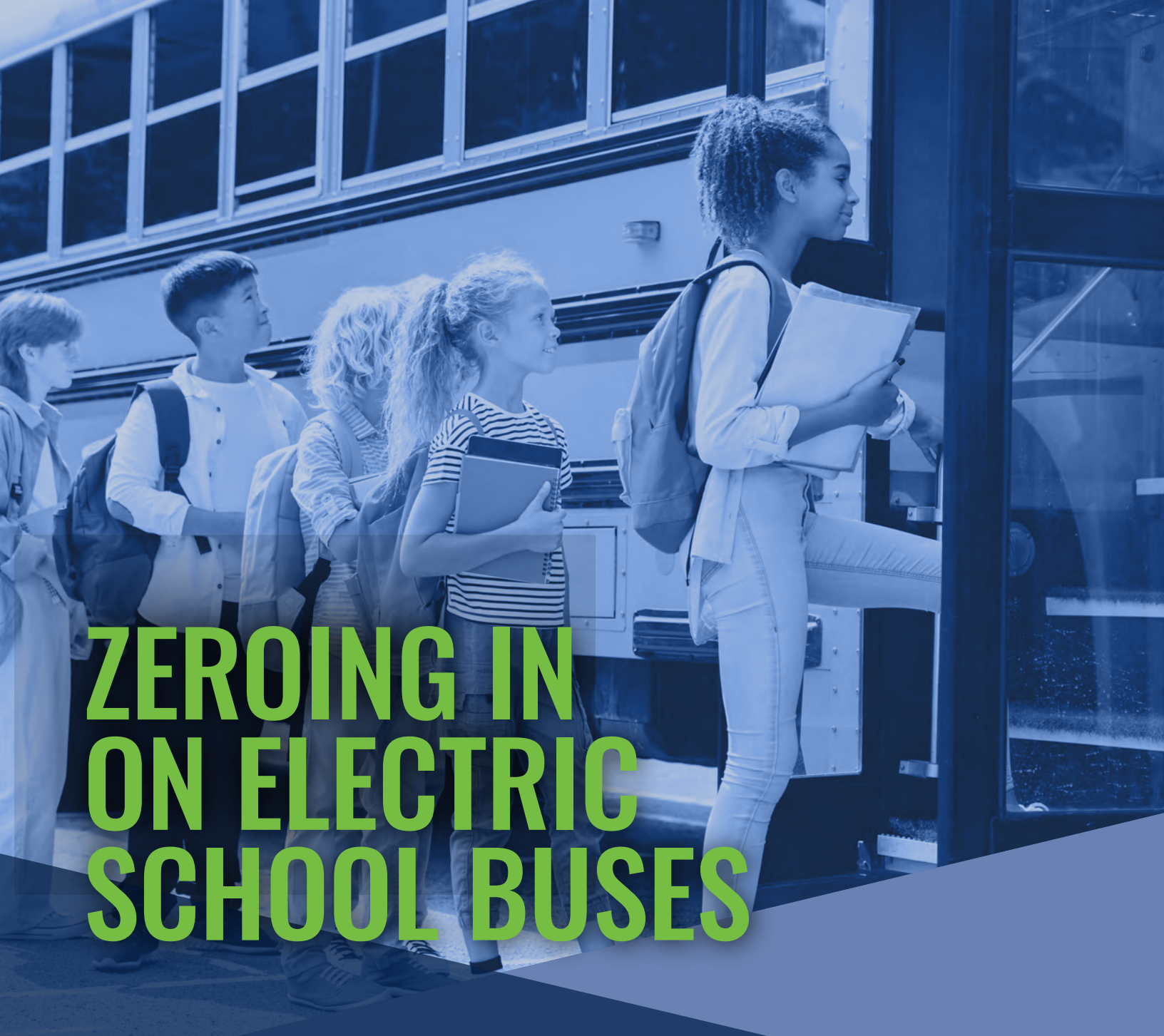

ZEROING IN ON ELECTRIC SCHOOL BUSES

THE ADVANCED TECHNOLOGY SCHOOL BUS INDEX: A U.S. ELECTRIC SCHOOL BUS INVENTORY REPORT

May 2023

A CALSTART Report
By Rachel Chard, Juan Espinoza,
Ian Fried, and Liza Walsh
www.calstart.org

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List of Acronyms

Acronym	Definition
ACT	Accelerating Clean School Transport
CARB	California Air Resources Board
CEC	California Energy Commission
CDPHE	The Colorado Department of Public Health and Environment
DERA	Diesel Emissions Reduction Act
EPA	Environmental Protection Agency
ESB	Electric School Bus
EV	Electric Vehicle
GHG	Greenhouse Gas
HVIP	Hybrid and Zero-Emission Truck and Bus Voucher Incentive Program
ICE	Internal Combustion Engine
IIJA	Infrastructure Investment and Jobs Act
MassCEC	Massachusetts Clean Energy Center
NCEF	Nevada Clean Energy Fund
NYGB	NY Green Bank
NYTVIP	The New York Truck Voucher Incentive Program
OEM	Original Equipment Manufacturer

