, and widespread vehicle–grid integration depends on standardized communication protocols to enable seamless communication among vehicles, chargers, and other actors.
- Charger deployments should be targeted toward the needs of the local community, built environment, and use case. This targeting means there is no one-size-fits-all charging solution. Generally speaking, the best-fit charging solution will maximize electric miles enabled by a charger at the lowest overall cost while reflecting local needs and constraints and supporting equitable access for all Californians. Fostering innovative or unique charging products and opportunities will help ensure that these solutions proliferate.

³² Ibid. For more information on these qualitative findings, see “Chapter 5: Meeting California’s Technological Charging Infrastructure Needs.”

Findings From the *California Electric Vehicle Charging Infrastructure Assessment: Senate Bill 1000 Reports*

Senate Bill 1000 (Lara, Chapter 368, Statutes of 2018) requires the CEC, as part of the development of the Clean Transportation Program Investment Plan Update, to assess whether chargers are disproportionately deployed by income level, population density, or geographical area.³³ If the CEC finds that chargers have been disproportionately deployed, the CEC shall use Program funds, to the extent authorized by law, and other mechanisms to deploy chargers more proportionately, unless the CEC finds that the disproportionate deployment was reasonable and furthered state energy and environmental policies as articulated by the CEC.

Staff published the first SB 1000 assessment (*California Electric Vehicle Infrastructure Deployment Assessment: Senate Bill 1000 Report*) on December 30, 2020. The report found that low-income communities, on average, have fewer public chargers per capita than middle- or high-income communities. It also found that public chargers are unevenly distributed across state air districts and counties but correlated with county populations and plug-in electric vehicles.

The latest analysis, *Senate Bill 1000 California Electric Vehicle Infrastructure Deployment Assessment Drive Times to Direct-Current Fast Chargers*, published July 14, 2022, assessed drive times from census tract population centers to the nearest public fast charger during peak traffic. The analysis sought to identify rural, low-income, and disadvantaged communities in California with sparse public fast charging station coverage, considered communities with drive times of 10 minutes or more. Drive time analysis allows the identification of charging network gaps that discourage travel within California communities and travel to and from those communities. Rural communities³⁴ have less public fast charging station coverage than urban communities (Figure 4). About 88 percent of urban communities are within 10 minutes of a public DC fast charger; in contrast, about 60 percent of rural communities are farther than 10 minutes away. About 11 percent of all low-income communities are rural. Low-income rural communities have the least access to public fast charging — 69 percent are 10 minutes or more from a public DC fast charger, which is more than any other group (Table 7). Finally, Figure 5 shows that several disadvantaged communities in the Los Angeles area have long drives to public fast charging.³⁵ The CEC has created drive time maps showing rural, low-

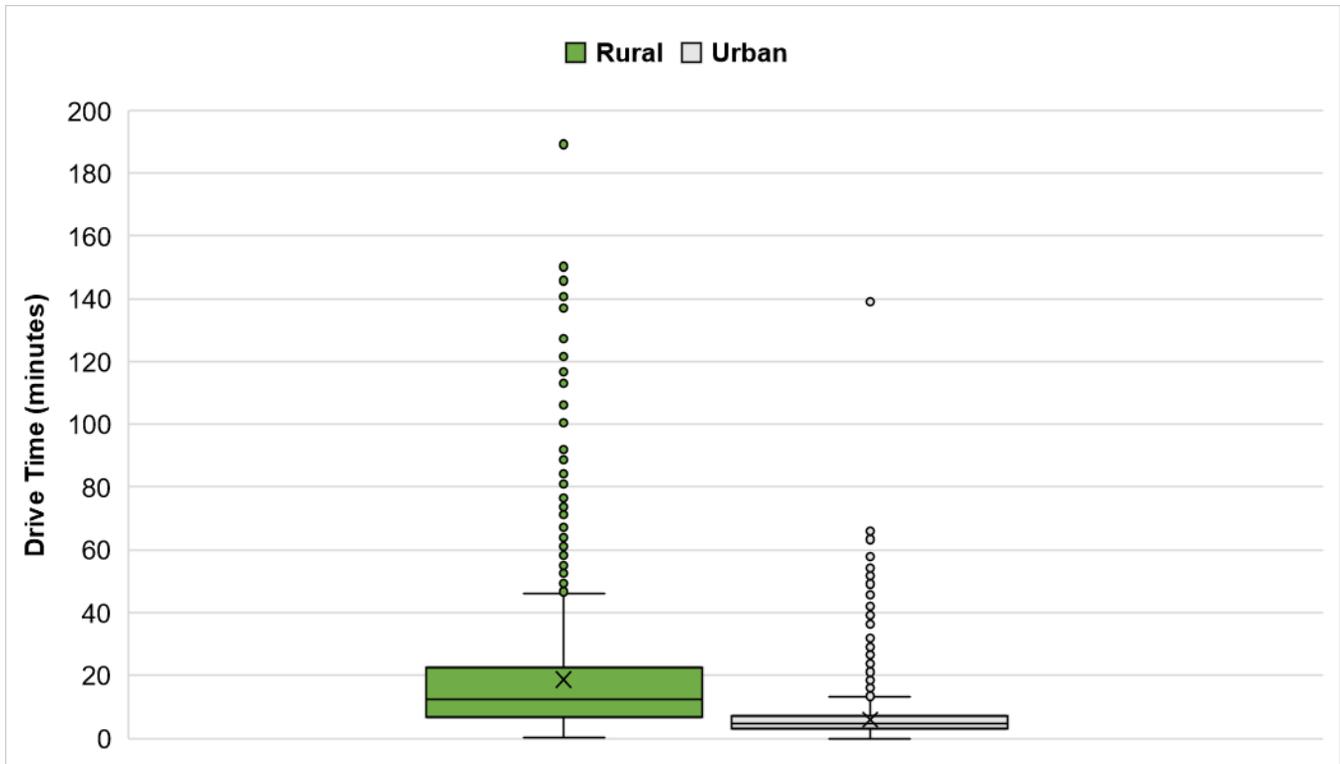
33 [More information](https://www.energy.ca.gov/programs-and-topics/programs/clean-transportation-program/electric-vehicle-infrastructure) about the SB 1000 reporting is available at <https://www.energy.ca.gov/programs-and-topics/programs/clean-transportation-program/electric-vehicle-infrastructure>.

34 *Rural communities* are census tracts where at least 50 percent of the land area in a census tract is designated as rural by the U.S. Census Bureau. Staff calculated rural area using the U.S. Census Bureau's 2010 rural census block designations. At the time of analysis, these were the most recent data available.

35 CEC staff referred to the most recent final disadvantaged community designations from CalEPA under CalEnviroScreen 3.0. At the time of this analysis, disadvantaged community designations by CalEPA under CalEnviroScreen 4.0 has not been finalized.

income, and disadvantaged communities with sparse public fast charging coverage.³⁶ These can be used to guide CTP DC fast charging investments within underserved communities.

Figure 4: Drive Time to the Nearest DC Fast Charging Station by Urban and Rural Communities



Source: U.S. Census Bureau 2010 Urban and Rural Classifications, U.S. Department of Energy’s Alternative Fuels Data Center Charger Data as of February 2021, and California Air Resources Board California Hydrogen Infrastructure Tool Roadway Data.

Table 7: Drive Time Ranges by Income Level and Urban or Rural Area

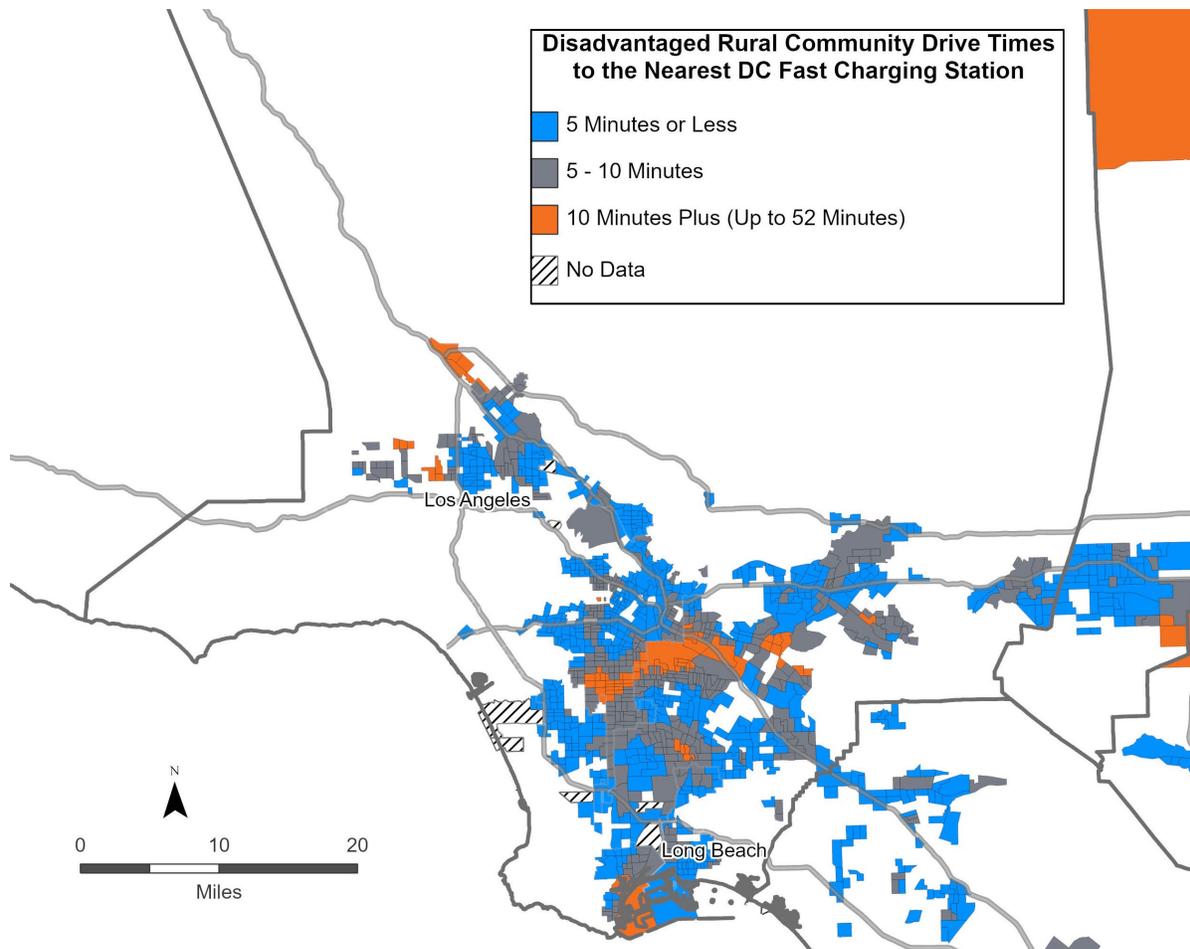
Income and Community Type	0 to 5 mins	6 to 9 mins	10 plus mins	N/A	Total
Low Rural	16%	14%	69%	1%	100%
Low Urban	61%	28%	11%	Less than 1%	100%
Middle Rural	19%	22%	58%	1%	100%
Middle Urban	62%	24%	14%	0%	100%
High Rural	25%	29%	45%	1%	100%
High Urban	54%	32%	14%	Less than 1%	100%

Source: California Energy Commission Analysis using data from the U.S. Census Bureau 2010 Urban and Rural Classifications, U.S. Census Bureau 2014–2018 American Community Survey Median Household Income and Average Household Size 5-Year Estimates, California Department of Housing and Community Development 2020

36 Drive time maps are available on the [SB 1000 webpage](https://www.energy.ca.gov/programs-and-topics/programs/clean-transportation-program/electric-vehicle-infrastructure) at <https://www.energy.ca.gov/programs-and-topics/programs/clean-transportation-program/electric-vehicle-infrastructure>.

