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COMMISSION REPORT

2021–2023 Investment Plan Update for the Clean Transportation Program

December 2021 | CEC-600-2021-038-CMF

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ABSTRACT

The *2021–2023 Investment Plan Update for the Clean Transportation Program* guides the allocation of program funding for Fiscal Years 2021–2023. The California Energy Commission (CEC) reviews the proposed allocations annually and makes adjustments as needed.

This 2021–2023 investment plan covers the thirteenth 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 *Electric Vehicle Charging Infrastructure Assessment* and the *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 2021–2023 investment plan establishes funding allocations based on identified needs and opportunities, including a focus on zero-emission vehicles and infrastructure. The investment plan also prioritizes jobs, economic stimulus, and equity in light of the challenges presented by the COVID-19 pandemic.

This Commission Report represents the last step in developing the *2021–2023 Investment Plan Update* and was adopted at an Energy Commission business meeting on November 15, 2021.

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, renewable gasoline, ethanol, natural gas, federal cost-sharing, disadvantaged communities, workforce, training, sustainability, fueling stations, fuel production, alternative fuel infrastructure, manufacturing, COVID-19

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EXECUTIVE SUMMARY

California has led the nation in combating climate change through aggressive greenhouse gas (GHG) emission reduction goals and innovative funding programs. The California Energy Commission's (CEC) Clean Transportation Program is one of the first transportation-focused grant programs created by the California Legislature to help achieve the state's climate change policies. The program has made significant progress through steady investments designed to transform California's fuel and vehicle types. Now in the thirteenth year, the Clean Transportation Program has provided over $1 billion to projects covering a broad spectrum of alternative fuels and technologies and in communities that can immediately 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, the introduction of hydrogen fuel cell electric vehicles, and a notable increase of in-state production and use of low-carbon alternative fuels. The Clean Transportation Program has supported this emerging revolution in the transportation sector with significant investments in zero-emission vehicle infrastructure and supporting projects and will continue to do so with this *2021–2023 Investment Plan Update*.

The CEC also recognizes the continued effects COVID-19 has had on the health, livelihood, and finances of Californians, especially the most vulnerable. The CEC will prioritize funding opportunities that put Californians back to work in good jobs building out the infrastructure needed for a clean transportation future while promoting equitable access to the benefits of a cleaner transportation system.

Purpose of the Clean Transportation Program

Since 2006, California has set several 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:

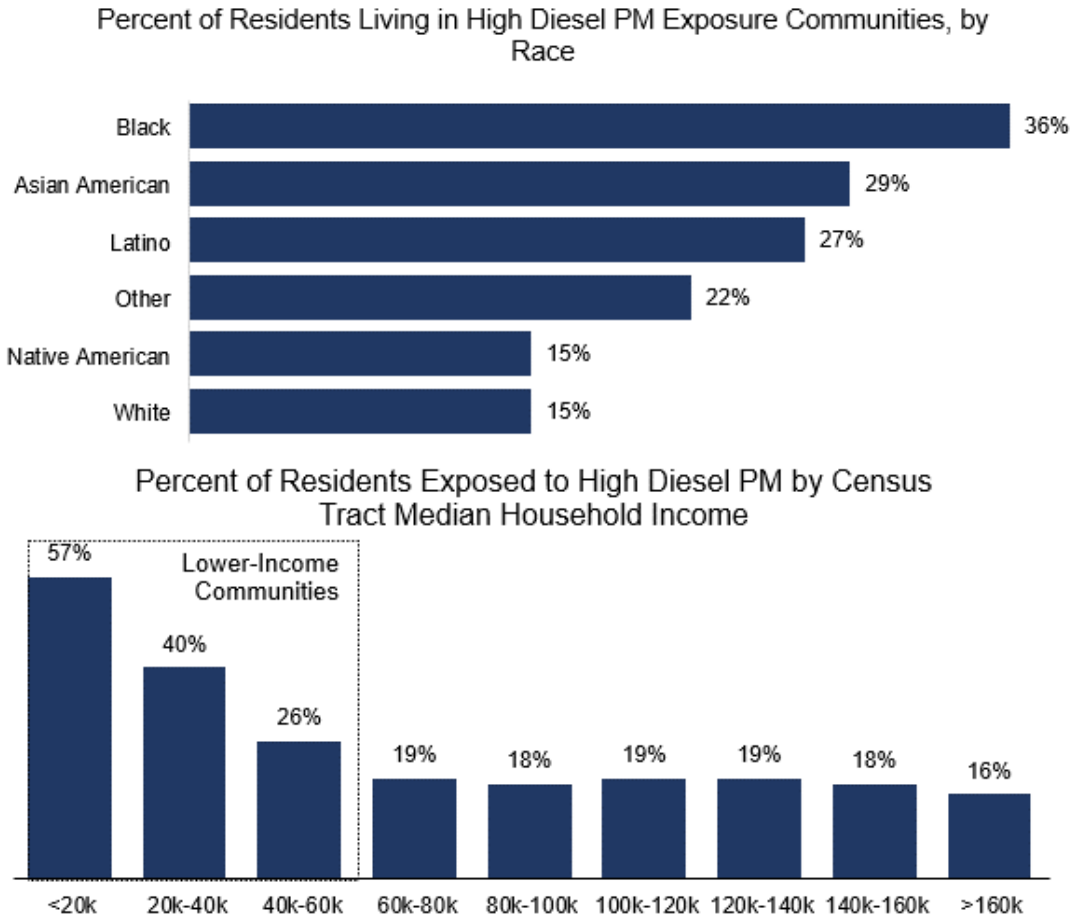
- Reducing GHG emissions to 40 percent below 1990 levels by 2030. (Senate Bill 32 in 2016).
- Reducing short-lived climate pollutant emissions, such as methane, to 40 to 50 percent below 2013 levels by 2030. (Senate Bill 1383 in 2016).
- Achieving a carbon-neutral economy by 2045. (Executive Order B-55-18).
- Setting specific goals to boost the supply of zero-emission vehicles (ZEVs) as well as charging and fueling stations, 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, by 2025. (Executive Order B-48-18).
    - By 2030,

        - Having 5 million ZEVs on the road. (Executive Order B-48-18)
        - Having 8 million ZEVs on the road. (California Air Resources Board estimate to meet Executive Order N-79-20).
    - By 2035,
        - Transitioning 100 percent of new sales of passenger vehicles and trucks to ZEVs. (Executive Order N-79-20).
        - Transitioning 100 percent of 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).
- Ensuring Clean Transportation Program investments benefit communities of color, disadvantaged communities, low-income communities, rural communities, tribal communities, and those living in multifamily housing.

Achieving these goals will require significant state and federal 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.

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 vulnerable and disadvantaged communities (Figure ES-1).

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



To help address these goals, the California Legislature passed Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007). This legislation 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 year. Assembly Bill 1314 (Wieckowski, Chapter 487, Statutes of 2011) reduced 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 are intended to reflect the unique technological and market conditions for each of these fuels and technologies, as well as state goals, policies, and directives.

Last fiscal year, the CEC prepared the first ever multi-year Investment Plan update to provide a more consistent signal about the state's planned clean transportation investments. The update covered investments through the Clean Transportation Program's expiration at the end of 2023. For the second year in a row, the CEC proposes 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. There will be modest annual updates to evaluate whether adjustments should be made to the allocations.

Funds appropriated to the CEC for the Clean Transportation Program are available for encumbrance by the CEC for up to four years from the date of the appropriation and for liquidation up to four years after expiration of the deadline to encumber. Each annual investment plan update allows the program to be responsive and shift funds to capitalize on new opportunities and priorities.

The funding recommendations in this report are guided by, and complementary to, the state's energy policies, executive orders, regulations, and actions by other state agencies. The CEC is committed to ensuring that the Clean Transportation Program funding is complementary to policies and grant programs administered by other agencies, including the California Air Resources Board (CARB) and the California Public Utilities Commission (CPUC).

Highlights of Investments

The Clean Transportation Program has been an essential part in making California a leader in near- and zero-emission transportation. The program has provided grants to ZEV manufacturers, like electric vehicle bus manufacturer Proterra, to help them scale up in-state operations and support economic development. California is home to more than 360 companies with 70,000 employees that work directly on zero-emission transportation, including vehicles, components, infrastructure, and research (CALSTART's California ZEV Jobs Study, January 2021). In addition to jobs, these companies are stimulating the state economy; in 2020, ZEVs were California's number one export.

The Program has also funded the buildout of ZEV infrastructure, helping California create the largest electric vehicle charger and hydrogen refueling networks in the nation. These investments in ZEV infrastructure are critical to support California's growing market for ZEVs. California comprises about half of U.S. ZEV sales and the state is on track to reach 1 million light-duty ZEVs sold in 2021. If California were a country, it would be the sixth-largest market for ZEVs in the world, after China, Germany, the United States as a whole, France, and the United Kingdom (World Economic Forum, February 2021).

Since the first Clean Transportation Program investment plan was released in 2009, the CEC has invested more than $1 billion in projects supporting the advancement and use of alternative fuels and advanced vehicle technologies. Key highlights through August 2021 from the Clean Transportation Program include:

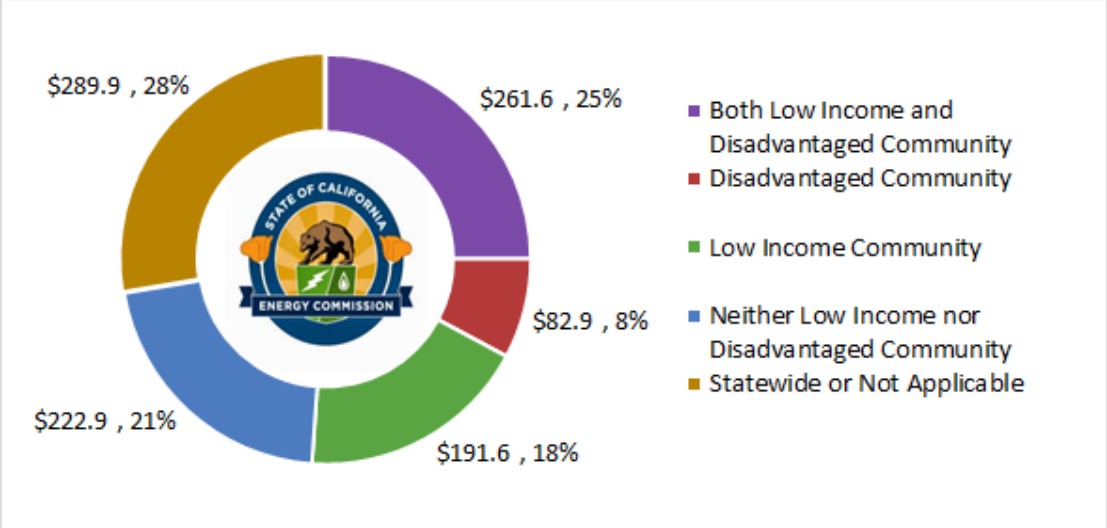
- Installed or planned 15,154 chargers for plug-in electric vehicles, including 4,277 at multi- and single-family homes, 155 for fleets, and 419 at workplaces; 8,454 public and shared private Level 2 and Level 1 chargers; and 1,601 public direct-current (DC) fast-chargers and 248 Level 2 chargers along highway corridors and urban metropolitan 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.
- Funded 83 new or upgraded publicly available hydrogen-fueling stations, and approved funding for an additional 73 stations based on deployment progress, funding availability, and Clean Transportation Program Investment Plan funding allocations, in addition to 23 privately funded stations under development, to help serve an emerging population of fuel cell electric vehicles. Once built, the 179 stations will exceed the 100 hydrogen-fueling stations called for by AB 8. As of November 2021, 52 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 titled "EnergIIZE" to accelerate the deployment of infrastructure needed to fuel zero-emission trucks, buses, and equipment. The project will use a concierge-like model working directly with eligible applicants to help plan and fund the purchase of charging and hydrogen fueling infrastructure. The $50 million multiyear project will help communities most impacted by transportation-related pollution by meeting essential infrastructure needs.
- 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.
- 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 expanded 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 2009 CARB regulation with a goal of reducing the overall carbon intensity of fuels within the transportation sector by 20 percent by 2030.
- Announced the availability of up to $7 million in grant funds for projects to design, engineer, construct, install, test, operate, and maintain a hydrogen plant in California that will 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.

