Appendix E: 2022 SB 1403 School Bus Incentive Program Report

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Table of Contents

Introduction

The State is making progress cleaning up the school bus fleet and improving air quality. More school districts are incorporating zero-emission school bus technology into their fleets and new funding allocations are becoming available. Older, higher-polluting, diesel school buses are harmful to children's health, as they expose children to toxic diesel particulate matter. The California Air Resources Board (CARB), the California Energy Commission (CEC), local air districts, utilities, school bus manufacturers, school districts, and communities continue their efforts to turn over older diesel school buses for more efficient zero-emission buses.

Starting in 2019, Senate Bill (SB) 1403 (Lara, Chapter 370, Statues of 2018) mandates that CARB, in consultation with CEC, provide a report annually on the State's school bus incentive programs as part of the Heavy-Duty Investment Strategy. This statute requires an update on the milestones achieved by the State school bus incentive programs and a projected need for funding considering the statewide school bus inventory, turnover, and useful life. In addition to what is required by statute, this report also includes a discussion of zero-emission school buses and their role in the ongoing transformation of the transportation sector to meet California's air quality and greenhouse gas goals and multiple case studies of school districts that have incorporated zero-emission school buses into their fleet.

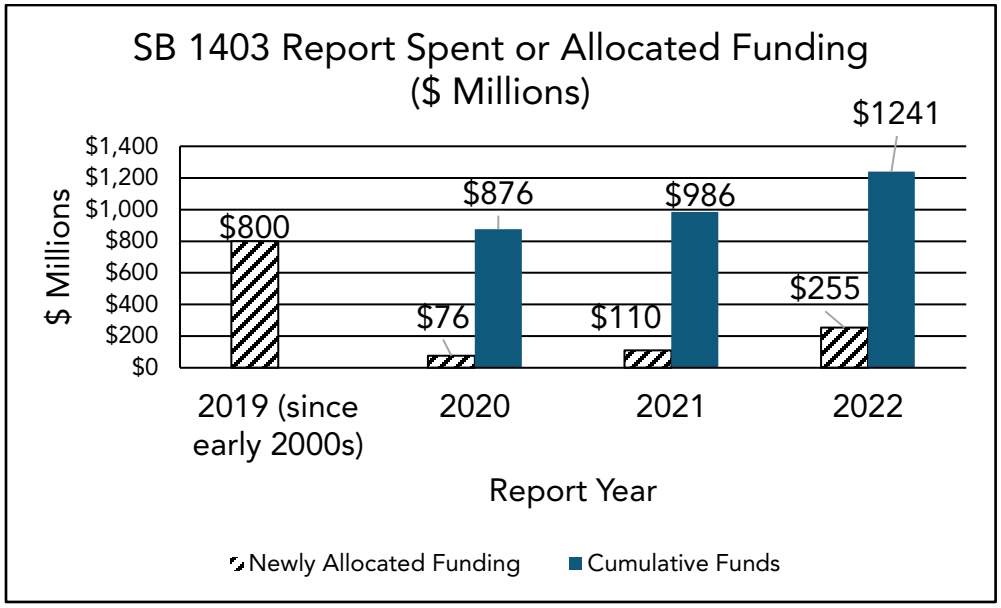
School Bus Funding Update

Public school districts often do not have the funding to replace their aging school bus fleet. Based on a comprehensive assessment of funding for home-to-school transportation conducted by the Legislative Analyst's Office in 2014,[1] the primary responsibility for school transportation funding lies with public school districts through the State legislative process. Investing in California's school bus fleet is a collective effort amongst agencies on the local, state, and federal level. CARB and CEC have led the effort in dedicating funding and resources to turning over old, dirty school buses and investing in new technologies. Together, CARB and CEC have made significant progress over the last year to make it easier for school districts to access zero-emission school bus and charging/fueling infrastructure incentives in a coordinated, streamlined manner. The State has spent or allocated approximately $255 million to school bus cleanup since last year's update, bringing the total to date to $1.2 billion. In addition, the Legislature appropriated additional funds totaling $1.8 billion over the next five fiscal years. For more background on California's school bus cleanup funding history please refer to the past *SB 1403 State School Bus Incentive Program*

1 Legislative Analyst's Office (2014), Review of School Transportation in California, retrieved from *https://lao.ca.gov/reports/2014/education/school-transportation/school-transportation-022514.pdf*

Reports[2]. See Figure E-1 which illustrates the newly spent or allocated funding reported in each SB 1403 Report and the cumulative amount.

Figure E-1: SB 1403 Report Spent or Allocated Funding



In the Fiscal Year (FY) 2022-23 State Budget, the Legislature provided $1.5 billion in one-time Proposition 98 General Funds to support grants to local educational agencies to replace internal combustion school buses with new zero-emission school buses over five FYs, beginning in FY 2023-24. *AB 181* (Committee on Education, Chapter 52, Statutes of 2022), the education omnibus budget trailer bill, provided CARB with $1.125 billion from Proposition 98 General Funds to CARB for the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) to replace heavy-duty internal combustion school buses with zero-emission school buses, and $375 million to CEC to fund school bus charging or fueling infrastructure. The Legislature also approved $150 million in funding dedicated to school buses in the FY 2022-23 State budget, $135 million for CARB to deploy zero-emission school buses, and $15 million to CEC for infrastructure. This is the second installment from the $450 million appropriated by the Legislature in FY 2021-22 to fund zero-emission buses and infrastructure over three years.

The following are some brief updates on major funding program developments, followed by Table E-1 that highlights past and current State school bus funding that has gone to school

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2 California Air Resources Board; *https://ww2.arb.ca.gov/resources/documents/low-carbon-transportation-investments-and-aqip-funding-plan-archive*

bus cleanup to support exhaust retrofits, full vehicle replacements, and supporting infrastructure. Air district-run funding programs such as the Carl Moyer Memorial Air Quality Standards Program (Moyer) and Lower-Emission School Bus Program funded by Assembly Bill (AB) 923 funds remain a steady and available source of funding for cleaner school buses.

Clean Truck and Bus Vouchers (HVIP)

Funded by Cap -and-Trade auction proceeds through Low Carbon Transportation funds, Air Quality Improvement Funds, and more recently, General Fund appropriations, Clean Truck and Bus Vouchers (HVIP) are available to assist with the incremental cost of zero-emission school bus purchases. The program is available statewide and currently administered by CALSTART. Since inception in 2010, approximately $157 million worth of HVIP vouchers has funded 962 school buses, 905 of which are zero-emission battery electric.

The FY 2021-22 budget included a three-year allocation of $450 million in funding to support incentives to deploy 1,000 zero-emission school buses in rural and underserved communities in California. The first installment of $150 million included $130 million to CARB for zero-emission buses and $20 million to CEC for complementary charging infrastructure. The CARB funding was provided as a set-aside through the HVIP program. Funding in the set-aside was prioritized to replace internal combustion engine school buses older than model year 2007 located in small and medium sized air districts. Voucher amounts for the set-aside were set significantly higher than standard HVIP voucher amounts and included a requirement to scrap the old school bus. HVIP opened to voucher requests on March 30, 2022 and was quickly oversubscribed. Applications are currently being reviewed. The State budget for FY 2022-23 allocated the second installment of $135 million to CARB for the school buses, and $15 million to CEC for supporting infrastructure.

CARB's part of the $1.5 billion in Proposition 98 funding will be administered through HVIP per the provisions of AB 181. CARB will work with CEC, Department of General Services, and stakeholders as set forth in the bill to implement the funding.

California Energy Commission School Bus Replacement Program

SB 110 (Chapter 55, Statutes of 2017) appropriated funds to establish the School Bus Replacement Program at the CEC. SB 110 provided one-time funding of $75 million from Proposition 39 for the replacement and scrap of old diesel school buses in disadvantaged and low-income communities throughout California. CEC prioritized battery electric school buses that are ready for Vehicle-to-grid (V2G) integration with this funding. CEC received applications from over 200 school districts to replace more than 1,600 diesel school buses. Sixty-two school districts were awarded 228 battery electric school buses. All of these school buses can be tracked (bus delivered and projected to be delivered) online on the *CEC website*.

As of June 30, 2022, 70 percent of the school buses were delivered to school districts. School districts should receive the remaining School Bus Replacement Program buses by March 2023.