State Income Limits, U.S. Department of Energy Alternative Fuels Data Center as of February 2, 2021, and California Air Resources Board California Hydrogen Infrastructure Tool roadway data.

Figure 5: Map of Los Angeles Area Disadvantaged Community Drive Times to the Nearest DC Fast Charging Station



Source: California Energy Commission analysis using data from the U.S. Census Bureau 2010 Urban and Rural Classifications, California Environmental Protection Agency CalEnviroScreen 3.0, U.S. Department of Energy Alternative Fuels Data Center as of February 2, 2021, and California Air Resources Board California Hydrogen Infrastructure Tool roadway data.

Clean Transportation Program Funding

The CEC has supported the rollout of light-duty PEVs by awarding more than \$250 million in Clean Transportation Program funding for electric vehicle charging infrastructure. Partly because of these investments, California has the largest network of publicly accessible electric vehicle chargers in the nation.

Clean Transportation Program investments have funded electric vehicle charging stations (EVCSs) at many types of locations, as detailed in Table 8. The “private access” chargers include home chargers that are generally dedicated to serving only one vehicle. The “shared access” chargers include fleets, workplaces, and multifamily housing chargers that may serve several vehicles but are not necessarily public. The “public access” chargers include public

Level 2 chargers, as well as corridor and urban metropolitan DC fast chargers. Finally, the “mixed access” chargers include shared-private and public access chargers.

Table 8: Chargers Funded by the Clean Transportation Program as of August 2022

	Private Access	Share-private Access	Shared-private Access	Shared-private Access	Public Access	Public Access	Mixed Access	Total
Charger Type / Setting	Level 2 - Residential (Single & Multifamily)	Level 2 - Fleet	Level 1 and Level 2 - Workplace	Level 2 - Residential (Multifamily)	Level 1 and Level 2 - Public	Level 2 and DCFC - Corridor/ Urban Metro	Level 2 and DCFC - CALeVIP*	-
Installed	3,936	155	419	341	3,108	493	1,456	9,908
Planned	0	0	0	120	12	72	7,519	7,723
Total	3,936	155	419	461	3,120	565	8,975	17,631

Source: California Energy Commission. Does not include chargers that have yet to be approved at a CEC business meeting or connectors that have yet to be funded under CALeVIP. *Planned CALeVIP chargers = number of chargers with rebate funding reserved. “Mixed Access” includes shared-private and public access chargers.

California Electric Vehicle Infrastructure Project (CALeVIP)

In December 2017, the CEC introduced the California Electric Vehicle Infrastructure Project (CALeVIP) to provide streamlined Clean Transportation Program incentives for light-duty electric vehicle charging infrastructure. The incentives provided through CALeVIP simplify the funding process and accelerate charger deployment compared to the previously used grant solicitations. Each CALeVIP project provides incentives for the purchase and installation of electric vehicle infrastructure in specific regions throughout the state, with funding targeted at regions that have low rates of infrastructure installation or lack adequate incentives from utilities and other sources.

Through 2022, the CEC has allocated \$200 million (\$186 million for rebates and \$14 million for administrative fees) for charger rebates through CALeVIP; however, not all of these funds have been paid out to, or reserved by, incentive recipients. CALeVIP has launched 13 regional incentive projects covering 36 counties. Table 9 shows the CALeVIP projects. Dedicated funding amounts or higher incentive amounts or both are also available under CALeVIP for project sites within disadvantaged communities and multifamily complexes. CEC staff continues to coordinate closely with local governments and councils of governments to leverage other funding opportunities to increase chargers in focused locations to maximize the effectiveness of limited Clean Transportation Program funds.³⁷

37 Statistics on the CALeVIP incentive projects can be found on the [CALeVIP website](https://calevip.org) at <https://calevip.org>.

Table 9: CALeVIP Investments

Incentive Project	Launch Date	Counties	CEC Rebate Funding (in Millions)	Additional Rebate Funding From Partners (in millions)	Technologies
Fresno County	December 2017	Fresno	\$2.66	-	Level 2
Southern California	August 2018	Los Angeles, Orange, Riverside, San Bernardino	\$29	-	DC Fast Chargers
Sacramento County	April 2019	Sacramento	\$14	\$1.5	Level 2 and DC Fast Chargers
Northern California	May 2019	Shasta, Humboldt, Tehama	\$4	-	Level 2 and DC Fast Chargers
Central Coast	October 2019	Monterey, Santa Cruz, San Benito	\$6	\$1	Level 2 and DC Fast Chargers
San Joaquin Valley	December 2019	San Joaquin, Kern, Fresno	\$15.34	-	Level 2 and DC Fast Chargers
Sonoma Coast	July 2020	Mendocino, Sonoma	\$5.1	\$1.5 (over three years)	Level 2 and DC Fast Chargers
San Diego County	October 2020	San Diego	\$15.8	\$5.9 (over three years)	Level 2 and DC Fast Chargers
Peninsula-Silicon Valley	December 2020	San Mateo, Santa Clara	\$33	\$17.7 (over four years)	Level 2 and DC Fast Chargers
Inland Counties	May 2021	Butte, El Dorado, Imperial, Kings, Merced, Napa, Nevada, Placer, Solano, Stanislaus, Sutter, Tulare, Yolo	\$17.5	-	Level 2 and DC Fast Chargers
South Central Coast	July 2021	San Luis Obispo, Santa Barbara, Ventura	\$7.1	\$4.9 (over two years)	Level 2 and DC Fast Chargers
Alameda County	December 2021	Alameda	\$14.5	\$2.8	Level 2 and DC Fast Chargers
Southern California Level 2	April 2022	Los Angeles, Orange, Riverside, San Bernardino	\$22	\$1	Level 2
		Totals	\$186	\$40	

Source: California Energy Commission.

Second Block Grants for Light-Duty EV Charging Infrastructure

In April 2021, the CEC released a solicitation seeking up to two implementers for block grants for light-duty EV charging infrastructure. The two implementers that received the highest scores were announced in September 2021, and both were approved at the CEC's December 2021 business meeting. Each new block grant has the funding authority of up to \$250 million, which would be added as future funding allocations become available. The two block grant

implementers will coordinate with one another and the CEC to design projects that complement one another. Both block grants will have strict readiness requirements as a means of minimizing charger installation times and attracting higher quality applications and installation projects. The application processes and project requirements may vary between the two block grants as they will be designed to best serve each project. Each block grant implementer plans to launch its first project in the first quarter of 2023.

Targeted Projects for Increasing Access and Innovation for Charging Infrastructure and ZEV Mobility

In addition to the use of block grants to distribute incentives efficiently for broader charging infrastructure deployment, the Clean Transportation Program also provides funding to solicitations and projects that target specific needs for charging infrastructure.

- On November 24, 2021, the CEC announced the Reliable, Equitable, and Accessible Charging for multifamily Housing (REACH) solicitation. This solicitation will fund projects that demonstrate replicable and scalable models for large-scale deployment of EV charging infrastructure capable of maximizing access and EV travel for multifamily housing (MFH) residents. Proposed projects must include charger installations that will benefit and be used by MFH residents within disadvantaged communities, low-income communities, or a combination of both and are encouraged to pursue installations for affordable housing. All projects will include community engagement and outreach to nearby residents on the benefits of electric vehicles and the convenience of the newly installed EV chargers. A NOPA was released May 11, 2022, recommending \$26.6 million in funding for 13 projects.
- On December 14, 2021, the CEC announced the Clean Transportation Program Rural Electric Vehicle (REV) Charging solicitation. This solicitation will 1) demonstrate replicable and scalable models that can dispatch EV charging stations to serve rural EV drivers; 2) support travel by EV drivers, especially those in low-income or disadvantaged communities; 3) provide EV charging access in rural areas that are not served or inadequately served by charging stations; 4) provide support and maintenance services to ensure reliable and readily accessible chargers; and 5) engage local rural communities and businesses in increasing charger awareness and promoting EV adoption. This is an active solicitation with results to become available later this year.
- The Charging Access for Reliable On-Demand Transportation Services (CARTS) was released August 31, 2021, with up to \$6 million in grant funds for projects that will support electric vehicle charging infrastructure for high-mileage on-demand transportation services, including services such as ride-hailing, taxis, and meal grocery delivery. On February 14, 2022, the CEC announced the proposed awards of more than \$16 million, which is an increase in the original funding amount.
- The CEC is partnering with CARB through an interagency agreement to expand program eligibility and funding under the Clean Mobility Options (CMO) Program. The CMO Program is a statewide program that offers vouchers for shared mobility projects in traditionally underserved communities, aiming to increase residents' access to clean

transportation and zero-emission mobility solutions. The interagency agreement will add \$8 million to the original CARB funding of \$37 million for additional vouchers, technical assistance, and outreach to communities not identified in the first round of funding. Projects are required to be operational for four years, and the interagency agreement will conclude in 2025.

Projects to Support Innovations and Standardization in Charging

Through the Clean Transportation Program, the CEC has invested in funding opportunities to support innovative charging solutions as well as the testing and standards that can support the principles of interoperability, competition and customer choice, cost control, and convenience.

- In August 2020, the CEC released the “BESTFIT Innovative Charging Solutions” solicitation, which offered funding to projects that demonstrate transformative technology solutions. They are meant to accelerate the successful commercial deployment of EV charging for light-duty and medium- and heavy-duty applications. There is no one-size-fits-all solution to charging needs, and there is instead a need to have a portfolio of charging solutions that complement one another.
- The Vehicle–Grid Innovation Lab (ViGIL) solicitation was released May 21, 2021. This solicitation will increase the capacity and throughput of electric vehicle supply equipment standards testing at a laboratory or laboratories. The funding will support the expansion of testing for light-duty and medium- and heavy-duty electric vehicle charging equipment. On October 14, 2021, the CEC announced a proposed award of nearly \$2 million in grant funding.
- The Vehicle Interoperability Testing Symposium (VOLTS) solicitation was released September 24, 2021. This solicitation will support the interoperability of electric vehicle charging with a focus on convening stakeholders to conduct interoperability tests, develop and finalize products and standards, and discuss requirements to overcome common technology barriers. On January 6, 2022, the CEC announced an award of nearly \$1 million to a proposed contractor.

Planning and Readiness

The CEC has provided funding to support regional alternative fuel readiness plans, with a new focus on zero-emission technologies. The Regional Alternative Fuel Readiness Planning allocation provides funding for planning that prepares for and expedites the launch of alternative fuel infrastructure and vehicles.

The CEC has conducted six grant solicitations for regional readiness planning, providing more than \$27 million for 86 agreements. Since the first regional readiness planning projects were approved in 2011, the zero-emission vehicle sector has matured significantly. Most regions in California have developed regional readiness plans as a result of this funding.

