Appendix E

2021 SB 1403 STATE SCHOOL BUS INCENTIVE PROGRAMS REPORT

(Health & Safety Code Section 39719.2)

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Contents

Introduction

Progress continues to be made toward cleaning up the State school bus fleet and improving air quality, not only for K-12 students riding school buses for home to school transportation, but the surrounding communities as well. More school districts are incorporating zero-emission school bus technology into their fleets and new funding allocations are becoming available. It is a collective effort among state agencies including the California Air Resources Board (CARB) and the California Energy Commission (CEC), local air districts, utilities, school bus manufacturers, school districts, and communities. Old, polluting, diesel school buses are harmful to children's health, as they expose children to transportation-related air pollution, and it is a continued effort to turn over these school buses for cleaner and more efficient zero-emission school buses.

Starting in 2019, Senate Bill (SB) 1403 (Lara, Chapter 370, Statues of 2018) mandates that CARB, in consultation with the 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

There are various sources of funding for school bus cleanup and the transition of the school bus fleet to zero-emission. 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 the CEC have led the effort in dedicating funding and resources to turning over old, dirty school buses and investing in new technologies. For more background on California's school bus funding history please refer to the *2019* and *2020* SB 1403 State School Bus Incentive Programs Reports. The state has spent or allocated approximately $110 million to school bus cleanup since last year's update.

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[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*

Funding is rarely recurring or dedicated exclusively to school buses, this year the Legislature appropriated exclusive funding to zero-emission school buses and supporting infrastructure. The Legislature approved $150 million in new funding dedicated to school buses in the FY 2021-2022 State budget, $130 million for CARB to deploy 1,000 zero-emission school buses and $20 million for CEC to deploy supporting infrastructure for the new zero-emission school buses. This is the first installment of $450 million over three years.

Table E-1 highlights past and current State school bus funding that has gone to school bus cleanup to support exhaust retrofits, full vehicle replacements, and supporting infrastructure. The following are brief updates of the key school bus funding programs.

Clean Truck and Bus Vouchers (HVIP)

Also funded by Cap-and-Trade auction proceeds through Low Carbon Transportation funds, Clean Truck and Bus Vouchers are available to assist with the incremental cost of zero-emission school bus purchases. The program is first-come, first-served; available statewide; and administered by CALSTART. In several cases, school districts have successfully paired HVIP funding with local air district funding for zero-emission school bus replacements. Since inception in 2010, approximately $33 million worth of HVIP vouchers has funded 200 school buses, 158 of which are electric. HVIP opened for new voucher requests in June 2021 for $170 million, this was available in two waves of funding and was quickly exhausted. There will be another $60 million available in the fall of this year.

The FY 2021-22 Budget includes funding to support incentives to deploy 1,000 zero-emission school buses in California. The proposal includes a three-year budget allocation of $450 million to CARB and the CEC for zero-emission school buses and supporting infrastructure. The first installment of $150 million was included in the State budget for FY 2021-22, $130 million to CARB for zero-emission school buses and $20 million to CEC for school bus infrastructure. CARB will implement this funding as a set-aside through the HVIP program for zero-emission school buses. The set-aside funds would be exclusively for California public school bus fleets purchasing zero-emission buses and will follow some of the existing requirements of the Rural School Bus Pilot Project. Moving forward the Rural School Bus Pilot Project will graduate from the pilot phase and move to the full program implementation phase through the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP). CARB and CEC are coordinating to ensure that funding for infrastructure is available for these new zero-emission school buses as the statute was designed for the funding for school buses and infrastructure to complement each other.

California Energy Commission School Bus Replacement Program

Senate Bill 110 (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. The CEC chose to

prioritize battery-electric school buses that are ready for vehicle-to-grid integration with this funding. The CEC received applications from over 200 school districts to replace more than 1,600 diesel school buses. Sixty-three school districts were awarded 236 electric buses. In 2019, five percent of the 236 buses funded were delivered to school districts, and by the end of 2020, 25 percent of the 236 buses were delivered to school districts. School districts will receive all School Bus Replacement Program buses by September 2022.

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 school buses and $1 million in Clean Transportation Program funds was provided for workforce training and development. As of June 2021, 18 school districts have completed the electric charging infrastructure to power the CEC awarded zero-emission school buses. The CEC collaborated with Cerritos Community College to develop workforce training and development curriculum for school districts that were awarded electric school buses through the School Bus Replacement Program.

California Energy Commission Clean Transportation Program

The CEC has allocated over $6 million from Clean Transportation Program funds for compressed natural gas (CNG) school bus replacements and supporting fueling infrastructure when electric school bus replacements were not feasible for school districts. The CEC received applications for over 200 school buses and was able to provide funding for 25 CNG school buses. All 25 school buses were delivered by December 2020 and as of June 2021, five school districts have completed the supporting CNG fueling infrastructure.

Clean Mobility in Schools Pilot Project

In 2018, the CARB Board approved Low Carbon Transportation Incentives funds for the Clean Mobility in Schools Pilot Project. The goal of the program 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, 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 to implement their projects. Because of the broad-reaching potential for benefits from these worthwhile projects, staff were able to re-allocate funds to provide grant awards to the three top-scoring applications. Subsequently, in early 2020, grant agreements were finalized with the winning grantees: El Monte Union High School District, San Diego Unified School District, and Stockton Unified School District, for a total of $24.6 million.

The El Monte Union High School District received $9.8 million in funding. The project includes: 11 battery electric school buses; 11 electric maintenance vehicles; three zero-emission carpool vehicles; five energy storage systems; charging hardware to support electric

vehicles (EV); an active transportation feasibility study that encompasses six school sites; and a Clean Energy Fellowship. The project will also deploy a communications plan and create a zero-emission technology curriculum tailored to their Career Technical Education pathways.