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 benefit from programs and services, and supporting in-state employment, in-state manufacturing, and economic development. In 2015, the CEC adopted a resolution committing the CEC to improving fair and equal opportunities to participate in and benefit from CEC programs. 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. 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. As depicted in Figure ES-2, roughly 51 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 August 1, 2021. "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 CEC recognizes project location is just one metric for evaluating the equity impacts of specific projects. 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 in disadvantaged and other communities.

In its comment letter to the CEC on June 28, 2019, the DACAG included a recommendation to "prioritize and invest in proper community outreach and engagement" and encouraged

investment into outreach to disadvantaged communities in partnership with local community-based organizations. This 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.

Strengthening outreach and education efforts can provide more equitable opportunities to participate in the Clean Transportation Program Advisory Committee, and allow the identification of funding needs and priorities (such as developing the program investment plan update), the development of more equitable funding solicitation criteria, and the application and award-making process. In addition to other equity related efforts, the CEC established the Inclusive, Diverse, Equitable, Accessible, and Local (IDEAL) Communities Partnership to put in place technical assistance, conduct a ZEV community survey and outreach forum, and implement a ZEV student ambassador program in partnership with the Foundation for California Community Colleges. The CEC also continues to coordinate with its Public Advisor's Office and Tribal Program to better reach underrepresented and underserved communities.

The Advisory Committee for the Clean Transportation Program has 34 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.

Senate Bill 1000 (Lara, Chapter 368, Statutes of 2018) requires the CEC to assess whether chargers are disproportionately deployed. Staff published the first *SB 1000 Electric Vehicle Charging Infrastructure Deployment Assessment* on December 30, 2020. The report found that electric vehicles and public chargers are collocated with populations and that low-income communities have the fewest public chargers per capita. Analysis done this year shows that about half of Californians live within a five-minute drive from a public fast charger. Low-income communities have the widest range of drive times, with a significant number of communities having to drive more than 30 minutes to reach the nearest DCFC station. Rural areas have some of the longest drive times to a DCFC, of up to four hours. Staff will continue to analyze charger deployment to help inform Clean Transportation Program investments in charging infrastructure, including project and grant funding design. Further details of this analysis can be found in Chapter 4.

Zero-Emission Vehicle Infrastructure Gap

Executive Order B-48-18 calls for the installation and construction of 250,000 electric vehicle charging ports, including 10,000 DC fast charging ports, and 200 hydrogen-fueling stations by 2025. Clean Transportation Program staff estimates that the sum of existing and expected future charging ports will not be enough to meet the state's goal of 250,000 chargers and 10,000 DC fast chargers by 2025. As depicted in Table ES-2, the identified investments leave a gap of more than 54,000 Level 2 chargers and 385 DC fast chargers by 2025.

Executive Order N-79-20, signed by Governor Gavin Newsom on September 23, 2020, provides even more ambitious goals and requirements for vehicles, and tasked the CEC with providing an updated assessment of the infrastructure needed to support this 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 more than 700,000 public and shared private chargers will be needed to support 5 million ZEVs, and nearly 1.2 million to support the roughly 8 million ZEVs anticipated under Executive Order N-79-20. An additional 157,000 chargers are needed to support 180,000 medium- and heavy-duty vehicles anticipated for 2030.

In addition to the charging infrastructure gap, there is a need to address the hydrogen infrastructure gap. Table ES-1 shows the number of hydrogen fueling stations from existing and allocated funds, indicating a gap of 21 hydrogen stations from the state's goal of 200 stations.

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)*	66,770	6,008	52
Number of Chargers/Fueling Stations For Which Funding Has Been Allocated (includes anticipated funding from Clean Transportation Program)**	118,950	3,607	127
Total	185,720	9,615	179
2025 Goal (Executive Order B-48-18)	*240,000*	*10,000*	*200*
Gap From Goal	54,280	385	21

Source: California Energy Commission. Analysis as of July 2021. *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 665 statewide public or shared-private Level 1 chargers, which are included in the CEC ZEV and Infrastructure Statistics page (available at https://www.energy.ca.gov/data-reports/energy-insights/zero-emission-vehicle-and-charger-statistics) but not 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. Does not include funding for new charging infrastructure under State Budget Act of 2021.

The 2021-2022 State Budget for Transforming Transportation in California

Accelerate Charging, Hydrogen Refueling Station Deployment, and In-State Zero-Emission Vehicle and Related Manufacturing

On July 12, 2021, Governor Gavin Newsom strengthened California's commitment to a clean transportation future by approving the 2021–2022 budget (Senate Bill 129, Skinner, Budget Act of 2021), which includes a three-year, $3.9 billion budget for ZEV-related investments by CARB, the Governor's Office of Business and Economic Development (GO-Biz), and the CEC. The budget prioritizes diesel emission reduction by earmarking funding to replace 1,125 drayage trucks, 1,000 school buses, and 1,000 transit buses with zero-emission alternatives

and refueling infrastructure. Of that package amount, the CEC will administer $1.165 billion over three years and $785 million in the current fiscal year.

The CEC funding is for infrastructure deployment to accelerate charging and hydrogen fueling station deployment and grants to promote instate ZEV and ZEV-related manufacturing, such as infrastructure equipment and ZEV components. The investments will help the markets for ZEVs 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 ZEV Package is also a multiagency investment that requires ongoing coordination with the CARB, California Governor's Office of Business and Economic Development, California State Transportation Agency, and others, for each program to complement each other and maximize the benefits to Californians.

As indicated, a lack of ZEV fueling infrastructure remains one of the largest barriers to meeting California's clean transportation goals. An immediate focus and sustained investment in zero-emission infrastructure are needed to ease the transition of California's vehicle fleet to zero-emission and ensure equitable access for all Californians. Sufficient, ubiquitous infrastructure and access to convenient and reliable zero-emission charging and fueling will be necessary to provide California drivers and businesses the confidence to adopt zero-emission vehicles for their transportation needs.

Investments in infrastructure beyond previous funding amounts under the Clean Transportation Program are necessary. Previous Clean Transportation Program funding levels were not sufficient to properly support light-duty and medium- and heavy-duty at the required pace and scale. The additional funding will allow the CEC to concurrently administer programs across vehicle segments. For example, for the passenger vehicle segment, the CEC could support a block grant, similar to CALeVIP, while administering programs focused specifically on rural communities and on apartments, condos, and other multifamily housing units. The budget 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, more healthy transportation system.

Funding Allocations for 2021–2023

For the second year in a row, the CEC proposes 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. There will be modest annual updates to evaluate whether adjustments should be made to the allocations.

The allocations for the *2021-2023 Investment Plan Update* combine both Clean Transportation Program funding and the general fund ZEV Package investments. Table ES-2 shows the funding allocations for FY 2021–2022, as well as funding projections for the remainder of the Clean Transportation Program as well as the $1.165 billion ($785 million in current budget) over three years made available through the general fund ZEV Package. The rationale for funding allocations is focused on ZEVs (both battery-electric and hydrogen fuel cells) infrastructure and ZEV manufacturing. The allocations reflect the state's goals for ZEVs, as well

as near- and long-term carbon reduction, improved air quality, and equity, with a focus on providing benefits for disadvantaged communities.

Table ES-2 shows an allocation of about $317 million to support light-duty passenger vehicles and about $391 million to support medium- and heavy-duty vehicles in FY 2021–2022. During the full three-year allocation represented in the table, the funding would total nearly $382 million to support light-duty passenger vehicles and about $695 million to support medium- and heavy-duty vehicles. Relative to the prior revised staff report version of the *2021–2023 Investment Plan Update*, this represents a one-time shift of $18 million toward medium- and heavy-duty ZEV infrastructure in recognition of the need to swiftly transition the most polluting vehicles toward zero-emission technologies in the most sensitive regions of the state.

For light-duty charging infrastructure, the CEC allocates $270.1 million in the current fiscal year and an additional $43.9 million in the remaining two years of the program, which should be sufficient to meet the state's goal of having 250,000 chargers by 2025 and put the state on course to reach 2030 goals. For light-duty hydrogen infrastructure, the CEC allocates $47 million for the current fiscal year and an additional $30 million in future years, which will be sufficient to meet the state goal of having 200 stations open by 2025. These stations should have the capacity to refuel about 280,000 fuel cell electric vehicles (FCEVs)s. The auto industry estimates that the population of fuel cell vehicles will grow from 7,129 in 2021 to 61,000 by the end of 2027, so station capacity will no longer be a barrier to near-term deployment.

General fund investments prioritize light-duty and medium- and heavy-duty infrastructure as well as in-state manufacturing. Furthermore, it is vital to front-load funding to ensure the public adoption of ZEVs is not stymied by lack of 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 Clean Transportation Program to deploy hydrogen fueling stations until there are at least 100 publicly available stations. The CEC allocates $20 million annually in Fiscal Years 2021–2022 through 2022–2023 to support light-duty, medium-duty, and heavy-duty hydrogen infrastructure. Staff expects there will be in excess of 100 light-duty stations in operation by the end of 2023, exceeding the AB 8 target, and 200 stations shortly after, thanks to the additional general fund investments allocated by the California Comeback Plan. With these targets in mind, the funding allocations of this investment plan propose a $10 million allocation (which equates to 20 percent of the expected funds for the Clean Transportation Program in 2023) for hydrogen fueling infrastructure. The CEC will evaluate whether the proposed allocation for the final year of the program is sufficient to meet the needs of the FCEV market and will adjust as needed in annual updates to the Investment Plan Update. This evaluation will be informed by CARB's *Annual Evaluation of Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development* (AB 8 Report) as well as input from the Advisory Committee, Disadvantaged Communities Advisory Group, and other stakeholders.

Table ES-2: Investment Plan Allocations for FY 2021–2022 and Subsequent Fiscal Years (in Millions)

Category	Funded Activity	2021-2022	2022-2023 [1/]	2023-2024 [1/ 2/]
Clean Transportation Program Zero-Emission Vehicles and Infrastructure	Light-Duty Electric Vehicle Charging Infrastructure and eMobility	$30.1	$30.1	$13.8
General Fund Zero-Emission Vehicles and Infrastructure	Light-Duty Electric Vehicle Charging Infrastructure	$240.0	-	-
Clean Transportation Program Zero-Emission Vehicles and Infrastructure	Medium- and Heavy-Duty Zero-Emission Vehicles and Infrastructure	$30.1	$30.1	$13.8
General Fund Zero-Emission Vehicles and Infrastructure	Medium- and Heavy-Duty Zero-Emission Vehicles and Infrastructure	$208.0	-	-
General Fund Zero-Emission Vehicles and Infrastructure	Drayage	$80.75	$85.0	$80.0
General Fund Zero-Emission Vehicles and Infrastructure	Drayage and Infrastructure Pilot	$25.0	-	-
General Fund Zero-Emission Vehicles and Infrastructure	Transit	$28.5	$30.0	$30.0
General Fund Zero-Emission Vehicles and Infrastructure	School Bus	$19.0	$15.0	$15.0
Clean Transportation Program Zero-Emission Vehicles and Infrastructure	Hydrogen Fueling Infrastructure	$20.0	$20.0	$10.0 [3/]
General Fund Zero-Emission Vehicles and Infrastructure	Hydrogen Fueling Infrastructure	$27.0	-	-
Clean Transportation Program Alternative Fuel Production and Supply	Zero- and Near Zero-Carbon Fuel Production and Supply	$10.0	$10.0	$5.0
General Fund Manufacturing	ZEV Manufacturing	$118.75	$125.0	-
Clean Transportation Program Related Needs and Opportunities	Workforce Training and Development	$5.0	$5.0	$5.0
	Total Clean Transportation Program Fund	**$95.2**	**$95.2**	**$47.6**
	Total General Fund	**$747** [4/]	**$255** [5/]	**$125** [5/]

Source: California Energy Commission.

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 final column of proposed funding is a half year due to the program expiring in middle of the fiscal year.

4/ The FY 2021–2022 funding amount from the general fund is reduced by $38 million, which is the maximum administrative costs the CEC is authorized to incur associated with that funding. The CEC is working to minimize the administrative costs to the greatest extent possible and reserves the ability to

use unused administrative costs to fund additional projects within each funding allocation. The anticipated general fund amounts in FY 2022–2023 and FY 2023–2024 have not been reduced to reflect administrative costs. Those fiscal year allocations will be reduced in accordance with direction in the associated Budget Act.