On August 12, 2020, the CEC released the “Electric Vehicle Ready Communities Challenge Phase II — Blueprint Implementation Solicitation.” This solicitation was Phase II of a two-phase effort for electric vehicle-ready communities. Phase I (GFO-17-604) provided funds to develop replicable blueprints that identify the actions needed to accelerate implementation of electrified transportation at the regional level.

Phase II was a competitive solicitation with \$7.5 million in grant funding available to implement projects developed and identified in Phase I. Phase II was open only to entities that completed Phase I blueprints within one year of their agreement start date. The solicitation resulted in four grant awards totaling about \$7.5 million, which include Contra Costa Transportation Authority, Kern Council of Governments, City of Sacramento, and Ventura County Regional Energy Alliance. In September 2021, the CEC added more than \$9 million to the Phase II solicitation by using funds from the Clean Transportation Program Investment Plan's Recovery and Reinvestment funding category from FY 2020–2021. This reallocation allowed the full funding of three additional projects: San Francisco Department of the Environment, the County of Los Angeles Internal Services Department, and the City of Long Beach Harbor Department, and the complete funding for the Kern Council of Governments, which was originally only partially funded.

Since the awarding of Phase II, the CEC has received positive feedback from local entities and their partners about the value of charging infrastructure planning grants. The CEC may explore concepts to develop and implement such funding opportunities in the future as well.

Increasing Consumer Awareness of EV Charging Opportunities Through Expanded Installation of Signs

Despite strong growth in ZEV sales and PEV charger installations, large numbers of Californians have limited awareness of PEV charging opportunities or ZEV mobility. Long-term attitudinal survey research from the UC Davis Institute for Transportation Studies indicates that more than 50 percent of Californians have limited awareness of ZEV purchase or PEV charging opportunities.³⁸ Informing larger numbers of California drivers about ZEVs will become increasingly important to meet California's vehicle and climate goals. One strategy to build consumer awareness is to increase the number of signs indicating nearby public PEV charging stations. Further, signs will aid existing PEV drivers by helping them locate stations near their homes or commute routes.

There are just 50 indicator signs along California freeways. As a result, many EV drivers and potential EV drivers are likely unaware of charging opportunities. Lack of awareness contributes to range anxiety, the concern that a PEV cannot meet a driver's needs for range and convenient refueling. This lack of awareness constrains PEV sales. In contrast, gas stations are highly visible to urban, suburban, rural, and freeway drivers due to the large, colorful display signs. Fossil fuel drivers benefit from the big neon signs and large footprint of gas stations. Further, they benefit from highway, surface street, and off-ramp signs indicating where gasoline can be found.

CEC staff has begun exploring opportunities to increase the number of physical signs throughout the state. Working collaboratively with staff from GO-Biz, California Department of Transportation (Caltrans), CPUC, and CARB, and in consultation with major charger companies, CEC staff is investigating strategies to increase the installation of physical indicator

38 Kurani, Ken. 2019. "[The State of Electric Vehicle Markets, 2017: Growth Faces an Attention Gap.](https://ncst.ucdavis.edu/research-product/state-electric-vehicle-markets-2017-growth-faces-attention-gap)" NCST Policy Brief, <https://ncst.ucdavis.edu/research-product/state-electric-vehicle-markets-2017-growth-faces-attention-gap>.

signs. One possible strategy is to use grant funding opportunities, such as the Regional Readiness Planning Grants, to provide funding to install signs along freeways and roadways.

Summary

Issued in January 2018, Executive Order B-48-18 set a directive to install 250,000 ZEV charging ports, including 10,000 DC fast charging ports, in California by 2025. Based on existing public and private commitments, Clean Transportation Program staff estimates that California should be meet the goal of 250,000 chargers and 200 hydrogen stations. However, based on AB 2127 analysis, California will need to deploy additional infrastructure by 2025 and 2030. For passenger vehicle charging in 2030, the AB 2127 analysis projects that California will need nearly 1.2 million public and shared-private chargers to support the roughly 8 million ZEVs needed to keep pace with the goals of Executive Order N-79-20.

Staff recommends an aggressive near-term funding solution to help close this gap and ensure equitable access. Staff will also consider land use, housing policies, and Sustainable Community Strategies³⁹ as they relate to ZEV infrastructure investments. To help achieve this adoption, the CEC is allocating \$30.1 million in Clean Transportation Program funding for light-duty electric vehicle charging infrastructure for FY 2022–2023. This funding, along with general fund allocations for FY 2022–2023 of \$237.5 million, will provide the buildout of EV infrastructure that can create much-needed jobs, support economic development, and close the EVSE gap.

Medium- and Heavy-Duty Zero-Emission Vehicles and Infrastructure

Freight and transit vehicles serve as a pillar to the California economy, providing indispensable functions for domestic goods movement, international trade, mass transportation, and other essential services. Clean Transportation Program funding in this sector has historically focused on medium- and heavy-duty vehicles, defined here as vehicles with a gross vehicle weight rating above 10,000 pounds. These vehicles represent a small share of California registered vehicle stock, accounting for about 1 million out of 31 million vehicles, or 2 percent. However, this small number of vehicles is responsible for about 23 percent of on-road GHG emissions in the state because of comparatively low fuel efficiency and high number of miles traveled per year.⁴⁰ Medium- and heavy-duty vehicles additionally account for one-third of statewide NO_x and 25 percent of PM_{2.5} emissions from on-road transportation in California.⁴¹ For these

39 California Air Resources Board. "[Sustainable Communities Strategies](https://ww2.arb.ca.gov/our-work/programs/sustainable-communities-program/what-are-sustainable-communities-strategies)." More information: <https://ww2.arb.ca.gov/our-work/programs/sustainable-communities-program/what-are-sustainable-communities-strategies>.

40 Based on analysis from California Energy Commission Energy Assessments Division, with data from the California Department of Motor Vehicles. California Air Resources Board. June 22, 2018. "[California Greenhouse Gas Inventory for 2000-2018](https://ww3.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_scopingplan_sum_2000-18.pdf)." Available at https://ww3.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_scopingplan_sum_2000-18.pdf.

41 California Air Resources Board. "[Almanac Emission Projection Data](https://www.arb.ca.gov/app/emsmv/2017/emssumcat_query.php?F_YR=2020&F_DIV=3&F_SEASON=A&SP=SIP105ADJ&F_AREA=CA#7)." Available at https://www.arb.ca.gov/app/emsmv/2017/emssumcat_query.php?F_YR=2020&F_DIV=3&F_SEASON=A&SP=SIP105ADJ&F_AREA=CA#7.

reasons, medium- and heavy-duty vehicles represent a significant opportunity to reduce GHG and criteria emissions while focusing on a small number of vehicles. Nonroad freight vehicles, such as forklifts and other cargo handlers, have similar or supporting purposes and potential for emission reductions.

Charging Infrastructure for Medium- and Heavy-Duty Vehicles

As part of the analyses conducted for the *AB 2127 Report*, the CEC evaluated infrastructure needs to support medium- and heavy-duty vehicles through the Medium- and Heavy-Duty Electric Vehicle Infrastructure Load, Operations, and Deployment (HEVI-LOAD) model in collaboration with Lawrence Berkeley National Laboratory. This model aims to characterize regional charging infrastructure needs for public, shared-private, and private charging for on-road medium- and heavy-duty electric vehicles. It will determine the number, locations, and types of charger deployments and examine suitable power levels ranging from overnight charging (<50 kilowatts [kW]) to public fast charging (multimegawatt) for the range of applications envisioned in California's transition to ZEVs. HEVI-LOAD leverages CARB's *Draft 2020 Mobile Source Strategy*, which projected that 180,000 medium- and heavy-duty electric vehicles will be needed in 2030 to achieve state climate and air quality goals and comply with Executive Order N-79-20. Preliminary modeling, which considered 50-kW and 350-kW charging power levels, suggests that to charge these vehicles, 157,000 DC fast chargers will be needed.

In addition to providing quantitative estimates of charging for medium- and heavy-duty vehicles, the *AB 2127 Report* provides qualitative descriptions of the charging needs of medium- and heavy-duty vehicles.

While private light-duty vehicles typically see extended periods of downtime and have flexible usage requirements, medium- and heavy-duty vehicles often adhere to demanding operation patterns that make infrastructure planning for these vehicles a unique challenge. Charging infrastructure planning for the medium- and heavy-duty sector requires close attention to the specific vehicle uses and environments, high-power charging demands, lack of consistency in charging connectors, and landlord-tenant relationships. The result of such operator-specific complexities is that the most appropriate charger type — whether it be a conductive connector, pantograph, or wireless — may vary significantly from site to site, even for ostensibly similar vehicles.

Hydrogen Fueling Infrastructure for Medium- and Heavy-Duty Vehicles

Fuel cell electric vehicles using hydrogen offer another zero-emission transportation option for California's medium- and heavy-duty sectors and short-range and long-range applications. Hydrogen fuel cell and battery-electric technologies present different strengths and challenges, and hydrogen fuel cell vehicles may serve an important role in applications that would be difficult to transition to battery-electric. Moreover, the further development and deployment of medium- and heavy-duty fuel cell vehicles will help accelerate the growth of hydrogen production and reach economies of scale earlier than with light-duty vehicles alone. These cost reductions may help support the further commercialization of all fuel cell vehicles, including light-duty fuel cell vehicles.

Companies are producing or planning to produce heavy-duty vehicles with hydrogen fuel cell electric powertrains, including transit buses and tractor-trailer trucks. These vehicles, and the fleets that operate them, may require dedicated fueling infrastructure to ensure the safety, security, and fuel supply of the vehicles. The CEC anticipates expanding its hydrogen focus toward hydrogen fueling infrastructure capable of supporting medium-duty and heavy-duty vehicles.

Clean Transportation Program Funding

In October 2019, CEC staff conducted a workshop to explore various solicitation concepts that prioritized infrastructure to support the use of zero-emission medium- and heavy-duty advanced vehicle technologies within the California freight system, transit bus fleets, and other sectors.⁴² The concepts evolved into solicitations that cover a wide range of support for medium- and heavy-duty zero-emission vehicle infrastructure. Similar to the light-duty investments, the CEC intends to use a complementary approach of block grants and in-house funding solicitations.

Energy Infrastructure Incentives for Zero-Emission Commercial Vehicles (EnergIIZE Commercial Vehicles)

Block grants are important tools to rapidly deploy funds to support infrastructure deployment. In March 2022 the CEC and CALSTART launched the EnergIIZE Commercial Vehicles block grant. This block grant for medium- and heavy-duty zero-emission vehicle infrastructure incentives is intended to be a cornerstone of the CEC's deployment strategy.

Under this grant solicitation, the CEC sought one block grant recipient to design and implement an incentive mechanism (similar to CALeVIP) for various medium- and heavy-duty zero-emission vehicle refueling infrastructure incentive projects throughout California. In December 2020, the CEC selected applicant CALSTART, Inc. to implement the block grant incentive with an initial budget of \$17 million. On March 17, 2021, the project was approved at a CEC business meeting. The block grant project EnergIIZE Commercial Vehicles has \$69 million available for incentives, and the funding authority for up to \$276 million, which was approved at the December 2021 CEC business meeting.

EnergIIZE Commercial Vehicles has launched two funding lanes in 2022, with two more planned to launch before the end of the year. The EV Fast Track funding lane launched March 23, 2022. Under this lane, a total of \$16 million was provided for incentives and was available on a first-come, first-served basis. The second lane to launch was the Hydrogen funding lane. The Hydrogen funding lane was a competitive scoring lane and provided \$17 million in incentive funding. The lane launched June 30, 2022, and closed July 14, 2022. Both funding lanes are fully subscribed.