Acronym	Definition
VW	Volkswagen
ZEB	Zero-Emission Bus

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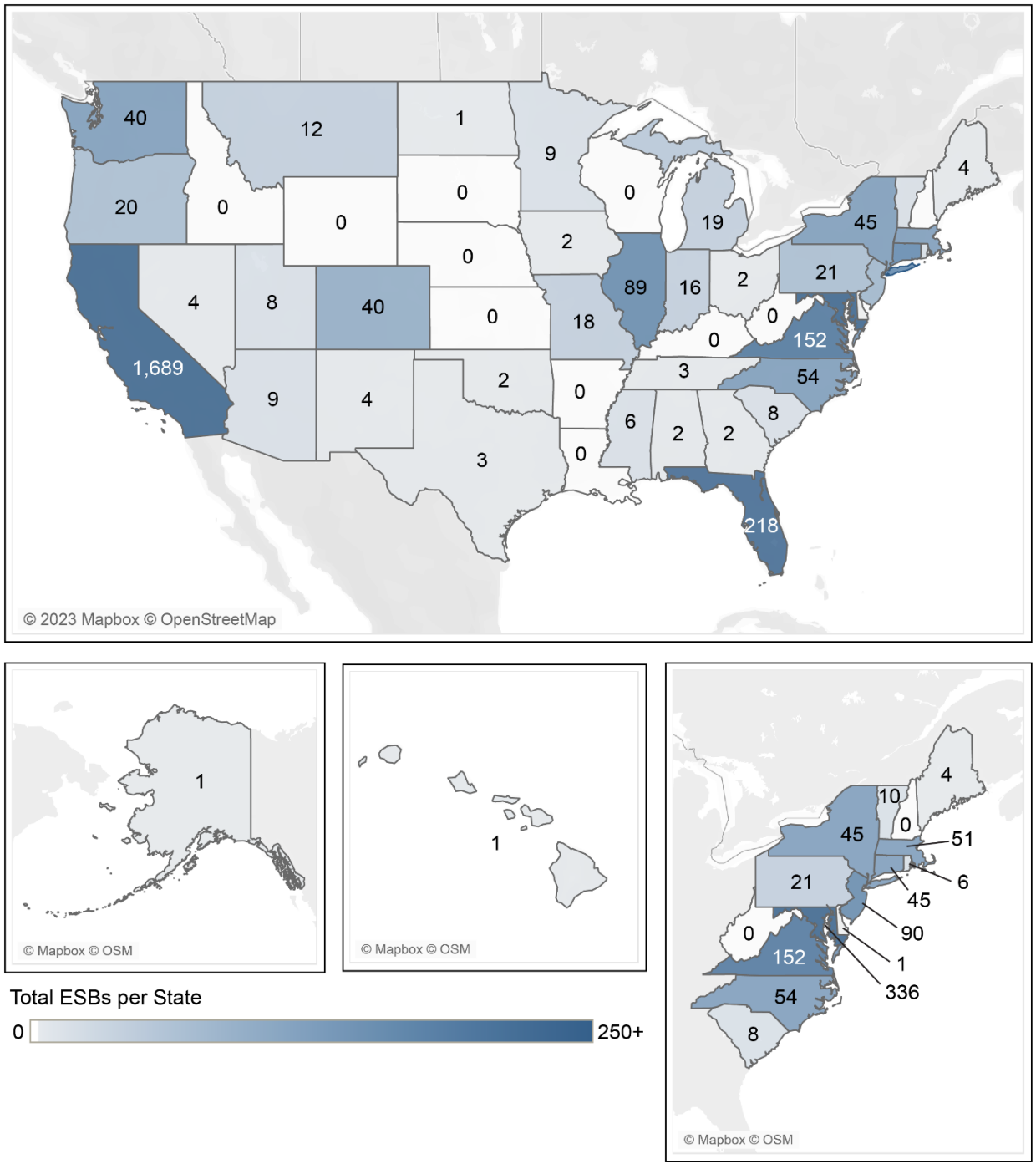
Executive Summary

This report aims to provide an inventory of the number of electric school buses (ESBs) currently adopted within the United States. In 2021, the federal government allocated $5 billion over the next five years to replace existing school buses with zero-emission and low-emission models. This funding marks the largest federal investment for electric school buses in history and has become a catalyst for other incentive programs across the country. The Zeroing in on Electric School Buses report analyzes adoption and tracks the ESB industry's growth. The report highlights trends, such as emerging financing models, funding and policy, and barriers to adoption such as cost and education. It also tracks the impacts of these trends and the distribution of funding in the market for ESBs to inform the adoption of electric school buses across the United States.

CALSTART tracks incentive funding and award reports as well as new sources and industry press releases to collect electric school bus adoption statistics within the United States. This report covers adoption statistics through December 2022 apart from the Environmental Protection Agency's (EPA) 2022 Clean School Bus Rebate program awards. At the time of writing this report, the Clean School Bus Rebate program awardees were not yet finalized. These numbers will not be represented in this edition as the total number of awarded ESBs is still fluctuating.

The report reveals that 3,043 electric school buses have been awarded, ordered, delivered, or deployed in the U.S. California continues to lead with the most electric school buses adopted, making up 56 percent of the total market share (**Figure 1**). The report also highlights the significant growth of electric school buses adopted in Illinois, New Jersey, North Carolina, Connecticut, and New York. However, despite the spike in federal and state funding programs over the past year, limited technical and financial resources available to school districts still pose challenges to ESB adoption.