5/ Actual pass-through funding amounts resulting from future general fund allocations are expected to be reduced to cover CEC administrative expenses.

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 against global climate change have begun to show progress, and in 2016, California achieved its goal of reducing GHG emissions to 1990 levels, four years ahead of schedule. Despite the overall reduction in GHG emissions, emissions from the transportation sector have increased over the last several years, as Californians purchased more light trucks (sport utility vehicles, pickups, and vans) instead of cars and drove more miles.[4] 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.[5]

In addition to greenhouse gases, the transportation sector is also a major emitter of criteria pollutants, with mobile sources responsible for nearly 80 percent of nitrogen oxide emissions and 90 percent of diesel particulate matter emissions statewide.[6] 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.[7]

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

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

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

3 Executive Order B-55-18. 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. 2019. *California Greenhouse Gas Inventory for 2000-2017*. Available at https://ww2.arb.ca.gov/ghg-inventory-data.

5 California Air Resources Board. July 11, 2018. *California Greenhouse Gas Emission Inventory*. Available at https://www.arb.ca.gov/cc/inventory/data/data.htm.

6 California Air Resources Board. May 2016. *Mobile Source Strategy.* Available at https://www.arb.ca.gov/planning/sip/2016sip/2016mobsrc.pdf.

7 Ibid.

Clean Transportation Program (formerly known as the Alternative and Renewable Fuel and Vehicle Technology Program). 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) 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 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 *2021–2023 Investment Plan Update* is the thirteenth 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 *2021–2023 Investment Plan Update*. As part of the development process for the *2021–2023 Investment Plan Update,* the CEC holds two public meetings with the Clean Transportation Program Advisory Committee. The first meeting was held April 29, 2021, and the second was held September 16, 2021. The advisory committee was reconstituted in early 2020 to include a broader representation of interests, better reflect California communities, and provide increased 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.[8]

The unexpected 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. Long-term Clean Transportation Program priorities remain the same, but the program must also play an immediate role in addressing job creation and economic recovery. Prioritizing investments in ZEV infrastructure, especially in the short term, 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 2021–2023. The subsequent chapters are organized by specific investment areas. Chapter 4 focuses

8 The Energy Commission's docket 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.

on zero-emission vehicles and the infrastructure necessary to support them. 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 alternative fuels and advanced technology vehicles and supporting infrastructure.

CHAPTER 2:
Context of the 2021–2023 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.

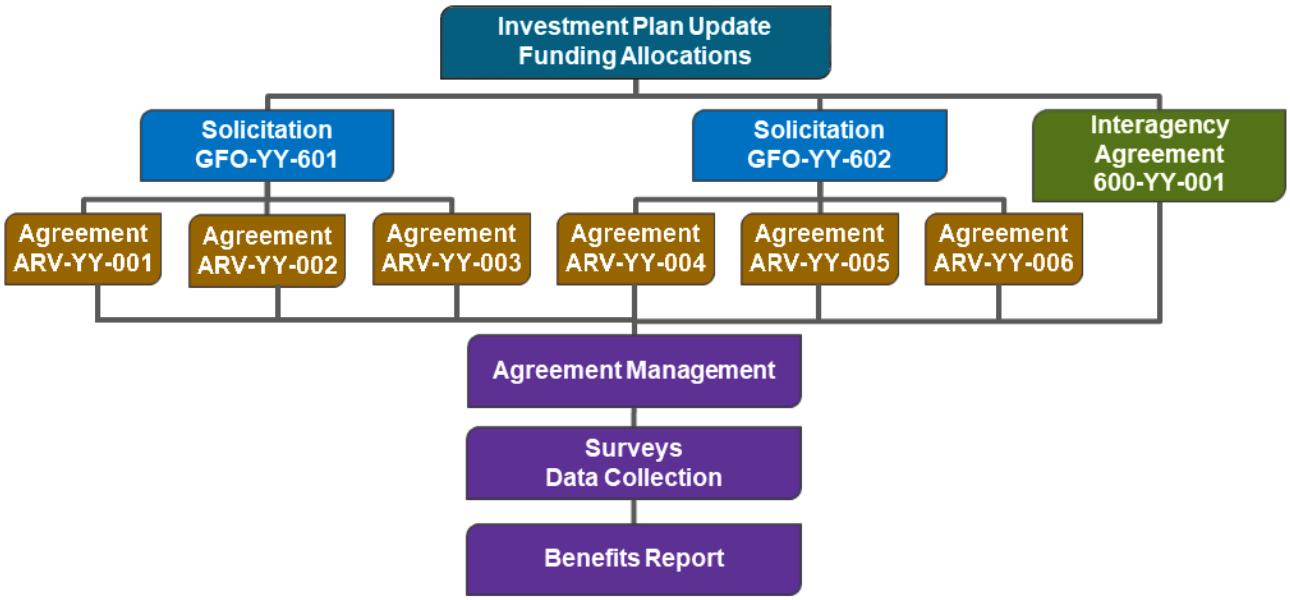
The funding allocations typically do not determine the specific funding solicitations and grant programs that will be issued. Rather, based on these funding allocations, the CEC subsequently issues a series of competitive solicitations, known as "grant funding opportunities" (GFOs).

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 also key parts 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. As alternative fuels and technologies have matured in the marketplace, the CEC has also implemented other funding and financing mechanisms, when appropriate. Each of these mechanisms has 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 other organizations such as local and regional governments, academic institutions, or nonprofit groups. Block grants allow the CEC to select another organization to administer Clean Transportation Program funding while following set procedures for project and applicant eligibility.
- **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. Similar to 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.

- **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 can 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 single-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.
- **Alternative Financing Mechanisms** — Pursuing innovative financing methods could increase private capital investment in projects that will be cofunded by the CEC's Clean Transportation Program. The CEC will explore pathways to redirect some projects to other financing options.

In general, the most important factor in considering the appropriate funding mechanism for an activity has been the technological and market maturity of the fuel or technology. Public subsidies, most commonly in the form of grants, are vital to advancing early-stage technologies because private financiers are often unwilling to accept the high risks associated with these projects. They are also key in targeting equity investments that may not be made by the private sector. As a technology or market matures, however, alternative financing mechanisms become a more effective method of support and can better leverage public funds with private financing.

Staff is exploring additional financing strategies. As part of the effort, CEC staff is coordinating with other state agencies, such as the California Governor's Office of Business and Economic Development (GO-Biz), IBank, and the California Pollution Control Financing Authority. CEC is also establishing a loan-funding working group with GO-Biz, IBank, and CEC staff to identify technology market segments that may be ready to shift from grants to loans, credit enhancements, and other funding support. This group will also assess the demand for debt programs, evaluate the level of Clean Transportation Program funding for loans, and make recommendations for Investment Plan Updates. For instance, funding from this or future Investment Plan Updates could be used to support a loan program administered by IBank.

Program Outreach and Engagement

The CEC seeks to increase the participation of disadvantaged and underrepresented communities from a diverse range of geographical regions. 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 Group[9] for guidance and recommendations on program effectiveness as it relates to disadvantaged communities and other vulnerable and underrepresented groups.
- 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 on potential funding opportunities to provide light-duty charging infrastructure that can serve rural and multifamily housing residents.
- Assessing whether electric vehicle charging station infrastructure is disproportionately distributed as examined in the SB 1000 analysis. The first iteration of the *SB 1000 Electric Vehicle Charging Infrastructure Deployment Assessment* was published December 30, 2020. The major results were that electric vehicles and public chargers are collocated with populations and low-income communities have the fewest public chargers per capita. Analysis done this year shows that about half of Californians live within a five-minute drive from a public fast charger. Low-income communities have the widest range of drive times, with a significant number of communities having to drive more than 30 minutes to reach the nearest DCFC station. Rural areas have some of the longest drive times to a DCFC, of up to four hours. Staff will continue to analyze charger deployment to help inform Clean Transportation Program investments in charging infrastructure, including project and grant funding design. Further details of this analysis can be found in Chapter 4.

In addition to the above actions, the CEC has provided a scoring preference for projects located in or benefitting disadvantaged communities, as defined by the California Communities Environmental Health Screening Tool (CalEnviroScreen3.0).[10] These preferences have been used in recent Clean Transportation Program solicitations, where appropriate, and nearly half of site-specific Clean Transportation Program funding is located in or benefitting disadvantaged communities.

In 2020, the IDEAL Communities Partnership was launched through an agreement with the Foundation for California Community Colleges (FCCC). The FCCC provides disadvantaged communities outreach and engagement for the California Climate Investments (CCI), a cap-

9 More information available on the Disadvantaged Communities Advisory Group Page. Available at https://www.energy.ca.gov/about/campaigns/equity-and-diversity/disadvantaged-communities-advisory-group.

10 The CalEnviroScreen 3.0 tool is available online from the California Office of Environmental Health Hazard Assessment at https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30.

and-trade program that helps fund clean technologies and innovative ways to reduce pollution, and is an equity implementation partner for CARB's Access Clean California.[11] The IDEAL Communities partnership will assess the development of a technical assistance program, conduct outreach and engagement with disadvantaged communities to better understand and support clean transportation, establish an IDEAL Student Ambassador Program, and conduct an IDEAL Community Forum for underrepresented communities to express their clean transportation needs.

Highlights of Investments

As of August 2021, 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 15,154 chargers for plug-in electric vehicles, including 4,277 at multi- and single-family homes, 155 for fleets, and 419 at workplaces; 8,454 public and shared private Level 2 and Level 1 chargers; and 1,601 public DC fast chargers and 248 Level 2 chargers along highway corridors and urban metropolitan areas.
- Created the California Electric Vehicle Infrastructure Project (CALeVIP) to provide streamlined Clean Transportation Program incentives for light-duty electric vehicle charging infrastructure.
- Funded 83 new or upgraded publicly available hydrogen-fueling stations, approval to fund an additional 73 stations based on deployment progress, funding availability, and Clean Transportation Program Investment Plan Update funding allocations, in addition to 23 privately funded stations under development, will help serve an emerging population of fuel cell electric vehicles. Once built, the 179 stations will exceed the 100 hydrogen-fueling stations called for by AB 8. As of November 2021, 52 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 titled "EnergIIZE Commercial Vehicles" to accelerate the deployment of infrastructure needed to fuel zero-emission trucks, buses, and equipment. The project will use a concierge-like model working directly with eligible applicants to help plan and fund the purchase of charging and hydrogen fueling infrastructure. The $50 million multiyear project will help communities most impacted by transportation-related pollution by meeting essential infrastructure needs.
- Funded 27 manufacturing projects supporting in-state economic growth and job creation, developing a supply chain for electric drive technology vehicles and infrastructure, and positioning businesses for growth and scale.
- Provided workforce training for more than 20,000 trainees and 277 businesses and invested in preparing workers for the clean transportation economy that lead to

11 Access Clean California, https://accesscleanca.org/.

sustainable wages and translate clean technology investments into sustained 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 will 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 (LCFS). The LCFS is a 2009 CARB regulation with a goal of reducing the overall carbon intensity of fuels within the transportation sector by 20 percent by 2030.
- Announced the availability of up to $7 million in grant funds for projects to design, engineer, construct, install, test, operate, and maintain a hydrogen plant in California that will produce 100 percent renewable hydrogen from in-state renewable resource(s). The facility, once constructed and operational, will be a source of 100 percent renewable hydrogen that will be used for transportation fuel. Projects will produce hydrogen that will meet California regulations when dispensed at the station for use in on-road fuel cell electric vehicles, both light-duty and medium-/heavy-duty.

Table 1: Clean Transportation Program Investments as of August 2021

Funded Activity	Cumulative Awards to Date (in Millions)*	# of Projects or Units
Alternative Fuel Production		
Biomethane Production	$67.86	26 Projects
Gasoline Substitutes Production	$26.94	14 Projects
Diesel Substitutes Production	$63.91	26 Projects
Renewable Hydrogen Production	$7.93	2 Projects
Alternative Fuel Infrastructure		
Electric Vehicle Charging Infrastructure**	$192.60	15,154 chargers
Hydrogen Fueling Infrastructure (Including Operations and Maintenance)	$166.82	83 Public Fueling Stations
Medium- and Heavy-Duty ZEV Infrastructure	$99.11	75 Projects
E85 Fueling Infrastructure	$3.61	21 Fueling Stations
Upstream Biodiesel Infrastructure	$3.98	5 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	$33.33	20,000 Trainees
Fuel Standards and Equipment Certification	$3.90	1 Project
Sustainability Studies	$2.04	2 Projects
Regional Alternative Fuel Readiness	$24.15	55 Regional Plans
Centers for Alternative Fuels	$5.41	5 Centers
Technical Assistance and Program Evaluation	$17.52	n/a
Total	**$1.049 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 $176.68 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 $734 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.