⁴² California Energy Commission. October 25, 2019. "[Staff Workshop for Medium- and Heavy-Duty Zero-Emission Vehicles](https://www.energy.ca.gov/event/workshop/2019-10/staff-workshop-medium-and-heavy-duty-zero-emission-vehicles-and)." Available at <https://www.energy.ca.gov/event/workshop/2019-10/staff-workshop-medium-and-heavy-duty-zero-emission-vehicles-and>.

The EV Jump Start funding lane launched in September 2022 and the EV Public Charging funding lane launched in October 2022, each of were competitive based lanes. All funding lanes are expected to open again for applications throughout 2023.

EnergIIZE Commercial Vehicles anticipates releasing additional carve-out lanes beginning in spring 2023 specifically targeting drayage trucks, school buses, and transit buses as fleets continue to transition to zero-emission.

Targeted Projects for Medium- and Heavy-Duty ZEV Infrastructure

The EnergIIZE Commercial Vehicles block grant will complement the several in-house solicitations that the CEC has used over the years and is deploying. In-house competitive solicitations are valuable tools to target specific segments or needs. They can be issued either solely by the CEC or in partnership with other agencies, such as CARB. The following grants funding opportunities target use cases throughout the state.

- “Zero-Emission Transit Fleet Infrastructure Deployment.” Released in July 2020, this grant solicitation announced the availability of up to \$20 million to fund the electric vehicle charging or hydrogen refueling infrastructure needed to support the large-scale conversion of transit bus fleets to ZEVs. Funding was divided into categories to support different fleet types. However, no applications were received in the “Small Fleet/Rural” or “Multiple Fleets/Shared” categories. In the “Small Fleet/Urban” category, \$5 million awards were proposed for one electrification project and one liquid hydrogen refueling project. In the “Large Fleet/Urban” category, a \$6 million electrification and microgrid project was proposed for funding, as was a \$4 million hydrogen refueling project, with \$2 million in general funds added. Subsequently, three additional transit fleet infrastructure projects were awarded, totaling \$14.2 million using general funds.
- “Zero-Emission Drayage Truck and Infrastructure Pilot Project.” In a joint solicitation with CARB, the CEC allocated \$20.1 million from the Clean Transportation Program to fund the zero-emission drayage truck infrastructure and installation, as well as any workforce training and development components. CARB allocated \$24 million from its FY 2019–20 Funding Plan for Clean Transportation Incentives to fund the purchase of on-road zero-emission Class 8 trucks. This solicitation sought to support large-scale deployments of on-road, zero-emission Class 8 drayage and regional haul trucks, as well as the infrastructure needed for service operation. On July 15, 2021, the CEC approved two projects at a CEC business meeting, one with South Coast Air Quality Management District for a battery-electric infrastructure project and one with the Center for Transportation and the Environment for a hydrogen refueling infrastructure project. In August 2021, the CEC increased the award amount for the Center for Transportation and the Environment’s project by \$713,173 using general fund dollars, in addition to proposing for funding three additional drayage truck and infrastructure pilot projects, totaling \$23.5 million using general fund dollars.
- “Hydrogen Fuel Cell Demonstrations in Rail and Marine Applications at Ports.” Released in July 2020, this solicitation was a collaboration between the CEC’s Clean Transportation Program and the CEC’s Natural Gas Research and Development Program. This solicitation sought to fund the design, integration, and demonstration of hydrogen fuel

cell systems and hydrogen fueling infrastructure for locomotive and commercial harbor craft applications at California ports. In December 2020, the CEC announced several proposed awardees from this solicitation, including one \$4 million award of Clean Transportation Program funding toward shared hydrogen refueling infrastructure at the Port of West Sacramento, which was approved at the August 11, 2021, CEC business meeting. On March 17, 2021, three projects from the CEC's Natural Gas Research and Development Program were approved at a CEC business meeting.

- "BESTFIT Innovative Charging Solutions." This solicitation, previously described in the Light-Duty Electric Vehicle Charging Infrastructure section, included eligibility for projects to demonstrate innovative electric vehicle charging solutions for light-duty and medium- and heavy-duty vehicles. On April 16, 2021, the CEC announced more than \$4.1 million in medium- and heavy-duty vehicle sector awards. Three additional medium- and heavy-duty projects were funded using general funds, totaling nearly \$4.3 million.
- "Blueprints for Medium- and Heavy-Duty Zero-Emission Vehicle Infrastructure." Released in July 2020, this solicitation offered up to \$3 million to fund planning "blueprints" that will identify actions and milestones needed for implementing medium- and heavy-duty zero-emission vehicles and the related electric charging or hydrogen refueling infrastructure. The solicitation included a set-aside for public entities. On April 8, 2021, the CEC announced nearly \$4 million in proposed funding to support public agencies and nearly \$2 million in proposed funding to support private entities. On August 16, 2021, a revised NOPA was posted proposing an additional 12 blueprint projects for award, totaling about \$2.4 million using general funds. On February 28, 2022, the CEC held another workshop focused on identifying funding opportunities for future medium- and heavy-duty ZEV infrastructure projects.⁴³ Concepts presented by CEC staff for consideration included:
 - Hydrogen Refueling: This concept seeks projects to build hydrogen refueling stations that would have a public fueling component for light-duty FCEVs and have a public or private component for fueling medium- and heavy-duty vehicles.
 - School District Vehicle Grid Integration: This concept seeks projects from electric vehicle service providers to partner with public school districts, county offices of education, or transportation joint power authorities in areas likely to experience power outages due to public safety power shutoffs or fire danger to minimize operational costs and improve resiliency in emergencies. These electric vehicle service providers would install bidirectional DCFC charging stations at key sites throughout the school districts, resulting in a final turnkey solution for other school bus operators to adopt.
 - Truck Parking EV Charging and Hydrogen Refueling: This concept seeks projects focused on the parking and charging or refueling needs or both of independent

43 CEC. February 28, 2022. "[Staff Workshop on Funding Allocations for Future Medium- and Heavy-Duty Charging and Refueling Infrastructure Projects](https://www.energy.ca.gov/event/workshop/2022-02/staff-workshop-funding-allocations-future-medium-and-heavy-duty-charging-and-refueling-infrastructure-projects)." Available at <https://www.energy.ca.gov/event/workshop/2022-02/staff-workshop-funding-allocations-future-medium-and-heavy-duty-charging-and-refueling-infrastructure-projects>.

owner operators and long-haul and regional-haul drivers, including the potential to fund centralized locations for overnight public charging.

- Warehouse and Regional Trucking: This concept seeks projects to support medium- and heavy-duty warehouse and regional trucking. Projects may support heavy-duty regional-haul fleets that stay within a 300-mile radius from a home base and medium-duty, last-mile delivery fleets that are in or near a metropolitan area servicing warehouse distribution and fulfillment centers.
- Innovative EV Charging and Hydrogen Refueling Technologies: This concept would replicate and improve upon the original “BESTFIT Innovative Charging Solutions” solicitation. This concept would target and fund innovative medium- and heavy-duty charging or hydrogen refueling solutions or both.
- Mobility-as-a-Service Models: This concept seeks projects that would provide EV charging or hydrogen refueling infrastructure to support medium- and heavy-duty mobility-as-a service applications, including charging as a service and infrastructure as a service.
- Rural Small Transit Fleet Infrastructure Deployment: This concept seeks projects to fund the EV charging or hydrogen refueling infrastructure needed to support the conversion of small rural transit fleets to zero-emission.
- Large-Scale Ultra-Fast Charging Stations: This concept seeks projects that would allow for the large-scale buildout for ultra-fast charging station infrastructure.
- Medium- and Heavy-Duty Blueprint Planning Documents: This concept would be similar to the previously released grant funding opportunity titled “Blueprints for Medium- and Heavy-Duty Zero-Emission Vehicle Infrastructure.” It would seek blueprint planning projects to accelerate the deployment of medium- and heavy-duty ZEVs and ZEV infrastructure with a holistic view of transportation planning.
- Infrastructure Concepts to Complement CARB Demonstration and Pilot Project Concepts: This concept seeks to complement CARB’s proposed FY 2021–2022 demonstration and pilot projects with the necessary ZEV infrastructure. CARB’s proposed FY 2021–2022 demonstration and pilot projects include tasks focused on “Municipal Green Zones,” “Resilient Zero-Emission Vessel Charging Project,” “Modular Zero-Emission Capable Cargo Handling Equipment Demonstration,” “Emission Reductions From Oceangoing Vessels,” and “Zero-Emission Intrastate Line-Haul Locomotive.”
- Medium- and Heavy-Duty Loan Pilot: This concept would complement the CECs grant opportunities by making loans available for medium- and heavy-duty zero-emission infrastructure projects. The CEC continues to seek information from the public to determine the viability of and interest in a medium- and heavy-duty loan program.

Because of limited funds, the CEC may not pursue all these funding opportunities or may provide grant funding for concepts not listed above or both. Decisions regarding funding implementation will be developed based on stakeholder feedback, emerging needs or opportunities, alignment with key state policies, and other considerations.

Summary

To meet state GHG and air-quality goals, this sector will need to transition to zero-emission technologies, and the resources required for this to be an equitable transition exceed available public funding. CEC staff expects an increasing demand for dedicated charging and fueling infrastructure for medium- and heavy-duty ZEVs funded through the Clean Transportation Program and by other state incentive programs. As the state's lead agency for ZEV infrastructure deployment, the CEC will focus on the infrastructure needs, both dedicated and publicly accessible infrastructure, of medium- and heavy-duty ZEVs. In addition, the CEC will seek ways to include grid integration, integrated storage solutions, and charging management as complementary technologies. Staff will also consider land use, housing policies, data and analyses from AB 2127 and SB 643, and Sustainable Community Strategies as they relate to medium- and heavy-duty ZEV infrastructure investments.

For FY 2022–2023, the CEC allocates \$30.1 million in Clean Transportation Program funding, in addition to \$683.75 million in general funds, dedicated to medium- and heavy-duty sectors to meet the growing needs of charging and hydrogen fueling infrastructure for medium- and heavy-duty ZEVs, as well as demonstrate the state's commitment to improving air quality. This \$683.75 million will be allocated to the specific categories of drayage, transit, clean trucks, buses, off-road equipment, and school bus applications.

Public Hydrogen Fueling Infrastructure

Assembly Bill 8 (Perea, Chapter 401, Statutes of 2013) directs the CEC to allocate \$20 million annually, not to exceed 20 percent of the funds appropriated by the Legislature, from the Alternative and Renewable Fuel and Vehicle Technology Fund for planning, developing, and building hydrogen-fueling stations until there are at least 100 publicly available stations in California.

Evaluating the Deployment of FCEVs and Hydrogen Fueling Stations

Assembly Bill 8 requires CARB to evaluate the need for additional publicly available hydrogen fueling stations annually. This evaluation includes the quantity of fuel needed for the actual and projected number of FCEVs (based on CARB's analysis of DMV registrations and auto manufacturer projections), geographic areas where fuel will be needed, and station coverage.

Based on this evaluation, CARB reports to the CEC the quantity of fuel needed for the actual and projected number of hydrogen-fueled vehicles, geographic areas where fuel will be needed, and station coverage. CARB estimates station and FCEV projections for up to six years in the future, based on mandatory survey information provided by vehicle manufacturers for the next three model years and voluntary information for an additional three following model years.