The San Diego Unified School District received $9.8 million in funding. Their project takes place in the Lincoln High School cluster area. The project includes: one battery electric food delivery truck, one food serving vehicle, and one retrofitted outreach vehicle; a variety of zero-emission landscape and custodial equipment including power washers, mowers, and utility carts; hybrid electric crew trucks; two zero-emission carpool vehicles; 13 battery electric school buses with managed charging stations, vehicle-to-grid capability and two battery storage units; a robust public education effort to support behavior changes for students, parents and staff; electric bicycle sharing projects for both senior students and staff; and a replicable template for other districts to use for implementing similar projects.

The Stockton Unified School District received $4.9 million in funding. Located in the Central Valley, the project aims to build a master plan to quickly move the school district towards becoming California's first fully carbon neutral school district. The project includes: a carbon emissions analysis of baseline and future pathways; four battery electric school buses; 22 managed charging stations; a variety of zero-emission maintenance and landscape equipment including eight maintenance vehicles; an expansion of a student-led Energy Patrol program for all school sites; and outreach and communication events in the school and surrounding community.

Volkswagen (VW) Environmental Mitigation Trust

VW's settlement allocates $423 million to California to offset the excess oxides of nitrogen emissions caused by VW's 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 categories. 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, exemplifying the importance of these efforts in California's most impacted communities. As of June 2021, contracts have been executed for 72 electric school buses and two electric school buses have been delivered. SJVAPCD will accept applications for school buses when CARB releases the second installment of funding planned for Fall 2021.

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. In the first three years of the program, the Legislature appropriated over $700 million 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 Assembly Bill 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 257 school buses, 157 of which are zero-emission. Overall, $56.2 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

Funded by CARB's Low Carbon Transportation Investments and administered by the North Coast Unified Air Quality Management District, the Rural School Bus Pilot Project has contributed $61.6 million to school bus replacements. The program gives preference to public school districts located in small air districts and funds both zero-emission and conventional engines using renewable fuel. The last solicitation in 2018 garnered nearly 600 applicants. To date, 180 zero-emission school buses have been funded through the Rural School Bus Pilot Project.

Moving forward, rural school buses will be funded through a significant new school bus set-aside through HVIP. This new funding continues the legacy of the Rural School Bus Pilot Project by replacing 1,000 rural school buses with zero-emission school buses.

Table E-1: Summary of State School Bus Incentives – Through August 2021

Funding Source	Amount Spent/ Allocated	Projects	Zero-Emission School Buses
Lower-Emission School Bus Program[+] since 2001	$310 million	7,456 retrofits, 1,642 school buses	0
School Bus Replacement Program (CEC)[+*] since 2019	$75 million	236 electric school buses	236
Rural School Bus Pilot Project[+*] since 2016	$62 million	~180 school buses	104

Funding Source	Amount Spent/ Allocated	Projects	Zero-Emission School Buses
Supplemental Environmental Projects for School Buses+ since 2012	$5.1 million	11 retrofits, 20 school buses, 297 recalled filter replacements	0
Carl Moyer Program & Carl Moyer State Reserve* since 1998	$15.6 million	106 school buses, 31 infrastructure projects	5
Assembly Bill 923* since 2008	$236.7 million	Retrofits, school buses, compressed natural gas (CNG) tanks, & infrastructure	Individual projects are not reported
Community Air Protection Incentives* since 2017	$56.2 million	257 school buses, 23 infrastructure projects	157
Clean Transportation Program (CEC) since 2012	$21 million	25 CNG school buses, 5 CNG & 63 electric infrastructure projects, & workforce training	0
Volkswagen Mitigation Trust *since 2018*	Up to $65 million	~80 school buses for first installment	~80
Sacramento Regional Zero-Emission School Bus Deployment Project since 2017	$14.5 million (State & match contribution)	28 school buses & infrastructure	28
Clean Truck and Bus Vouchers (HVIP)* since 2010	$88.8 million	557 school buses	500
Clean Mobility in Schools Pilot Project* since 2018	$24.6 million	~28 school buses & infrastructure	~28

Funding Source	Amount Spent/ Allocated	Projects	Zero-Emission School Buses
Diesel Emissions Reduction Act* since 2008	$15.2 million (Federal & State contribution)	549 retrofits, 109 school buses	29

[+] Represents funding sources that are dedicated to school bus cleanup
** Represents funding sources and figures that have been updated since the 2020 SB 1403 State School Bus Incentive Programs Report*

California School Bus Fleet Update

Defining the California School Bus Fleet has been an ongoing and extensive project, 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 2020 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 bus to legally transport children[2]. 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, 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, per authority granted by the Truck and Bus Regulation (CCR sections 2025(s), 2025(t)), school districts are required to submit records to CARB upon request.