CEC distributed the funding among four areas in California: Northern, Central, Southern, and Los Angeles County. In addition, approximately $14 million in Clean Transportation Program funds were provided for the necessary charging infrastructure to operate the zero-emission battery electric school buses, and $1 million in Clean Transportation Program funds were provided for workforce training and development. As of June 30, 2022, 52 school districts have completed the electric charging infrastructure. CEC collaborated with Cerritos Community College to develop workforce training and development curriculum for school districts that were awarded battery electric school buses through the School Bus Replacement Program.

California Energy Commission Clean Transportation Program

CEC allocated over $6 million from Clean Transportation Program funds for 25 compressed natural gas (CNG) school bus replacements and supporting fueling infrastructure. All 25 school buses were delivered by December 2020, and the supporting CNG fueling infrastructure is completed. Additionally, CEC has allocated over $8 million from Clean Transportation Program funds to create planning "blueprint" projects that will identify actions and milestones needed for the implementation of medium and heavy--duty zero-emission vehicle fleets and related electric charging infrastructure. Four of the projects that were awarded centered around the transition of school district bus fleets and could provide useful insights for future school districts looking to transition to zero-emission vehicles. The blueprint projects began in July 2021, and are expected to be completed by July 2023.

Clean Mobility in Schools Pilot Project

In 2018, CARB approved funding from the Low Carbon Transportation Investment Program for the Clean Mobility in Schools Pilot Project[3]. The goal of the project is to increase the visibility of, and access to, zero-emission transportation options by placing various commercially available zero-emission technologies, along with the supporting charging/fueling infrastructure, including battery electric school buses and Level 2 and 3 chargers, in one or more schools located in disadvantaged communities in California. CARB issued a grant solicitation in August 2019 and received seven applications from eligible school districts requesting over $55 million. In early 2020, grant agreements were finalized with El Monte Union High School District, San Diego Unified School District, and Stockton Unified School District, for a total of $24.6 million. As of May 31, 2022, 40 school buses have been purchased through the Project.

In 2021, the CARB Board approved $10 million in Low Carbon Transportation Investments to be allocated to the fourth top-scoring application from the August 2019 solicitation applicant pool and to supplement Stockton Unified School District's grant to the original requested

3 *https://ww2.arb.ca.gov/lcti-clean-mobility-schools-pilot-project*

amount. The fourth grant agreement is anticipated to be signed in early fall 2022 at Twin Rivers Unified School District in Sacramento, California.

Volkswagen Environmental Mitigation Trust

Volkswagen's settlement allocates $423 million to California to mitigate the excess oxides of nitrogen emissions caused by their illegal actions. California's Beneficiary Mitigation Plan designates $130 million of the State's allocation for zero-emission bus replacements including shuttle, transit, and school buses, with a 50 percent cap for any one of the three bus types. The San Joaquin Valley Air Pollution Control District (SJVAPCD) is administering the bus replacements statewide on a first-come, first-serve basis. SJVAPCD accepted applications for the first installment of funds, $65 million, in fall 2019 and received 495 school bus applications requesting approximately $198 million. The first installment will replace approximately 80 school buses. School bus applications quickly exceeded the available 50 percent funding cap for this installment. As of May 2022, contracts have been executed for 74 battery electric school buses, and of those, 55 have been delivered.

Community Air Protection Incentives

Community Air Protection (CAP) incentive projects, funded by Cap -and -Trade auction proceeds since FY 2017-18, are community-focused and community-driven. Local air districts select projects according to guidance from community members and work to reduce emissions exposure in communities most affected by air pollution. Currently, the Legislature has appropriated over $1.2 billion to reducing criteria pollutant and toxic air contaminant emissions with a priority towards disadvantaged and low-income communities, particularly those communities selected for air monitoring plans or emissions reduction programs pursuant to AB 617 (C. Garcia, Chapter 136, Statutes of 2017).

School bus replacements are eligible projects for these funds and community groups have voiced priority for school bus projects when describing community needs. This program has funded 317 school buses, 208 of which are zero-emission. Overall, $71.4 million of CAP incentives have gone toward school bus replacement and charging and fueling infrastructure in the state's most impacted, low-income, and disadvantaged communities.

Rural School Bus Pilot Project

The Rural School Bus Pilot Project has contributed $61.55 million of Low Carbon Transportation Investments for replacement projects with renewable fueled internal combustion engine school buses or new zero-emission school bus projects. Funded for four consecutive FYs (2016-17 through 2019-20), the statewide project has been administered by the North Coast Unified Air Quality Management District. Public school bus fleets in small-sized air districts, per the California Air Pollution Control Officers Association, received priority because small-sized air districts traditionally lack the funding sources available to large-sized air districts allocated for school bus replacement incentive programs. This project will fund the replacement of over 180 cleaner school buses by 2025, 60 percent of which are

expected to be zero-emission school buses. To date, 78 zero-emission school buses have been delivered through the Rural School Bus Pilot Project.

The public school bus set-aside in HVIP continues the legacy of the Rural School Bus Pilot Project by funding 1,000 school bus replacements in rural and underserved communities throughout the state, as described above.

AB 181, the Education Omnibus Budget Trailer Bill

This bill from FY 2022-23 appropriates $1.125 billion to CARB for HVIP to replace heavy-duty internal combustion school buses with zero-emission school buses, and $375 million to CEC to fund school bus charging or fueling infrastructure. Commencing with the 2023-24 fiscal year, the bill requires that CARB award grants totaling $225 million and the CEC award grants totaling $75 million in each fiscal year to local education agencies. School districts that are small, rural, and that enroll a higher share of disadvantaged students and propose to replace the oldest buses will receive priority for the funding.

EnergIIZE Program

Funded and developed by the California Energy Commission (CEC), the CEC implemented the Energy Infrastructure Incentives for Zero-Emission (EnergIIZE) Commercial Vehicles Project. Project funding will provide the infrastructure needed to support the transition of old, polluting medium- and heavy-duty (MD/HD) equipment to zero-emission battery electric and hydrogen fuel cell vehicles. The project provides a user-friendly and streamlined process for participation by breaking down infrastructure deployment barriers through targeted incentives and specialized assistance. EnergIIZE designed four funding lanes to support the unique infrastructure needs of each commercial fleet user. Applications for the EV Fast Track lane opened March 23, 2022, Hydrogen funding lane applications opened June 30,2022 and with subsequent funding lanes for EV Jumpstart, and EV Public Charging funding lane will open by the end of 2022. Additionally, there is a separate School Bus Infrastructure funding lane that pairs with CARB HVIP Public School Bus Set Aside funding. CARB and CEC are coordinating on project requirements to ensure that funding for infrastructure is available and appropriate for the new zero-emission school buses funded through HVIP.

Table E-1 below highlights the State's past and current school bus funding that has gone to school bus cleanup to support exhaust retrofits, full vehicle replacements, and supporting infrastructure.

Table E-1: Summary of State School Bus Incentives – Through May 2022

Funding Source	Amount Spent/ Allocated	Projects	Zero-Emission School Buses
Carl Moyer Program & Carl Moyer State Reserve* *since 1998*	$17.4 million	110 school buses, 32 infrastructure projects	9
Assembly Bill 923* *since 2008*	$245.9 million	Retrofits, school buses, compressed natural gas (CNG) tanks, & infrastructure	NA
Lower-Emission School Bus Program+ *since 2001*	$310 million	7,456 retrofits, 1,642 school buses	0
Diesel Emissions Reduction Act *since 2008*	$15.8 million (Federal & State contribution)	549 retrofits, 115 school buses	36
Clean Truck and Bus Vouchers (HVIP)* *since 2010*	$157.2 million	962 school buses	905
Supplemental Environmental Projects for School Buses+ *since 2012*	$5.1 million	11 retrofits, 20 school buses, 297 recalled filter replacements	0
Clean Transportation Program (CEC) *since 2012*	$21.3 million	25 CNG school buses, 5 CNG & 62 electric infrastructure projects, & workforce training	0
Rural School Bus Pilot Project+* *since 2016*	$62 million	180 school buses	108
Community Air Protection (CAP) Incentives* *since 2017*	$71.4 million	317 school buses, 30 infrastructure projects	208
Sacramento Regional Zero-Emission School Bus Deployment Project *since 2017*	$14.5 million (State & match contribution)	28 school buses & infrastructure	28
Volkswagen Mitigation Trust *since 2018**	Up to $65 million	74 school buses for first installment	74
Clean Mobility in Schools Pilot Project* *since 2018*	$34.6 million	40 school buses & infrastructure	40

School Bus Replacement Program (CEC)[+] *since 2019*	$75 million	228 battery electric school buses	228
HVIP Public School Bus Set-Aside* (CARB and CEC) since 2021	$150 million in 1st year	300 school buses with infrastructure	300
Total**	**$1.24 billion**		**1,836****

[+] Represents funding sources that are dedicated to school bus cleanup
** Represents funding sources and figures that have been updated since the 2021 SB 1403 State School Bus Incentive Programs Report*
*** About 100 school buses were co-funded by the Carl Moyer Program and HVIP, so 100 was subtracted from the total to avoid double-counting them.*

Many of the school buses represented in Table E-1 are presented in an online *dashboard* which shows zero-emission school buses that have been delivered or are projected to be delivered from CARB-funded and CARB-implemented school bus funding sources.