Figure 1. Electric School Buses Currently Awarded, Ordered, Delivered, or Deployed within the United States



Tracking electric school bus adoption data is crucial in monitoring progress, evaluating incentive program effectiveness, identifying potential barriers, and improving city plans and resource allocation. States can evaluate their incentive programs' performance and determine whether the adoption rate trajectory meets expectations or goal mandates.

Officials can also use this data to identify potential barriers to adoption and develop strategies to overcome them while prioritizing resource allocation and infrastructure development where electric school bus adoption is already high. Ultimately, tracking adoption data is essential to create sustainable and efficient transportation systems. As such, the Zeroing in on ESBs annual report is an essential tool for tracking ESB adoption in the United States, providing industry context for the data collected, and insight into the electrification of the nation's school bus fleet.

I. Introduction and Background

The electric school bus (ESB) industry has seen significant leaps in adoption over the past year through federal and state funding initiatives and policy adoption. The electrification of the national school bus fleet has become a prominent focus area for the United States government, which allocated $5 billion over the next five years to replace existing school buses with zero-emission and low-emission models through the Infrastructure Investment and Jobs Act (Environmental Protection Agency, 2023). The year 2022 was a pivotal year for the mode of transportation that carries 26 million students to their destinations daily (De La Garza, 2021).

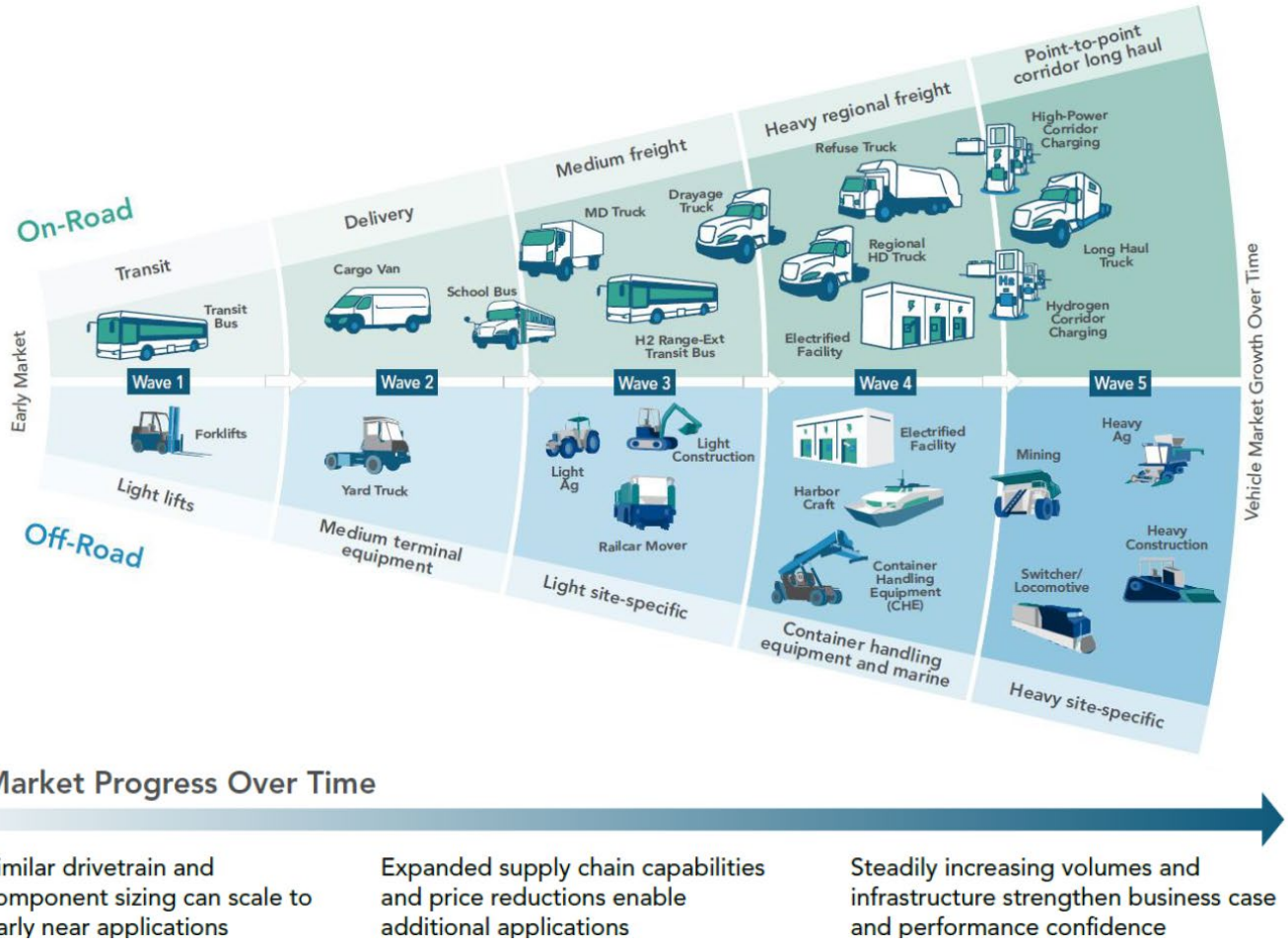
School districts are some of the most influential entities in communities across the country, sometimes operating as the largest employers in their respective counties (Hensley, 2022). The growing effort to reduce greenhouse gas (GHG) vehicle emissions in all 50 states makes schools a leverage point for emission reductions. CALSTART began tracking ESB purchases in 2021 through the inaugural edition of Zeroing in on ESBs in response to this shift in adoption and will continue to quantify this transformation as school bus electrification proves to be a significant trend in the zero-emission vehicle (ZEV) market. The Zeroing in on ESBs report highlights the ESB deployments within the U.S. and shows the breakdown of electric school buses awarded in each state.