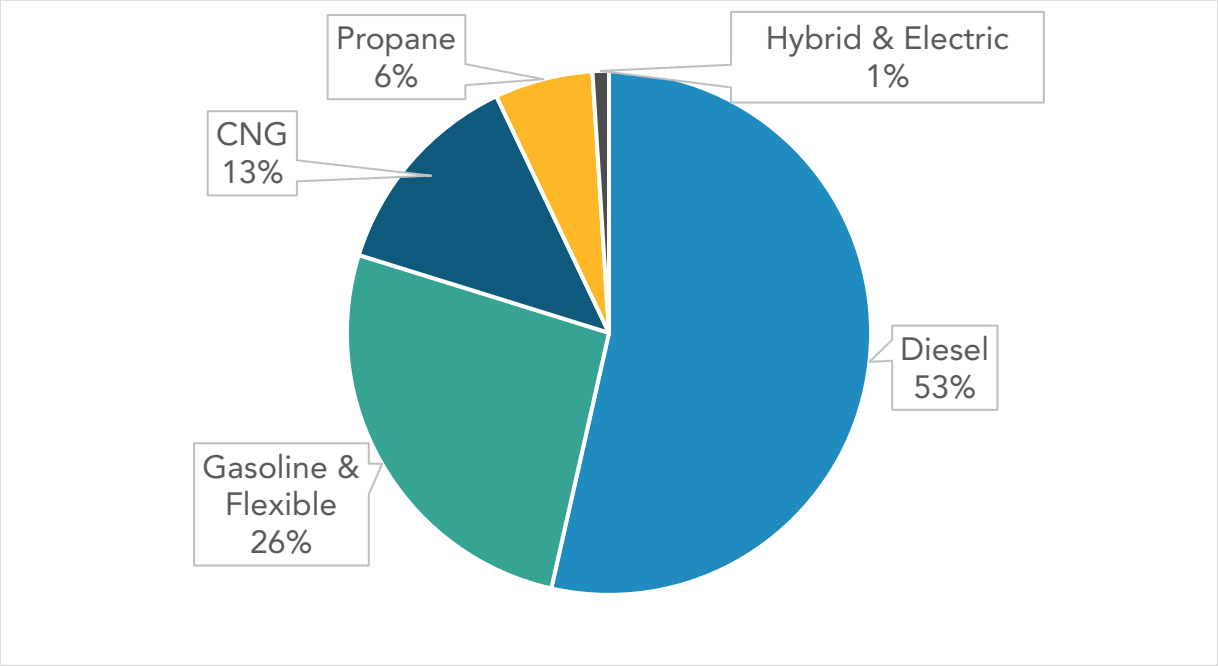
To refine the school bus inventory and identify school districts operating school buses in need of replacement, CARB mailed a letter to school districts on April 15, 2021. The letter request records on diesel fueled school buses that are 2007 and older model year. Staff requested school districts submit the school bus information online in TRUCRS. While many

[2] California Vehicle Code, Section 2807

fleets submitted the requested information, staff are determining the best way to move forward to obtain the information requested from fleets that did not respond to the request.

Staff estimates there are approximately 24,100 school buses operating in California. This number is higher than the 21,600 in the inventory last year. Staff conducted additional analysis of the CHP inspection and DMV registration data and identified more vehicles for the inventory. Figure 1 depicts the California School Bus Population by fuel type.

Figure 1 California School Bus Population by Fuel Type



The bus population by fuel type is nearly identical to 2020. Approximately 53 percent of the fleet is diesel, which is CARB's main area of focus and concern. 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 electric. The percentage of CNG buses, a cleaner alternative to diesel-fueled buses, is steady at 13 percent. Hybrid and electric school buses currently still make up approximately one percent of the inventory.

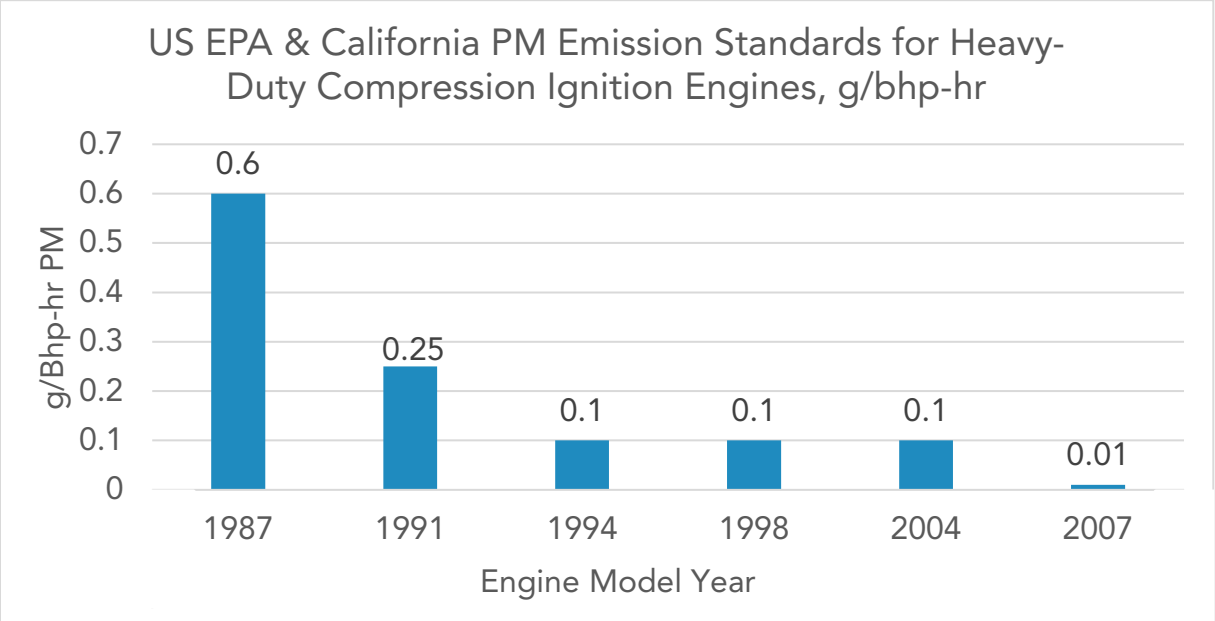
Need for Turnover

Amongst California school buses, the diesel-fueled vehicles are CARB's main area of focus and concern because diesel particulate matter (PM) is a toxic air contaminant. 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 testing, idling restrictions, and in-use regulations such as the Truck and Bus Regulation. School bus fleets must be regularly test 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 2 illustrates how emission standards have become more stringent over time.