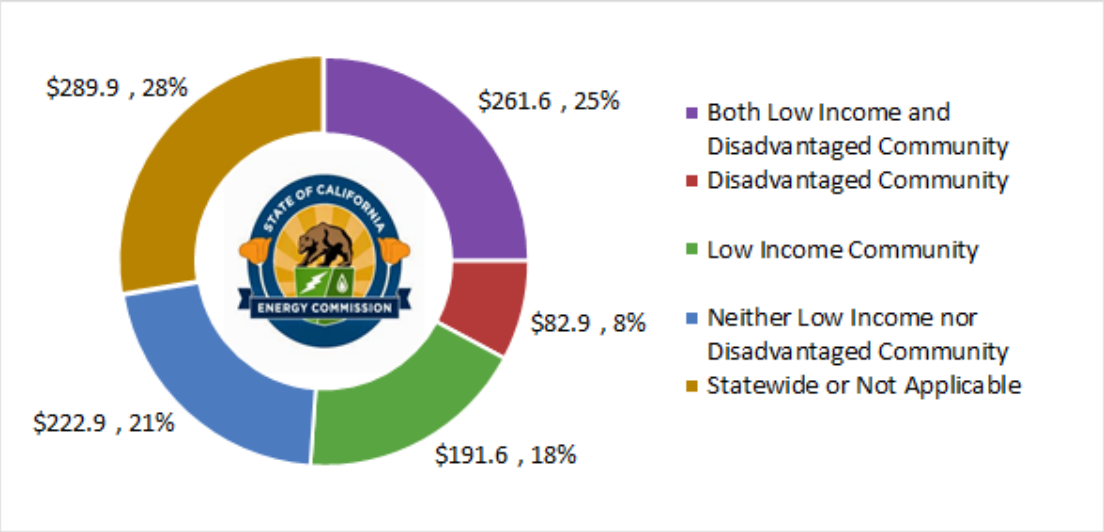
Summary of Program Funding for Disadvantaged Communities

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 51 percent of Clean Transportation Program project funding has gone into disadvantaged communities or low-income communities or both.[12] 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, measure, 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.

12 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 August 1, 2021.

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 address these issues, reduce emissions, and reduce petroleum use in California. CEC staff consulted with other state agencies and considered these 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
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 trucks 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 by 2045
Zero-Emission Vehicle Regulation	Increase Zero-Emission Vehicles	Increase the deployment of plug-in hybrid, battery, and fuel cell electric vehicles
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 Law: 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.[13]

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. *California's 2017 Climate Change Scoping Plan*, published by CARB in November 2017, helped inform and guide the development of this Investment Plan Update.[14]

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.[15] In response, the DACAG provided comments on the *2019–2020 Investment Plan Update* on June 28, 2019.[16] These comments included recommendations on how the *2019–2020 Investment 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.*[17] Recommendations

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

14 California Air Resources Board. November 2017. *California's 2017 Climate Change Scoping Plan*. Available at https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf. CARB is in the process of developing the 2022 Scoping Plan Update.

15 DACAG meeting materials available at https://www.cpuc.ca.gov/DACAG/. The previous version of this Investment Plan Update (Lead Commissioner Report version) is available at https://www.energy.ca.gov/altfuels/2018-ALT-01/documents/.

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

17 SB 350 Disadvantaged Communities Advisory Group, "SB 350 Disadvantaged Communities Advisory Group comments on 2020-2023 Investment Plan Update," 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.

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 (newly reconstituted in 2020 to include greater representation from community and equity groups as well as other stakeholders), DACAG, and others will also have the opportunity to provide recommendations for the *2021–2023 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 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, and track community benefits from the Clean Transportation Program.
Expanding the definition of disadvantaged communities beyond the CalEnviroScreen definition.	Expanded solicitation eligibility 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 and/or disadvantaged communities.
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 focus and methods used in the biennial Benefits Report, including documentation of 1) benefits for underrepresented communities and 2) air quality impacts and associated health outcomes.
Prioritizing and investing in community outreach and engagement.	1) Explicit inclusion of scoring criteria for drayage truck projects located in disadvantaged communities and low-income communities and development of an equity outreach and engagement plan[18] and 2) Established the IDEAL Communities Partnership focused on community engagement activities such as the establishment of technical assistance, conduct a ZEV Community Survey and Outreach Forum, and implement a ZEV Student Ambassador Program in partnership with the Foundation for California Community Colleges.

18 GFO-20-606 Zero-Emission Drayage Truck and Infrastructure Pilot Project: https://www.energy.ca.gov/solicitations/2020-11/gfo-20-606-zero-emission-drayage-truck-and-infrastructure-pilot-project.

Expanding support for workforce development.	Dedicated Clean Transportation Program funding allocations that will expand workforce development beyond investments in state entities to include community-based workforce training and development in and near ZEV deployments in priority communities. The IDEAL ZEV Workforce Pilot is a new CEC community-based workforce initiative where CARB is a partner and is contributing $1 million.
Expanding the Clean Transportation Program Advisory Committee to increase representation of program beneficiaries, environmental justice communities, rural communities, tribes, and others.	Reconstituted and diversified the Clean Transportation Program Advisory Committee in 2020 to better reflect California communities and provide increased representation of program beneficiaries.
Prioritize investments in the medium- and heavy-duty vehicle category and target disadvantaged communities.	Funding allocation for this activity will increase dramatically after Fiscal Year 2021–2022 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, especially in low-income and disadvantaged communities.

Source: California Energy Commission

Assembly Bill 841: Electric Vehicle Infrastructure Training Program

The Electric Vehicle Infrastructure Training Program (EVITP) 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."[19] Assembly Bill 841 (Ting, Chapter 372, Statutes of 2020) requires that at least 25 percent of total installation crew members of any state-funded electric vehicle charging infrastructure be certified under the EVITP. 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 is using the findings from the workshop and public comment to determine if the EVITP curriculum should be supplemented, and EVITP will have six months to implement the supplemented curriculum.

Executive Orders (EO)

EO B-55-18: Carbon Neutrality

EO B-55-18 established a goal to achieve carbon neutrality, or achieving net-zero carbon dioxide emissions, 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

19 Electric Vehicle Infrastructure Training Program is available at https://evitp.org/about-us/.

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.[20] 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.[21] These executive orders have been part of the guidance for the electric vehicle charging and hydrogen fueling infrastructure investments of the Clean Transportation Program to date.

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-29-20, Governor Newsom tasked the Governor's Office of Business and Economic Development (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* [22] 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 and anticipates sharing additional information on its website moving forward.[23]

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.

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20 Executive Order B-16-12 available at https://www.ca.gov/archive/gov39/2012/03/23/news17463/index.html.

21 Executive Order B-48-18 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.

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

23 Zero-Emission Vehicle Market Development Strategy is available at https://business.ca.gov/industries/zero-emission-vehicles/zev-strategy/.

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 reached all-time highs in 2019 and 2020, ranging from a low of $22 in May 2015 to a high of $206 in February 2020.[24] Prices remained near $200 through February 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 also restructure the approach for providing PEV rebates through utilities 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. CARB is working on updates to the ZEV Regulation under the Advanced Clean Cars II rulemaking, which will look at regulatory actions beyond 2025 that help ensure zero- and near-zero-emission technology options continue to grow in the market and are accessible to all consumers.

Innovative Clean Transit Regulation

The Innovative Clean Transit Regulation[25] 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.

Within California, trucks are the largest source of air pollution among all vehicles, responsible for one-third of statewide oxides of nitrogen (NO_x) emissions and 25 percent of statewide diesel particulate matter (PM) emissions, 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.[26]

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24 California Air Resources Board. April 2021. *LCFS Monthly Credit Price and Transaction Volumes Spreadsheet.* Available at https://www.arb.ca.gov/fuels/lcfs/dashboard/creditpriceserieswithoutargusopis.xlsx.

25 California Air Resources Board Innovative Clean Transit. Available at https://ww2.arb.ca.gov/our-work/programs/innovative-clean-transit/about.

26 California Air Resources Board. California Takes Bold Step to Reduce Truck Pollution. 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 to secure financing for newer trucks to meet compliance deadlines; as well as funding for other advanced emission-reduction vehicle technologies for vehicles.

CARB also distributes Greenhouse Gas Reduction Fund (GGRF) capital through its Low Carbon Transportation Investments. The Legislature appropriated more than $2.1 billion to CARB for Low Carbon Transportation Investments between 2013 and 2019. Projects initially funded by AQIP, such as CVRP, are now funded by Low Carbon Investments because demand has exceeded available funding from AQIP.

In December 2020, CARB approved the *Proposed FY 2020–21 Funding Plan for Clean Transportation Incentives* that included $28.64 million in clean transportation investments from AQIP, of which $25 million is dedicated to HVIP. CARB's recommendations for AQIP allocations focused on determining which projects most critically needed an immediate influx of funding. The Heavy-Duty Investment Strategy and the Three-Year Plan for CVRP, ZEV Market, Clean Transportation Equity Investments, and Outreach played key roles in this assessment. CARB also considered which projects have funds allocated in previous fiscal years remaining, other available funding sources, and stakeholder input.

Table 4: FY 2019–2020 and FY 2020–2021 CARB Clean Transportation Incentives Allocations

Project Category	Funding Allocation (in Millions)
Low Carbon Transportation Vehicle Purchase Incentives and Clean Mobility Projects	
Clean Vehicle Rebate Project	$238.0
Clean Transportation Equity Projects	$55.5
Low Carbon Transportation Heavy-Duty and Off-Road Equipment Investments	
Clean Truck and Bus Vouchers (HVIP)	$119.9
Heavy-Duty Advanced Technology Demonstration and Pilot Projects	$33.9
AQIP Investments	
Clean Truck and Bus Vouchers (HVIP)	$25.0*
Clean Cars 4 All	$3.0*
Truck Loan Assistance Program	$48.0

Source: California Air Resources Board. *FY 2020–2021 Funding Plan

For FY 2021-22, the state budget includes $1.5 billion in ZEV Package funding appropriated to CARB to accelerate an equitable ZEV transition in the light-duty and heavy-duty sectors. CARB is developing the FY 2021-22 Funding Plan for Clean Transportation through a public process. The plan will describe CARB's proposed investments and is slated for board consideration in late 2021.

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), San Diego Gas & Electric Company (SDG&E), and Southern California Edison (SCE) to install a total of up to 12,500 charging stations with initial budgets up to $197 million.[27] In December 2018, the CPUC approved $22 million in bridge funding for the 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.

27 California Public Utilities Commission. Decisions (D.)16-01-023, D.16-01-045, and D.16-12-065. Available at http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442454831.

Assembly Bills 1082 (Burke, Chapter 637, Statutes of 2017) and 1083 (Burke, Chapter 638, Statutes of 2017) allowed, but did not require, the utilities to file applications to support charging infrastructure at schools and state parks and beaches. In late 2019, the CPUC approved a total of $54.5 million for eight pilot programs to install up to 800 charging ports at parks, beaches, and schools. The utilities are working on finalizing program designs for the two-year pilot programs with expected launch in 2021.

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. To date, the CPUC has authorized about $774 million in ratepayer spending on Senate Bill 350 transportation electrification programs.

Volkswagen Diesel Emissions Settlement

California received about $423 million from the Volkswagen Environmental Mitigation Trust for projects to reduce the lifetime excess 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.[28] 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 instalment 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 fueling infrastructure for plug-in electric vehicles and hydrogen fuel cell electric vehicles; brand-neutral education and public outreach to increase consumer awareness of ZEVs; programs or actions to increase public exposure or access or both to ZEVs without requiring a consumer purchase or lease (for example, 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 will begin January 1, 2022.

28 California Air Resources Board. June 2018. *Beneficiary Mitigation Plan for the Volkswagen Environmental Mitigation Trust.* Available at https://ww2.arb.ca.gov/resources/documents/californias-beneficiary-mitigation-plan.