The Beachhead Model, illustrated in **Figure 2**, depicts the significance of school buses and their likelihood to be a successful zero-emission technology. Developed in partnership between CALSTART and the California Air Resources Board (CARB), the Beachhead Model identifies commercial vehicle applications where zero-emission technologies are most likely to succeed. The vehicle segments with applications and duty cycles more suited to zero-emission technology typically operate along known routes of relatively short distances and can charge overnight at depots. Securing an initial position within these markets catalyzes further advancement by contributing to the development of other types of ZEVs (Welch, 2020).

In the Beachhead Model, ESBs fall under the second wave of adoption as ZEVs with typically predictable, but not fixed, routes. ESB deployments are an ideal application to demonstrate zero-emission technology in real-world scenarios, portraying their capabilities in extreme weather conditions and operating through various terrain environments (Welch, 2020). It is crucial to track these demonstrations as the technology gains prominence. While this model

places ESB adoption prior to many other vehicle applications, there are still barriers that this technology poses to school districts.

Figure 2. The Beachhead Model (CARB, 2022)



ESBs have a unique opportunity to leverage the influence of school districts in communities across the country. Still, the challenges of this technology exist through resource and budget constraints for school districts. The spike in federal and state funding programs over the past year has curtailed the cost barriers for some school districts. Despite the cost barriers, funding programs do not always fully address all of a school district's needs. The rapid expansion of ESBs will result in the need for school districts to have assistance with gaps in technical knowledge and the resources for fleet electrification planning as their ESB fleet grows.

Although electric buses have significantly impacted the transit market, the electric school bus industry is still in the early stages of adoption. This report, published annually to track the growth of the ESB market as it matures over time, documents ESB adoption in the U.S. by providing industry context for the data collected. The report highlights trends, such as emerging financing models, funding and policy, and barriers to adoption such as cost and

education. The Zeroing in on ESBs annual report will track the impacts of those trends and the distribution of funding in the market to provide insight into the electrification of the nation's school bus fleet.

II. Results and Analysis of Report

ESB Deployment

To track zero-emission school bus adoption numbers within the United States, CALSTART reviewed funding and award reports from federal, state, and local incentive programs. CALSTART also reviewed press releases, social media posts, and the World Resources Institute's (WRI) Dataset of Electric School Bus Adoption in the United States (Lazer and Freehafer, February 2023) to ensure data accuracy.

This report defines the adoption of ESBs as those that have been funded, ordered, delivered, or deployed. If data collected falls into one of these categories during the collection window, it is included in the total adoption numbers. The stages of ESB adoption are defined as follows:

- **Funded:** Funding to support the procurement of the electric school bus has been officially awarded and accepted.
- **Ordered:** The school district has officially placed an order for an electric school bus.
- **Delivered:** The electric school bus has been received by the school district and is being prepared to be placed into operational service.
- **Deployed:** The electric school bus has been placed in operational service and is actively running in service.

It is important to note that all data, both past and new, is checked for accuracy for each edition of the report. For this reason, the previous year's total adoption data stated in this report may not match the data previously reported in the 2022 edition. The changes to the previous year's adoption numbers may be the result of canceled orders, complications with incentive funding, or any number of reasons.

Since September 2021, there were 888 new ESBs adopted, making a total of 3,043 ESBs adopted in the United States. California continues to lead the U.S. with the most zero-emission school buses. The top five states with zero-emission school buses are California (1,689), Maryland (336), Florida (218), Virginia (152), and New Jersey (90) (**Table 1**). Currently, California makes up 56 percent of the zero-emission school bus adoption within the U.S. The following states saw significant growth in their zero-emission school bus population: Illinois (81

buses added), New Jersey (58 buses added), North Carolina (48 buses added), Connecticut (43 buses added), and New York (15 buses added) (**Figure 3**).