Figure 2: 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 particulate matter 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[3], 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 school buses are more polluting with higher deterioration of PM filters due to aging and therefore, exposing children, a sensitive population group, to more emissions. Turnover of the oldest and dirtiest school buses is essential for reducing exposure to pollutants. Turning over the oldest buses also has the added benefits of supporting California's air quality, climate change, and petroleum reduction goals.

Improving Safety Standards – Turnover means Safer Buses on the Road

Besides reducing PM emissions, another reason to turn over the oldest buses in the inventory is the improvement of 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 buses manufactured on or after July 1, 2004.[4] It is not required to retrofit new seats with seat belts, but the updated safety features are a positive outcome of replacing the oldest buses.

Analysis of Diesel School Buses in California

Since January 1, 2014, diesel school buses with a GVWR of 14,001 pounds or more 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 103 buses in the oldest category with bus model years of 1978-1988 in the inventory, and 74 of those are publicly owned. 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 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. Based on the inventory, approximately half of these buses are not equipped with a PM filter. Considering public school buses only, nearly half operate in disadvantaged communities and one operates in an AB 617 designated community. Staff found 364 diesel buses in the next oldest category of concern which includes bus model years of 1989-1991. CARB staff have shared a list of all public-school buses operating within each air basin with the air district. This information helps air district staff identify which school districts own these old school buses and how many old school buses may be operating within the air district.

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[3] Title 13, California Code of Regulations (CCR), Section 2025

[4] California Vehicle Code (CVC), Section 27316

Nearly 90 percent of the entire school bus inventory has a diesel particulate matter filter or is not diesel-fueled. CARB staff will continue to do research and follow up with school districts to resolve the status of the school buses and determine filter status.

Projected Need for Funding

School bus turnover requires significant and long-term funding and although the turnover of the State school bus fleet continues to progress each year, there are still a significant number of school buses that still need to be replaced. The new funding approved by the Legislature for the FY 2021-2022 budget will help the state make significant progress in turning over old school buses in rural air districts. Funding allocations such as this, for school bus replacement is what is needed for significant progress to be made in cleaning up the state 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 electric school buses. Many school buses that are currently operating throughout the State are very old, some more than 30 years old, so even a diesel-to-diesel replacement represents real, immediate reductions of emissions and PM exposure. However, diesel vehicles have a long operational lifespan, replacing with diesel could prolong eventual turnover to electric school buses. It may take a progressive combination of fuel types and technologies before the entire school bus fleet can make a full transition to zero-emission.

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, which is due in 2022 will also reflect California's goal to achieve carbon neutrality by 2045. Governor Newsom's September 23, 2020 Executive Order N-79-20 states that CARB would develop regulations to mandate that all operations of medium- and heavy-duty vehicles shall be 100 percent zero-emission by 2045 where feasible, with all drayage trucks zero-emission by 2035.[5] 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 electrify 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 electric school buses, will further support the transition of the California fleet overall and move the

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

State closer to its goals.[6] School bus replacement funding generally prioritizes the replacement of the oldest buses.

There is an ongoing high demand for school bus funding. The largest sources of school bus funding have been oversubscribed including VW Mitigation funding, CEC's School Bus Replacement Program, and HVIP. There is currently not enough money to fund all the eligible school bus projects. School bus replacement costs range from $130,000 to about $200,000 for conventional school bus replacements including diesel, CNG, low-NOx 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). The higher up-front costs of electric school buses and required infrastructure means that a fixed amount of funding can buy fewer school buses.

As discussed in the previous section, the school buses that fall in the priority category for replacement are the oldest school buses in the State fleet. There are approximately 74 publicly owned diesel fueled 1978-1988 model year school buses; these school buses likely have engines that fall into the category of 1977-1987 engine model year. As explained in the previous section, the engines in these school buses are the dirtiest and highest polluting in the State fleet. Of these school buses, CEC's School Bus Replacement Program and the VW Mitigation Fund will fund replacement of approximately one third. To fund the replacement of the remaining school buses in this category, it would cost approximately $13.5 million for new conventional fueled school buses, or approximately $20 million for zero-emission battery-electric school buses. The next emission standard category has approximately 393 publicly owned diesel fueled 1989-1991 model year school buses; these school buses likely have engines that fall into the 1988-1991 category. This category of school buses has a more stringent emission standard than the previous category but are still far from the current emission standards and although they have a higher probability of being filtered because they are a bit newer than the previous category, older school buses and PM filters continue to age and deteriorate. Approximately one third of the school buses in this category are also slated to be replaced with funds from CEC's School Bus Replacement Program and the VW Mitigation Fund.

There are approximately 24,100 school buses in the statewide fleet, 15,800 of these buses are publicly owned. 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 24 years at a rate of four percent turnover per year, or approximately 658 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 $130 million for new conventional fueled school buses, or approximately $260 million annually for zero-emission

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[6] 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*

battery-electric (not including infrastructure). The new zero-emission school bus funding of $400 million over the next three years approved by the Legislature in the FY 2021-2022 budget is a great step in moving closer to achieving this turnover; this funding will cleanup 1,000 of the dirtiest school buses in rural areas of the state. In addition to helping achieve economies of scale and further zero-emission investments. Building on zero-emission deployment successes is a great next step on the road to zero-emission school buses by 2045. Many factors could affect these calculations, such as an increase or decrease of K-12 home to school transportation.