CHAPTER 3:
Funding Allocations for 2021–2023

The funding allocations for FY 2021–2022, and the projected funding allocations for subsequent fiscal years, are outlined in Table 5. For FY 2021–2022, $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. On July 12, 2021, Governor Gavin Newsom approved Senate Bill 129 — the Budget Act of 2021 (Skinner, Chapter 69, Statutes of 2021),[29] which includes $785 million to be administered by the CEC. The additional funds will help close funding gaps in infrastructure deployment, accelerate charging and hydrogen fueling station deployment, and promote instate ZEV and ZEV-related manufacturing, including infrastructure manufacturing and ZEV components.

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 the lead the nation and pave the way to a cleaner, more healthful transportation system.

The CEC will seek to provide 50 percent of Clean Transportation Program funds toward projects that benefit low-income and disadvantaged communities, and will continue to investigate new metrics to ensure these investments enhance equity within the state.

As shown in Table 5, the CEC directs investments in light-duty ZEVs for Fiscal Years 2021–2022 and 2022–2023 to narrow the charging and hydrogen refueling gaps as described in earlier analysis, with further depth later in this report. In parallel, the CEC will also concentrate significant investments toward medium- and heavy- duty zero-emission vehicles and infrastructure for battery-electric and hydrogen fuel cell electric technologies.

Table 5 shows an allocation of about $317 million to support light-duty passenger vehicles and about $391 million to support medium- and heavy-duty vehicles in FY 2021–2022. During the full three-year allocation represented in the table, the funding would total nearly $382 million to support light-duty passenger vehicles and about $695 million to support medium- and heavy-duty vehicles. Relative to the prior revised staff report version of the *2021–2023 Investment Plan Update*, this represents a one-time shift of $18 million toward medium- and heavy-duty ZEV infrastructure, in recognition of the need to swiftly transition the most polluting vehicles toward zero-emission technologies in the most sensitive regions of the state.

The following chapters describe each funded activity.

29 Senate Bill 129 (Skinner, Budget Act of 2021) is available at https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220SB129.

Table 5: Investment Plan Allocations for FY 2021–2022 and Subsequent Fiscal Years (in Millions)

Category	Funded Activity	2021-2022	2022-2023 [1/]	2023-2024 [1/ 2/]
Clean Transportation Program Zero-Emission Vehicles and Infrastructure	Light-Duty Electric Vehicle Charging Infrastructure and eMobility	$30.1	$30.1	$13.8
General Fund Zero-Emission Vehicles and Infrastructure	Light-Duty Electric Vehicle Charging Infrastructure	$240.0	-	-
Clean Transportation Program Zero-Emission Vehicles and Infrastructure	Medium- and Heavy-Duty Zero-Emission Vehicles and Infrastructure	$30.1	$30.1	$13.8
General Fund Zero-Emission Vehicles and Infrastructure	Medium- and Heavy-Duty Zero-Emission Vehicles and Infrastructure	$208.0	-	-
General Fund Zero-Emission Vehicles and Infrastructure	Drayage	$80.75	$85.0	$80.0
General Fund Zero-Emission Vehicles and Infrastructure	Drayage and Infrastructure Pilot	$25.0	-	-
General Fund Zero-Emission Vehicles and Infrastructure	Transit	$28.5	$30.0	$30.0
General Fund Zero-Emission Vehicles and Infrastructure	School Bus	$19.0	$15.0	$15.0
Clean Transportation Program Zero-Emission Vehicles and Infrastructure	Hydrogen Fueling Infrastructure	$20.0	$20.0	$10.0 [3/]
General Fund Zero-Emission Vehicles and Infrastructure	Hydrogen Fueling Infrastructure	$27.0	-	-
Clean Transportation Program Alternative Fuel Production and Supply	Zero- and Near Zero-Carbon Fuel Production and Supply	$10.0	$10.0	$5.0
General Fund Manufacturing	ZEV Manufacturing	$118.75	$125.0	-
Clean Transportation Program Related Needs and Opportunities	Workforce Training and Development	$5.0	$5.0	$5.0
	Total Clean Transportation Program Fund	**$95.2**	**$95.2**	**$47.6**
	Total General Fund	**$747** [4/]	**$255** [5/]	**$125** [5/]

Source: California Energy Commission.

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 final column of proposed funding is a half year due to the program sunsetting in middle of the fiscal year.

4/ The FY 2021–22 funding amount from the general fund is reduced by $38 million, which is the maximum administrative costs the CEC is authorized to incur associated with that funding. The CEC is working to minimize the administrative costs to the greatest extent possible and reserves the ability to use unused administrative costs to fund additional projects within each funding allocation. The anticipated general fund amounts in FY 2022–2023 and FY 2023–2024 have not been reduced to reflect administrative costs. Those fiscal year allocations will be reduced in accordance with direction in the associated Budget Act.

5/ Actual pass-through funding amounts resulting from future general fund allocations are expected to be reduced to cover CEC administrative expenses.

CHAPTER 4:
Zero-Emission Vehicles and 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.

The expansion of ZEVs will depend on the availability of fueling infrastructure that meets consumers' needs and expectations. In recognizing this dependence, Executive Order B-48-18 also set goals for installing 250,000 electric vehicle chargers (including 10,000 DC fast chargers) and 200 hydrogen fueling stations by 2025.

To meet the ambitious statewide targets set in Executive Order N-79-20, GO-Biz published the *California Zero-Emission Vehicle Market Development Strategy* [30] in February 2021. The ZEV Strategy is a multiagency, partner, and stakeholder collaboration and is an ongoing effort to turn California's 100 percent ZEV vision into reality. The strategy focuses on the opportunities and priorities to build the infrastructure network, bring more vehicle types to market in all vehicle classes and applications, increase economic development and high-road jobs, build a skilled workforce, and enable consumers and fleets to adopt ZEVs.

Every year, each state agency will submit a brief action plan to GO-Biz, setting the priorities under their ZEV strategy objectives and communicating key equity strategies that the agency is seeking to implement, advance, or improve. On March 15, 2021, the CEC submitted its state agency action plan.[31] This plan includes efforts to expand charging and hydrogen fueling infrastructure, vehicle-grid integration, and planning for resilient transportation systems powered by renewable energy. The plan also includes funding research, development, and deployment of next-generation ZEV technologies and investments in ZEV-related manufacturing.

The CEC is the lead agency on ZEV infrastructure investment and analysis and will catalyze the development and deployment of economically and environmentally sustainable ZEV infrastructure, with 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

Cumulative sales of PEVs, which include battery-electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs), are growing rapidly in California, with more than 800,000 cumulative

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

31 The CEC's action plan, along with those of other agencies, is available at https://static.business.ca.gov/wp-content/uploads/2021/03/CEC-ZEV-Action-Plan.pdf.

sales at the end of 2020.[32] These sales account for about half of the PEVs sold in the United States.

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 existing within California. The CEC also tracks recent and proposed charging infrastructure investments of the Clean Transportation Program and other key state funding mechanisms. 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 2020. 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. Finally, the table summarizes the estimated shortfall in charging infrastructure relative to the goals of Executive Order B-48-18. This estimate does not consider the additional funding from the ZEV Package under Senate Bill 129 — Skinner Budget Act of 2021, which provides light-duty electric vehicle charging infrastructure funding with the purpose of reducing the shortfall to the goal.

Table 6: Progress Toward 250,000 Chargers by 2025

	Level 2 Chargers	DC Fast Chargers
Existing Chargers (Estimated)*	66,770	6,008
Anticipated Chargers for Which Funding Has Been Allocated (including anticipated funding from Clean Transportation Program)**	118,950	3,607
Total	185,720	9,615
2025 Goal (Executive Order B-48-18)	*240,000*	*10,000*
Gap From Goal	54,280	385

Source: California Energy Commission. Analysis as of July 2021. *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 665 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, including an estimated 2,000 Level 2 chargers pending CPUC approval from San Diego Gas & Electric. Does not include funding for new charging infrastructure under State Budget Act of 2021.

As indicated in the final row of Table 6, CEC staff estimates that there is a sizable gap (more than 54,600) between the number of charging connectors needed in 2025 and the number of expected charging connectors available that year.

32 Based on CEC staff analysis of data from the California Department of Motor Vehicles. Cumulative PEV sales through end of 2020 (regardless of vehicle status) were estimated at more than 800,000.

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 and reducing emissions of GHGs to 40 percent below 1990 levels by 2030. The assessment will also provide the CEC direction on charging infrastructure priorities that relate to special location types, such as ports, airports, and railyards. 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* [33] (*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 has 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 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 by NREL is a planning tool that helps determine the number, locations, and types of chargers required to meet the 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 an additional scenario using CARB's *Draft 2020 Mobile Source Strategy* that projected nearly 8 million ZEVs by 2030. This scenario is roughly 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 by 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

33 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. 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.

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 more than 700,000 public and shared private chargers will be needed to support 5 million ZEVs and nearly 1.2 million to support the roughly 8 million ZEVs anticipated under Executive Order N-79-20.

In addition to providing quantitative discussions of charging infrastructure needs, the *AB 2127 Report* provides a qualitative review of charging infrastructure needs.[34] 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 plug-in electric vehicles 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.

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

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, and geographical area. If the CEC finds that chargers have been disproportionately deployed, the CEC shall use Clean Transportation 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.

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34 Ibid. For more information on these qualitative findings, see Chapter 5: Meeting California's Technological Charging Infrastructure Needs.

Staff published the first *SB 1000 Electric Vehicle Charging Infrastructure Deployment Assessment* on December 30, 2020.[35] The distributions of PEVs, public chargers, and populations are correlated, but public chargers are unevenly distributed by income, population density, and geography. On average, low-income communities have fewer public Level 2 and DC fast chargers combined per capita than middle- or high-income communities.[36] High-population-density communities have fewer public chargers within their census tract boundaries than lower-density communities.

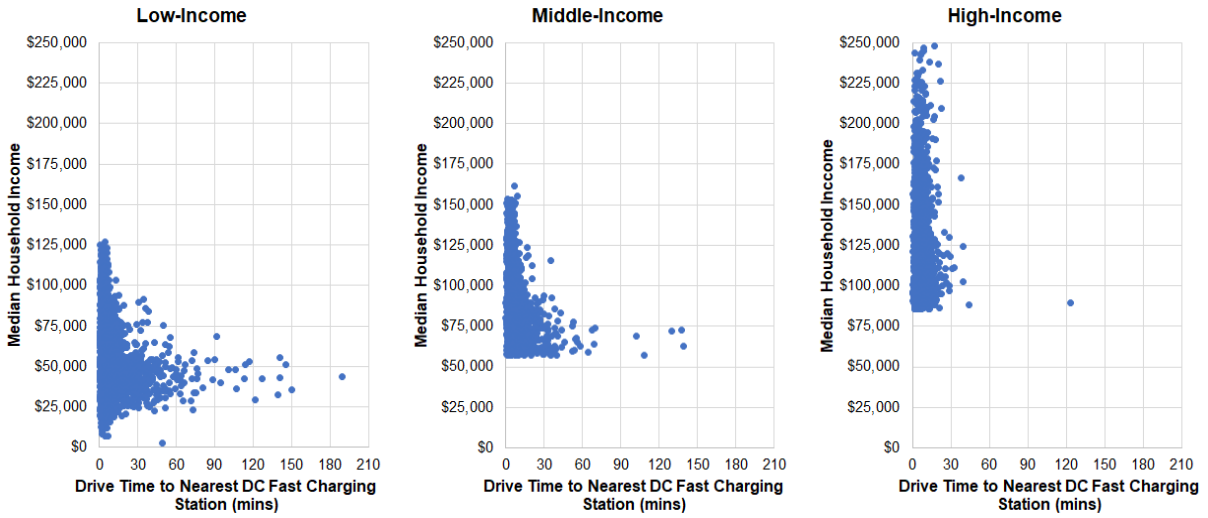
This year, staff considered drive times from community centers to the nearest public DCFC. Low-income communities have some of the longest drive times to DCFCs (Figure 3). Middle- and high-income communities can also have long drive times, but there is more variation across low-income communities. Disadvantaged communities vary in drive times to DCFC (Figure 4).[37] Rural communities have some of the longest drive times to DCFCs. The longest drive time for a rural community in California is twice that of the longest drive time for an urban community. Figure 5 shows drive times by rural communities.

35 California Electric Vehicle Infrastructure Deployment Assessment: Senate Bill 1000 Report, https://www.energy.ca.gov/publications/2020/california-electric-vehicle-infrastructure-deployment-assessment-senate-bill.