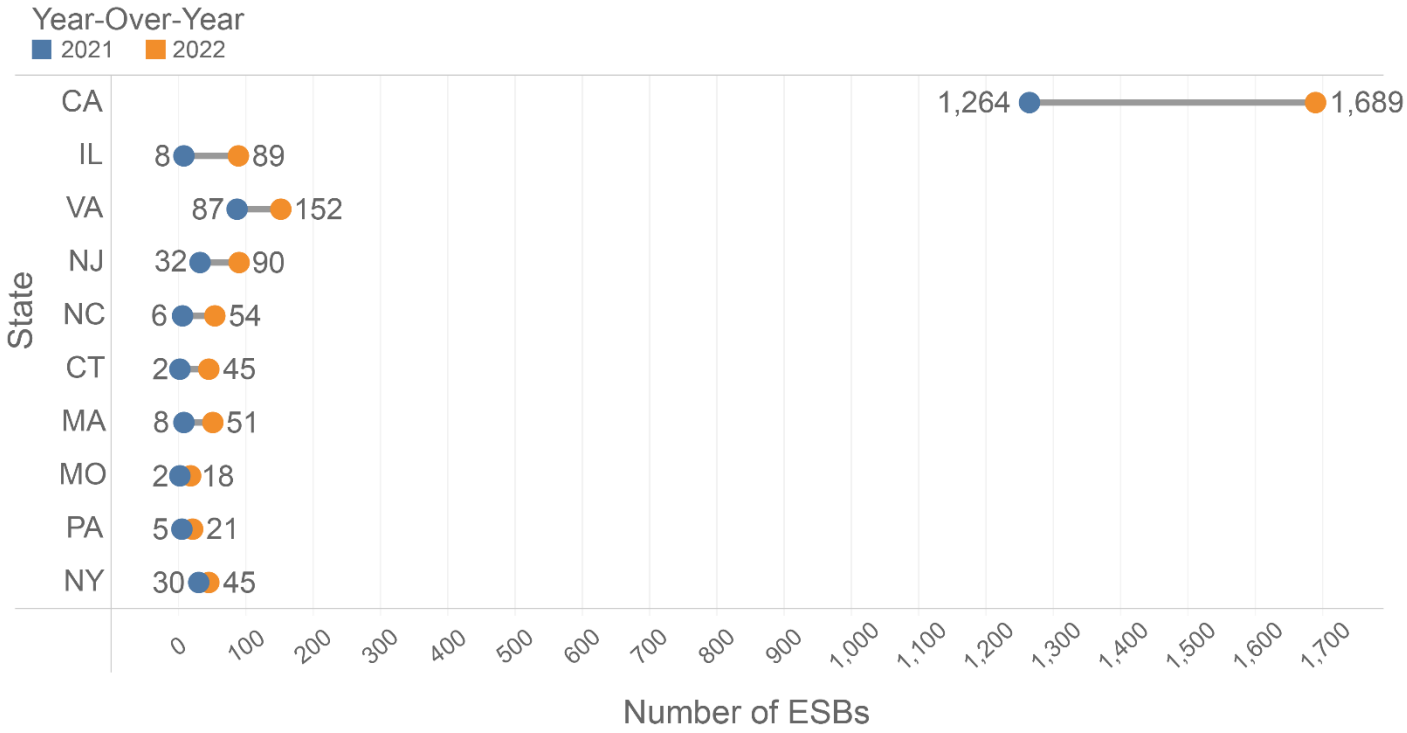
CALSTART has excluded the EPA's 2022 Clean School Bus Rebate Program award list from the 2022 ESB adoption data. At the time of writing this report, the award list is not final and subject to change. Considering the number of potential awards through the Clean School Bus Rebate Program, we did not want to incorrectly state the adoption numbers.

Table 1. Year over Year Change in Electric School Bus Adoption by State

State	2021 (Through Sept 2021)	2022 (Oct 2021-Dec 2022)	Total	Percent Change
Alabama	2	0	2	0%
Alaska	1	0	1	0%
Arizona	2	7	9	350%
Arkansas	0	0	0	0%
California	1,264	425	1,689	34%
Colorado	36	4	40	11%
Connecticut	2	43	45	2,150%
Delaware	1	0	1	0%
Florida	218	0	218	0%
Georgia	1	1	2	100%
Hawaii	1	0	1	0%
Idaho	0	0	0	0%
Illinois	8	81	89	1,013%
Indiana	12	4	16	33%
Iowa	2	0	2	0%
Kansas	0	0	0	0%
Kentucky	0	0	0	0%
Louisiana	0	0	0	0%
Maine	1	3	4	300%
Maryland	331	5	336	2%
Massachusetts	8	43	51	538%
Michigan	17	2	19	12%
Minnesota	9	0	9	0%
Mississippi	0	6	6	600%
Missouri	2	16	18	800%
Montana	0	12	12	1,200%
Nebraska	0	0	0	0%
Nevada	2	2	4	100%
New Hampshire	0	0	0	0%
New Jersey	32	58	90	181%
New Mexico	1	3	4	300%
New York	30	15	45	50%

State	2021 (Through Sept 2021)	2022 (Oct 2021-Dec 2022)	Total	Percent Change
North Carolina	6	48	54	800%
North Dakota	1	0	1	0%
Ohio	0	2	2	200%
Oklahoma	1	1	2	100%
Oregon	14	6	20	43%
Pennsylvania	5	16	21	320%
Rhode Island	0	6	6	600%
South Carolina	0	8	8	800%
South Dakota	0	0	0	0%
Tennessee	1	2	3	200%
Texas	3	0	3	0%
Utah	8	0	8	0%
Vermont	6	4	10	67%
Virginia	87	65	152	75%
Washington	40	0	40	0%
West Virginia	0	0	0	0%
Wisconsin	0	0	0	0%
Wyoming	0	0	0	0%
Total	**2,155**	**888**	**3,043**	**41%**

Figure 3. Top 10 States for Electric School Bus Growth in 2022



III. Funding Programs and Policy

Federal Funding Programs

In 2021, a monumental shift in the adoption of electric school buses was set in motion by the passage of the Infrastructure Investment and Jobs Act (IIJA), which allocated $5 billion for the EPA Clean School Bus Program. Over the next five years, the Clean School Bus program will allocate $5 billion to replace existing school buses with zero-emission and low-emission models across all 50 states (Environmental Protection Agency, 2023). The EPA Inflation Reduction Act will also provide tax credits through the 45W Clean Commercial Vehicle Credit adding to the EPA's existing list of incentives that include the Diesel Emissions Reduction Act (DERA), the American Rescue Plan Act ESB rebates, and the EPA Airshed Grant that are also available to school districts looking to electrify their school bus fleets.