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 progression and turn over the fleet to cleaner options. Over 100 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 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 at an incredible rate. The transformation of the State school bus fleet to electric is also an important component in achieving California's longer term 2030 and 2050 clean air and climate change goals. Local, state, and the federal governments continue to introduce legislation and allocate funding toward the transition to zero-emission school buses. California's U.S. Sen. Alex Padilla introduced the *Clean Commute for Kids Act* in April 2021, which would invest $25 billion into electric school buses nationwide over the next decade. In addition, President Joe Biden included funding for zero-emission electric buses in his *American Jobs Plan* and Vice President Kamala Harris visited an electric school bus manufacturing plant in South Carolina to advocate for the zero-emission school bus technology.[7] President Joe Biden's job plan will electrify at least 20 percent of the national school bus fleet through a new Clean Buses for Kids Program at the Environmental Protection Agency, with support from the Department of Energy. These investments will set the nation on a path to 100 percent clean school buses, while ensuring that the American workforce is trained to operate and maintain the new vehicles and infrastructure.[8]

Community focused programs and incentives that concentrate support on disadvantaged communities will provide access to clean transportation and mobility options in areas in California that are most burdened by air pollution. The Assembly Bill (AB) 617 (Garcia, C.,

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7 *https://www.mercurynews.com/2021/05/20/opinion-all-electric-buses-will-provide-clean-school-transportation/*

8 *https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/31/fact-sheet-the-american-jobs-plan/*

Chapter 136, Statutes of 2017) Community Air Protection Program, provides opportunities to understand community needs and address some of the most critical barriers to access clean technology. In response to *AB* 617, CARB established the Community Air Protection Program (CAPP). The 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 (CERPs) to outline emission reduction priorities and strategies specific to the community. Seven out of eleven communities that have completed their CERP identify replacing old diesel school buses with zero-emission school buses as a priority including: El Centro-Heber-Calexico Corridor, Eastern Coachella Valley, the Portside Environmental Justice Neighborhoods (San Diego), Shafter, South Central Fresno, San Bernardino-Muscoy, and Stockton. To emphasize the importance of cleaning up school buses in these communities, some of the steering committees have created subcommittees focused on school bus replacement, to ensure timely and effective action. Although the air districts are primarily responsible for implementing the CERPs, CARB staff engage in the process by assisting community members and air district staff as these school bus replacement strategies are put into action. CARB is committed to having ongoing conversations with these communities and hearing what is needed to support the integration of zero-emission school buses into the future.

Electric school buses have many attractive characteristics including reduced fuel and maintenance costs, reduced operational noise, and no tailpipe emissions, which ensures cleaner air for the students and the local communities. School transportation has been a promising sector to demonstrate the viability of electric school buses. The Beachhead strategy (found in Appendix D, Long-Term Heavy-Duty Investment Strategy to this Funding Plan) a strategy followed by CARB for technology commercialization, has identified school buses as a secondary market where zero- and near-zero technologies are most likely to succeed and help drive growth in other segments. However, the integration of electric school buses requires more effort than simply replacing conventional fueled school buses with electric school buses. Research, good planning, and a partnership between the school district, manufacturers, and public agencies are necessary to make the transition successful.

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 electric school buses on their own. It is important to build partnerships with local, state, and federal agencies, manufacturers of school buses and charging equipment, and utilities to make the adoption of electric school buses and infrastructure installation easier and more accessible. While there is more growing and learning to do, projects such as the Clean Mobility in Schools Pilot, CEC's School Bus Replacement Program, and utility infrastructure programs, among others, help build connections and partnerships with the goal of understanding the transition to new

technology and how to facilitate the transition successfully. We benefit from and continue to learn from early adopters of zero-emission technology.

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. In addition, vehicle-to-grid (V2G) and Low Carbon Fuel Standard (LCFS) Credits may be added incentive for a school district to incorporate electric school buses. V2G technology is evolving through the support of various projects that are underway to demonstrate its successful use in the field, such as those by the CEC and the Dominion Energy project in Virginia. LCFS credits may help the fleet lower overall costs of operating electric school buses.

Zero-Emission School Bus Supplier Update

Currently, all major school bus manufacturers have a commercially available electric school bus model available. Zero-emission school buses are available and are being deployed throughout California and the country. Approximately 110 school districts in the state are operating at least one electric school bus. Based on a survey of manufacturers conducted by CARB staff in April 2021, approximately 318 zero-emission school buses have been delivered and are operating in California, with another 388 on order. Due to the COVID-19 pandemic and national and international shutdowns, some manufacturers experienced delays in expected delivery timelines due to supply chain disruption and halts in manufacturing.

Zero-emission school buses can drive between 75-155 miles on a single charge, which is enough for most school bus routes.[9] Expanded battery storage capacity, and therefore miles per recharge, continue to expand. Zero-emission school buses are available in Type A, B, C and D, and weight classes four through eight with battery capacity ranging up to 226 kWh. CALSTART, a clean transportation nonprofit, developed the *Zero-Emission Technology Inventory (ZETI)* tool. The ZETI tool is an interactive online resource that shows all commercially available offerings of zero-emission medium- and heavy-duty vehicles (MHDVs). According to ZETI, 18 school bus models are currently available for 2021.[10] Also, 10 of these school buses are eligible for HVIP funding and the technical specifications are listed on the website.

Many school districts do not have the funding to purchase new school buses on their own and while electric school buses can be more cost effective in the long term, the initial investment has proven difficult for school districts to overcome. To meet the State's air quality goals described in the previous section, several state and local school bus incentive programs have prioritized funding zero-emission school bus replacements and supporting infrastructure. Electric pilot projects such as the Rural School Bus Pilot Project, the Clean

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[9] National Renewable Energy Laboratory: *https://www.nrel.gov/docs/fy14osti/60068.pdf*, page 3

[10] Global Drive to Zero, "Zero emission technology inventory": *https://globaldrivetozero.org/tools/zero-emission-technology-inventory/*

Mobility in Schools Program, and HVIP are important for fleets to address key barriers to adoption of the technology. The lessons learned from these programs will help develop best practices moving forward. The projects give fleets a chance to see how integrating a limited number of zero-emission school buses works before making the investment to transitioning large portions of the fleet to electric. In contrast, some utilities have suggested that incorporating more zero-emission school buses at one time could be more efficient for infrastructure installation and development: the CEC School Bus Replacement program funded up to 10 school buses per fleet. Many fleets have already started integrating electric school buses into their fleet with varied challenges and successes. Please refer to the case studies later in this report for more details. In addition, the Department of Energy (DOE) is conducting a nationwide data collection effort for the purpose of better understanding how medium-duty and heavy-duty EV's, including electric school buses, are performing in early deployments. Capturing these learnings and insights are important as electric school buses are deployed on a larger scale.