CARB released the *2022 Annual Evaluation of Fuel Cell Electric Vehicle Deployment & Hydrogen Fuel Station Network Deployment* (Annual Evaluation) report in September 2022 to

comply with the requirements of Assembly Bill 8.⁴⁴ In this assessment, CARB noted that the growth potential put in place by the planned hydrogen station network will provide an opportunity for auto manufacturers to accelerate their FCEV deployment plans for California. CARB also reported that automakers project having 65,600 FCEVs on the road by 2028.

In December 2021, the CEC and CARB released the *Joint Agency Staff Report on Assembly Bill 8: 2021 Annual Assessment of Time and Cost Needed to Attain 100 Hydrogen Fueling Stations in California* (Joint Report).⁴⁵ The report stated that the state expects up to 179 stations by 2027 (including 16 to be privately funded under CEC agreement and 7 privately funded stations outside any CEC agreement). Since the release of the 2021 Joint Report, three stations that were in development canceled, changing the total number of expected stations to 176. At least 13 of these stations will have the capability to serve medium- or heavy-duty vehicles in addition to light-duty vehicles. With the expended funds and committed allocation of funds, California is on track to meet the original AB 8 minimum requirement of 100 stations. Funding from last year's ZEV Package is expected to help California meet the 200-station goal.

When all 200 stations are open, the CEC staff estimates that the network of hydrogen stations will be capable of supporting about 273,000 light-duty FCEVs when operating at 100 percent availability and assuming the remaining stations yet to be funded have a capacity of 1,000 kilograms of hydrogen per day (kg/day) per station. This capacity is more than four times the projected demand for 2028.

Clean Transportation Program Funding to Date

Through the Clean Transportation Program, the CEC has provided nearly \$166 million of funding to support 79 publicly available hydrogen stations capable of light-duty vehicle fueling, including associated operations and maintenance. As of August 2022, 61 hydrogen fueling stations were open retail in California.

Furthermore, the three awardees under Solicitation GFO-19-602 can receive additional grant funds of up to \$85.9 million for subsequent batches of stations depending on performance, funding availability, and Clean Transportation Program Investment Plan Update funding allocations. If fully funded, the solicitation combined with privately funded stations should result in 176 stations, with at least 13 stations being capable of fueling light-, medium-, and heavy-duty vehicles. This leveraged infrastructure will address several markets and accelerate the development of commercial fuel cell electric trucks with the potential to reduce local air pollution from the goods movement sector.

Stations funded by the Clean Transportation Program before GFO-19-602 are required to dispense fuel with at least 33 percent renewable hydrogen content, and stations resulting from

44 California Air Resources Board. September 2022. [2022 Annual Evaluation of Fuel Cell Electric Vehicle Deployment & Hydrogen Fuel Station Network Development](https://www2.arb.ca.gov/resources/documents/annual-hydrogen-evaluation). Available at <https://www2.arb.ca.gov/resources/documents/annual-hydrogen-evaluation>.

45 Baronas, Jean, Belinda Chen, et al. 2021. [Joint Agency Staff Report on Assembly Bill 8: 2021 Annual Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California](https://www.energy.ca.gov/sites/default/files/2021-12/CEC-600-2021-040.pdf). California Energy Commission and California Air Resources Board. Publication Number: CEC-600-2021-040. Available at <https://www.energy.ca.gov/sites/default/files/2021-12/CEC-600-2021-040.pdf>.

GFO-19-602 are mandated to reach at least 40 percent of the hydrogen from renewable sources. CARB's definition of renewable hydrogen per the Low Carbon Fuel Standard includes hydrogen produced through fossil natural gas, which is combined with carbon capture from biomethane through "book and claim." According to the 2021 Joint Report, about one-half of the open retail stations indicated about 82 percent of the hydrogen dispensed was renewable hydrogen in 2020 (mostly through the purchase of biogas credits in lieu of renewable hydrogen produced directly from renewable sources). More recently, CARB's 2022 Annual Evaluation stated that 65 percent renewable content for the first quarter of 2022 was reported to CARB's Low Carbon Fuel Standard (LCFS) Hydrogen Refueling Infrastructure (HRI) program.

Other Sources of Project Support

The HRI credit provision of the LCFS became effective in January 2019. This provision allows eligible hydrogen fueling station operators to earn HRI credits based on the capacity of the hydrogen station for a limited period, rather than being limited to credit generation based on the amount of hydrogen fuel dispensed.⁴⁶

One hydrogen fueling station funding recipient has received \$5 million from the Volkswagen Mitigation Trust fund to support development of five hydrogen refueling stations as part of GFO-19-602. The use of the \$5 million mitigation trust funds and cooperation among CARB, the Bay Area Air Quality Management District, and the CEC will reduce the time and funding required to reach the statutory goal of at least 100 publicly available hydrogen fueling stations operating in California. This approach will fund additional stations to set California on the path toward 200 stations.

Summary

For FY 2022–2023, the CEC allocates \$20 million of Clean Transportation Program funds for hydrogen fueling infrastructure, consistent with AB 8.⁴⁷ Stations funded under GFO-19-602 will have larger fueling capacities than most of the stations that the CEC funded early in the program. These stations should be able to provide fueling capability adequate to support more than the number of FCEVs that automakers project in 2028 as reported in CARB's Annual Evaluation. The expected fueling capability will also enable additional FCEV market penetration beyond 2028. However, the CEC, in collaboration with CARB, will continue to monitor the market.

California is on track to meet the 100-station goal set by AB 8 with the stations funded by the combined expended and committed funds. California is also committed to meeting the 200-station goal set forth by Executive Order B-48-18 with planned investments. With this in mind, the funding allocations of this investment plan include \$10 million (which equates to 20

46 California Air Resources Board [Resolution 18-34](https://www.arb.ca.gov/fuels/lcfs/rulemakingdocs.htm) information is available at <https://www.arb.ca.gov/fuels/lcfs/rulemakingdocs.htm>. This modification to the LCFS provides credits to hydrogen fueling station owners for 15 years, with the credits being calculated based on the nameplate capacity of the station not to exceed 1,200 kilograms of hydrogen per day and the availability (or uptime) of the station relative to the permitted hours of operation. The amount of dispensed hydrogen is subtracted from the calculation of HRI credits so that credits are not double earned.

47 California Health and Safety Code Section 43018.9.

percent of the expected funds for the Clean Transportation Program in 2023) for hydrogen fueling infrastructure for the final half-year (FY 2023–2024) of the Clean Transportation Program. Looking further ahead, the budget framework proposed by the Governor includes an additional \$60 million to the expansion of hydrogen refueling infrastructure for the subsequent three fiscal years (2023–2024, 2024–2025, and 2025–2026).

Emerging Opportunities

The Emerging Opportunities allocation will support fueling infrastructure for emerging vehicle segments and the development of vehicle–grid integration products and services. Funded activities may include:

- Zero-Emission Vehicle Infrastructure for Emerging Sectors: Funding to support zero-emission efforts in segments that are in earlier stages of transition to zero-emission, such as aviation, locomotive, and marine vehicles.
- Vehicle–grid integration: Funding to develop and scale charging products that optimize charging in response to customer and grid needs, enable load flexibility, and realize EVs as distributed energy resources.
- Bidirectional Charging: A subset of vehicle–grid integration, bidirectional charging products can enable EVs to discharge energy from onboard batteries to homes, buildings, the grid, or other loads.

Vehicle–grid integration will be particularly important as California continues advancing toward decarbonization. By shifting charging in response to customer and grid needs, the load flexibility enabled by vehicle–grid integration can help reduce renewable curtailment, decrease emissions, shave on-peak consumption, and even provide additional generation during times of electrical system stress. The CEC, CPUC, and utilities are working jointly to develop rates and other compensation mechanisms that promote vehicle–grid integration and offer incentives for customer charging flexibility. Concurrently, industry players are developing products and services that help customers manage their charging and take advantage of these compensation mechanisms.

In July 2022, the CEC held a workshop discussing the market status of vehicle–grid integration and potential funding concepts.⁴⁸ Industry panelists presented developments in the vehicle–grid integration space such as upcoming dynamic rate options, advanced products that help customers manage usage under dynamic rates, and bidirectional charging deployments. The CEC outlined funding concepts, including one that would improve charging load flexibility in response to dynamic grid signals, blueprints for municipal electrification and resilience centers, and additional funding for at-home and bidirectional charging.

48 CEC. July 28, 2022. "[Workshop on Vehicle-Grid Integration Market Status and Funding Concepts](https://www.energy.ca.gov/event/workshop/2022-07/workshop-vehicle-grid-integration-market-status-and-funding-concepts)." Available at <https://www.energy.ca.gov/event/workshop/2022-07/workshop-vehicle-grid-integration-market-status-and-funding-concepts>.

In line with allocations from the Budget Act of 2022 and anticipated future budgets, the CEC expects to allocate \$97.3 million toward emerging opportunities over the next three fiscal years, including \$51.3 million in Fiscal Year 2022–2023.

CHAPTER 5:

Alternative Fuel Production and Supply

Zero- and Near-Zero-Carbon Fuel Production and Supply

The California transportation sector relies largely on petroleum, which accounts for 89 percent of ground transportation fuel used in the state.⁴⁹ Low-carbon substitute fuels that can displace the roughly 14 billion gallons of petroleum-based gasoline and 3.3 billion gallons of petroleum-based diesel used per year in California have the potential to provide immediate and long-term opportunities to reduce GHG emissions and criteria air pollution.⁵⁰ Biofuels — defined in this document as nonpetroleum diesel substitutes, gasoline substitutes, and biomethane — represent the largest existing stock of alternative fuel in the California transportation sector.⁵¹ In addition, production of and demand for renewable hydrogen are expected to increase in the coming years as more hydrogen fuel cell electric vehicles are sold and applications in other sectors expand.

The carbon intensity of renewable fuels can vary significantly depending on the pathway, which accounts for the specific feedstock and production process of the fuel. CARB provides carbon intensity values for most transportation fuels as part of the LCFS. The carbon intensity value accounts for the life-cycle GHG emissions of the fuel, including production, transportation, and consumption, and is reported in grams of carbon dioxide equivalent greenhouse gases per megajoule (gCO₂e/MJ).⁵² Maximizing renewable fuel production from the lowest carbon pathways represents a key opportunity to reduce near-term GHG emissions in combustion engines and fuel cell electric vehicles. Clean Transportation Program funding uniquely drives innovative biofuel production plants to California, which may otherwise come from out of state.

Fuel Type Overview

Renewable Diesel and Biodiesel

In 2021, renewable diesel was the most common diesel substitute in California, with 1.049 billion diesel-gallon equivalents sold and nearly doubling in use compared to 2019 usage.⁵³

49 Based on analysis from California Energy Commission Energy Assessments Division, with data from the California Department of Motor Vehicles.

50 Ibid.

51 The term “gasoline substitutes” refers to any liquid fuel that can directly displace gasoline in internal combustion engines, including ethanol and renewable drop-in gasoline substitutes. The term “diesel substitutes” refers to any liquid fuel that can significantly displace diesel fuel, including biodiesel and renewable diesel. These definitions differ from similar terms used by CARB under the LCFS, which are broader and include fuels such as electricity, natural gas, and hydrogen.