A surge in federal funding in conjunction with a growing number of opportunities in state funding, has led to a broader reach for ESBs in communities throughout the United States. Though not included in this report's adoption numbers, the 2022 rebate round of the EPA's Clean School Bus Program has the potential to award around 2,400 ESBs, many of which will be adopted in rural communities across the country. This round of awards alone would nearly double the total number of ESBs currently adopted in the United States.

State and Local Funding Programs

While federal funds have never been more plentiful than over the past year, these funding programs are still limited in the type and number of districts they can reach. Some states addressed this in 2022 by offering complementary or individual funding opportunities for ESBs. A direct correlation is seen between state funding support and the number of electric school buses deployed in states such as California. California's Hybrid and Zero-Emission Truck and Bus Voucher Incentive Program (HVIP), administered through the California Air Resources Board (CARB), is currently the largest state funding source for ESBs. In 2022, CARB awarded over $4 million through standard HVIP funds to transition school bus fleets and allocated $130 million to the Public School Bus Set-Aside Project (California HVIP, 2023). CARB also administers the Carl Moyer Program and Community Air Protection Incentive Program, amounting to over 1,200 funded ESBs. In addition to CARB, the California Energy Commission

(CEC) has funded over 200 ESBs through the School Bus Replacement Program, making California the most supportive state for ESB funding in the country (Lazer and Freehafer, February 2023).

Other states such as Massachusetts have joined California in offering ESB incentive programs. The Massachusetts Clean Energy Center (MassCEC) is providing funding through the Accelerating Clean School Transportation (ACT) School Bus Advisory Services Program to complement the EPA Clean School Bus Program, supporting awarded school districts in the state with technical assistance, a key element of fleet transition planning. Other state funding sources impacting the market outside of California include (but are not limited to): the New York Truck Voucher Incentive Program (NYTVIP), the Colorado Department of Public Health and Environment (CDPHE) CleanFleets Vehicle and Technology Grant Program, the Oregon Clean Fuels Program with PG&E, and Volkswagen Settlement Funds through the VW Mitigation Trust. By providing essential financial support and technical assistance, state funding sources help to fuel the expansion of the ESB sector.

Policy

In recent years, electric school bus policies in the United States have gained momentum, driven by the urgent need to address climate change and reduce greenhouse gas emissions from the transportation sector. One significant piece of legislation in this regard is the Advanced Clean Trucks (ACT) regulation. Adopted in California in June 2020 by CARB, the ACT regulation mandates a progressive shift toward ZEVs in commercial fleets (CARB, n.d.). ACT establishes zero-emission medium and heavy-duty vehicle sales targets that will include school bus manufacturers. Massachusetts, New Jersey, New York, Oregon, and Washington have also adopted the ACT regulation, with another dozen states planning to adopt ACT within the next few years (Kryczka and Portillo, 2022).