California is not the only market for electric school buses. The Volkswagen (VW) settlement will provide states with a total of $2.9 billion for projects to reduce NOx emissions from large vehicles, including school buses. States have the flexibility to choose which projects on the list of eligible mitigation actions are the best options for their citizens. Many states have released either draft or final versions of their beneficiary mitigation plans, and it appears that school bus replacement projects will be included in most of the states' plans. The California VW Mitigation Trust has $130 million in funds to replace older, high-polluting transit, school, and shuttle buses with new battery-electric or fuel-cell buses; the first installment of $65 million will fund approximately 80 zero-emission school buses. As previously mentioned, the first installment of VW funding for school buses was oversubscribed. States such as Virginia, Washington, and Illinois are dedicating $20 million, $12 million, and $9 million to zero-emission school buses, respectively.

Financial assistance from the VW Mitigation fund is a unique opportunity to fund zero-emission school buses that provides incentives nationwide that are important for both school districts and technology advancement. For school districts, it covers most of the cost of purchasing electric school buses providing financial support to replace their older combustion powered school buses with reliable zero-emission school buses. For technology advancement, the funding contributes to an increased demand for zero-emission school buses and market acceleration for zero-emission technologies.

Dominion Energy, an electric utility headquartered in Virginia, has collaborated with local Virginia school districts on the single largest electric school bus deployment in the country to replace diesel school buses in their fleets with electric models. Dominion Energy is covering the incremental cost of purchasing an electric school bus over a diesel school bus and the cost of charging infrastructure and related equipment. School districts within Dominion Energy's Virginia service territory have been selected. The goal is to have 50 percent of all

diesel school bus replacements be electric by 2025 and 100 percent by 2030.[11] The electric school buses deployed through this program will be equipped with vehicle-to-grid capabilities; read more about *vehicle-to-grid* later in this section.

While there are various zero-emission school bus models available, and a strong demand for the technology nationwide, many fleets will need assistance from emerging funding programs from utilities and others to fund associated costs of incorporating the new technology, in particular, infrastructure costs.

Zero-Emission School Bus Infrastructure

Successful and cost-efficient charging infrastructure for zero-emission school buses 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 much funding to future-proof their charging infrastructure for future expansion. CALSTART has developed the *School Bus Fleet Infrastructure Planning Tool*; this document covers 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, the CEC is leading efforts on ensuring that school districts have the infrastructure needed to support their school bus fleets and that California's grid is reliable and resilient. As stated in a prior section, under its School Bus Replacement Program, the CEC was able to provide funding for its 236 electric school buses with an additional $60,000 for infrastructure funding per bus utilizing Clean Transportation Program funding. Additionally, the CEC is working directly with electric utilities to assist in upgrading the electrical infrastructure required to charge the 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 the CEC approved the EnergIIZE Commercial Vehicles (Energy Infrastructure Incentives for Zero-Emission Commercial Vehicles) project, to accelerate the deployment of infrastructure needed to fuel zero-emission trucks, buses, and equipment. This program will provide support for eligible applicants to help plan and fund the purchase of charging and hydrogen fueling infrastructure.[12]

In July 2021, $50 million was allocated to the CEC from the FY 2021-2022 budget to fund school bus charging infrastructure. The first installment of $20 million will complement CARB

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[11] Dominion Energy, Electric School Buses: *https://www.dominionenergy.com/electricschoolbus*

[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 rural school districts. Incentive projects, such as CARB's HVIP and CEC's EnergIIZE Commercial Vehicles (Energy Infrastructure Incentives for Zero-Emission Commercial Vehicles), may 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. The 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; 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 May 2021, SCE had completed the installation of charging infrastructure at nine school district sites, resulting in the electrification of 79 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 offers incentives and rebates to facilitate the installation of EVSE make-ready infrastructure for medium- and heavy- duty vehicle fleets, eligible electric fleet vehicles include school buses. By 2024, PG&E's EV Fleet Program goal is to support over 700 commercial and public fleets convert to EVs. The program offers dedicated electrical

infrastructure site design and permitting, construction services and reduced costs for electrical infrastructure work. Sites located in disadvantaged communities may be eligible to receive a rebate for the purchase of the EVSE or charger. Fleets must demonstrate commitment to procurement of a minimum of two electric fleet vehicles and a long-term electrification growth plan and schedule of load increase. In addition, fleets must provide data for charger usage for a minimum of five years, and own or lease the property where chargers are installed and operate and maintain 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 1000 companies are eligible for an additional rebate of up to 50% 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

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. 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 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 the California Public Utilities Commission (CPUC)

jointly created the Vehicle Grid Integration (VGI) Working Group. The 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 the CPUC on June 30, 2020 that 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 the next steps for California state agencies, the California ISO, utilities, community choice aggregators and other load -serving entities, and other VGI stakeholders should include a variety of policy actions, interagency coordination and convening, and 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. SDG&E recently partnered with Cajon Valley Union School District to conduct a five-year V2G pilot. The project will connect six electric school buses to 60kW bi-directional DC fast chargers. The batteries on board the buses will soak up energy during downtime and when clean energy is abundant on the grid (such as midday when solar energy production is at its peak) and return energy to the grid in the afternoon and evening.[13]

Although V2G adds additional cost to the price of the vehicle and infrastructure, if proven successful, it may be an attractive option to help school districts build a stronger business case for zero-emission school bus adoption while supporting grid resiliency and security. As part of the CEC School Bus Replacement Program, the CEC required awarded school buses to have V2G capabilities. This was required to both standardize vehicle charging as well as provide added resiliency and emergency capabilities for school bus recipients.