While not reflected in Table E-1, new federal programs are worth noting because they will help replace old school buses with zero-emission replacements. In addition to the Federal Clean School Bus Program and Federal American Rescue Plan the Inflation Reduction Act will provide additional support for zero-emission school buses.

Federal Clean School Bus Program

The *Clean School Bus Program* provides $5 billion in funding over five years from 2022 to 2026 for the replacement of existing school buses with low and zero-emission school buses. Under the Clean School Bus Program, half of the available funding is dedicated for zero-emission school buses and half is for clean school buses. Clean school buses include those that reduce emissions and operated entirely or in part using alternative fuels. The U.S. Environmental Protection Agency (U.S. EPA) may cover up to 100 percent of the vehicle cost and infrastructure through grants, rebates, or contracts. The Clean School Bus Program allows U.S. EPA to prioritize applications that will replace buses serving high-need local education agencies, Tribal Schools, and rural or low-income areas.

Applications for rebates in the 2022 Clean School Bus Program were accepted from May 20 to August 19.

Federal American Rescue Plan

The 2021 American Rescue Plan (ARP) is a $7 million national program that provided funds to replace old diesel school buses with new, zero-emission school buses. The funds are reserved exclusively for school districts in underserved communities, Tribal schools, and private fleets serving those schools. This program will award funding for 23 zero-emission school bus

replacements and associated charging infrastructure. In California, the Terra Bella Union Elementary was awarded $600,000 for two school buses.

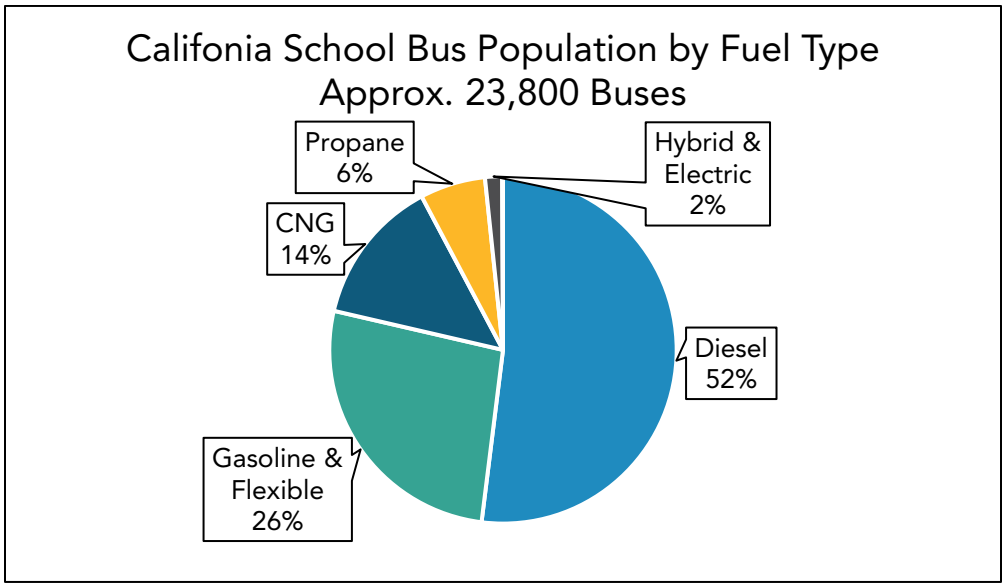
California School Bus Fleet Update

Defining the California School Bus Fleet has been an ongoing and extensive project and critical to understanding bus fleet composition and projected needs for funding cleanup. There is no single data source that gives a complete picture of the State's school bus population. To provide this update and further understand the inventory, staff compile data from the California Highway Patrol (CHP) School Bus Inspection Program, the current Department of Motor Vehicles (DMV) Vehicle registration database, and data from the various State funding programs that have replaced or plan to replace school buses. The 2022 CHP school bus inspection data served as the primary data source for determining the school bus population because CHP requires an inspection every 13 months for a school bus to legally transport children[4]. This data was used to help update the school bus fleet database from last year. All the school bus records in the inventory have had a recent CHP safety inspection in the previous two years. To supplement the data, staff also compiled compliance information from the Truck and Bus Regulation Reporting system called the Truck Regulation Upload Compliance and Reporting System (TRUCRS). Under the Truck and Bus Regulation, public school districts are not required to report their fleet information, but some funding programs require school districts to report their school buses in TRUCRS to demonstrate compliance to be eligible for grant funding. Also, the Truck and Bus Regulation (CCR sections 2025(s), 2025(t)), requires school districts to submit records to CARB upon request.

Staff estimates there are approximately 23,800 school buses operating in California. This number is nearly the same as the 24,100 school buses in the inventory last year. Figure E-2 depicts the California School Bus Population by fuel type.

4 California Vehicle Code, Section 2807

Figure E-2: California School Bus Population by Fuel Type



The bus population by fuel type is nearly identical to 2021. Approximately 52 percent of the fleet is diesel. The rest of the school bus fleet is made up of gasoline and flexible fuel (a gasoline blend with up to 85 percent ethanol), CNG, propane, and hybrid and battery electric. The percentage of CNG buses is 14 percent. Hybrid and battery electric school buses currently make up approximately two percent of the inventory.

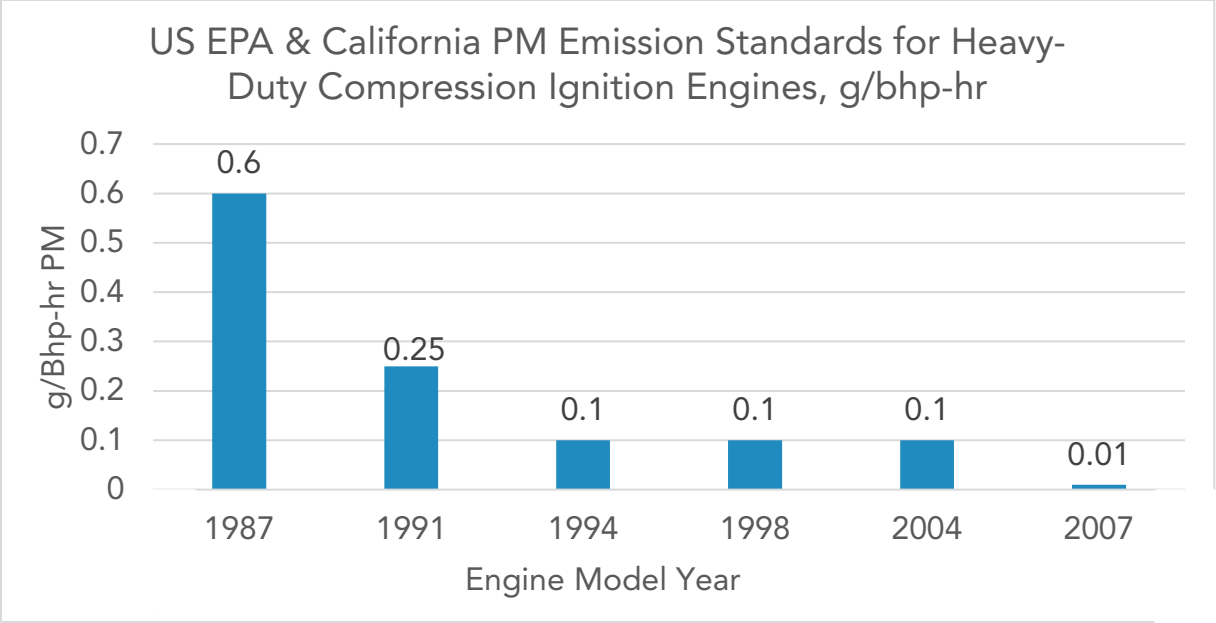
Need for Turnover

Amongst California school buses, the diesel-fueled vehicles are CARB's main area of focus because diesel particulate matter (PM) is a toxic air contaminant and children are particularly vulnerable to health impacts. Toxic air contaminants may have health impacts at any amount, so reducing diesel PM exposure is a major focus of efforts to clean up the school bus fleet.