52 Consult the glossary for the definition of “megajoule.”

53 California Air Resources Board. April 29, 2022. “[CARB Data Dashboard](https://ww3.arb.ca.gov/fuels/lcfs/dashboard/dashboard.htm).” Available at <https://ww3.arb.ca.gov/fuels/lcfs/dashboard/dashboard.htm>.

Renewable diesel that meets the fuel specification requirements of ASTM International Standard D975 is fungible, or interchangeable, with conventional diesel fuel and can be used in existing diesel engines and fuel infrastructure. Biodiesel is another diesel substitute; however, unlike renewable diesel, it is not fully fungible with conventional diesel fuel.

Renewable diesel and biodiesel have carbon intensities up to 92 percent lower than diesel fuel, depending on the pathway used.⁵⁴ Together, renewable diesel and biodiesel accounted for about 45 percent of LCFS credits in 2021.⁵⁵ Of the 3.6 billion gallons of diesel fuel consumed in California in 2020, about 855 million (or 24 percent) were from low-carbon biodiesel or renewable diesel.

Within California, there are limited distribution methods for the different types of low-carbon fuels. As LCFS continues to encourage increased production and supply of low-carbon fuels in California, the infrastructure to distribute low-carbon fuels will have to be in place to meet California's low-carbon fuel production potential and consumption needs, as well as accomplish California's greenhouse gas emission goals. Two blending projects were funded under the CEC's recent solicitation GFO-20-609 for fuel production to address bottleneck issues associated with the integration of renewable diesel into conventional diesel as a part of emission reduction efforts in heavy-duty vehicle applications that have limited ZEV options.

Ethanol and Renewable Gasoline

Ethanol is the only widely available gasoline substitute for gasoline-powered vehicles and is used primarily as a fuel additive with gasoline. California limits ethanol blends in conventional gasoline to 10 percent, although the U.S. EPA permits blends of up to 15 percent for a conventional engine and 85 percent for a flex-fuel engine. Though ethanol continues to be the largest volume alternative fuel used in California, in-state ethanol use has not substantially changed since 2011.

Renewable gasoline is a potential gasoline substitute, although it is undergoing research and development and is not commercially available. Renewable crude oil products can serve as a fully fungible substitute for petroleum crude oil at refineries. Renewable crude oil is in the research and development phase.

Biomethane

Biomethane (or "renewable natural gas") is a commercially mature biofuel that serves as a low- or negative-carbon substitute for conventional natural gas. Biomethane from anaerobic digestion of wastewater sludge can reduce GHG emissions by as much as 92 percent below diesel. Biomethane derived from high-solids anaerobic digestion of prelandfill food and green wastes has a carbon intensity around *negative* 23 gCO₂e/MJ (or roughly 125 percent below diesel), indicating that the pathway contributes a net GHG emission reduction. Biomethane

54 Compared to California diesel (102.01 gCO₂e/MJ), with biodiesel carbon intensity as low as 8.63 gCO₂e/MJ and renewable diesel carbon intensity as low as 19.51 gCO₂e/MJ. Based on data from the [LCFS Fuel Pathway Table](https://www.arb.ca.gov/fuels/lcfs/fuelpathways/current-pathways_all.xlsx) (August 25, 2022), available at https://www.arb.ca.gov/fuels/lcfs/fuelpathways/current-pathways_all.xlsx.

55 California Air Resources Board. October 31, 2021. "[LCFS Quarterly Data Spreadsheet.](https://www.arb.ca.gov/fuels/lcfs/lrtqsummaries.htm)" Available at [http://www.arb.ca.gov/fuels/lcfs/lrtqsummaries.htm](https://www.arb.ca.gov/fuels/lcfs/lrtqsummaries.htm).

derived from dairy biogas has the lowest carbon intensity approved under the LCFS — about negative 377 gCO₂e/MJ.⁵⁶

The potential of low-carbon biomethane to replace natural gas in the transportation sector is based on the availability of waste-based feedstocks, and estimates vary on technical and economical availability. The University of California, Davis, Institute of Transportation Studies indicated an economically feasible potential of roughly 623 million diesel gallon equivalents (DGE). According to the U.S Department of Energy's *2016 Billion Ton Report*, slightly higher estimates indicate that waste residues from in-state dairies, landfills, food diversion, and wastewater treatment plants could be used to produce biomethane in volumes ranging from 750 million to 1.2 billion gallons DGE per year. This amount would displace 23 to 36 percent of the on-road diesel fuel consumption in California.⁵⁷ However, based on other studies provided by NREL, the technical availability (under preferable market conditions) could be four times higher.⁵⁸ Regardless, given the limited availability, the carbon reduction benefits from biomethane need to be prioritized for specific transportation applications (as well as other purposes), where appropriate.

Renewable Hydrogen

Senate Bill 1505 (Lowenthal, Chapter 877, Statutes of 2006) requires that at least 33.3 percent of hydrogen used for transportation come from renewable sources. As part of the Low Carbon Fuel Standard credits for ZEV infrastructure that took effect in January 2019, qualifying stations must have a renewable content of 40 percent or higher. Renewable hydrogen is typically produced through steam reformation of biomethane or through electrolysis using water and renewable electricity. Other renewable hydrogen production pathways are also being explored through research and development efforts globally.

According to the California Independent System Operator, increasing amounts of renewable power generation may result in electricity oversupply as California renewable power requirements grow from 33 to 50 percent.⁵⁹ Renewable hydrogen production is being investigated as a viable technology for beneficial use of this surplus renewable energy. While the capital costs of electrolyzers have decreased, the overall cost of renewable hydrogen remains high and is not expected to be competitive with fossil-based hydrogen for 10 years; however, the use of renewable electricity could contribute to reductions in capital costs for renewable hydrogen production. Additional cost-reduction methods include improvements in

56 California Air Resources Board. August 25, 2022. "[LCFS Pathway Certified Carbon Intensities.](https://www.arb.ca.gov/fuels/lcfs/fuelpathways/pathwaytable.htm)" Available at <https://www.arb.ca.gov/fuels/lcfs/fuelpathways/pathwaytable.htm>.

57 U.S. Department of Energy. July 2016. [2016 Billion Ton Report: Advancing Domestic Resources for a Thriving Bioeconomy.](https://www.energy.gov/sites/prod/files/2016/12/f34/2016_billion_ton_report_12.2.16_0.pdf) Available at https://www.energy.gov/sites/prod/files/2016/12/f34/2016_billion_ton_report_12.2.16_0.pdf.

58 California Energy Commission staff. 2017. [2017 Integrated Energy Policy Report.](https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2017-integrated-energy-policy-report) California Energy Commission. Publication Number: CEC-100-2017-001-CMF. Available at <https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2017-integrated-energy-policy-report>.

59 California Independent System Operator. "[Managing Oversupply.](http://www.caiso.com/informed/Pages/ManagingOversupply.aspx)" <http://www.caiso.com/informed/Pages/ManagingOversupply.aspx>.

how hydrogen is treated, stored, and delivered, as well as economies of scale afforded by expanding applications of hydrogen fuel.

Clean Transportation Program Funding to Date

To date, the CEC has awarded more than \$216 million to low-carbon fuel production projects. These awards are summarized by fuel type in Table 10.

Table 10: Summary of Clean Transportation Program Low-Carbon Fuel Production Awards as of July 22, 2022

Fuel Type	Qualifying Proposals* Submitted	Funds Requested by Qualifying Proposals* (in Millions)	Awards Made	Funds Awarded (in Millions)
Gasoline Substitutes	28	\$71.8	14	\$31.8
Diesel Substitutes	62	\$187.1	26	\$75.1
Biomethane	71	\$221.4	33	\$92.6
Renewable Hydrogen	13	\$38.7	5	\$16.9
Total	174	\$519	78	\$216.4

Source: California Energy Commission. Does not include results from GFO-19-601, which was funded through a separate source of funding called the California Climate Investment Fund. *The term “qualifying proposals” refers to proposals that received at least a passing score.

The Clean Transportation Program investments into low-carbon fuel production are typically focused on either smaller precommercial projects or large community- or commercial-scale projects. The smaller, precommercial projects have typically focused on transformative technology solutions that have the potential to increase yields, productivity, or cost-effectiveness of low-carbon fuel production. The CEC funds these pilot and demonstration projects with the expectation that, after successful operations at this scale, the technology will be suitable for commercial use. These precommercial projects are focused on advanced new technologies and approaches that can subsequently be expanded into wider markets.

In April 2021, the CEC released GFO-20-608 titled “Ultra-Low Carbon Fuel Production: Commercial-Scale Production Facilities & Blending Infrastructure.” This solicitation was an offer to fund ultra-low carbon transportation fuel production at new and existing advanced fuel production plants and fuel blending infrastructure projects. The solicitation provided \$9 million from the Clean Transportation Program, and in November 2021, the CEC issued a NOPA of five grants to fully use the funding.

Also in April 2021, the CEC released GFO-20-609 titled “Renewable Hydrogen Transportation Fuel Production.” This solicitation was an offer to fund the construction or expansion (or both) of hydrogen production facilities that produce renewable hydrogen transportation fuel using in-state renewable resources. The solicitation provided \$9 million from the Clean Transportation Program, and in February 2022, the CEC issued a NOPA for three grants to fully use the funding.

In the future, the CEC expects to provide funding to low-carbon fuel production with an emphasis on fuels and feedstocks that support several overarching California goals, including GHG emissions reductions and wildfire mitigation. The California Natural Resources Agency's 2021 California Wildfire and Forest Resilience Action Plan⁶⁰ recommends expanding forest thinning operations to 1 million acres by 2025. Creating a beneficial low-carbon fuel product using forest biomass may enhance the economics of forest thinning and reduce net carbon emissions.

In July 2022, the CEC held a staff workshop to present and collect stakeholder feedback on funding concepts related to zero- and near-zero-carbon fuel production and supply.⁶¹ CEC staff expects to incorporate feedback from the workshop into future funding opportunities.

Other Sources of Funding

Other state and federal programs provide support and incentives to low-carbon fuel producers. For instance, from 2017 to 2020, the California Department of Food and Agriculture (CDFA) has awarded more than \$174 million for anaerobic digesters at dairies through the Dairy Digester Research and Development Program (DDRDP). In the most recent 2022 DDRDP funding opportunity, CDFA received 27 applications totaling more than \$35.3 million in requested funding.

In October 2020, the CDFA awarded nearly \$25.4 million in grant funding to methane reduction projects across the state. These projects, part of the DDRDP and the Alternative Manure Management Program (AMMP), will reduce GHG emissions from manure on California dairy and livestock farms. An additional \$32 million was made available in 2022 under the AMMP, with 62 applications received totaling more than \$42 million. Projects for 2022 funding opportunities under the DDRDP and AMMP will be available in fall 2022. However, to date the DDRDP has successfully completed 80 percent of the 117 projects already funded, and the AMMP has completed 83 percent of its 113 awarded projects.

On the federal level, the Higher Blend Infrastructure Incentive Program has provided incentives to increase the availability of higher blends of biofuels such as ethanol and biodiesel through transportation fueling and fuel distribution facilities. This program supports efforts in California to increase access to fuels with a lower carbon intensity than conventional fuels. Since the debut of the Higher Blends Infrastructure Incentive Program in August 2020, USDA has invested more than \$77.8 million in projects expected to increase biofuels sales by 1.2 billion gallons annually.⁶²

60 California Natural Resources Agency. 2021. [California's Wildlife and Forest Resilience Action Plan](https://www.fire.ca.gov/media/ps4p2vck/californiawildfireandforestresilienceactionplan.pdf), <https://www.fire.ca.gov/media/ps4p2vck/californiawildfireandforestresilienceactionplan.pdf>.