Low Carbon Fuel Standard (LCFS) Credits

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 operating on low carbon fuels, the greater the credit generation and cost savings. The average credit price for the last 12 months is about $190 per credit.[14] LCFS credit value depends on a few variables, including the LCFS credit price, the annual carbon intensity (CI) target for the year, the CI of the fuel dispensed (in this case, electricity), and the vehicle type. For 2021, the LCFS value is 26 cents/kWh when charging school buses with California average grid electricity[15] and 31 cents/kWh with zero-CI electricity. LCFS staff has developed a *credit value calculator* that is available on the LCFS dashboard 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.[16]

Furthermore, as of January 1, 2021, school districts that operate fossil propane school buses purchased after January 1, 2020, or other propane vehicles are required to report fuel transaction quantities to the LCFS and balance the deficit. School districts operating compressed natural gas (CNG) buses purchased after Jan 1, 2020 are also subject to reporting requirements under the regulation. However, buses purchased prior to Jan 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 (gge) of fossil CNG per year are exempt until December 31, 2023. To balance the deficit and comply with the program, the reporting entity must acquire an equivalent number of credits to match the deficits it has incurred. 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 an important 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 fleet must make to maximize the benefits of the technology. There are differences in zero-emission school bus

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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: March 15, 2021: *https://ww2.arb.ca.gov/sites/default/files/classic/fuels/lcfs/fuelpathways/comments/tier2/2021_elec_update.pdf*

[16] 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*

maintenance and operation when compared to conventional fueled school buses. For example, zero-emission 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 are developing a new, innovative project which will 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). IDEAL ZEV Workforce Pilot complements CARB's Clean Transportation Program Investments, including the Clean Mobility in Schools Pilot, due to providing funding for curriculum projects and promoting workforce training and career development partnerships. The COVID-19 pandemic has forced the use of connective online technology to conduct virtual trainings and webinars. Although this doesn't work for all fleets, it is an avenue to reach additional fleets that need zero-emission school bus training.

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 CARB incentive programs. In addition, Assembly Bill 841 (Ting, Chapter 372, Statutes 2020) section 740.20 approved in September 2020, 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, California Public Utilities Commission, or the CEC.[17] Training and certification requirements such as this will be especially important as more school districts incorporate zero-emission school buses.

All major zero-emission school bus manufacturers provide mechanic and driver training to new zero-emission school bus owners along with on-going support. Training is offered to support customers through the steps of 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 and via online training platforms. A leader in zero-emission school bus integration, Twin Rivers Unified School District, has developed and refined its own in-house training program to familiarize school bus drivers with the new technology. The California Department of Education (CDE) has also developed a supplemental module on zero-emission school bus operation that is included in the state certified school bus driver trainings.

In 2019, the 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

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

required to maintain the zero-emission 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 zero-emission school buses and school bus charging. In 2020, the CEC launched the training project. Following California Governor Newsom's March 19, 2020 Executive Order N-33-20, in-person training options diminished so an online training tool, Today's Class Technician, was deployed.[18] The first cohort trained 61 school bus technicians across 20 school districts as of January 2021. As of June 2021, 14 technicians are participating in the second round of training, and plans for future, in-person trainings are still in development.

The West Coast Center of Excellence in Zero-emission Technology hosted by Sunline Transit Agency has developed a workforce-training program focused on maintaining and operating zero-emission buses in public fleets. The program offers various courses related to zero-emission technology, operation, and maintenance. A similar workforce-training program can be developed for school bus fleets with lessons incorporated from programs such as this.

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

Significant progress continues to be made to clean up the State's school bus fleet. This progress continues to be achieved through cooperative and dedicated funding to school bus cleanup. The approval of $450 million in new funding for school buses and infrastructure in the FY 2021-2022 State budget to deploy 1,000 new zero emission school buses and infrastructure will continue the progress of cleaning up the state school bus fleet. School bus cleanup continues to be a priority for CARB, CEC, and other state agencies, as well as local air districts and surrounding communities.

Since the last report, the State has spent or allocated approximately $560 million to school bus cleanup. Turnover of all publicly owned school buses over the next 24 years at a rate of four percent turnover per year would require an investment of approximately up to $260

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

million annually (not including infrastructure costs, total cost of ownership savings, or additional training/support). California school districts continue to need more funding and support each year to continue to build on past successes.

Case Study – Clovis Unified School District

Clovis Unified School District (USD) received funding for their first two electric school buses and infrastructure through the San Joaquin Valley Air Pollution Control District (SJVAPCD) LESBP funds and their local utility provider, PG&E. The district received $800,000 for two Blue Bird Type D electric school buses and more than $400,000 for charging infrastructure. Clovis USD is also scheduled to receive another six Blue Bird Type D electric school buses through the Volkswagen mitigation settlement.

Transportation Profile

Total # of Students: >43,000

Daily Transport: ~5,000 students per day

Routes: 112 routes per day

Average Route Length: 30 miles

Bus Inventory: 162 total school buses, 2 Blue Bird Type D Electric School Buses

To provide infrastructure for the electric school buses the Clovis USD facilities department started working PG&E right away. The biggest challenge according to Sheryl Boe, the Director of Transportation at Clovis USD, was not knowing who to turn to in the beginning for help. She said, "It is a challenge to start venturing out into a completely new technology. I feel very supported by the SJVAPCD, PG&E, and other entities. It can be intimidating going with brand new infrastructure and technology, just make sure you have everyone's support." PG&E did a site assessment, and the school district went out to bid for an electrical contractor. It was a collaborative effort between the school district facilities department, PG&E, and the electrical contractor. The district had to increase the performance of the transformer they already had on site, the panel will now support additional charging capacity beyond the current needs. The footprint of the Clovis USD Campus currently allows for future expansion of up to 23 electric school buses.