Several actions taken to reduce children's exposure to vehicle-related pollutants during their school bus trips include smoke opacity testing, idling restrictions, and in-use regulations such as the Truck and Bus Regulation. Diesel-fueled school bus fleets must be regularly tested for excessive smoke. School buses of any type are restricted from idling at or near public or private schools. Drivers must turn off engines immediately after arriving at a school and restart no more than 30 seconds before departure.

Engine emissions standards play a major role in reducing harmful exposure to particulate matter. Figure E-3 illustrates how emission standards have become more stringent over time.

Figure E-3: Heavy-Duty PM Emission Standard by Engine Model Year



The current PM standard of 0.01 g/bhp-hr has been the standard since 2007. The PM emission standard prior to 1991, for example, of 0.60 g/bhp-hr is 60 times the emissions of the current PM standard. This shows why it is most important to turn over the oldest buses as the emission standards of the past are so much more polluting than buses meeting the current emission standards. The oldest buses in the inventory are 1978-1986 model year engine buses. Buses in this range have the same basic emission characteristics, so there is no significant emission benefit associated with retiring an older bus versus a newer bus in this model year engine range. Buses with model year engines of 1987-1990 and 1991-1993 are the next categories of concern. These buses have a higher emission standard and emit more pollutants than 1994 and newer buses.

The presence of PM exhaust filters reduces PM emissions by at least 85 percent. Nearly all engines that have an engine model year of 2007 or newer come assembled from the manufacturer equipped with a PM exhaust filter. Under the Truck and Bus Regulation[5], CARB requires diesel-fueled school buses over 14,000 pounds gross vehicle weight rating (GVWR) to be equipped with a PM exhaust filter (retrofitted or original equipment), or they must operate less than 1,000 miles per year.

Older diesel school buses are more polluting with higher deterioration of the engines and PM filters due to aging, exposing children, a sensitive population group, to more emissions. Turnover of the oldest and dirtiest school buses is essential for reducing exposure to

5 Title 13, California Code of Regulations (CCR), Section 2025

pollutants. Turning over the oldest buses also has the added benefits of supporting California's air quality, climate change, and petroleum reduction goals. Accelerating the introduction and deployment of zero-emission technologies will further help achieve these goals.

Improving Safety Standards – Turnover Means Safer Buses on the Road

Besides reducing PM emissions, another reason to turn over the oldest school buses in the inventory is the improvement of school bus safety standards, including seatbelt safety laws and the child safety check. California law requires school buses manufactured on or after July 1, 2005 with a rated seating capacity of 16 or more passengers to be equipped with three-point seat belts and on all other school buses manufactured on or after July 1, 2004.[6] It is not required to retrofit new seats with seat belts, but the updated safety features are a positive outcome of replacing the oldest school buses.

Analysis of Diesel School Buses in California

Since January 1, 2014, diesel school buses with a GVWR over 14,000 pounds were required to be equipped with a PM filter, unless the bus was designated as a low use school bus traveling less than 1,000 miles per year or reported for a PM filter extension. Staff found 79 school buses in the oldest category with bus model years of 1978-1988 in the inventory, and 64 of those are publicly owned. Table E-2 illustrates the number of publicly owned diesel school buses by bus model year and engine model year. Note, the model year of a vehicle is typically one year ahead of the engine model year. For example, a bus with a model year of 1988 will most likely be equipped with a 1987 model year engine. These are the school buses of greatest concern that need to be turned over since they were designed to meet the less stringent, higher-emitting, emission standard that existed at the time. Considering public school buses only, about two-thirds operate in school districts that have census tracts identified as disadvantaged communities. Staff found 242 diesel school buses in the next oldest category of concern which includes bus model years of 1989-1991.

6 California Vehicle Code (CVC), Section 27316

Table E-2: Publicly Owned Diesel-Fueled School Buses

Bus Model Year (Engine Model Year)	Number of Buses
1978 – 1988 (1977 – 1987)	64
1989 – 1991 (1988 – 1990)	242
1992 – 1994 (1991 – 1993)	308
1995 – 2007 (1994 – 2006)	5,976
2008 – 2010 (2007 – 2009)	1,839
2011 & Newer (2010 & Newer)	7,390

Nearly 85 percent of the entire school bus inventory has a diesel PM filter, or is not diesel-fueled and therefore a PM filter is not applicable.

Projected Need for Funding

School bus turnover requires significant and long-term funding. Although the turnover of the State school bus fleet continues to progress each year, a significant number of school buses still need to be replaced. The new Federal funding and State funding approved by the Legislature for the FY 2022-23 budget will help the state make significant progress in cleaning up the school bus fleet. When it comes to school bus replacement, there are tradeoffs to consider, the lower upfront costs of conventional fueled school buses and immediate short-term emissions benefits, versus the long-term emissions benefits of upgrading to zero-emission school buses. Some of the school buses operating in the state are more than 30 years old, so even a diesel-to-diesel replacement represents real, immediate reductions of emissions and PM exposure and safety improvement. However, diesel vehicles have a long operational lifespan, replacing with diesel could prolong eventual turnover to zero-emission school buses. Because school buses can have such a long life, it's important to replace older buses with the cleanest possible new buses.

California faces mandates to reduce air pollutants to protect public health and to meet State air quality and climate change targets, including a 40 percent reduction in greenhouse gases by 2030 and an 80 percent reduction in greenhouse gases by 2050. The AB 32 Climate Change Scoping Plan also reflects California's goal to achieve carbon neutrality by 2045. Governor Newsom's Executive Order N-79-20 states that all operations of medium and heavy-duty vehicles shall be zero-emission by 2045 where feasible, with all drayage trucks

zero-emission by 2035.[7] In addition, the Advanced Clean Trucks Regulation approved on June 25, 2020 requires all new medium and heavy-duty vehicles sold in California to be zero-emission by 2045. CARB is also developing the Advanced Clean Fleets Regulation, a medium and heavy-duty zero-emission fleet regulation, with the goal of achieving a zero-emission California truck and bus fleet by 2045 everywhere feasible and significantly earlier for certain market segments such as last mile delivery and drayage applications. CARB has also set rules to incorporate zero-emission buses used by transit agencies and shuttles at the state's largest airports no later than 2030 and is developing a measure to drive greater deployment of zero-emission off road forklifts throughout the state. Replacing existing school buses with zero-emission school buses, will further support the transition of the California fleet overall and move the State closer to its goals.[8]

There is an ongoing high demand for school bus funding. Sources of school bus funding have been oversubscribed including Volkswagen Mitigation funding, CEC's School Bus Replacement Program, and HVIP. School bus replacement costs range from $130,000 to about $200,000 for conventional school bus replacements including diesel, CNG, and propane. Zero-emission battery electric school bus costs range from $270,000 to over $400,000 depending on the bus type and options (does not include infrastructure costs).

There are approximately 23,800 school buses in the statewide fleet, 15,500 of these buses are publicly owned and equipped with internal combustion engines. To align the turnover of school buses with the State mandate that all operations of medium and heavy-duty vehicles to be zero-emission by 2045, it would take 23 years at a rate of four percent turnover per year, or approximately 674 school buses per year, to turn over all the publicly owned school buses operating in the State. To fund replacement of these school buses it would cost annually approximately $270 million for zero-emission battery electric (not including infrastructure costs, total cost of ownership savings, or additional training/support). The new $1.125 billion from the Education Omnibus Budget Trailer Bill, and years two and three from the HVIP Public School Bus Set-aside of $135 million and $130 million respectively, which total $1.39 billion, are huge steps to achieve this turnover. This funding will enable replacement of about 20 percent of the school bus fleet with zero-emission school buses. Additional funding from Federal programs and for infrastructure will further advance California's zero-emission school bus fleet. CEC will implement $50 million over three years, and the Education Omnibus Budget Trailer Bill provides an additional $375 million to CEC, all to fund zero-emission school bus charging or fueling infrastructure and related activities including equipment, site design, construction and related infrastructure upgrades. New funding will build on zero-emission deployment successes and provide the next steps on the road to zero--emission school buses by 2045.

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7 Executive Order N-79-20: *https://www.gov.ca.gov/wp-content/uploads/2020/09/9.23.20-EO-N-79-20-Climate.pdf*

8 California Air Resources Board, "California takes bold step to reduce truck pollution": *https://ww2.arb.ca.gov/news/california-takes-bold-step-reduce-truck-pollution*

With tight budgets, limited resources, and competing requests for funding, replacing California's school bus fleet continues to occur enthusiastically, but gradually. School buses need ongoing funding to continue turning over the fleet. Nearly 150 California school districts have deployed hundreds of zero-emission school buses and have valuable experience to share. The next section will discuss the expanding presence of zero-emission battery electric school buses in California and why more fleets are seeing the technology as a viable option.