36 Low-income communities are "census tracts with median household incomes at or below 80 percent of the statewide median income or with median household incomes at or below the threshold designated as low income by the Department of Housing and Community Development's list of state income limits adopted pursuant to Section 50093" (Assembly Bill 1550, Gomez, Chapter 369, Statues of 2016). Middle-income communities census tracts with median household incomes between 80 to 120 percent of the statewide median income or with median household incomes between the threshold designated as low and moderate income by the Department of Housing and Community Development's list of state income limits adopted pursuant to Section 50093. High-income communities are census tracts with median household incomes at or above 120 percent of the statewide median income or with median household incomes at or above the threshold designated as moderate income by the Department of Housing and Community Development's list of state income limits adopted under Section 50093.

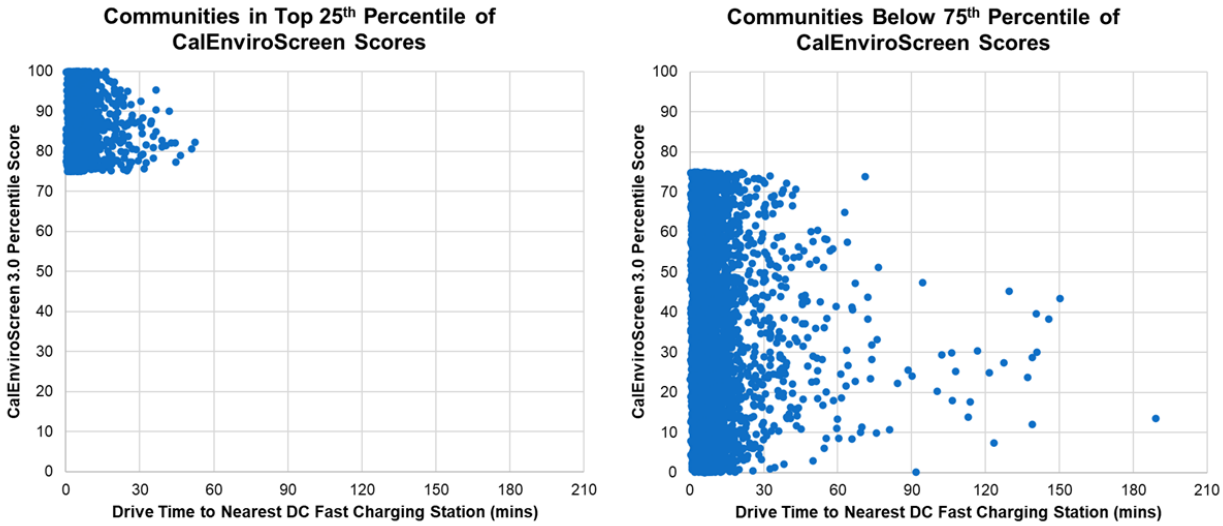
37 Disadvantaged communities are census tracts that score within the top twenty-fifth percentile of CalEnviroScreen 3.0 scores. Rural communities are defined using the Census Bureau's 2010 urban and rural classifications. Rural blocks include all population, housing, and territory that is not included within an urban area. Blocks with no population were removed before conducting the drive-time analysis.

Figure 3: Community Drive Times to DC Fast Charging Stations by Income Level



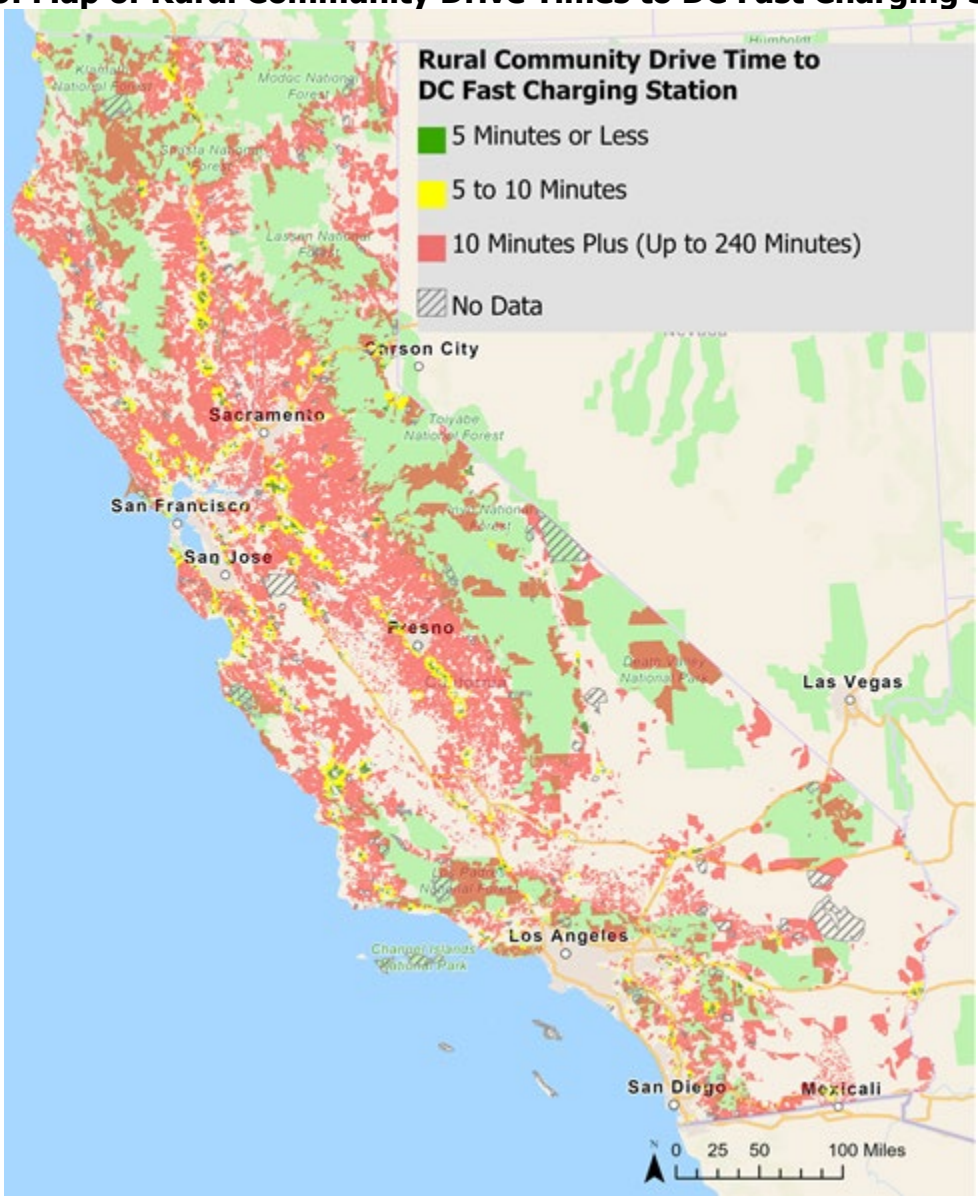
Source: U.S. Census Bureau 2014–2018 American Community Survey Median Household Income 5-Year Estimates, U.S. Department of Energy's Alternative Fuels Data Center Charger Data as of February 2021, and California Air Resources Board California Hydrogen Infrastructure Tool Roadway Data.

Figure 4: Community Drive Times to DC Fast Charging Stations by CalEnviroScreen 3.0 Percentile Scores



Source: California Environmental Protection Agency CalEnviroScreen 3.0, 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.

Figure 5: Map of Rural Community Drive Times to DC Fast Charging Stations



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.

Staff held a workshop July 8, 2021, to receive public feedback on new analysis. This work is being used to inform design of solicitations for charging that serves multifamily housing residents and rural drivers.

Clean Transportation Program Funding

The CEC has supported the rollout of light-duty PEVs by awarding more than $188 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 EVCS at many types of locations, as detailed in Table 7. The "private access" chargers include home chargers that are generally dedicated to serving only one vehicle; the CEC has moved away from providing incentives for these chargers. The "shared access" chargers include fleets, workplaces, and multifamily housing chargers that may serve multiple 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 7: Chargers Funded by the Clean Transportation Program as of May 31, 2021

	Private Access	Shared 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	3,090	482	950	**9,373**
Planned	0	0	0	0	18	52	5,711	**5,781**
Total	**3,936**	**155**	**419**	**341**	**3,108**	**534**	**6,661**	**15,154**

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 2021, 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 10 regional incentive projects covering 32 counties. An additional three incentive projects have been announced and will cover an additional four counties. Table 8 shows all the current CALeVIP projects, with more planned in 2021 and 2022. 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.

Table 8: CALeVIP Investments Through 2021

Incentive Project	Launch Date	Counties	Funding (in Millions)	Funding From Partners (in millions)	Technologies
Fresno County	December 2017	Fresno	$4	-	Level 2
Southern California	August 2018	Los Angeles, Orange, Riverside, San Bernardino	$29	-	DC Fast Chargers
Sacramento County	April 2019	Sacramento	$15.5	$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	$9	$3 (over three years)	Level 2 and DC Fast Chargers
San Joaquin Valley	December 2019	San Joaquin, Kern, Fresno	$14	-	Level 2 and DC Fast Chargers
Sonoma Coast	July 2020	Mendocino, Sonoma	$6.75	$1.65 (over three years)	Level 2 and DC Fast Chargers
San Diego County	October 2020	San Diego	$21.7	$5.9 (over three years)	Level 2 and DC Fast Chargers
Peninsula-Silicon Valley	December 2020	San Mateo, Santa Clara	$55.23	$22.23 (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
		Totals	**$176.68**	**$34.28**	

Source: California Energy Commission.

Innovations in Charging Technology and Use Cases

Aligning charging with the availability of cheaper, cleaner energy resources is also a priority for the state. For instance, most charging at workplaces is expected to occur during the day, which is likely to create opportunities for electricity demand management at these sites. Electric vehicle charging with demand-side management can increase charging during times of excess electricity and decrease use during peak times. As more intermittent renewable energy is available to the electricity grid, such as solar and wind, the electricity supply available during the day will increase and possibly result in overgeneration. Vehicle-to-grid technologies and daytime PEV charging, especially at workplace and fleet-use stations, can increase the use of renewable energy. The CEC is committed to enabling "smart" charging (controlling when and how charging occurs) and vehicle-grid integration, which help reduce costs for PEV drivers and all electricity customers.

As expressed in one of the qualitative findings of the *AB 2127 Staff Report*, the CEC recognizes the need to support the development and demonstration of innovative charging technologies and use cases. 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. This need is reflected in the CEC's development and release of the "BESTFIT Innovative Charging Solutions" solicitation, which was released in August 2020. On April 16, 2021, the CEC announced a total of more than $4.1 million in light-duty sector awards.

eMobility

New mobility services, including car- and ridesharing and autonomous and connected vehicles, present other opportunities to expand the use of ZEVs. Thus far, ZEV use has been limited largely to those who have the means to purchase a new vehicle. Dedicated ZEV car- and ridesharing services, however, can provide zero-emission transportation options for drivers and passengers who would otherwise have no alternatives to conventional automobiles.[38]

The Clean Mobility Options (CMO) Program is a statewide administrator 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 CMO Program is a first-come, first-served voucher program that focuses on disadvantaged, low-income, and California native tribal communities. Mobility vouchers will fund clean transportation projects, including zero-emission vehicles, bicycles, charging infrastructure, site improvements, outreach, and capacity building. In addition, CMO provides funding for community transportation needs assessments for evaluating transportation gaps within the community to better understand residents' priorities and mobility needs before applying for shared mobility project vouchers. Furthermore, the CMO administrative team provides comprehensive technical assistance and support for applicants and voucher awardees. The CEC is partnering with CARB though an interagency agreement to expand program eligibility and funding. 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.

Planning and Readiness

The CEC has provided funding to other project types to achieve the goals of the Clean Transportation Program, including regional alternative fuel readiness plans. The Regional Alternative Fuel Readiness Planning allocation provided a funding source 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 $18 million for 55 agreements to prepare for and expedite the deployment of alternative fuel infrastructure and vehicles. 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 because of this funding, and the plans have aided the launch of the first generation of zero-emission vehicles and the continued installation of charging and fueling infrastructure.

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. Eight project teams submitted applications requesting $19,184,958. The solicitation resulted in four grant awards totaling $7,493,000, which include Contra Costa Transportation Authority, Kern Council of Governments, City of Sacramento, and Ventura County Regional Energy Alliance.