Clovis USD is getting the expected range of about 89-90 miles for the electric school buses they received and would like to see a higher range capacity on the electric school buses to cover more of their routes. Currently the electric school buses can cover approximately 15 percent of the school districts daily routes. Sheryl emphasized the importance of understanding the capabilities of the electric school buses and how a bus with a specified range will fit into the fleet so that you do not limit yourself once you have the new buses. Sheryl also said the electric buses would be able to be used on longer trips and field trips once there is charging available at destination locations. The in-house district mechanics are very interested in the new technology and are interested in additional training opportunities. These buses have been in service for about a year and a half and are still under warranty and no major work has had to be done to them.

Case Study – Natomas Unified School District

Natomas Unified School District (NUSD) received funding for three zero-emission school buses and supporting charging infrastructure from the California Energy Commission's (CEC) School Bus Replacement Program. The district received $1,143,552 which included $963,552 to purchase three Lion Electric Company. Type C electric school buses, and $180,000 for charging infrastructure. The grant funds were sufficient to cover 100 percent of the total cost of purchasing the electric buses and installation of charging infrastructure.

Transportation Profile

Total # of Students: 15,290

Daily Transport: 915 students per day

Routes: 16 routes running twice daily

Average Route Length: 44 miles

Bus Inventory: 32 total school buses, 3 Lion Electric School Buses

NUSD operates a fleet of 32 buses running 16 daily routes that support special needs students and general education students in addition to athletics programs and field trips. Currently, due to decreased student attendance due to the pandemic, NUSD is operating 13 routes, with an average route length of 44 miles and eight to ten stops per run. The school district is using two of their awarded electric buses on fixed routes and using the third as an alternate. NUSD Director of Facilities and Strategic Planning, Jen Mellor, has expressed interest in expanding the number of electric buses in the districts fleet and has stated that electric buses could cover 90 percent of the district's routes, making a future majority electric bus fleet possible.

NUSD contracted out to an engineering firm to assess the transportation site needs for charging infrastructure installation. It was determined that no additional utility electrical infrastructure upgrades were required to install three, Blink IQ200 Level 2 smart charging stations, apart from a dedicated electrical panel. The transportation site electrical infrastructure has the capacity to add seven additional charging stations in the future, minimizing the cost of installing charging stations for electric fleet expansion. Sacramento Municipal Utility District (SMUD) also participated in the upgrade determination process and was able to assist the district with installation of the new electrical panel to support current and future electric bus charging needs.

NUSD has expressed a desire to obtain more hands-on mechanic training in anticipation of future bus maintenance. NUSD is eligible for and has attended mechanic and driver training through Cerritos Community College, funded by the CEC as part of its workforce development.

Case Study – Red Bluff Joint Union High School District

Red Bluff Joint Union High School District (UHSD) received funding for three Blue Bird Type D electric school buses funded through CARB's Rural School Bus Pilot Project which is currently being administered by the North Coast Unified Air Pollution Control District. The district received $1,215,000 which included $1,200,000 to purchase three Blue Bird Type D electric school buses, and $15,000 for charging infrastructure. Red Bluff High School Transportation provides transportation to students from both Red Bluff Joint UHSD and Red Bluff Elementary School District.

Transportation Profile

Total # of Students: 3,700

Daily Transport: ~1,800

Routes: 11 routes per day

Route Length: 16-75 miles

Bus Inventory: 23 total school buses, 3 Blue Bird Type D Electric School Buses

The electric school buses are used daily on both morning and afternoon routes. They are charged between routes and during optimal charging time after nine in the evening. The buses were advertised as having approximately 100-mile range, however the district is seeing around 88 miles per charge if the heater or air conditioner is being used. The advertised range allows the buses to cover all but two routes; with a higher range the buses will be able to cover 100 percent of the routes. The electric school buses have had more downtime than the conventional fueled school buses in the fleet, the downtime is associated with the implementation of the new technology and doesn't represent long term characteristics of the electric school buses. Red Bluff Joint UHSD did not plan on incorporating electric buses until grant funds became available and now plans to further expand the fleet to incorporate more electric school buses.

Red Bluff Joint UHSD worked with PG&E's EV Fleet Program to plan the charging infrastructure. PG&E installed a new service specifically for the electric buses. PG&E handled the infrastructure before the meter and the school district's contractor handled the infrastructure after the meter. Infrastructure was installed for three electric school buses and can be expanded to accommodate up to ten electric buses. PG&E was involved early in the process and performed a site assessment and rate analysis. The bus dealer, A-Z Bus Sales, provided references for charging equipment and the district decided on Clipper Creek CS-100's. The director of transportation, Zach Pierce, expressed the importance of understanding the different charging options and technology available especially if a school district would like to take advantage of time-of-use rate plans. Infrastructure costs were covered by PG&E fully up to the meter with some rebates for after the meter costs.

The three bus drivers assigned to the electric school buses like that the buses have a stronger acceleration than the diesel school buses, stronger air conditioner and lack of engine noise. The bus drivers are becoming accustomed to the new technology and still have some range

anxiety. The mechanics are concerned about the new technology because of lack of experience, and they are open to learning the new technology and training opportunities. The district's location and distance to the nearest repair facility makes it important for in house mechanics to learn to diagnose and perform repairs related to the battery electric technology on site.