Achieving a State Zero-Emission School Bus Fleet by 2045

Momentum to transition the California school bus fleet to zero-emission continues to increase. The transformation of the State school bus fleet to zero-emission is an important component in achieving California's longer term 2030 and 2050 clean air and climate change goals.

Community-focused programs and incentives that concentrate support in disadvantaged communities help provide access to clean transportation and mobility options in areas that are most burdened by air pollution. The AB 617 Community Air Protection Program (CAPP), provides opportunities to understand community needs and address some of the most critical barriers to access clean technology. CAPP's focus is to reduce exposure in communities most impacted by air pollution. Local air districts work with AB 617 Community Steering Committees and local partners to develop Community Emission Reduction Programs to outline emission reduction priorities and strategies specific to the community.

Zero-emission battery electric school buses have many attractive characteristics including reduced fuel and maintenance costs, reduced noise and vibration, and no tailpipe emissions, which ensures cleaner air for students and local communities. School transportation continues to be an important area to demonstrate the benefits of battery electric school buses. The Beachhead strategy (found in Appendix D, Long-Term Heavy-Duty Investment Strategy to this Funding Plan) followed by CARB for technology commercialization, identified school buses as a secondary market where zero-emission technologies are prime for early success and can help drive growth in other segments. The integration of battery electric school buses requires more effort than simply replacing conventional -fueled school buses with battery electric school buses. Research, good planning, and a partnership between the school district, manufacturers, and public agencies are necessary to make the transition successful.

Zero-emission battery electric school buses are available and successfully operating in many school districts in the State. There is a learning curve associated with the new technology and school districts have their own set of hurdles to overcome, such as availability or turnover of transportation directors, shortage of school bus drivers, and extensive procurement processes. One of the main hurdles is that many school districts do not have the administrative bandwidth to support the deployment of zero-emission school buses on their own. It is important to build partnerships with local, State, and Federal agencies, manufacturers of school buses, manufacturers of supporting equipment, and power or fuel providers to make the adoption of zero-emission school buses and infrastructure installation

easier and more accessible. State investments and utility infrastructure programs help build connections and partnerships with the goal of understanding and facilitating the transition to new technology successfully. We benefit from and continue to learn from early adopters of zero-emission technology.

The transition to zero-emission transportation also provides opportunities for specific types of additional support. For battery electric school bus projects, local air districts and school districts should explore the variety of different ways to get support for charging infrastructure through the State and local utility programs. V2G and Low Carbon Fuel Standard (LCFS) credits may add incentive for school districts to incorporate battery electric school buses. V2G technology is evolving through the support of various projects that are underway to demonstrate its successful use in the field. LCFS credits may help the school bus fleets lower overall costs of operating zero-emission school buses. The following sections briefly touch on several factors critical to making the transition to zero-emission school buses.

Zero-Emission School Bus Supplier Update

Zero-emission school buses are available and being deployed throughout California and the country. Battery electric school buses are the only zero-emission technology commercially available today. Nearly 200 school districts in California operate at least one battery electric school bus. Approximately 570 battery electric school buses are operating in the state.

Battery electric school buses can drive between 100-155 miles per trip when fully charged, which is enough for most school bus routes. Increased battery storage capacity continues to expand and develop. At least one battery electric school bus is available in all the same types and classes as conventional school buses. CALSTART developed the *Zero-Emission Technology Inventory (ZETI)* tool, an interactive online resource that shows all commercially available offerings of zero-emission medium and heavy-duty vehicles. According to ZETI, 16 battery electric school bus models are currently available as of February 2022. Also, 13 of these school buses are eligible for HVIP funding.

Within the United States, 480,000 school buses each year travel a combined total of 3.5 billion miles (Electric School Buses Market Study).[9] School buses play a vital role in transporting students to and from school. Diesel, gasoline, and propane fuels predominantly power the school bus population. School districts have been transitioning to zero-emission fleets to address the adverse effects of fossil fuels. School bus duty cycles are conducive to electrification due to low-speed operations and charging opportunities.

School buses fall into four categories: Type A, Type B, Type C, and Type D. Each school bus type is unique regarding size and passenger capacity. Table E-3 below shows the distinctive

9 CALSTART, "Electric School Buses Market Study: A Synthesis of Current Technologies, Costs, Demonstrations and Funding", https://calstart.org/wp-content/uploads/2021/12/Electric-School-Bus-Market-Report-2021.pdf.

differences between battery electric school bus types (Zeroing In On Electric School Buses).[10] Tables E-4, E-5, and E-6 show available Type A, C, and D electric school buses respectively. There is currently no Type B battery electric alternative.

Table E-3: Zero-Emission School Bus comparison by Type

	Passenger Capacity	Electric Bus Range	Manufacturers	Cost Estimate
Type A	16-20	100-150 miles	Lightning eMotors, Lion Electric, Micro Bird, Motiv Power Systems, Phoenix Motor Cars, Optimal EV, BYD	$265,000-$450,000
Type B	20-30	NA	NA	NA
Type C	60-72	100-120 miles	Blue Bird, IC Bus, Lion Electric, Thomas Built	$300,000-$400,000
Type D	72-90	120-155 miles	Blue Bird, BYD, GreenPower Motor Company, Lion Electric	$345,000-$410,000

10 CALSTART, "Zeroing in on Electric School Buses", *https://calstart.org/wp-content/uploads/2022/01/ZIO-Electric-School-Buses-2021-Edition.pdf*

Type C and Type A buses are the most popular battery electric school bus models. Type C buses are the most iconic bus type and make up 70 percent of vehicles sold.[11] Type A buses are typically the least expensive and commonly used for shorter routes and special needs routes. The table below provides more information on the features of the different types (*Zeroing on ESB report*).

Table E-4: Available Type A Electric School Buses

Manufacturer	Lightning eMotors	Lion Electric	Micro Bird	Motiv Power Systems	Phoenix Motor Cars
Chassis	Ford E-450 Cutaway	Lion Electric	Ford E-450 Cutaway	Ford E-450 Cutaway	Ford E-450 Cutaway
GVWR	14,5000 pounds	22,350 pounds	14,500 pounds	14,500 pounds	14,500 pounds
Battery Size	94 kWh or 125 kWh	84 kWh or 168 kWh	88 kWh	127 kWh	70 kWh, 105 kWh, 140 kWh
Charge System	Level 2 and DC Fast Charge	Level 2	Level 2 and DC Fast Charge	Level 2 and DC Fast Charge	Level 2 and DC Fast Charge
Level 2 Charge Time	5.5 hours or 7.5 hours	8.75 hours	7 hours	8 hours	Not Specified
DC Fast Charge Time	1.5 hours or 2 hours	3.5 hours	NA	Not Specified	Not Specified

11 CALSTART, "Electric School Buses Marketing Study: A Synthesis of Current Technologies, Costs, Demonstrations, and Funding" *https://calstart.org/wp-content/uploads/2021/12/Electric-School-Bus-Market-Report-2021.pdf*

Table E-5: Available Type C Electric School Buses

Manufacturer	Blue Bird	IC Bus	Lion Electric	Thomas Built
Chassis	Blue Bird	IC Bus	Lion Electric	Thomas Built
GVWR	33,000 pounds	33,000 pounds	33,000 pounds	33,000 pounds
Battery Size	155 kWh	105 kWh, 210 kWh, 315 kWh	126 kWh, 125 kWh, 210 kWh	226 kWh
Charge System	Level 2 and DC Fast Charge	Level 2 and DC Fast Charge	Level 2 and DC Fast Charge	Level 2 and DC Fast Charge
Level 2 Charge Time	8 hours	Not Specified	6.5 to 11 hours	Not Specified
DC Fast Charge Time	3 hours	Not Specified	2.5 to 4.25 hours	3 hours

Table E-6: Available Type D Electric School Buses

Manufacturer	Blue Bird	BYD	GreenPower Motor Company	Lion Electric
Chassis	Blue Bird	BYD	GreenPower Motor Company	Lion Electric
GVWR	36,000 pounds	39,153 pounds	42,990 pounds	36,000 pounds
Battery Size	155 kWh	274 kWh, 300 kWh	194 kWh	126 kWh, 168 kWh, 210 kWh
Charge System	Level 2 and DC Fast Charge	Level 2 and DC Fast Charge	Level 2 and DC Fast Charge	Level 2 and DC Fast Charge
Level 2 Charge Time	8 hours	Not Specified	10.5 hours	6.5 to 11 hours
DC Fast Charge Time	3 hours	Not Specified	3.25 hours	2.5 to 4.25 hours

The CALSTART report, "Zeroing In On Electric School Buses," addresses zero-emission school bus deployment outside of California. The report indicated zero-emission adoption by awarded, ordered, and deployed status. The report showed 888 zero-emission school buses across the United States (not counting California). Top states that have the most zero-emission school buses, outside of California, are Maryland (331), Florida (218), Virginia (89), and Washington (40). CALSTART expects many more zero-emission school buses have been deployed since the report was published.