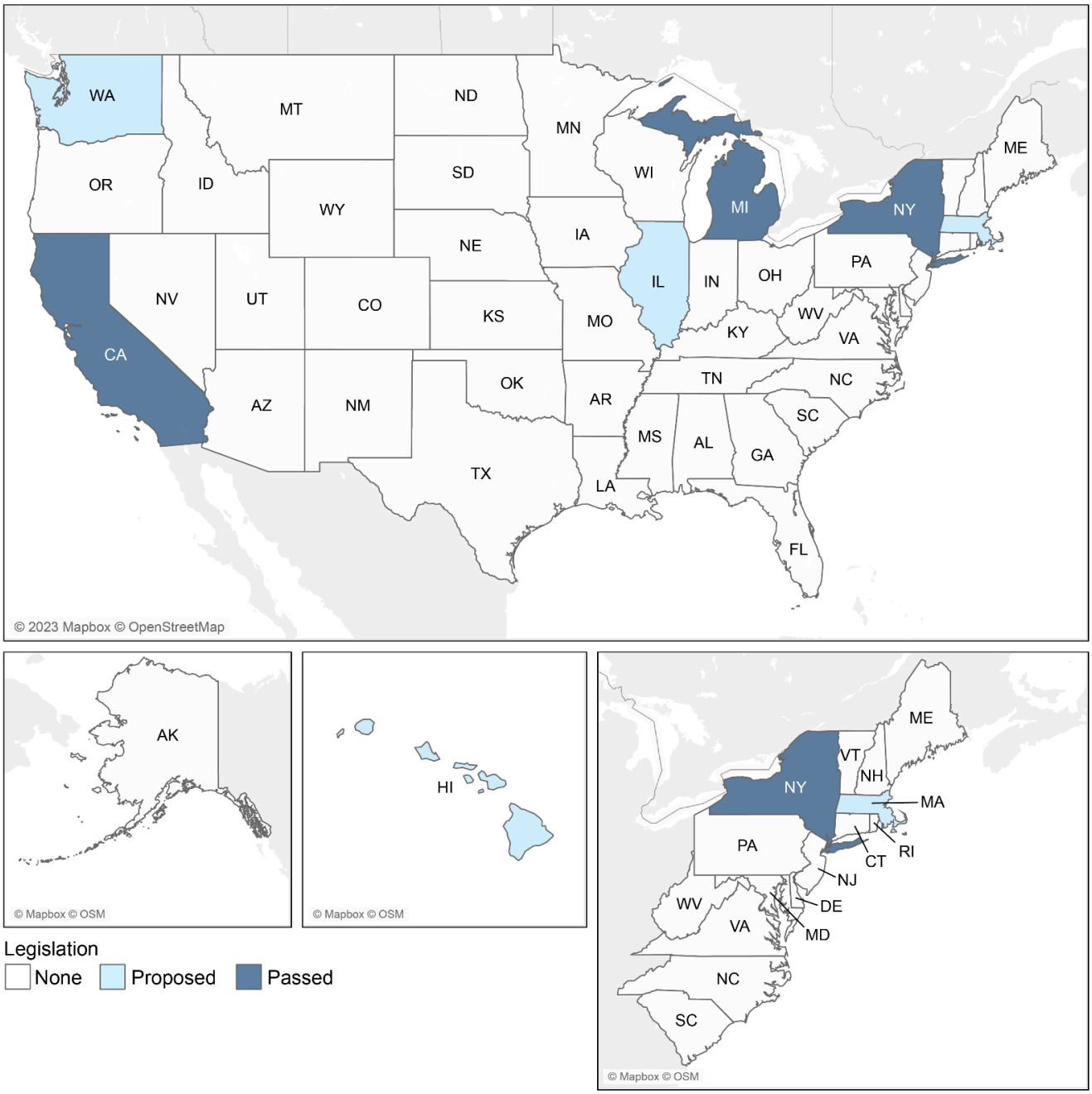
States such as Washington, Illinois, Michigan, New York, Massachusetts, and Hawaii have also pursued electric school bus legislation in various forms. The most common example of legislation proposed or passed by states includes adoption timeline mandates that will require a percentage of new school bus purchases to be zero-emission by a specific date. For example, Washington has active legislation that would require 70 percent of new school buses purchases to be zero-emission by 2030 and all purchases be zero-emission by 2033.

These policies help support the market for ESBs by increasing adoption rates and generating momentum for widespread adoption. These policies help create a stable market for manufacturers, suppliers, and charging infrastructure providers. By encouraging the transition to electric school buses, these policies serve as examples for other states to follow

in implementing similar initiatives, leading to nationwide progress toward clean transportation solutions.

The states currently working on and/or have passed legislation that impacts school bus electrification are outlined in **Figure 4** below. The legislation recapped in this figure includes adoption mandates, lease term extensions, and funding programs (Lazer and Freehafer, February 2023).

Figure 4. States with Electric School Bus Legislation Currently Proposed or Previously Passed



IV. Market Trends

Electric School Bus Pricing

Approximately 480,000 school buses in the United States are responsible for transporting 26 million students daily, with over 95 percent of these buses relying on diesel fuel. Still, less than 1 percent of the nation's school bus fleet is electric, partly due to the high upfront cost associated with transitioning school bus fleets to electric (Levinson, 2022). The electric school bus transition poses a significant barrier because electric school buses can cost up to three times more than conventional diesel buses (Levinson, 2022). The price of an electric school bus ranges from $270,000 to more than $400,000, depending on vehicle type, make, and model (Williams, 2022; Office of General Services, 2022). This price range has increased in the past year with some original equipment manufacturers (OEMs) raising prices to offset inflation and increase costs for raw materials, transportation, and labor (Business Wire, 2022).

Repowered School Buses

Repowered school buses, or repowers, are an alternative to purchasing newly built ESBs for school bus operators interested in electrifying their fleets. Repower companies remove unnecessary components from former internal combustion engine (ICE) school buses and install a proprietary high-voltage electric drivetrain system and batteries. Repowered school buses reduce upfront costs compared to purchasing new ESBs, costing less than a new ICE school bus and up to 40 percent of the cost of a new ESB, depending on the manufacturer and battery range. Repower companies face challenges in increasing production rates, such as engineering a unique solution to integrate their repower components into every vehicle model year and sourcing used school buses to repower.

Legislation for funding ESBs does not often include language to cover the cost of a repowered school bus. However, incentives for repowers could provide a more cost-effective approach to full-scale electrification. Major school bus OEMs are partnering with repower companies to offer repowering as an in-house service (Manthey, 2022). Two low-production companies in the United States provide repowered vehicles to customers, with three more companies planning to begin school bus repowers in 2023 (Ly and Werthmann, 2023). Repower companies may also experience name recognition issues, as this

technology is new to the market and school district operators. Repowered ESBs are not sold through typical channels such as school bus dealerships, which poses a challenge to repower companies trying to gain recognition in the market.