61 CEC. July 14, 2022. "[Staff Workshop to Discuss Zero- and Near-Zero-Carbon Fuel Production and Supply Funding Concepts](https://www.energy.ca.gov/event/workshop/2022-07/staff-workshop-discuss-zero-and-near-zero-carbon-fuel-production-and-supply)." Available at <https://www.energy.ca.gov/event/workshop/2022-07/staff-workshop-discuss-zero-and-near-zero-carbon-fuel-production-and-supply>.

62 USDA. August 2022. "[Higher Blends Infrastructure Incentive Program](https://www.rd.usda.gov/sites/default/files/fact-sheet/508_rd_factsheet_hbiip.pdf)." Available at https://www.rd.usda.gov/sites/default/files/fact-sheet/508_rd_factsheet_hbiip.pdf.

In addition, the LCFS and the Renewable Fuel Standard (the federal program that requires transportation fuel sold in the United States to contain a minimum volume of renewable fuels) can support low-carbon fuel producers by creating markets for carbon credits and renewable fuels. The incentives earned through the LCFS provide steady financial support to low-carbon fuel producers, distributors, and blenders in California. In 2019, about 81.3 percent of LCFS credits were granted for biofuels including biomethane, ethanol, biodiesel, and renewable diesel.⁶³ These credits equate to an incentive of more than \$1.36 billion for biofuel producers and retailers if sold at the average credit price of \$191 for 2019.⁶⁴ CARB and CEC staff expects that the LCFS will serve as the state's primary source of financial support for low-carbon fuel production and distribution.

Summary

The CEC will continue to examine the best use of funds in these categories through a public stakeholder process and backed up with data and analysis. Several factors will be considered, including the near-term petroleum and GHG emission reduction potential of low-carbon, drop-in gasoline or petroleum replacement, the need to decarbonize hydrogen production, and market conditions. There may also be opportunities to expand or otherwise improve the limited distribution of liquid biofuels (whether for drop-in substitutes or blending).

Some fuel types and pathways have shown minimal improvement in carbon intensity or cost-effectiveness in recent funding solicitations, which may indicate that the technology or process has fully matured. The CEC may evaluate renewable fuel types and production pathways to determine when state incentives are no longer necessary and explore opportunities to use feedstocks that have not previously been considered due to technology constraints.

For FY 2022–2023, the CEC allocates \$10 million in Clean Transportation Program funding for zero- and near-zero-carbon fuel production and supply. Funding priorities for this allocation may include increasing the in-state production of low-carbon fuels from waste-based feedstocks such as woody biomass from forest or agricultural sources, supporting upstream blending infrastructure, and improving the state's supply of renewable hydrogen from renewable electricity or biomethane.

63 California Air Resources Board. March 26, 2021. "[LCFS Quarterly Data Spreadsheet.](http://ww3.arb.ca.gov/fuels/lcfs/dashboard/figure2_053120.xlsx)" Available at http://ww3.arb.ca.gov/fuels/lcfs/dashboard/figure2_053120.xlsx.

64 Ibid.

CHAPTER 6:

Related Opportunities

Manufacturing

Electric vehicles were the number one California export in 2020.⁶⁵ California is also home to more than 360 companies with 70,000 employees that work directly on zero-emission transportation, including vehicles, components, infrastructure, and research.⁶⁶ California has 43 ZEV-related manufacturers and leads the nation in ZEV manufacturing jobs.

The range of ZEV platforms includes light-, medium-, and heavy-duty on- and off-road vehicles. Some of the Clean Transportation Program-funded companies are completely vertically integrated, such as Proterra and Zero Motorcycles. Other companies manufacture parts and components, such as electric vehicle chargers, electric powertrains, and battery control systems, as represented by ChargePoint, Motiv Power Systems, and Freewire Technologies. Support for California's ZEV supply chain companies can be seen by the incentives offered through the California Alternative Energy and Advanced Transportation Financing Authority, California Competes, and the CEC's Clean Transportation Program.

Since the inception of the Clean Transportation Program, five solicitations have been issued under the manufacturing category totaling \$55 million for 27 projects. Clean Transportation Program grants have been invaluable in attracting companies to California, leveraging the state's policy objectives, scaling growth in-state and abroad, and creating jobs.

Some California ZEV manufacturers have established formal worker relationships with organized labor. GILLIG, a battery-electric bus manufacturer in Livermore (Alameda County), is partnered with Teamsters Local 853 and Auto, Marine & Specialty Painters Local Union 1176 since 1976 and the 1960s, respectively. BYD Coach and Bus in Lancaster (Los Angeles County) has established an apprenticeship program with Sheet Metal Workers Local 105 and Antelope Valley College. Proterra Inc. in the City of Industry (Los Angeles County) announced in November 2019 it's joining the United Steelworkers. Manufacturing jobs are critical to disadvantaged communities, low-income communities, and small businesses. More than 800 manufacturing jobs have been created or retained under the Clean Transportation Program manufacturing portfolio.

The Budget Act of 2021 provides \$125 million of general fund money in Fiscal Year 2021–2022 for the CEC to invest in manufacturing grants to "increase in-state manufacturing of zero-emission vehicles, zero-emission vehicle components, and zero-emission vehicle charging or

65 U.S. Census Bureau. "[State Exports From California](https://web.archive.org/web/20211105091310/https://www.census.gov/foreign-trade/statistics/state/data/ca.html)." Archived page available at <https://web.archive.org/web/20211105091310/https://www.census.gov/foreign-trade/statistics/state/data/ca.html>.

66 CALSTART. January 2021. "[CALSTART's California ZEV Jobs Study](https://calstart.org/wp-content/uploads/2021/02/CA-ZEV-Jobs-Study-Final-0203.pdf)." Available at <https://calstart.org/wp-content/uploads/2021/02/CA-ZEV-Jobs-Study-Final-0203.pdf>.

refueling equipment.” An additional \$125 million for the same activity was included in the Governor’s budget plan for Fiscal Year 2022–2023.

The Zero Emission Transportation Manufacturing grant funding opportunity initially proposed \$60 million for projects to increase in-state manufacturing of ZEVs, ZEV components, EV batteries, and ZEV infrastructure.⁶⁷ A NOPA for this agreement was released August 24, 2022, announcing plans for awards totaling more than \$180 million among 12 projects, as indicated in Table 11.

Table 11: Summary of Proposed Awards for ZEV and ZEV-Related Manufacturing Under GFO-21-605

Project Category	Applications Received	Funding Requested	Proposed Awards	Proposed Funding	Proposed Match
Complete ZEVs	15	\$183 million	6	\$112 million	\$134 million
ZEV Infrastructure	2	\$18 million	1	\$15 million	\$15 million
ZEVs and ZEV Infrastructure Components	2	\$16 million	1	\$9 million	\$17 million
ZEV and ZEV Infrastructure Batteries	7	\$94 million	4	\$49 million	\$102 million
TOTAL	26	\$311 million	12	\$185 million	\$268 million

Source: CEC

Separately, the ZEV Battery Manufacturing Block Grant solicitation, released in August 2022, offers \$25 million in grant funds for projects that will increase in-state manufacturing of ZEV batteries. Additional funds may be allocated if they become available. An implementer selected through a competitive solicitation will award these funds to manufacturers through a process in collaboration with the CEC. The range of available subgrant award amounts, for example, \$1 million to \$10 million, will be decided upon by the implementer in consultation with the CEC during the development of their subsolicitation. A preapplication workshop for this solicitation was held on September 28, 2022.⁶⁸

Summary

Meeting the state’s goals of zero-emission transportation while growing the number of high-quality manufacturing jobs will continue to be hallmarks of CTP manufacturing solicitations. As such, maintaining a steady and consistent flow of public capital will help lower the risk for manufacturers establishing and scaling up operations in California.

67 CEC. “[GFO-21-605 - Zero-Emission Transportation Manufacturing](https://www.energy.ca.gov/solicitations/2022-03/gfo-21-605-zero-emission-transportation-manufacturing).” Available at <https://www.energy.ca.gov/solicitations/2022-03/gfo-21-605-zero-emission-transportation-manufacturing>.

68 CEC. “[GFO-21-606 - Zero-Emission Vehicle Battery Manufacturing Block Grant](https://www.energy.ca.gov/solicitations/2022-08/gfo-21-606-zero-emission-vehicle-battery-manufacturing-block-grant).” Available at <https://www.energy.ca.gov/solicitations/2022-08/gfo-21-606-zero-emission-vehicle-battery-manufacturing-block-grant>.

Workforce Training and Development

Investments into workforce training and development are critical to the advancement of ZEV markets. More than \$42 million has been invested in workforce projects for more than 22,000 trainees, faculty, and trainers. Workforce investments are driven by state policies and priorities, needs of the ZEV and ZEV infrastructure market, job placement, and economic sustainability in priority communities, which include:

- Directing workforce investments and accruing benefits to disadvantaged and low-income communities.
- Paring workforce projects in ZEV deployment areas.
- Requiring ZEV workforce plans for solicitations and incentives.
- Building new partnerships for co-investments, job growth, and community workforce priorities.
- Supporting high-road principles, job quality, and job quantity.
- Addressing workforce, market trends, and growth in all ZEV and ZEV infrastructure industries.

The CEC's recent IDEAL (Inclusive, Diverse, Equitable, Accessible, and Local) ZEV Workforce Pilot solicitation provided more than \$6.5 million in funding for community-based workforce training and development projects that support ZEVs and ZEV infrastructure in California. Fourteen projects were approved that will grow new ZEV workforces with high-road principles that can be replicated in rural and priority communities. Project examples include:

- **Tribal ZEV Training Project** — The National Indian Justice Center (NIJC) will partner with 23 California tribes and the Electric Vehicle Infrastructure Training Program (EVITP) to develop ZEV and EV charging curriculum, conduct training, and create a workforce pipeline from tribal communities to into ZEV industries and occupations.
- **South Valley ZEV Talent Pipeline Project** – Kern Community College District, in partnership with the Kern Electrical Apprenticeships Program, the National Electrical Contractors Association, the Kern Black Chamber of Commerce, ChargerHelp! and others, will establish the South Valley ZEV Talent Pipeline project. This project will develop a workforce to support the installation, operations, maintenance of electric vehicle charging infrastructure for new employee training and incumbent worker training.
- **ZEV Service Technician Educational Pathway Project** — Fresno City College will partner with three Fresno County high schools to establish a dual-enrollment program, conduct classroom and lab training on EVs, and administer ZEV Internships with local automotive dealerships.
- **ZEV Engineering Workforce Pilot (Hydrogen)** — California State University, Los Angeles (CSULA), is uniquely positioned to implement training, internship, and job placement programs by the presence of its Hydrogen Research and Fueling Facility (HRFF) on campus. Curricula and hands-on fueling station instruction will be developed

for ZEV engineering that will benefit students from priority communities where this project is located and the subsequent high-road jobs that await graduates.