Zero-Emission School Bus Infrastructure

Successful and cost-efficient charging/fueling infrastructure results from extensive pre-planning, starting with determining both immediate and future infrastructure needs. It is also important to align with the servicing utility and to get the utility involved early in the process. There is no standard approach to infrastructure as each school district and site are unique. The bigger the project, the more planning that is required. Due to lack of funding, school districts often do not have resources to future-proof their charging/fueling infrastructure for future expansion. CALSTART has developed the *School Bus Fleet Infrastructure Planning Tool*. This document complements the tools and provides important considerations for school districts planning to install infrastructure, a systematic installation timeline, and an infrastructure-planning checklist.

In its role as the State's primary energy policy and planning agency, CEC is leading efforts on ensuring that school districts have the infrastructure needed to support their zero-emission school bus fleets and that California's power grid is reliable and resilient. As stated in a prior section, under its School Bus Replacement Program, CEC was able to provide funding for 228 battery electric school buses with an additional $60,000 for infrastructure funding per bus utilizing Clean Transportation Program funding. Additionally, CEC is working directly with electric utilities to assist in upgrading the electrical infrastructure required to charge the battery electric school buses awarded through the CEC School Bus Replacement Program while also emphasizing the need to plan for future electrical capacity needs. In April 2021, CEC approved the EnergIIZE Project to accelerate the deployment of infrastructure needed to fuel zero-emission trucks, buses, and equipment. This program has begun to accept applications in 2022 to provide support for eligible applicants to help plan and fund the purchase of charging and hydrogen fueling infrastructure.[12] In this effort, the EnergIIZE team has held meetings with stakeholders to better understand the best ways to incentivize installation of infrastructure needed to fuel zero-emission trucks, buses, and equipment, and provided informative webinars to provide information about their opportunities, and installation of zero-emission fueling infrastructure in general.

In July 2021, $50 million was allocated to CEC from the FY 2021-22 budget to fund school bus charging/fueling infrastructure. The first installment of $20 million will complement CARB

12 *Energy Commission Announces Nation's First Incentive Project for Zero-Emission Truck and Bus Infrastructure (ca.gov)*

funding allocated for school buses in underserved and rural school districts. The State budget for FY 2022-23 allocated the second installment of $15 million to CEC for supporting infrastructure. Incentive projects, such as CEC's EnergIIZE, will be utilized to accelerate this deployment of zero-emission school buses and supporting infrastructure.

The Clean Energy and Pollution Reduction Act requires the California Public Utilities Commission (CPUC) to direct the investor-owned electric utilities to invest in infrastructure or transportation electrification. CPUC has approved projects that support infrastructure development for school buses. *Southern California Edison (SCE)*, *Pacific Gas and Electric (PG&E)*, and *San Diego Gas and Electric (SDG&E)* have no-cost, make-ready infrastructure programs. Many of California's publicly-owned utilities (such as Sacramento Municipal Utility District, Los Angeles Department of Water and Power and other municipal utilities) also have programs to provide low or no-cost infrastructure and favorable EV rates. Others can provide infrastructure and support services on an ad hoc basis. The following sections provide updates on programs and funds available from the major utilities in California.

SCE's Charge Ready Transport (CRT) Program supports both California's greenhouse gas (GHG) reduction goal and local air quality requirements by offering low-to no-cost electrical system upgrades to support the installation of EV charging equipment for qualifying vehicles. This program provides a unique opportunity for fleet owners and other operators of medium and heavy-duty vehicles, including school buses, choosing to acquire EVs by providing support and reducing the costs with installing the necessary charging equipment. To be eligible for the program, the applicant must be an SCE customer and will be required to lease, purchase, or convert at least two medium or heavy-duty battery powered EVs; own or lease the property where chargers are installed, and operate and maintain chargers for a minimum of 10 years. In addition, participants must select, purchase, and install SCE approved charging equipment; provide data related to charging equipment usage for a minimum of five years (on-road vehicles only); provide a property easement for the SCE infrastructure; and agree to program terms and conditions. When a customer is approved to participate in the program, SCE will design, construct, and install the necessary infrastructure on both the utility-side and customer-side of the electric meter. If the customer prefers, they can perform the customer-side of the meter electrical work and receive a rebate. Additional rebates are available to school districts, transit agencies, and eligible companies within disadvantaged communities to offset a portion of the costs associated with the purchase of EV charging equipment approved by SCE. As of March 2022, SCE has completed the installation of charging infrastructure at 34 sites and is working with a total of 154 sites that may support over 4,000 vehicles. Visit *SCE's Charge Ready Transport Program* website for more information and fleet electrification tools and resources, or email *chargereadytransport@sce.com*.

PG&E's EV Fleet Program supports the electrification of medium and heavy-duty vehicles, including school buses, by facilitating the installation of EVSE make-ready infrastructure. This support comes in the form of constructing some or all of the make-ready infrastructure and offering cash incentives to reduce construction costs incurred by customers. Additionally,

customers may be eligible to receive rebates to offset their EVSE purchase costs. The program aims to support the electrification of 6,500 vehicles by 2024. To be eligible, participants must demonstrate a commitment to procuring a minimum of two electric fleet vehicles and agree to operate and maintain the vehicles and chargers for a minimum of ten years. Visit PG&E's EV Fleet Program website for more information.

SDG&E's Power Your Drive for Fleets helps fleet owners and operators reduce operating costs, eliminate emissions, and simplify vehicle maintenance by transitioning to EVs. SDG&E helps install make-ready charging infrastructure for medium and heavy-duty EVs, working with fleets from the initial infrastructure planning stage through to design, construction, and ongoing site maintenance. Power Your Drive for Fleets is applicable to Class 2-8, on-road and off-road vehicles including school buses. By deploying EVs, fleets eliminate emissions, help meet sustainability goals, and save money on fuel costs, operational costs, and maintenance. School districts, and fleets located in disadvantaged communities that are not Fortune 1,000 companies are eligible for an additional rebate of up to 50 percent of the costs to purchase charging stations. The goal of the program is to serve a minimum of 3,000 medium and heavy-duty on-road and off-road class 2-8 vehicles at 300 customer sites throughout SDG&E's service area. Visit *SDG&E's Power Your Drive for Fleets* website for more information.

Vehicle-to-Grid

V2G enabled battery electric school buses have the potential added benefit of providing on-site back-up energy, reliability, and serving as a grid resource, including integrating renewable energy as well as providing excess capacity and storage when needed. V2G capability is the bidirectional flow of energy between an EV and the grid. Batteries on board vehicles can boost grid reliability by returning electricity to the grid during times of high energy demand. Battery electric school buses have been determined to be a good application for V2G because of their large batteries, predictable duty-cycles, and long down times throughout the day when energy demand is greatest. This capability allows the battery electric school bus to export power stored in its battery packs to any islanded load and to the grid if an interconnection agreement is in place with the local utility. One benefit is on-site resiliency in the case of an emergency power shut-off by the utility or during a catastrophic event. Schools may also recognize some financial benefits through either on-site power offset using vehicle-to-building (V2B) or participating in the energy market using V2G and selling electricity back to the grid. This has the potential to accelerate zero-emission adoption by adding an additional revenue stream to lower the total cost of ownership.

To help realize the goals and methods of V2G integration, the California Independent System Operator (California ISO), CEC, CARB, and CPUC jointly created the Vehicle Grid Integration (VGI) Working Group. The VGI Working Group was made up of diverse representatives of VGI stakeholders including state agencies, utilities, community choice aggregators, the California ISO, EV manufacturers, battery manufacturers, charging network and energy service providers, advocacy and research groups, industry associations, and ratepayer interest groups. The VGI Working Group developed a report that was presented to CPUC on

June 30, 2020. The report discusses a wide range of current use cases and policy recommendations to provide a foundation for the next stages of VGI in California. The report identified that the next steps for California State agencies, the California ISO, utilities, community choice aggregators, other load-serving entities, and other VGI stakeholders should include a variety of policy actions, interagency coordination and convening, and conduct further analysis on various VGI specific topics. Based on the information presented from the VGI Working Group, the CPUC released their *Decision Concerning Implementation of Senate Bill 676 and Vehicle-Grid Implementation Strategies* on December 17, 2020.