Financing Models

Unique financing models for electric school bus purchases are gaining interest due to their potential to make electric school buses more affordable and accessible. These models can help overcome the upfront cost barrier that often prevents schools from adopting these vehicles by providing low-interest loans or other financing options. Some financing models can also provide additional benefits to school districts, such as charging management and training services. Overall, emerging financing models show promise to increase electric school bus adoption significantly. Below are three examples of financing that may become more prevalent with ESB adoption.

As-a-Service Models

Peak to Peak Charter School in Lafayette, Colorado is currently collaborating with Highland Electric Fleets of Massachusetts to finance the electrification of their school bus operations. To help reduce the upfront costs associated with fleet electrification, companies such as Highland Electric Fleets offer school districts a comprehensive financing solution with a subscription service. These subscriptions typically include services such as infrastructure installation, charging management, and operations staff training. Like many as-a-service contracts, Highland Electric Fleets' contract with Peak to Peak has a fixed annual charge in lieu of a high upfront procurement cost and lasts for ten years (Highland Electric Fleets, 2022). Peak to Peak Charter School became the first all-electric school bus fleet in Colorado after Highland Electric Fleets delivered four electric school buses to them (Bounds, 2022). The partnership between Peak to Peak Charter School and Highland Electric Fleets illustrates an approach to obtaining ESBs that is possible with or without the use of incentive funding.

DTE E-Fleet Battery Support Program

DTE Energy is a Michigan-based company focusing on developing and managing energy-related services. They currently service 2.2 million customers with electricity in Southeast Michigan. DTE is currently working with Michigan Public Service Commission to develop a pilot program that focuses on solving the high upfront cost of batteries for electric transit buses. DTE Energy will pay the upfront cost of the battery, while recovering costs through the electricity service charge of the transit agency (Parra, 2022). While this battery financing option is not yet available for school districts, this innovative approach is likely to make its way over to electric school buses with the increased demand for adoption.

Green Banks

Green Banks currently assist in the deployment of clean energy technology to improve climate change resiliency by providing loans, loan guarantees, and credit enhancements to finance clean energy technology, with funding from sources such as governments, private investors, or charities. They offer affordable rates by bundling investments, partnering with private investors, standardizing lending, and supporting low-risk technologies (Coalition for Green Capital, n.d.). Green Banks in the U.S. have invested $7 billion in clean energy projects, with a significant opportunity for medium- and heavy-duty (MHD) fleet vehicle electrification, according to Virginia Energy's Commonwealth Clean Energy Financing Authority Preliminary Market Assessment Report. (American Green Bank Consortium, 2021).

The Connecticut Green Bank has successfully mobilized private capital investment into the Connecticut green economy. One of their projects uses carbon credits generated from electrified infrastructure, which began collecting credits in 2020 and expects to have sellable credits in 2021. The sale of these carbon credits will support the expansion of electric vehicle charging infrastructure (American Green Bank Consortium, 2021). The California Alternative Energy and Advanced Transportation Financing Authority (CAEATFA) awards $100 million in sales and tax exclusions to assist electric vehicle and green component manufacturers in purchasing equipment. CAEATFA first launched the program in 2010, and the California State Assembly extended the program ending date from 2021 to 2026 (CAEATFA, 2022).

NY Green Bank (NYGB) in New York and the Nevada Clean Energy Fund (NCEF) are state-sponsored financial institutions facilitating clean energy projects by providing financing and market development support. In 2022, NYGB closed a $10 million revolving warehouse facility to securitize EV loans originated in the state of New York, making history for the first time a government-backed Green Bank has funded a facility of this kind. This model can provide financial incentives for individuals to adopt EVs (Lewis, 2022). NCEF is collaborating with school districts to execute clean energy initiatives, such as energy efficiency, renewable energy, and fleet electrification. The fund's specialists offer unbiased technical assistance to identify and evaluate projects, assess equipment providers and financing alternatives, and obtain grants and funding opportunities (Nevada Clean Energy Fund, n.d.).

V. Conclusion

As the electrification of the national school bus fleet has become a significant focus area for the United States in reducing greenhouse gas vehicle emissions, the Zeroing in on ESBs annual report will continue to track the growth of the ESB market as it matures over time. The increase in federal and state funding programs over the past year has reduced the most significant barrier of cost, despite the fact that school districts frequently face resource limitations that prevent them from implementing this technology. For new school districts adopting ESBs, technical support and fleet electrification planning continue to be significant obstacles.

In 2022, there were 3,043 ESBs accounted for in the U.S., with states like California, Maryland, Florida, Virginia, and New Jersey leading the way toward widespread adoption. Other states such as Illinois, New Jersey, North Carolina, Connecticut, and New York saw significant progress in 2022 in the growth of their zero-emission school bus adoption.

The Zeroing in on ESBs annual report plays an essential role in tracking the growth of the ESB market. By analyzing the distribution of funds in the market for ESBs, documenting the states that have formed ESB policies, and providing a state-by-state breakdown for a total ESB count, this report informs ESB advocates and implementers about the electrification of the nation's school bus fleet. As more school districts adopt this technology, the industry will continue to grow, and organizations like CALSTART can continue to address the barriers of this technology by assisting school districts and informing the industry of its progress.

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