In 2021, Senate Bill 589 (Hueso, Chapter 732, Statutes of 2021) was signed by Governor Newsom. SB 589 requires, as part of the AB 2127 statewide charging infrastructure assessment, that the CEC “identify workforce development and training resources needed to meet these goals,” which will be addressed in the CEC’s upcoming update to the AB 2127 report. Findings from this SB 589 analysis will further inform funding allocations and implementation decisions for workforce training, preapprenticeships, and apprenticeship support.

Summary

Based on the state’s ZEV regulations, increased deployment of ZEVs and ZEV infrastructure, status of approved preapprenticeship and apprenticeship programs, and the need to meet critical ZEV and ZEV infrastructure training needs, especially in priority communities, the CEC allocates \$5 million for workforce training and development in FY 2022–2023. The CEC will continue to explore new public-private partnerships and leverage limited resources to determine how Clean Transportation Program funding can best be invested to maximize the benefits of this funding. Workforce training and development investments will continue to support priority communities, meet ZEV industry needs, create workforce partnerships, and advance job quality and quantity across the entire ZEV workforce ecosystem.

GLOSSARY

AIR POLLUTANT — Amounts of foreign or natural substances occurring in the atmosphere that may result in adverse effects to humans, animals, vegetation, or materials or any combination thereof.

ANAEROBIC DIGESTION — A biological process in which biodegradable organic matter is broken down by bacteria into biogas, which consists of methane (CH₄), carbon dioxide (CO₂), and trace amounts of other gases. The biogas can be further processed into a transportation fuel or combusted to generate heat or electricity.

BATTERY-ELECTRIC VEHICLE — A type of electric vehicle that derives power solely from the chemical energy stored in rechargeable batteries.

BIODIESEL — A transportation fuel for use in diesel engines that is produced through the transesterification of organically derived oils or fats. Transesterification is a chemical reaction between oil and alcohol that forms esters (in this case, biodiesel) and glycerol.

BIOMETHANE — A pipeline-quality gas that is fully interchangeable with conventional natural gas and can be used as a transportation fuel to power natural gas engines. Biomethane is most commonly produced through anaerobic digestion or gasification using various biomass sources. Also known as "renewable natural gas (RNG)."

BRITISH THERMAL UNIT (Btu) — A unit of heat energy. One Btu is equal to the amount of energy required to raise the temperature of 1 pound of water by 1 degree Fahrenheit at sea level. One Btu is equivalent to 252 calories, 778 foot-pounds, 1,055 joules, or 0.293 watt-hours.

CALENVIROSCREEN — A screening method that can be used to help identify California communities that are disproportionately burdened by several sources of pollution. The CalEnviroScreen tool combines different types of census tract-specific information into a score to determine which communities are the most burdened or "disadvantaged."

CALSTART — A national nonprofit consortium that provides trusted third-party performance analysis and evaluation of clean vehicles, technologies, and fuels.

CARBON DIOXIDE EQUIVALENT — A measure used to compare emissions from various greenhouse gases based upon the related global warming potential. The carbon dioxide equivalent for a gas is derived by multiplying the mass of the gas by the associated global warming potential.

CARBON INTENSITY — A measure of greenhouse gas emissions by weight per unit of energy. A common measure of carbon intensity is grams of carbon dioxide equivalent greenhouse gases per megajoule of energy (gCO₂e/MJ).

CRITERIA AIR POLLUTANT — An air pollutant for which acceptable levels of exposure can be determined and for which the U.S. Environmental Protection Agency has set an ambient air quality standard. Examples include ozone (O₃), carbon monoxide (CO), nitrogen oxides (NO_x), sulfur oxides (SO_x), and particulate matter (PM₁₀ and PM_{2.5}).

DISADVANTAGED COMMUNITIES — Disadvantaged communities refers to the areas throughout the state that most suffer from a combination of economic, health, and environmental burdens. These burdens include poverty, high unemployment, air and water pollution, presence of hazardous wastes, as well as high incidence of asthma and heart disease.

DIRECT-CURRENT FAST CHARGER — Equipment that provides charging through a direct-current plug, typically at a rate of 50 kilowatts or higher.

ELECTRIC VEHICLE — A vehicle that uses an electric propulsion system. Examples include battery-electric vehicles, hybrid electric vehicles, and fuel cell electric vehicles.

ELECTROLYSIS — A process by which a chemical compound is broken down into associated elements by passing a direct current through it. Electrolysis of water, for example, produces hydrogen and oxygen.

EQUITY — Refers to the fair treatment, meaningful involvement, and investment of resources through clean transportation programs, incentives, and processes for all Californians so that race, color, national origin, or income level are not barriers to increased opportunities, benefits, and sustainability.

ETHANOL — A liquid that is produced chemically from ethylene or biologically from the fermentation of various sugars from carbohydrates found in agricultural crops and cellulosic residues. Used in the United States as a gasoline octane enhancer and oxygenate, or in higher concentration (E85) in flex-fuel vehicles.

FEEDSTOCK — Any material used directly as a fuel or converted into fuel. Biofuel feedstocks are the original sources of biomass. Examples of biofuel feedstocks include corn, crop residue, and waste food oils.

FLEX-FUEL VEHICLE — A vehicle that uses an internal combustion engine that can operate on alcohol fuels (methanol or ethanol), regular unleaded gasoline, or any combination of the two from the same fuel tank.

FUEL CELL — A device capable of generating an electrical current by converting the chemical energy of a fuel (for example, hydrogen) directly into electrical energy.

FUEL CELL ELECTRIC VEHICLE — A type of electric vehicle that derives power from an onboard fuel cell.

GREENHOUSE GAS — Any gas that absorbs infrared radiation in the atmosphere. Common examples of greenhouse gases include water vapor, carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), halogenated fluorocarbons (HCFCs), ozone (O₃), perfluorinated carbons (PFCs), and hydrofluorocarbons (HFCs).

HIGH-SOLIDS ANAEROBIC DIGESTION — High-solids anaerobic digestion process is one in which the percentage of total solids of the feedstock is greater than 15 percent and little or no water is added to the digester.

HYBRID VEHICLE — A vehicle that uses two or more types of power, most commonly using a combustion engine together with an electric propulsion system. Hybrid technologies typically

expand the usable range of electric vehicles beyond what an electric vehicle can achieve with batteries alone and increase fuel efficiency beyond what an internal combustion engine can achieve alone.

IBANK — The California Infrastructure and Economic Development Bank (IBank) was created in 1994 to finance public infrastructure and private developments.

INVESTOR-OWNED UTILITY — A private company that provides a utility, such as water, natural gas, or electricity, to a specific service area. The California Public Utilities Commission regulates investor-owned utilities that operate in California.

LANDFILL GAS — Gas generated by the natural degradation and decomposition of municipal solid waste by anaerobic microorganisms in sanitary landfills. The gases produced, carbon dioxide and methane, can be collected by a series of low-level pressure wells and processed into a medium-Btu gas that can be further processed into a transportation fuel or combusted to generate heat or electricity.

LEVEL 1 CHARGER — Equipment that provides charging through a 120-volt alternative-current plug.

LEVEL 2 CHARGER — Equipment that provides charging through a 240-volt (typical in residential applications) or 208-volt (typical in commercial applications) alternative-current plug. This equipment requires a dedicated 40-amp circuit.

LOW-INCOME COMMUNITIES/HOUSEHOLDS — Defined as the census tracts and households, respectively, that are either at or below 80 percent of the statewide median income, or at or below the threshold designated as low-income by the California Department of Housing and Community Developments 2018 Income Limits.

METRIC TON — A unit of weight equal to 1,000 kilograms (2,205 pounds).

MEGAJoule — One million joules. A joule is a unit of work or energy equal to the amount of work done when the point of application of force of 1 newton is displaced 1 meter in the direction of the force. One British thermal unit is equal to 1,055 joules.

METHANE — A light hydrocarbon that is the main component of natural gas. It is the product of the anaerobic decomposition of organic matter or enteric fermentation in animals and is a greenhouse gas. The chemical formula is CH₄.

MICROMETER — One millionth of a meter, equal to roughly 0.00004 inches.

NATIONAL AMBIENT AIR QUALITY STANDARDS — A set of standards established by the U.S. EPA for six criteria air pollutants, measured by the amount of each pollutant for a specified period.

NATURAL GAS — A hydrocarbon gas found in the earth composed of methane, ethane, butane, propane, and other gases.

NO_x — Oxides of nitrogen, a chief component of air pollution that is commonly produced by the burning of fossil fuels.

OVERGENERATION — A condition that occurs when total electricity supply exceeds total electricity demand. This condition may negatively affect the reliable operation of the regional, state, or interstate electrical grid.

PARTICULATE MATTER — Any material, except pure water, that exists in a solid or liquid state in the atmosphere. The size of particulate matter can vary from coarse, wind-blown dust particles to fine-particle combustion products.

PATHWAY — A descriptive combination of three components including feedstock, production process, and fuel type.

PLUG-IN ELECTRIC VEHICLE — A type of vehicle that is equipped with a battery than can be recharged from an external source of electricity. It may or may not also have an internal combustion engine.

PLUG-IN HYBRID ELECTRIC VEHICLE — A type of hybrid vehicle that is equipped with a larger, more advanced battery that can be recharged from an external source of electricity. This larger battery allows the vehicle to be driven on battery power alone, gasoline fuel alone, or a combination of electricity and gasoline.

VEHICLE–GRID INTEGRATION – Policies, technologies, and strategies that help coordinate vehicle charging with both customer mobility needs and grid needs. Examples of vehicle–grid integration include managed one-way charging, bidirectional charging, and automated load management systems.

ZERO-EMISSION VEHICLE — A vehicle that produces no pollutant emissions from the onboard source of power.

APPENDIX A:

List of Acronyms

AB	Assembly Bill
AMMP	Alternative Manure Management Program
AQIP	Air Quality Improvement Program
BEV	battery-electric vehicle
CALeVIP	California Electric Vehicle Infrastructure Project
CARB	California Air Resources Board
CCS	Combined Charging System
CEC	California Energy Commission
CMO	Clean Mobility Options
CO ₂ e	carbon dioxide-equivalent greenhouse gases
CPUC	California Public Utilities Commission
CVRP	Clean Vehicle Rebate Project
DC	direct current
DDRDP	Dairy Digester Research and Development Program
DGE	diesel gallon-equivalent
EVs	electric vehicles
EVCS	electric vehicle charging station
EVI-Pro	Electric Vehicle Infrastructure Projections
EVITP	Electric Vehicle Infrastructure Training Program
FCEV	fuel cell electric vehicle
FY	fiscal year
GFO	grant funding opportunity
GGRF	Greenhouse Gas Reduction Fund
gCO ₂ e/MJ	grams of carbon dioxide-equivalent greenhouse gases per megajoule
GO-Biz	California Governor's Office of Business and Economic Development
GHG	greenhouse gas
HVIP	Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project
HRI	hydrogen fueling infrastructure
IBank	Infrastructure and Economic Development Bank
LCFS	Low Carbon Fuel Standard
MJ	megajoule
NAAQS	National Ambient Air Quality Standards
NO _x	oxides of nitrogen
NOPA	notice of proposed award
NREL	National Renewable Energy Laboratory
PM _{2.5}	particulate matter, 2.5 micrometers and smaller
PEV	plug-in electric vehicle
PG&E	Pacific Gas and Electric Company
SB	Senate Bill

SCE	Southern California Edison
SDG&E	San Diego Gas & Electric Company
SIP	State Implementation Plan
U.S. EPA	United States Environmental Protection Agency
ZEV	zero-emission vehicle