Multiple pilot projects studying both V2B and V2G are underway in California and throughout the country. CEC's Electric Program Investment Charge (EPIC) program has invested in technology demonstrations focused on advancing and validating the performance of bidirectional charging technologies with battery electric school buses, including a recently awarded project with eIQ Mobility located in Richmond, California. SDG&E recently partnered with Cajon Valley Union School District to conduct a V2G pilot program with five battery electric school buses. The buses will discharge excess energy to the grid during peak demand hours with the goal of reducing grid impacts and demand costs for the school district.[13]

Although V2G adds additional upfront cost to the price of the vehicle and infrastructure, it has the potential to be an attractive option to help school districts build a stronger business case for zero-emission battery electric school bus adoption while supporting grid resiliency and security. In 2018, CEC required awarded battery electric school buses to have V2G capabilities in their School Bus Replacement Program. This was required to assist in standardizing vehicle charging as well as providing added resiliency and emergency capabilities for school bus recipients. And in January 2022, CARB added V2G capabilities as a requirement on battery electric school buses purchased through the Public School Bus Set-aside.

Low Carbon Fuel Standard Credits

The LCFS credits can also reduce operational costs for both public and privately owned electric fleets. The LCFS regulation is designed to reduce the carbon intensity (CI) associated with the lifecycle of transportation fuels in California and provide an increasing range of low-carbon and renewable alternatives, which reduce petroleum dependency and achieve air quality benefits. For example, a fleet operating a battery electric or hydrogen-fueled school bus may generate credits for the quantity of electricity charged or hydrogen consumed on the buses. For battery electric buses, additional credits are generated by charging with renewable or low-CI electricity. Credits and deficits are designated in metric tons of GHG emissions.

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13 *Vehicle-to-Grid Pilot: Leveraging Big Batteries on Electric School Buses to Support the Grid | SDGE | San Diego Gas & Electric - News Center (sdgenews.com)*

The number of credits generated is tied to total fuel consumption; therefore, the more the vehicles or school buses operate on low carbon fuels, the greater the credit generation and cost savings potential. The average credit price for the last 12 months is about $170 per credit.[14] LCFS credit value depends on a few variables, including the LCFS credit price, the annual CI target, the CI of the fuel dispensed, and the vehicle type. For 2022, LCFS credit revenue may be worth approximately 14 cents/kWh when charging battery electric school buses with California average grid electricity[15] and 19 cents/kWh with zero-CI electricity, assuming a credit price of $170. LCFS staff has developed a *credit value calculator*[16] that is available on the *LCFS dashboard*[17] which can help estimate the LCFS value for different fuels. The fleet has the option to sell the credits directly to LCFS regulated parties or opt-in entities or sell them using a broker. Additional regulatory flexibility took effect in 2019 to allow fleets to delegate fuel transaction reporting, credit generation, and trading of credits to a third-party aggregator. While the credits cannot be used to generate revenue, the fleet can use the money toward EV purchases, infrastructure, operating costs, or associated LCFS program administration costs.[18]

While some fuels generate credits in the LCFS program and are optional for reporting, others (typically fossil fuels) generate "deficits" in the program and may need to be reported to CARB. The reporting requirements are based on the date of school bus purchase, station owner through which fuel is dispensed for transportation use, and the fuel type used, such as propane or CNG by school bus fleets.

As of January 1, 2021, school districts that operate fossil propane school buses purchased after January 1, 2020, or other propane-operated vehicles are required to report fuel transaction quantities to LCFS and purchase credits to balance the deficits they incur from use of these fuels. The school districts operating CNG buses purchased after January 1, 2020 are also subject to reporting requirements under the regulation. However, buses purchased prior to January 1, 2020 are exempt from reporting requirements under the regulation, for both propane and CNG. In addition, CNG fueling stations dispensing less than 150,000 gasoline gallons equivalent of fossil CNG per year are exempt through December 31, 2023. A LCFS Frequently Asked Questions document titled "Reporting

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[14] LCFS Credit Transfer Activity Reports page: *https://ww2.arb.ca.gov/resources/documents/lcfs-credit-transfer-activity-reports*

[15] California Air Resources Board, "2021 Carbon Intensity Values for California Average Grid Electricity Used as a Transportation Fuel in California and Electricity Supplied Under the Smart Charging or Smart Electrolysis Provision." Page 2. Posted: January 24th, 2022: *https://ww2.arb.ca.gov/sites/default/files/classic/fuels/lcfs/fuelpathways/comments/tier2/2022_elec_update.pdf*

[16] Credit *V*alue *C*alculator*: http://ww3.arb.ca.gov/fuels/lcfs/dashboard/creditvaluecalculator.xlsx*

[17] LCFS dashboard: *https://ww2.arb.ca.gov/resources/documents/lcfs-data-dashboard*

[18] Guidance 20-03: Electricity Credit Proceeds Spending Requirements, for more details on eligible uses for electricity credit proceeds: *https://ww3.arb.ca.gov/fuels/lcfs/guidance/lcfsguidance_20-03_ADA.pdf*

Requirements for School Buses"[19] describes these requirements in detail, as well as opportunities for credit generation for using low-carbon fuels to drive school buses.

Lastly, unlike the requirement for propane and natural gas, school districts are not required to report consumption of gasoline or diesel, as liquid fuel reporting is conducted by the producer or importer of the fuel, rather than the owner of the dispensing equipment.

Workforce Training

Workforce training is a critical consideration when incorporating zero-emission school buses into a fleet and the opportunities are continuing to expand. As with most new technologies, there is a learning curve and operational adjustments the school district must make to maximize the benefits of the technology. There are differences in zero-emission school bus maintenance and operations when compared to conventional-fueled school buses. For example, battery electric school buses have fewer moving parts, do not have an exhaust system, or require oil changes, and their braking systems last longer. State agencies and stakeholders recognize the need for significant support and workforce training for successful zero-emission school bus deployment. CARB and CEC, in collaboration, developed a new, innovative project to provide funding for zero-emission vehicle workforce training and development in the state's most underserved communities. The project is called the Inclusive, Diverse, Equitable, Accessible, and Local Zero-Emission Vehicle Workforce Pilot (*IDEAL ZEV Workforce Pilot*). On February 22, 2022, the *notice of proposed awards* was released and a total of 14 proposals were awarded, requesting nearly $6.6 million in funds. IDEAL ZEV Workforce Pilot complements CARB's Clean Transportation Program Investments, such as the Clean Mobility in Schools Pilot, by providing funding for educational curriculum for students and promoting workforce training and career development partnerships.

Support to community colleges, universities, vocational programs at high schools, and other training institutions can help develop a training curriculum and train technicians on the maintenance and operation of advanced technology vehicles and equipment supported by EV incentive programs. In addition, AB 841 (Ting, Chapter 372, Statutes 2020) added Section 740.20 to the Public Utilities Code, which requires electrical infrastructure contractors installing EV charging infrastructure and equipment on the customer side of the electrical meter to hold an Electric Vehicle Infrastructure Training Program certification if the project is funded or authorized by CARB, CPUC, or CEC.[20] Training and certification requirements such as this will be especially important as more school districts incorporate zero-emission school buses.

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[19] Frequently Asked Questions, Reporting Requirements for School Buses, November 2021: *https://ww2.arb.ca.gov/sites/default/files/classic/fuels/lcfs/guidance/schoolbusexemptions.pdf*

20 California Legislative Information, Assembly Bill No. 841: *http://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201920200AB841*

All major zero-emission school bus manufacturers provide technician and driver training to new zero-emission school bus owners along with on-going support. Training is offered to support customers throughout the purchase and integration process for a zero-emission school bus as well as training programs for both technicians and drivers. Trainings are offered both on-site at school district locations and via online training platforms. The California Department of Education (CDE) has also developed a supplemental module on battery electric school bus operation that is included in the state certified school bus driver trainings.