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.[39] 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 physical 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 now more than 6,000 public DC fast chargers and 66,000 L2 chargers in California, yet many drivers of fossil fuel vehicles are unaware that there may be sizeable numbers of chargers within their daily commute and travel range. For example, for the more than 6,000 DC fast chargers already installed, there are just 50 indicator signs along California freeways. As a result, this sizable number of PEV chargers is invisible to most drivers. 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 their 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 an initiative to increase the number of physical signs throughout the state. Working collaboratively with staff from GO-Biz, California Department of Transportation

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

(Caltrans), CPUC, and CARB, and in consultation with major charger companies, CEC staff is investigating strategies to increase the installation of physical indicator 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 for previously installed chargers.

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. CEC staff estimates that the sum of existing charging ports and charging ports funding across all state funding programs will result in more than 183,000 Level 2 chargers and 9,570 DC fast chargers 2025, leaving gaps of more than 56,000 Level 2 chargers and 430 DC fast chargers by 2025.

Staff recommends an aggressive near-term funding solution to help close this gap. Staff will also consider land use, housing policies, and Sustainable Community Strategies as they relate to ZEV infrastructure investments. To help achieve this adoption, the CEC is allocating $30.1 million in Clean Transportation Program funding and $240 million in general funds for light-duty electric vehicle charging infrastructure for FY 2021–2022. These funding allocations will provide the buildout of EV infrastructure that can create much-needed jobs and support economic development in response to COVID-19 while narrowing 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 3 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 reasons, medium- and heavy-duty vehicles represent a significant opportunity to reduce GHG emissions and criteria emissions while focusing on a small number of vehicles. Nonroad freight

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." 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." Available at https://www.arb.ca.gov/app/emsinv/2017/emssumcat_query.php?F_YR=2020&F_DIV=3&F_SEASON=A&SP=SIP105ADJ&F_AREA=CA#7.

vehicles, such as forklifts and other cargo handlers, have similar or supporting purposes and potential for emission reductions.

California moved dramatically further in reducing medium- and heavy-duty vehicle emissions when CARB adopted the Advanced Clean Truck Regulation (ACT) in June 2020. The ACT is modeled after the ZEV Regulation that CARB adopted for light-duty vehicles. Starting in 2024, the ACT will require truck manufacturers to sell an increasing proportion of zero-emission trucks in California. This is the first such regulation in the world.

Furthermore, with the adoption of the Innovative Clean Transit (ICT) regulation in 2018, large urban transit districts will need to have 25 percent of new bus acquisitions be zero-emission buses starting in 2023, rising to 100 percent in 2029. The goal is to transition the entire California transit fleet to zero-emission by 2040. The ICT regulation reduces GHG, PM, and NOx emissions, which will result in health benefits for individuals and communities in California. The CEC will play a pivotal role as the primary agency tasked with providing the infrastructure to support the targets for zero-emission vehicles, as described in ACT and ICT.

Charging Infrastructure for Medium- and Heavy-Duty Vehicles

As part of the analyses conducted for the *AB 2127 Report,* the CEC is evaluating 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 projects 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, of which 141,000 are 50 kW and 16,000 are 350 kW.

In addition to providing quantitative estimates of charging for medium- and heavy-duty vehicles, the *AB 2127 Report* also 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 charger — may vary significantly from site to site, even for ostensibly similar vehicles.

Medium- and heavy-duty vehicles, being more massive than the light-duty counterparts, generally use more energy to operate and require higher charging power. Power levels to charge these vehicles may reach several megawatts, introducing significant challenges to local distribution grids and vehicle operators who face costly facility upgrades. A preliminary analysis using the CEC's EVSE Deployment and Grid Evaluation tool found that California's investor-owned utilities should plan to accommodate medium- and heavy-duty fleets, including grid upgrades or other mitigative actions. This finding indicates that charger deployments for larger vehicles may frequently require new utility grid hardware in addition to the charger itself. Furthermore, in some off-road applications such as construction or agriculture, access to the grid may be nonexistent, and mobile or other emerging charging solutions will need to be deployed.

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 would 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 that is 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 in need.[42] The concepts evolved into solicitations that cover a wide range of support for medium- and heavy-duty zero-emission vehicle infrastructure:

- "Block Grant for Medium-Duty and Heavy-Duty Zero-Emission Vehicle Refueling Infrastructure Incentive Projects." 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

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

infrastructure incentive projects throughout California. The grant solicitation announced the availability of up to $50 million based on current and future fiscal years' funds. 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.

- "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. 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.
- "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 and work to accelerate the successful commercial deployment of these solutions. On April 16, 2021, the CEC announced a total of more than $4.1 million in medium- and heavy-duty vehicle sector awards.
- "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 seeks 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. For FY 2021–2022, the CEC proposes $25 million from the General Fund Drayage Truck & Infrastructure Pilot Project dedicated specifically to this joint solicitation with CARB to fully fund the passing projects in this solicitation.
- "Hydrogen Fuel Cell Demonstrations in Rail and Marine Applications at Ports." Released in July 2020, this solicitation was a collaborative effort 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. On March 17, 2021, three projects were approved at a CEC business meeting.

- "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 the implementation of medium- and heavy-duty zero-emission vehicles and the related electric charging or hydrogen refueling infrastructure or both. The solicitation included a set-aside for public entities. On April 8, 2021, the CEC announced nearly $4 million in public agency proposed funding and nearly $2 million in private entity proposed funding.

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 far exceed available 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 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, and Sustainable Community Strategies[43] as they relate to medium- and heavy-duty ZEV infrastructure investments, as well from the forthcoming HEVI-LOAD assessments.

For FY 2021–2022, the CEC allocates $30.1 million in Clean Transportation Program funding and $208 million in general funds dedicated to medium- and heavy-duty 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. In accordance with Senate Bill 129, an additional $153.25 million is allocated to heavy-duty covering drayage, transit, and school bus applications.

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. The Clean Transportation Program funds the development of hydrogen fueling stations to support the fuel cell electric vehicle (FCEV) market. These annual allocations also support the goal of having 200 hydrogen fueling stations by 2025, which was established by Governor Edmund G. Brown Jr. in Executive Order B-48-18.

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43 California Air Resources Board. Sustainable Communities Strategies. More information: https://ww2.arb.ca.gov/our-work/programs/sustainable-communities-program/what-are-sustainable-communities-strategies.

Evaluating the Deployment of FCEVs and Hydrogen Fueling Stations

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

Based on this evaluation, CARB reports to the CEC the number of needed stations; areas where additional stations will be needed; and minimum operating standards, such as number of dispensers, filling protocols, and pressure. CARB determines 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 *2020 Annual Evaluation of Fuel Cell Electric Vehicle Deployment & Hydrogen Fuel Station Network Deployment* (annual evaluation) report in September 2020 to comply with the requirements of Assembly Bill 8.[44] In this assessment, CARB determined that "California's hydrogen fueling station network has continued to add new, highly capable stations" and that "[t]he hydrogen fueling industry is responding favorably to the State's maturing support mechanisms." Manufacturer surveys conducted in 2020 project that 48,900 FCEVs will be on California roads by the end of 2026. This projection remains roughly the same as reported for 2025 in 2019.

Table 9 shows a compilation of reported data in CARB's annual evaluation reports from 2018 to 2020. The information in the table shows the number of FCEVs registered with DMV in 2020 is less than what auto manufacturers had projected in their mandatory reporting periods so far.

Table 9: Deployment of FCEVs and Hydrogen Fueling Stations as Reported in CARB's Annual Evaluation Reports

Report Year	Number of FCEVs Registered with DMV	Number of Projected FCEVs in Mandatory Period	Number of Stations Reported
2018	4,411	10,500 (projected in 2015)	36
2019	5,923	13,500 (projected in 2016)	41
2020	7,172	13,400 (projected in 2017)	42

Source: California Energy Commission staff compiling data from CARB's 2015–2020 Annual Evaluation reports.

In December 2020, the CEC and CARB released the *Joint Agency Staff Report on Assembly Bill 8: 2020 Annual Assessment of Time and Cost Needed to Attain 100 Hydrogen Fueling Stations*

44 California Air Resources Board. September 2020. *2020 Annual Evaluation of Fuel Cell Electric Vehicle Deployment & Hydrogen Fuel Station Network Development.* Available at https://ww2.arb.ca.gov/sites/default/files/2020-09/ab8_report_2020.pdf.

in California.[45] The report states that when all the 91 funded stations are open, the network will have enough fuel to support nearly 98,000 FCEVs. The 91 stations include 83 that are receiving grant funding and 8 that are privately funded under CEC agreement. The report also explains that the total number of stations approved at the December 9, 2020, CEC business meeting will result in CEC agreements and, if fully funded through future appropriations and Clean Transportation Program funds, will be 172 (including 16 to be privately funded under CEC agreement). In addition, 7 privately funded stations are anticipated outside CEC agreements, making for 179 stations expected in California. However, a gap of 21 stations from the goal set by Executive Order B-48-18 will remain after these 179 stations are opened. For FY 2021–2022, the CEC allocates $27 million from the general fund for this category dedicated to closing this gap in light-duty ZEV infrastructure.

With some of the stations resulting from GFO-19-602 planned to become open retail in the next few years, two of which are already opened, California is estimated to have in excess of 100 open retail stations by the end of 2023, thereby meeting the original AB 8 minimum requirement of 100 stations.

With the addition of stations from the most recent CEC funding solicitation (GFO-19-602), the state anticipates available fueling capacity will exceed the forecasted need in 2026. The additional capacity generates a vehicle deployment opportunity that has not existed previously in the state, which will help achieve the goal of having 5 million ZEVs in California by 2030, as well as the target of ensuring all new passenger vehicles sold are ZEVs by 2035.

The report also highlighted the ways in which the solicitation was designed to achieve economies of scale in hydrogen fueling equipment and showed that station costs could decrease while station capacity increased. California may benefit as countries around the world are pursuing hydrogen as a solution to decarbonize the transportation sector and other economic sectors.

Clean Transportation Program Funding to Date

Through the Clean Transportation Program, the CEC has provided nearly $160 million of funding to install or upgrade 83 publicly available hydrogen stations capable of light-duty vehicle fueling, including associated operations and maintenance. (One station has been taken out of service.). As of February 2021, 47 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 approved at the December 9, 2020, CEC business meeting, depending on performance, funding availability, and Clean Transportation Program Investment Plan Update funding allocations to install additional publicly available hydrogen stations. If fully funded, the solicitation combined with privately

45 Baronas, Jean, Gerhard Achtelik, et al. 2020. *Joint Agency Staff Report on Assembly Bill 8: 2020 Annual Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California.* California Energy Commission and California Air Resources Board. Publication Number: CEC-600-2020-008. Available at https://ww2.energy.ca.gov/2020publications/CEC-600-2020-008/CEC-600-2020-008.pdf.

funded stations should result in 179 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 GFO-19-602 are mandated to reach at least 40 percent of the hydrogen from renewable sources. Many open retail stations are dispensing hydrogen with about 90 percent renewable content.

Other Sources of Project Support

The Hydrogen Refueling Infrastructure (HRI) credit provision of the Low Carbon Fuel Standard (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 will receive $5 million from the Volkswagen Mitigation Trust fund to support the development of five hydrogen refueling stations. The use of the $5 million mitigation trust funds and cooperation among CARB, BAAQMD, 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 2021–2022, the CEC allocates $20 million of Clean Transportation Program funds for hydrogen fueling infrastructure, which is the maximum allocation allowable under current law.[47] Furthermore, for FY 2021–2022, the CEC allocates $27 million in general funds for this category dedicated to light-duty ZEV infrastructure to meet the goal of having 200 hydrogen fueling stations by 2025, which was established by Governor Edmund G. Brown Jr. in Executive Order B-48-18. These stations 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 adequate to support more than the number of FCEVs that the original equipment manufacturers (OEMs) have projected will be on the roads in 2026 and enable additional FCEV market penetration beyond then.

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46 California Air Resources Board Resolution 18-34 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.