In 2019, CEC approved a contract for $1 million with Cerritos Community College to develop and deliver the "Electric School Bus Training Project" to provide grantees the skills required to maintain the battery electric school buses funded through CEC's School Bus Replacement Program. Training is available for both school district maintenance technicians and school bus operators. Course subjects include high-voltage safety, proper operation, and maintenance of battery electric school buses and charging. In 2020, CEC launched the training project. To respond to the risk surrounding the COVID-19 pandemic, in-person training options diminished so an online training tool, Today's Class Technician, was deployed.[21] The first cohort trained 61 school bus technicians across 20 school districts as of January 2021. The second round of training concluded in July 2021 with 18 technicians participating, representing seven high school districts and one community college. Successful project and budget management by Cerritos Community College and CEC has enabled them to extend trainings to Rural School Bus Pilot Project recipients as well. Future, in-person trainings are still being scheduled and "train-the-trainer" training is planned for summer 2022 to begin implementing the courses at community colleges.

Sunline is planning on incorporating the school bus fleet types into its safety, maintenance, and operations courses. These courses focus on the deployment and maintenance of zero-emission fleets. The funding from HVIP and the IDEAL ZEV Workforce Pilot will assist with the development of the course materials, transporting vehicles, and developing the Subject Matter Experts to deliver the training.

The funding will also be utilized for outreach through various platforms including the recently concluded California Electric School Bus Working Group presentation. Course offerings will be posted on the West Coast Center of Excellence in Zero-Emissions and Alternative Fuels section of Sunline's *website*. The program will be integral to developing a blueprint for zero-emission training for school districts in California.

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21 Executive Order N-33-20. March 19, 2021: Available at *https://covid19.ca.gov/img/Executive-Order-N-33-20.pdf*

Zero-Emission School Bus and Infrastructure Case Studies

The case studies at the end of this report provide several real-world experiences of incorporating zero-emission school buses into a fleet. Each case study is unique and gives insight to the operation of zero-emission school buses and associated infrastructure. The insight and perspective gained from the growing numbers of zero-emission school bus experiences throughout the State will be a continued benefit to those incorporating zero-emission school buses into their fleet into the future.

Conclusion

The State has allocated approximately $255 million to school bus cleanup since last year's update, bringing the total to date to $1.2 billion. This funding has supported about 1,800 zero-emission school buses, and of these approximately 570 are already on the road in approximately 200 California school districts. In addition, in the past two budget years, the Legislature appropriated additional funds totaling $1.8 billion over the next five fiscal years.

Case Study –San Diego Unified School District

San Diego Unified School District (SDUSD) received funding for three Blue Bird Type D battery electric school buses and ten IC Type C wheelchair-lift battery electric school buses funded through CARB's Clean Mobility in Schools Pilot Grant. The district received a $9.6 million grant, which included funding for the battery electric school buses in addition to e-bikes, landscape and custodial equipment, food and outreach vehicles, and battery storage infrastructure. The district received $4.8 million for the 13 battery electric school buses and $1.1 million for energy storage.

Transportation Profile

Total # of Students: 94,837

Daily Transport: 6,200 students per day

Routes: 400 routes per day

Average Route Length: 10 miles

Inventory: 477 total school buses, 3 Bluebird Electric Type D School Buses,10 IC Electric Type C School Buses

SDUSD will use battery electric school buses daily on both morning and afternoon routes. So far, the district is running one bus daily while awaiting more buses to arrive. The buses have an expected range of 100 miles and a battery capacity of 150 kW. SDUSD noticed a reduced range when taking freeway routes compared to routes on surface streets with more stop and go activity. The installation of the Level 2 and DC fast chargers is ongoing and SDUSD expects to run all 13 battery electric school buses within the 2022-23 school year. The district will conduct inspections of all bus tires, suspension, and routine maintenance. School bus original equipment manufacturer cover all non-routine maintenance and provide battery electric school bus training. So far, SDUSD students, staff, and community have expressed positive support of the buses.

SDUSD partnered with local utility SDG&E and Nuvve to install 11 Level 2 chargers and 3 DC fast chargers with V2G bidirectional charging. The district's energy management group collaborated with SDG&E since the very beginning of the project to select and install the appropriate charging stations, additional meters, and transformers. Infrastructure funding was primarily provided by the $9.6 million CARB grant in addition to SDG&E's Power Your Fleet program. A 12-year agreement with Nuvve will cover all charger maintenance and programming, with a 50/50 share of any carbon credit or V2G revenue.

One of the biggest challenges throughout procurement and deployment processes for battery electric school buses and infrastructure was supply chain shortages and delays due to COVID-19. SDUSD recognizes that more spatial planning is necessary to deploy additional

battery electric school buses. Each Level 2 charging station on the transportation lot requires the space of four bus parking spots. The current infrastructure being deployed will reduce about 20 percent of parking capacity at the school district's bus depot.

Case Study – El Monte Union High School District

El Monte Union High School District (EMUHSD) received funding for 11 zero-emission battery electric school buses along with infrastructure development through the Clean Mobility in Schools Project and their local utility provider, Southern California Edison (SCE).

Transportation Profile

Total # of Students: ~9,000

Daily Transport: 80 students

Routes: 40 daily routes

Average Route Length: 40 miles

Bus Inventory: 5 diesel buses in operation – awaiting installation of chargers

The district received $9.8 million in funding for zero-emission district fleet vehicles, battery electric school buses, and infrastructure equipment. EMUHSD received eight Blue Bird Type D and three Type A Micro Bird battery electric school buses. The expected range for the Micro Bird is 100 miles and 120 miles for the Type D Blue Bird. EMUHSD is using 12 Level 2 and 3 DC fast chargers. The district took part in the SCE Charge Ready Program to facilitate the infrastructure development process and incentive offerings. The district assembled a project team that coordinated with the SCE, Shell Recharge Solutions, and A-Z Bus Sales to determine the correct infrastructure equipment. The final installation of infrastructure equipment is ongoing.

A-Z Bus Sales and Blue Bird have supported EMUHSD by providing on-site bus repairs and transition support. They also provide EMUHSD resources to assist in workforce training, which will allow the school district to pursue in house maintenance. However, proper maintenance of the battery electric school buses and chargers has been a challenge. EMUHSD stressed the need for greater coordination from equipment providers to ensure repairs are completed within a reasonable response time. EMUHSD recommends other districts to properly prepare deeds and design drawings to expedite the infrastructure installation process. The district also recommends to be mindful of battery electric school bus and infrastructure deployment delays because of COVID-19 and supply chain issues.

Case Study – McKinleyville Unified School District

McKinleyville Unified School District (MUSD) received $1.6 million in funding for five zero-emission school buses through the Rural School Bus Pilot Program and DERA. Infrastructure funding was provided by PG&E. The zero-emission school bus fleet consists of four Blue Birds Type C buses, and one Micro Bird Type A bus. MUSD currently has an order for two zero-emission school buses through the Public School Bus Set-aside for Small and Medium Air Districts. The four battery electric school buses can cover 80 percent of the routes, with the school district striding for 100 percent coverage. The coastal climate fluctuates between cold and warm weather extremes. Cold weather requires running bus heaters therefore lowering battery electric school bus range. Transportation Director Nelson Vinum recommends having an additional bus to assist in route logistics.

Transportation Profile

Total # of Students: ~950

Daily Transport: 300 students

Routes: 4 daily routes

Average Route Length: 56 miles

Bus Inventory: 11 total school buses, 4 Blue Bird Electric Type C School Buses, 1 Micro Bird Electric Type A School Bus

MUSD is using Clipper Creek Level 2 chargers with plans to add 2 DC fast chargers and smart charging capabilities. Incorporation of the DC fast chargers will expand battery electric school bus use because of the 2-hour charge time. MUSD developed an infrastructure plan and coordinated with PG&E to assess infrastructure needs. Nelson emphasized the importance of using a contractor with larger project experience to work around long-term infrastructure goals to accommodate future charging needs. The infrastructure development included groundwork and an additional pole and transformer. Due to successful in-depth planning, the infrastructure process had minimal effects on the transportation operation.

MUSD emphasized the importance of connecting with partners and resources as early as possible in the process of adding battery electric school buses. Adjustments will need to be made, but MUSD expect overall less maintenance work for the battery electric school bus fleet. Mr. Vinum reports he has performed 80 percent less maintenance on the battery electric school buses and saved around $15,000 on typical maintenance last year. Mr. Vinum also recommends coordinating with the original equipment manufacturer to assist in training in-house mechanics. MUSD worked with Cummins Electric Motors to train and assist their mechanics. MUSD learned to monetize their Low

Carbon Fuel Standard credits by working with PG&E and have been earning between $12,000 - $15,000 in funds.