Staff expects there will be an excess of 100 stations in operation by the end of 2023, on the path to reaching the 200 station target enabled by economies of scale achieved through the Clean Transportation Program's recent multiyear, multistation funding approach (GFO-19-602); LCFS HRI credits; increased private investment; and a one-time general fund investment. With this in mind, the funding allocations of this investment plan propose a $10 million allocation (which equates to 20 percent of the expected funds for the Clean Transportation Program in 2023) for hydrogen fueling infrastructure for the final half-year of this multiyear investment plan. The CEC will evaluate whether the proposed allocation for the final year of the program is sufficient to meet the needs of the FCEV market and will adjust as needed in annual revisions to the plan. This evaluation will be informed by CARB's annual evaluation, as well as input from the Advisory Committee, Disadvantaged Communities Advisory Group, and other stakeholders.

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.[48] Any low-carbon substitute fuel 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 can provide an immediate and long-term opportunity to reduce GHG emissions and criteria air pollution.[49] 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.[50] 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 (gCO_2e/MJ).[51] 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 through other funding mechanisms.

Fuel Type Overview

Renewable Diesel and Biodiesel

In 2019, renewable diesel was the most common diesel substitute in California, with 609 million diesel-gallon equivalents sold.[52] Renewable diesel that meets the fuel specification

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

49 Ibid.

50 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.

51 Consult the glossary for the definition of "megajoule."

52 California Air Resources Board. October 30, 2020. CARB Data Dashboard Available at https://ww3.arb.ca.gov/fuels/lcfs/dashboard/dashboard.htm.

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.[53] Together, renewable diesel and biodiesel accounted for about 45 percent of LCFS credits in 2019.[54] Of the 3.8 billion gallons of diesel fuel consumed in California in 2019, about 830 million (or 22 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.

Ethanol and Renewable Gasoline

Ethanol is the only widely available gasoline substitute 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 and, if developed into a commercially viable product, may contribute significantly to California's environmental and energy goals.

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 grams of carbon dioxide equivalent greenhouse gases per megajoule (gCO_2e/MJ) (or roughly 125 percent below diesel), indicating that the pathway contributes a net GHG emission reduction. Biomethane derived from dairy

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53 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 16.89 gCO2e/MJ. Based on data from the LCFS Fuel Pathway Table (April 16, 2019), available at https://www.arb.ca.gov/fuels/lcfs/fuelpathways/current-pathways_all.xlsx.

54 California Air Resources Board. April 30, 2019. "LCFS Quarterly Data Spreadsheet." Available at http://www.arb.ca.gov/fuels/lcfs/lrtqsummaries.htm.

biogas has the lowest carbon intensity approved under the LCFS — about negative 255 gCO_2e/MJ.[55]

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, which would displace 23 percent to 36 percent of the on-road diesel fuel consumption in California.[56] However, based on other studies provided by NREL, the technical availability (under preferable market conditions) could be four times higher.[57] 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 zero-emission alternatives are not feasible.

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 percent to 50 percent.[58] 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

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55 California Air Resources Board. October 31, 2018. "LCFS Pathway Certified Carbon Intensities." Available at https://www.arb.ca.gov/fuels/lcfs/fuelpathways/pathwaytable.htm.

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

57 California Energy Commission staff. 2017. *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.

58 California Independent System Operator. Managing Oversupply. 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 nearly $210 million to 68 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 April 16, 2021

Fuel Type	Qualifying Proposals* Submitted	Funds Requested by Qualifying Proposals* (in Millions)	Awards Made	Funds Awarded (in Millions)
Gasoline Substitutes	27	$68.8	14	$36.8
Diesel Substitutes	62	$187.1	26	$75.1
Biomethane	67	$212.4	26	$89.6
Renewable Hydrogen	4	$16.9	2	$7.9
Total	**160**	**$485.2**	**68**	**$209.4**

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.

Outside the Clean Transportation Program in August 2019, the CEC released GFO-19-601 titled "Low-Carbon Fuel Production Program." The solicitation was an offer to fund ultralow-carbon transportation fuel production at new and existing advanced fuel production plants. The solicitation provided $12.5 million from the Greenhouse Gas Reduction Fund, and in January 2020, the CEC issued a NOPA of four grants to fully use the funding. The solicitation produced $53 million in requested funds, indicating a strong interest in the sector.

Other Sources of Funding

Other state and federal programs also provide support and incentives to low-carbon fuel producers. The California Department of Resources Recycling and Recovery (CalRecycle) Organics Grant Program conducted three grant cycles in 2014, 2017, and 2018, which awarded $32.9 million to nine biomethane-producing projects. For Fiscal Year 2018–2019, CalRecycle awarded about $15.8 million to six projects for waste diversion using greenhouse gas reduction funds.

The California Department of Food and Agriculture awarded $35.2 million in October 2017 for anaerobic digesters at dairies through the Dairy Digester Research and Development Program and awarded $72.4 million for additional dairy digester projects in 2018. For 2019, the California Department of Food and Agriculture (CDFA) awarded an additional funding more than $67.3 million for these activities. 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 Dairy Digester Research and Development Program (DDRDP) and the Alternative Manure Management Program (AMMP), will reduce greenhouse gas emissions from manure on California dairy and livestock farms. Twelve DDRDP projects totaling $16.5 million and 13 AMMP projects totaling $8.9 million are being funded through the most recent round of funding. The CEC will work with these agencies to ensure future funding awards are complementary.

In addition, the LCFS and RFS requirements 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.[59] 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.[60] 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

Given the near-term petroleum and GHG emission reduction potential of any low-carbon, drop-in gasoline or petroleum replacement, future solicitations under this category may emphasize renewable gasoline, renewable crude oil, and similar products to accelerate development. There may also be opportunities to expand or otherwise improve the limited distribution of liquid biofuels (whether for drop-in substitutes or blending), which impedes the state's supply of low-carbon transportation fuel.

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. As the market for low-carbon fuels continues to develop, the CEC may also consider alternative funding mechanisms, such as revolving loan or loan guarantee programs, which may be more suitable for large projects and developed industries.

For FY 2021–2022, 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

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

60 Ibid.

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 overgeneration or biomethane.

CHAPTER 6:
Related Opportunities

Manufacturing

Electric vehicles were the number one California export in 2020.[61] 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.[62] 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. Products from these companies are sold predominantly in domestically and globally distributed markets. 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 24 projects. Clean Transportation Program grants have been invaluable in attracting companies to California, leveraging the state's policy objectives, and scaling growth in-state and abroad.

Some California ZEV manufacturers have established formal worker relationships with organized labor. 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 or both under the Clean Transportation Program manufacturing portfolio.

Senate Bill 129 provides $250 million in general fund money. This money, less administrative costs, is to be used for manufacturing grants to "increase in-state manufacturing of zero-emission vehicles, zero-emission vehicle components, and zero-emission vehicle charging or refueling equipment."

Implementation of a successful grant program for in-state manufacturing requires collaboration and alignment with state agencies that provide funding and support, such as the California Business Investment Services in the Governor's Office, the California Alternative Energy and Advanced Transportation Financing Authority in the State Treasurer's Office, and

61 State Export from California is available at https://www.census.gov/foreign-trade/statistics/state/data/ca.html.

62 CALSTART's California ZEV Jobs Study. January 2021. Available at https://calstart.org/wp-content/uploads/2021/02/CA-ZEV-Jobs-Study-Final-0203.pdf.

the California Employment Training Panel. Program success will also include engagement with the economic and business development entities of local cities and counties who provide frontline services to manufacturing companies. To this end, staff will immediately begin working with these entities to promote ZEV manufacturing and will conduct workshops to allow public input and deeper engagement with ZEV manufacturers and supply chains to leverage this opportunity.

As previously noted, SB 129 provides $250 million ($125 million for FY 2021–2022 and $125 million for FY 2022–2023) in general funds for manufacturing. As a result of this significant funding increase, the CEC finds it appropriate to shift Clean Transportation Program funding from manufacturing in FY 2021–2022 to workforce training and development.

Workforce Training and Development

Clean Transportation Program investments into workforce training and development are central to the advancement of clean transportation technologies in commercial markets. More than $35 million has been invested in workforce projects for more than 20,000 trainees. The primary workforce delivery systems for Clean Transportation Program funding have been through state entities such as the Employment Development Department, the California Employment Training Panel, and the California Workforce Development Board.

The CEC has a long-standing partnership with California community colleges primarily through its Advanced Transportation and Logistics Initiative (ATL). This partnership includes:

- ZEV Curricula — College faculty developed ZEV curricula for degrees, credit, and certificates at their college for zero-emission vehicle technology for light-duty and truck/bus platforms. A new training project focuses on ZEV curricula in community colleges serving students in disadvantaged communities and low-income populations.
- Electric School Bus Training Project — The CEC awarded funding to school districts to replace diesel school buses with electric school buses in 2019. School districts will receive customized training from nearby experienced community college faculty on these buses for maintenance/service technician staff and school bus operators.
- ZEV High School Pilot Career Opportunity Project — In 2018, ATL, led by Cerritos Community College, developed a pilot training project for high school automotive programs. The project builds on existing high school automotive programs and increases awareness for the state's high school students in clean transportation careers. Twenty-seven high schools have been awarded funds to establish "Auto 3: ZEV Technology" technical training programs that have a career pathway to programs offered at California community colleges.

These projects have already provided a significant return on investment, especially in underserved communities where schools are located. As an example, for the high school project, early results show more than 1,800 students have enrolled in these programs and more than 36 faculty have been trained in ZEV technology. These results are critical as ZEV employers are partners and offer immediate job employment opportunities with sustainable wages.

Based on the state's development of zero-emission transportation regulations, the continued deployment of ZEVs for on- and off-road markets, and the need to meet critical ZEV training needs especially in equity communities in FY 2021–2022, the CEC allocates $5 million for workforce training and development projects. 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 prioritize disadvantaged communities, low-income communities, underrepresented populations, and economically disadvantaged high schools to ensure equitable participation in the clean transportation economy.

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 (CH_4), carbon dioxide (CO_2), 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 multiple 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."

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 (gCO_2e/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 (O_3), carbon monoxide (CO), nitrogen oxides (NO_X), sulfur oxides (SO_X), and particulate matter (PM_{10} and $PM_{2.5}$).

DISADVANTAGED COMMUNITIES — Disadvantaged communities refers to the areas throughout the state which 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 strategic 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 and participation.

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 (CO_2), methane (CH_4), nitrous oxide (N_2O), halogenated fluorocarbons (HCFCs), ozone (O_3), 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.

INTELLIGENT TRANSPORTATION SYSTEM — The application of advanced information and communications technology to surface transportation to achieve enhanced safety, efficiency, and mobility while reducing environmental impact.

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 CH_4.

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.

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
ARPA-E	Advanced Research Projects Agency – Energy
ASE	Automotive Serve Excellence
ATL	Initiative Advanced Transportation and Logistics Initiative
BEV	battery-electric vehicle
CaFCP	California Fuel Cell Partnership
CA-GREET	California Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation Model
CALeVIP	California Electric Vehicle Infrastructure Project
CalRecycle	California Department of Resources Recycling and Recovery
CARB	California Air Resources Board
CEC	California Energy Commission
CHIT	California Hydrogen Infrastructure Tool
CMO	Clean Mobility Options
CNG	compressed natural gas
CO_2e	carbon dioxide-equivalent greenhouse gases
COE	county office of education
CPUC	California Public Utilities Commission
CSFAP	California Sustainable Freight Action Plan
CVRP	Clean Vehicle Rebate Project
DAS	Division of Apprenticeship Standards
DC	direct current
DDRDP	Dairy Digester Research and Development Program
DGE	diesel gallon-equivalent
EPIC	Electric Program Investment Charge
ETAP	Energy Transit Apprenticeship Program
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
GGE	gasoline gallon-equivalent
GGRF	Greenhouse Gas Reduction Fund
gCO_2e/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
I-Bank	Infrastructure and Economic Development Bank
ICT	Innovative Clean Transit
LCFS	Low Carbon Fuel Standard
LCTI	Low Carbon Transportation Investment
LIC	Low-income communities
MJ	megajoule
$MMTCO_2e$	million metric tons of carbon dioxide-equivalent greenhouse gases
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
PHEV	plug-in hybrid electric vehicle
PON	program opportunity notice
RFS	Renewable Fuel Standard
SB	Senate Bill
SCE	Southern California Edison
SDG&E	San Diego Gas & Electric Company
SIP	State Implementation Plan
SoCal Gas	Southern California Gas Company
U.S. EPA	United States Environmental Protection Agency
USW	United Steelworkers
VTA	Santa Clara Valley Transport
ZEV	zero-emission vehicle